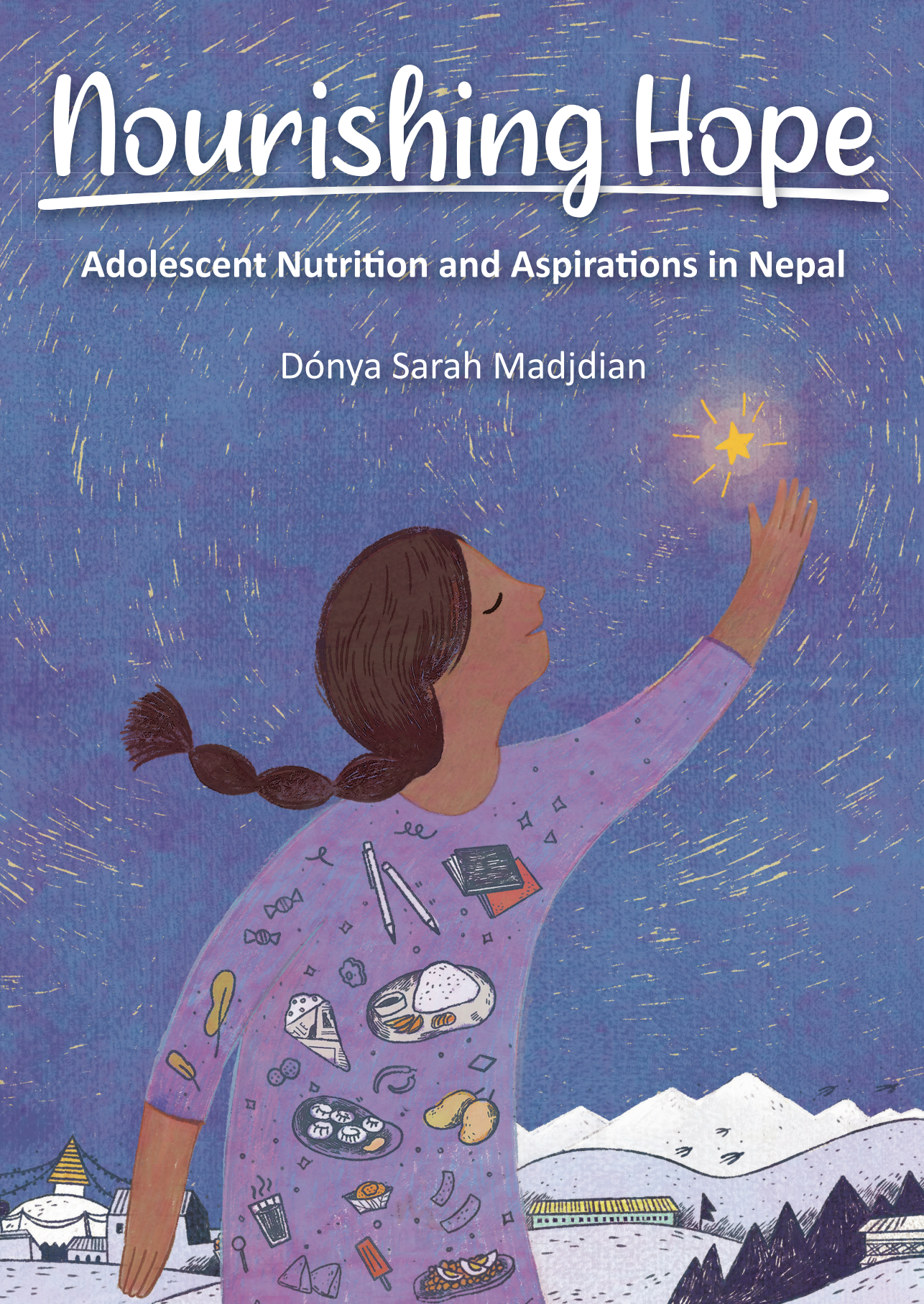
Nourishing Hope

Adolescent Nutrition and Aspirations in Nepal

Dónya Sarah Madjdian



Propositions

1. Life skills programs that address adolescent girls' sense of agency cultivate aspirations, but only when poverty and social inequity are tackled simultaneously.
   (this thesis)

2. Evidence on the adolescent nutrition-aspirations nexus underscores the need for including broader wellbeing indicators as drivers of later-life outcomes in nutrition research.
   (this thesis)

3. For improving health and development in low-and middle-income countries, it is vital to eliminate high-income country research bias.

4. Empowering adolescent girls will not succeed if we overlook adolescent boys.

5. No research will ever achieve a holistic approach using statistics only.

6. The COVID-19 pandemic widens the gap between aspirations and reality worldwide, but particularly for those in emerging economies.

7. Being provided the opportunity to receive a vaccine is a privilege.

8. Cats are great co-workers during a pandemic.

Propositions belonging to the thesis, entitled

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Dónya Sarah Madjdian

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Nourishing Hope

Adolescent Nutrition and Aspirations in Nepal

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Thesis

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"Hope sees the invisible, feels the intangible, and achieves the impossible."

~ Helen Keller

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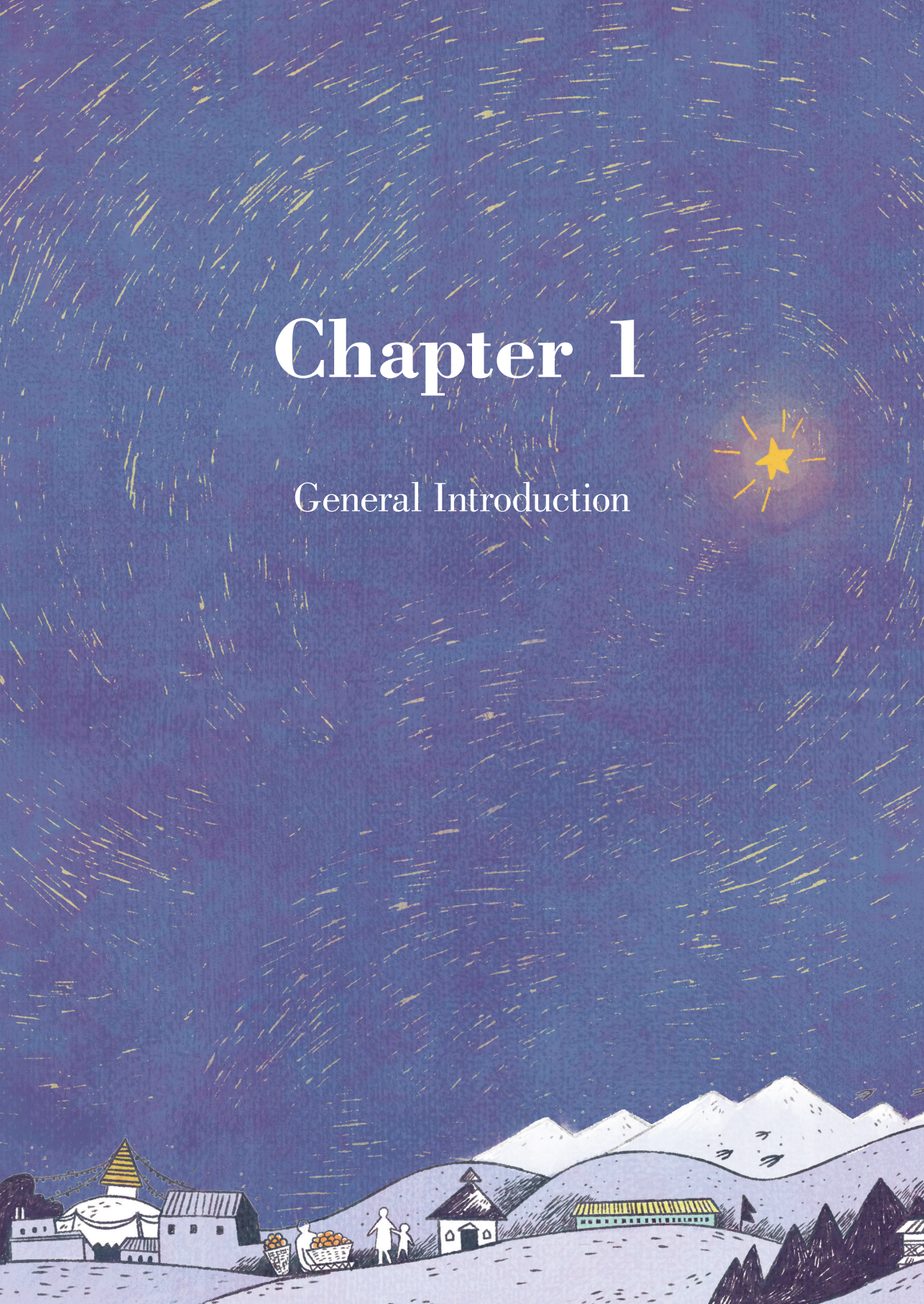
Abbreviations and Acronyms

25(OH)D	25-Hydroxyvitamin D
aOR	adjusted Odds Ratio
BA	BMI-for-Age
BAZ	BMI-for-Age Z-score
BMI	Body Mass Index
CBS	Central Bureau for Statistics
CI	Confidence Interval
DDS-W	Dietary Diversity Score for Women
HA	Height-for-Age
HAZ	Height-for-Age Z-score
Hb	Hemoglobin
HIC	High-Income Country
HKI	Helen Keller International
ID	Iron Deficiency
IDA	Iron Deficiency Anemia
LLMIC	Low- and Lower-Middle-Income Country
LMIC	Low- and Middle-Income Country
MDD-W	Minimum Dietary Diversity for Women
MoH	Ministry of Health
MoHP	Ministry of Health and Population
NANS	Nepal Adolescent Nutrition Survey
NDHS	Nepal Demographic Health Survey
NHRC	Nepal Health Research Council
NPR	Nepalese Rupee
NSCO	Nepal Standard Classification of Occupations
ODK	Open Data Kit
OR	Odds Ratio
PPS	Probability Proportional to Size
Ref	Reference Category
RQ	Research Question
SCE	Socio-Cultural and Economic
SD	Standard Deviation

SDG	Sustainable Development Goal
SEE	Secondary Education Examination
SES	Socio-Economic Status
SII	*Suaahara II*
SLC	School Leaving Certificate
UN	United Nations
USAID	United States Agency for International Development
VAD	Vitamin A Deficiency
VDC	Village Development Committee
VIF	Variance Inflation Factor
WA	Weight-for-Age
WAZ	Weight-for-Age Z-score
WH	Weight-for-Height
WHO	World Health Organization
WHZ	Weight-for-Height Z-score

Chapter 1

General Introduction



Background

Good nutrition stands at the core of sustainable global development. It is a vital building block for the health, wellbeing, and development potential of today's youth, and future generations. In 2015, the United Nations (UN) committed to achieving Zero Hunger by 2030, and to, under Sustainable Development Goal (SDG) two, "end all forms of malnutrition", which includes "addressing the nutritional needs of adolescent girls, pregnant, and lactating women" (UN, 2015). Despite efforts over the past decade to improve nutritional outcomes however, malnutrition remains a pressing and complex challenge. Globally, poor diets and hunger are currently one of the main causes of mortality and morbidity and lead to high economic and social costs (GBD Diet Collaborators, 2019).

Malnutrition encompasses both undernutrition and overnutrition and refers to deficiencies, excesses, or imbalances in intake of energy and/or nutrients (Webb et al., 2018; World Health Organization, 2020). Undernutrition may manifest in linear growth faltering or stunting (too short for one's age), as indicated by more than two height-for-age z-scores, or standard deviation scores, below the refence mean of the World Health Organization (WHO) Growth Standards (de Onis et al., 2007). Stunting, however, is often the result of a combination of adverse circumstances (e.g., early childhood undernutrition, infections, poor health, and poverty) that are signals of growing up in a deficient environment (Leroy & Frongillo, 2019). More acute undernutrition refers to low body weight or thinness (low weight for one's age), as indicated by more than two Body-Mass-Index (BMI)-for-age z-scores or standard deviations below the reference mean (de Onis et al., 2007). Lastly, undernutrition can refer to micronutrient deficiencies, or deficiencies in vitamins and minerals. Overweight and obesity concerns individuals who are too heavy for their height.

In low-and middle-income countries (LMICs), and particularly in South Asia, adolescent undernutrition is a major cause of concern (Akseer, Al-Gashm, Mehta, Mokdad, & Bhutta, 2017). Not only because the world currently faces the largest cohort of adolescents (aged 10-19 years) ever - 1.2 billion and growing -, but also since this is a life stage characterized by rapid growth, biological, neurological, social, and emotional transitions. These transitions are accompanied by increased health- and nutrition-related requirements (Patton et al., 2016; Sheehan et al., 2017). South Asia, which hosts 30% of the world's adolescents and is one of the fastest growing regions globally, carries the largest adolescent undernutrition burden, despite remarkable progress on some nutritional indicators (Aguayo & Paintal, 2017). This paradox, also referred to as the South-Asian Enigma, disproportionally affects women and adolescent girls (Sharma, 2020). Besides poor diets, poverty, and food insecurity, nutritional deprivation is often reinforced by a patriarchal society and a gender gap that widens upon adolescence and girls' social transition from being a child to becoming a woman, wife, daughter-in-law, or mother (Christian & Smith, 2018). Resultingly, anemia,

underweight, micronutrient deficiencies, and linear growth faltering are highly prevalent issues (NCD Risk Factor Collaboration, 2017). An estimated 50% of all girls is affected by micronutrient deficiencies, including iron deficiency and iron deficiency anemia, with only slow improvement over the last decade (Aguayo & Paintal, 2017; Christian & Smith, 2018). Increasingly, undernutrition, including micronutrient deficiencies, co-exists with adolescent overweight, due to the nutrition transition. This transition is caused by, amongst others, shifting dietary patterns, which has doubled, or even tripled the malnutrition burden (Keats et al., 2018; Popkin, 2001; Subedi, Marais, & Newlands, 2017).

Adolescence has great potential to break intergenerational cycles of malnutrition and deprivation (Anonymous, 2013; Black et al., 2008; WHO, 2006). There is growing consensus that "investments not made during this phase, often are opportunities missed for a lifetime" (National Research Council and Institute of Medicine, 2005, p. 575). When adolescents are well-nourished and healthy, this can generate a triple dividend for optimal growth and youth potential, healthier transitions across the life course, and a healthy next generation (Patton et al., 2016). For girls specifically, good nutrition has, for instance, been associated with delayed marriage and pregnancy, better learning outcomes and economic chances, and participation in the labor market (Aguayo & Paintal, 2017; Alderman, Hoddinott, & Kinsey, 2006; Glewwe, Jacoby, & King, 2001). While there is consensus that early childhood, also known as the first 1000 days, is crucial and formative for later-life outcomes (Black et al., 2017), adolescence is now increasingly recognized as an important second window of opportunity, which encompasses the first 8000 days (Bundy et al., 2018).

Problem statement: the nutrition-aspirations nexus

The life stage of adolescence provides great opportunities for catch up growth or reversing nutritional deficits, and developing and fostering healthy behaviors, which lay the foundation for lifelong health and wellbeing (Schott, Aurino, Penny, & Behrman, 2019). Limited knowledge, however, exists on the associations between good nutrition and broader wellbeing or non-cognitive outcomes, including one's aspirations for the future.

There are several definitions of aspirations. In this thesis aspirations are defined as constructs that are "future-oriented, driven by conscious and unconscious motivations and indicative of an individual's commitments towards a particular trajectory or end point" (Hart, 2016, p. 326). Aspirations are shaped whilst transitioning through adolescence (Nurmi, 1991). They serve as engines of progress (Hart, 2016; Nussbaum, 2011) and are hypothesized as a driving force to shifting negative behaviors to more positive health outcomes (Mathur, Malhotra, & Mehta, 2001). As such they are able to positively influence adolescents' life choices, and consequently later-life wellbeing and development outcomes

related to education, occupation, family formation (i.e., marriage and having children), and nutrition and health (Favara, 2017; Ross, 2019; Sirin, Diemer, Jackson, Gonsalves, & Howell, 2004; Wang, Chen, Tang, Lee, & Jian, 2011). The failure to realize one's aspirations may lead to a sense of hopelessness or a sense of fatalism, which has negative implications for developmental outcomes and attainments (Bernard, Dercon, & Taffesse, 2011; Dalton, Ghosal, & Mani, 2016; Janzen, Magnan, Sharma, & Thompson, 2017). For instance, fatalism may reinforce poverty, thereby creating a vicious cycle of deprivation (Appadurai, 2004; Ray, 2006).

Both adolescent nutrition and aspirations play an important role for longer-term health development and wellbeing. However, there is a paucity of knowledge on these two important building blocks of adolescence, as well as its potential interrelation during adolescence, and in LMICs. More specifically, a three-fold knowledge gap exists in the adolescent nutrition and aspirations literature and in relation to relationships between the two concepts – here referred to as– the nutrition-aspirations nexus.

First, notwithstanding the increasing interest, context-specific knowledge on adolescents' nutritional trajectories, alongside other changes in social status and gender roles during the transition into adulthood, is still lacking due to relatively few or fragmented data on dietary practices, nutrition adequacy, and anthropometric data in LMICs (Anonymous, 2013; Black et al., 2013; Christian & Smith, 2018; Delisle, Chandra-Mouli, & de Benoist, 2000; Thurnham, 2013; WHO, 2006). This includes a better understanding of what sociocultural and economic factors determine adolescents' nutritional status in specific contexts of LMICs (Christian & Smith, 2018). Whilst a growing amount of studies have started to recognize the need to address the sociocultural and economic determinants of adolescent nutrition (Herman et al., 2014; Keats et al., 2018; Salam, Das, Lassi, & Bhutta, 2016), most studies still focus on single determinants of, or associations with adolescent nutritional status at one specific point in time. However, adolescent nutritional trajectories are conditional on other often reinforcing areas including gender equality, education, societal norms and values, or relative wealth. Moreover, studies tend to largely focus on early childhood or on adolescent girls of reproductive age (15-19 years) as bearers of our future generation (Vir, 2016). Current research and programs often fail to focus on the entire adolescence phase (10-19 years), as defined by the WHO, and to consider specific transitions and turning points within adolescence as a result of life events (e.g., marriage, school dropout, puberty). Younger adolescents (10-14 years), sometimes referred to as 'the missing middle', are particularly overlooked.

A second research gap pertains to the knowledge on adolescents' aspirations in key life domains, in general, but especially in the context of LMICs. First, limited knowledge exists on adolescents' aspirations in important life domains of education, occupation, family formation, health, and nutrition. The majority of research on aspirations focuses on

educational (vocational), or occupational aspirations ("what do you want to become when you grow up?") (Nurmi, 1991), or studies are conducted in high-income countries (HIC) (Massey, Gebhardt, & Garnefski, 2008). Scholars are particularly interested in the relationships between educational aspirations, educational outcomes, and adult achievements. However, aspirations in the domains of family formation, health, and nutrition, remain mostly understudied. Moreover, research on what exactly drives a range of adolescents' aspirations in an LMIC context is scant. Aspirations develop in context, and are influenced by a range of internal and individual constraints and opportunities, such as agency or self-efficacy: the extent to which an adolescent feels in charge of her/his own life (Ray, 2006). Aspirations are also shaped by context-specific external constraints or opportunities, such as household wealth or geographic location and the broader sociocultural and economic context (Hart, 2016). Hence, adolescents' capacity to aspire is often not evenly distributed (Favara, 2017). Additionally, aspirations are socially determined. Important individuals within adolescents' lives and social networks, or those in their so-called 'aspirations window' are crucial to the formation of aspirations (Ray, 2006). So far, it remains unclear what, who, and how aspirations are influenced throughout adolescence, particularly in the South-Asian context.

Finally, there is a knowledge gap on the specific consequences or impacts of undernutrition during adolescence. More specifically, a thorough understanding of the associations with, and effects of nutritional and dietary indicators on adolescents' aspirations is still in its infancy. Whilst a considerable number of studies have addressed the associations between malnutrition and cognitive skills including learning outcomes, associations with adolescents' psychosocial or non-cognitive skills remain largely unexplored. Although this association may not be self-evident, some evidence indicates that height-for-age, or childhood stunting, is positively associated with educational aspirations during adolescence (Dercon & Sánchez, 2013). Moreover, iron deficiency anemia has not only been associated with lower schooling outcomes and impaired mental development, but also with lower educational aspirations (Chong, Cohen, Field, Nakasone, & Torero, 2016). In addition, household food insecurity, which could lead to adolescent undernutrition, has been associated with lower social skills and academic development (Howard, 2011; Jyoti, Frongillo, & Jones, 2005). These findings are suggestive of a potential linkage between undernutrition and non-cognitive skills, including aspirations. However, empirical evidence on which specific aspects of undernutrition or diets are associated with adolescents' aspirations and in which aspiration domain remains unexplored. The dearth of research leads to many unanswered questions: is there an association between other nutritional and dietary indicators and adolescents' aspirations? Do malnourished adolescents have lower aspirations than well-nourished adolescents? And, if good nutrition and diets are associated with adolescents' aspirations, what happens with a malnourished adolescent's aspirations, upon a shift to a better nutritional status or diet, over time?

Aim of this study

This thesis aims to improve the understanding of the context-specific multilevel drivers of undernutrition during adolescence in LMICs, specifically in Nepal, and to explore the nature of, and relationships between adolescent girls' aspirations in the key life domains of education, occupation, family formation, health and nutrition, and indicators of nutritional status and dietary diversity. The study ultimately aims to contribute to integrated efforts that optimize adolescent girls' nutritional and developmental outcomes in Nepal, and beyond.

The dynamicity of the life stage of adolescence, due to its many interwoven nutritional, social, and economic trajectories, social transitions, and differing sociocultural contexts, within a rapidly changing world (Christian & Smith, 2018; National Research Council and Institute of Medicine, 2005) makes research on the topic of the aspirations-nutrition nexus complex and sparse. Nutritional trajectories include for instance rapid growth and increased (micro)nutrient requirements, with menarche as an important landmark as well as a social turning point in girls' lives. Social trajectories refer to pathways of education and family formation, including marriage and having children. In the South-Asian context, this is often determined by girls' position in the household, patriarchal society, and adverse cultural norms and practices, which are not seldom perpetuated by girls themselves, and which may lower girls' agency. The economic trajectory refers to adolescents' informal contribution to the household which is dependent on household composition and educational attainment, but also restrictions imposed because of social status. For instance, upon marriage and a girl's move to her husband's household, workload increases and autonomy will be more restrictive (Chorghade, Barker, Kanade, & Fall, 2006). In the LMIC context of Nepal, girls are likely to marry too young and become pregnant too soon because of poverty, or culturally-driven family and societal pressure (Smith, 2002). This dynamic leads to nutritional stress before growth completion and at the same time deprives girls of education, developing their self-efficacy, and acquiring a higher social position within their households (Soekarjo, Shulman, Graciano, & Moench-Pfanner, 2014; Christian & Smith, 2018).

For adolescents to become the heart of a prosperous society, and to unlock their future potential, a better understanding of their nutritional trajectories and their aspirations throughout adolescence, is vital. Research with, rather than on, adolescents, and focused on their own needs and aspirations, including nutrition, is essential to facilitate the aspired triple dividend. A shift towards positioning adolescents as competent and capable individuals who assert influence on their transitions through adulthood is therefore needed.

The research detailed here adopts an innovative multidisciplinary mixed-methods research design combining nutrition science and life-course sociology, including participatory creative research methods. The study is largely based on empirical research from Nepal, as a specific case of a low-income context in South-Asia, where there is a

huge window of opportunity for investing in adolescents' health and nutrition, and their opportunities. However, despite considerable progress in improving population health and wellbeing alongside rapid social and economic changes, living circumstances of many Nepali adolescents, and specifically of girls, are far from what is envisioned in the SDGs.

The current study is grounded in theories of human development and life course sociology. In the remainder of this introductory chapter, the theoretical framework on which this thesis is based will be introduced. Next, an overview of the specific objectives, research questions, and methods is provided. This is followed by a description of the study setting and a summary of the *Suaahara II* program in which part of this study is embedded. The chapter ends with a brief thesis outline.

Theoretical framework

Bio-ecological theory on human development

A holistic framework on adolescent development that takes a life-course perspective and considers the sociocultural and economic determinants of health and wellbeing, is needed to address the research aim. Therefore, a combination of theories grounded in life course sociology and human ecology is used. This combination facilitates a better understanding of the interplay between trajectories and how inequalities related to nutrition, as well as aspirations, play out within an everyday life context and over time (Bronfenbrenner, 1977; Elder, 1998). The thesis starts from the notion that the adolescent individual and context are inseparable, and that growing up into adulthood follows a dynamic interplay between biology, society, and time. This interplay involves a range of multilevel factors which may be mutually influencing (Green, 2017). In order to holistically chart and understand adolescents' transitions into adulthood, it is thus vital to consider how factors at several levels, including time, social, and cultural location, shape pathways and experiences.

Bronfenbrenner's theory of human development is well-suited to study the different components of adolescent development over time, as it can detect and mitigate differences and inequalities at critical periods (Bronfenbrenner, 1977; 1979). This bio-ecological model places adolescent development within a complex series of interdependent systems, or nested layers, consisting of the adolescent (individual) itself, the microsystem, mesosystem, exosystem, and macrosystem. A cross-cutting, fifth, layer is the chronosystem, which includes how time and historical location affect all systems. The bio-ecological model has undergone several revisions since its origin. While the first models were mostly focused on context, later models equally emphasized the individual (adolescent) within these contexts of development and over time, also known as the Process-Person-Context-Time model (Bronfenbrenner, 1995).

The bio-ecological model posits human development as a process of continuity and change over the life course in bio-psychological characteristics of individual, and as groups, across generations and through time (Bronfenbrenner, 1979). The onion-like layers of this model closely connect to life course or life span theory. These theories acknowledge growing up as a life-long process, during which advantages and disadvantages over time accumulate and play out in multiple life domains, thus linking earlier causes and later consequences (Buchmann & Steinhoff, 2017; Elder, 1998). They also help identifying turning points and life events at specific ages, which contribute to the history and timing of influences on experiences, opportunities, and outcomes (Dornan & Woodhead, 2015). It was Herbert who famously argued that "adolescence begins in biology (the variable time of puberty), and ends in culture", which is "the even more variable point at which young people are deemed responsible and independent by society" (2008, p. 368). Indeed, adolescent development takes place at biological, psychological, institutional, cultural, social, and historical levels, and within an everyday life context. Bio-ecological theory positions adolescents as 'agents of change' in the first place, because their own knowledge, opinions, agency, aspirations, and beliefs co-shape life trajectories (National Research Council and Institute of Medicine, 2005). Besides acknowledging individual agency in actively contributing to individual development (Jeffrey, 2012), the model views processes of adolescents' lives becoming embedded within social structures. This closely links to the life course perspective, which addresses how lives are always interdependent and linked, resulting in one's actions and aspirations to be shaped in interaction with others and society (Elder, 1998; Mayer, 2003).

The bio-ecological theory is built around five main layers (see Figure 1.1). The adolescent is at the center of the bio-ecological model. The microsystem is the closest to the adolescent him/herself and thus the most influential. It includes immediate biological characteristics of the adolescent, such as age, sex, and his/her physical status. It also includes the adolescent's immediate and everyday-life home environment, or characteristics of parents, siblings, or close peers. This system works in two directions: the adolescent is to be influenced by important other people in this system, and vice versa. In relation to nutrition, factors at the microlevel influencing nutritional status may be biological, including one's age, sex, but also household access to food, socio-economic status, nutritional knowledge, or the educational level of parents. For example, unequal resource-allocation at the household level, including skewed allocation of food to adolescents according to age, sex, or birth order can deprive girls of essential nutrients resulting in nutrient deficiencies (Christian & Smith, 2018; Harris-Fry, Shrestha, Costello, & Saville, 2017; Madjdian & Bras, 2016). Adolescents' aspirations are, at the microlevel, amongst others, influenced by self-efficacy, physical condition, household poverty, and age (Bernard et al., 2011). Self-efficacy is particularly important in the context of Nepal, where on the one hand more girls than boys reported lower self-confidence, self-efficacy, and life satisfaction (Cunningham & D'Arcy, 2017),

whilst on the other hand, research showed that girls perceived adolescence as a period of not only problems, but also a time for dreaming about education, careers, and successful family lives as well, in which they hold the power to make informed choices themselves (Mathur et al., 2001). Household poverty has been largely associated with aspirations, but evidence is conflicting, with studies reporting poverty as the reason for a lack of, or low aspirations, as well as motivating poorer children to aspire high (Massey, et al., 2008; Treanor, 2012).

The next level is the mesosystem, which includes interactions and interrelations between at least two components or actors within the adolescent's microsystem at points during adolescence (e.g., interactions between the household and community etc.). These components are all interconnected and indirectly impact adolescent development. At the mesosystem are relationships between siblings, parents, and teachers, which may indirectly influence adolescent nutrition and development through pressure or support, or through expectations from important others in adolescents' lives. In Nepal, important others may include parents, grandparents, parents-in-law or husbands (when married), peers, and teachers.

The exosystem is an intermediate system that does not directly influence adolescents, but the components or events within the adolescent's microsystem. This includes household economic status, the neighborhood, (social) media, or government agencies. These actors and events influence the setting in which an adolescent grows up, and thereby indirectly the adolescent. The exosystem relates to the more structural determinants of adolescent health, including community norms surrounding gender or decision-making practices related to important life domains.

The macrosystem is the broader society and culture, including prevailing attitudes and ideologies, or traditions that are often deeply rooted in society. It refers to the broader sociocultural and economic environment in which an adolescent grows up and includes aspects of economy (poverty), politics and policies, social and ethnic values, geographical location, including health care infrastructure, educational opportunities, and food systems. In low-income contexts, gendered norms in particular may structurally influence adolescent girls' health and nutrition. They steer behavior and through this, influence adolescents' beliefs, perceptions, aspirations, and nutrition.

The final layer is the chronosystem, the cross-cutting layer of the bio-ecological model. Time and historical context belong to this layer, which also links to the concept of "timing of lives" in the life course perspective (Elder, 1998). The chronosystem refers to the time in which an adolescent grows up, as well as the life events (turning points) that take place, and environmental changes through the life course. Both adolescents and their everyday life contexts, including social systems, change over time and may impact the way adolescents develop. In Nepal, these may include events such as early marriage, leaving school, pregnancy and motherhood, social transitions, or social changes that take place. For

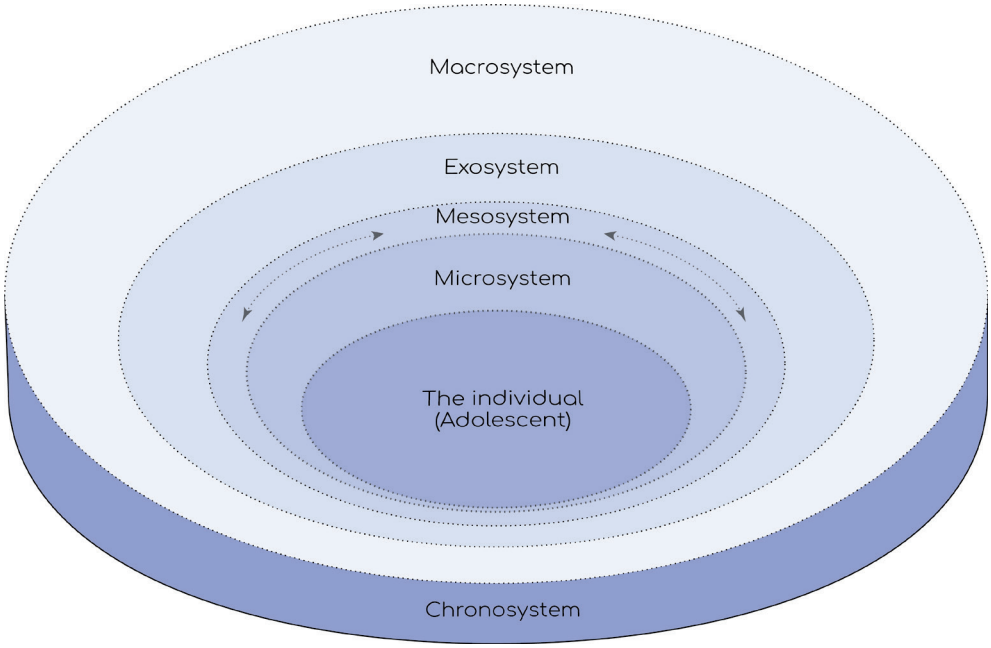


Figure 1.1. Bio-ecological theory on human development.

girls for instance, early marriage, followed by early pregnancy, may cause nutritional stress. The same events may lead to an adjustment of educational and occupational aspirations. Aspirations develop over time, particularly during adolescence, where "levels of planning, realization and knowledge concerning the future increase with age" (Nurmi, 1991, p. 48). They can be adjusted in accordance to outcomes or attainments (Favara, 2017). For girls in LMICs, aspirations and nutrition status tend to decrease with age, due to changes in autonomy and decision-making power (Christian & Smith, 2018; Samuels, Ghimire, Tamang, & Uprety, 2017).

Aspirations within the bio-ecological theory

The concept of aspirations has been linked with many theories and perspectives, including capability approaches (Nussbaum, 2001, 2011; Sen, 2005), the poverty of aspirations hypothesis, and the capacity to aspire (Appadurai, 2004). A common assumption of these theories is that individuals generally desire to do well. In this thesis, aspirations are framed within the bio-ecological theory of human development. During adolescence, people start to decide upon, and actively use their resources and capabilities. By doing so, adolescents contribute to shaping their own lives, depending on restrictions and opportunities in their personal environment and the freedom to act upon capabilities (Nussbaum, 2001; Sen,

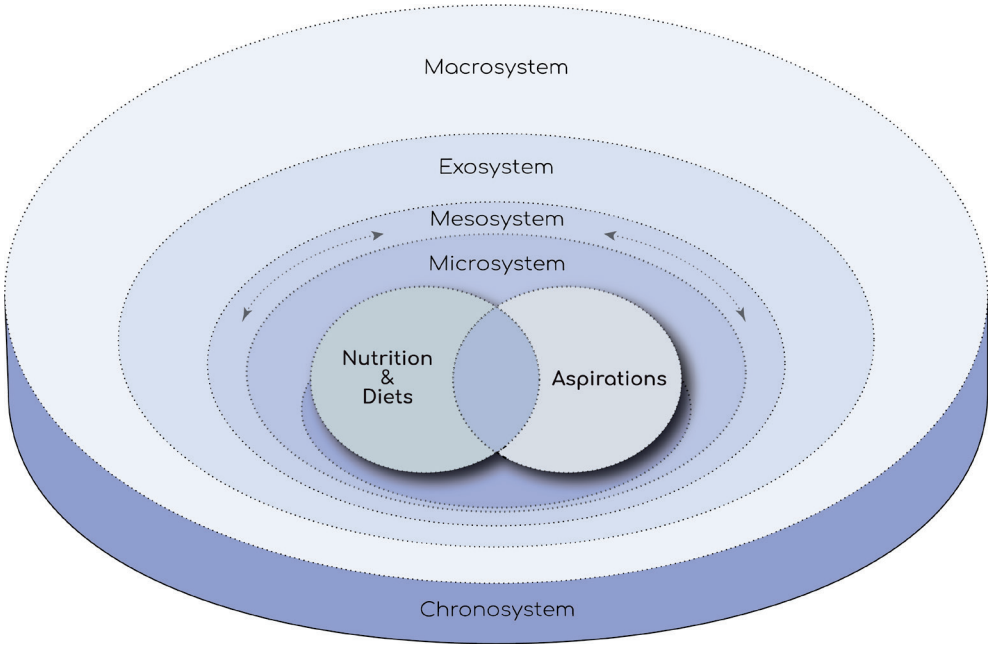


Figure 1.2. Conceptual model

2005). Aspirations are thus dynamic and time-bound, socially situated and created, and inherently linked to agency and one's own capabilities (DeJaeghere, 2018; Ray, 2006).

Conceptual framework of this thesis

Figure 1.2 presents a conceptual model of this thesis. This model integrates the bio-ecological model and the two dynamic building blocks of adolescent development, which are central in this study. On the left side of the model are the multileveled sociocultural and economic factors that influence adolescents' nutritional indicators. On the right side of the model are the multileveled sociocultural and economic determinants of aspirations in the key life domains of education, occupation, marriage and having children (or fertility), and health and nutrition. The overlap in the middle connecting the two building blocks depicts the potential associations between adolescents' nutritional indicators and aspirations.

In this thesis it is hypothesized that a range of indicators of nutritional and dietary status are associated with adolescent girls' aspirations in domains of education, occupation, family formation, health, and nutrition. Indicators of interest include: height-for-age or stunting; BMI-for-age and thinness; hemoglobin as one of the key indicators of anemia indicating

nutrient adequacy; and dietary diversity as another key determinant of healthy diets or nutrient adequacy. It is hypothesized that higher aspired educational levels, jobs requiring professional skills or higher education, older aspired ages for the first age of marriage, older aspired age of having a first child, and higher perceived importance of health and nutrition – referred in this thesis to as "higher aspirations" - are associated with better nutritional status or greater dietary diversity. Thus, that over time, improvements in adolescent girls' nutrition or dietary diversity are associated with changes in aspirations.

Objectives and research questions

The overall aim of this thesis is to improve the understanding of the context-specific multilevel drivers of undernutrition during adolescence in LMICs, and specifically in Nepal. Additionally, it aims to explore the nature of, and relationships between Nepalese adolescent girls' nutrition and their aspirations in key life domains of education, occupation, family formation, health, and nutrition, to contribute to integrated efforts that optimize adolescent girls' nutritional and developmental outcomes in important life domains.
In this thesis the following objectives will be addressed:

1. To synthesize the evidence on the sociocultural and economic determinants and consequences associated with undernutrition and micronutrient deficiencies among adolescents in LMICs.
2. To examine which sociocultural and economic factors influence undernutrition (stunting and thinness) amongst adolescent boys and girls aged 10–19 years in Nepal.
3. To explore which non-nutritional-related factors are associated with Nepalese adolescent girls' aspirations in domains of education, occupation, family formation, health, and nutrition.
4. To advance the understanding of Nepalese adolescent girls' aspirations related to school, work, family life, food, and health and explore factors that influence adolescent girls' aspirations.
5. To examine the associations between malnutrition and Nepalese adolescent girls' aspirations related to important life domains of education, occupation, and family formation, and to investigate any changes in these associations, over time.

This study adopts a mixed-methods research approach, employing both quantitative and qualitative methods including: a systematic narrative literature review for objective 1; cross-sectional surveys for objectives 2 and 3; qualitative in-depth interviews, complemented with creative elicitation techniques for objective 4; and panel surveys for objective 5. These

Table 1.1. Overview of chapters and objectives, research questions, methods, and study population

Chapter - objective	Research questions	Methods	Study Population
2 - 1	1. What are the sociocultural and economic determinants of undernutrition and indexes of nutritional status during adolescence in Low- and Lower-Middle-Income Countries (LLMIC)? 2. What are the sociocultural and economic determinants of micronutrient status and deficiencies during adolescence in LLMICs? 3. What are the sociocultural and economic consequences of undernutrition and micronutrient deficiencies during adolescence in LLMICs?	Systematic narrative literature review	Adolescent boys and girls in LLMICs
3 – 2	1. Which individual-, household- and community-level sociocultural and economic factors influence stunting and thinness of adolescent boys and girls while aged 10–19 years in Nepal? 2. Do these determinants differ between younger (10-14 years) and older (15-19 years) adolescents?	Quantitative analyses of cross-sectional secondary survey data (2014)	Adolescent boys (n= 1888) and girls (n=1885) in Nepal
4 - 3	1. What are adolescent girls' aspirations in several key life course domains - education, occupation, marriage, fertility, health, and nutrition? 2. Which individual, household, and community factors are associated with these different aspirations? 3. How do these associations differ between younger (ages 10-14) and older (ages 15-19) adolescent girls?	Quantitative analyses of cross-sectional survey data (2018)	Adolescent girls in Nepal (n=975)
5 – 4	1. What are Nepalese adolescent girls' aspirations related to school, work, family life, food and health, and by whom and how are these aspirations shaped within an everyday life context in two districts in Nepal?	Qualitative in-depth interviews with creative elicitation tools (2018)	Adolescent girls in two districts in Western Nepal (n=17)
6 - 5	1. What are the associations between adolescent girls' nutritional and dietary indicators (stunting, thinness, anemia and dietary diversity) and their educational, occupational, marital, and fertility aspirations in Nepal in year 2018 and 2019? 2. Are changes in nutritional indicators between 2018 to 2019 associated with a change in girls' educational, occupational, marital, and fertility aspirations between 2018 and 2019?	Quantitative analyses of two-period panel survey data (2018 and 2019)	Adolescent girls in Nepal (n=613)

specific methods will be described in detail in the respective chapters. Table 1.1 provides an overview of chapters two through six, the research questions, and methods. A population column is added to specify the focus of the studies. For the first two research objectives, the focus is on both adolescent boys and girls, the last three research objectives only focus on adolescent girls in Nepal.

Description of the setting and the *Suaahara II* project

The context of Nepal

A considerable part of this thesis is based on empirical research that was conducted in Nepal. Nepal is a low-income country with a population of over 28 million people. Tucked in-between China and India, it has 75 districts over three ecological zones (i.e., plains, hills, and mountains), and five developmental regions (i.e., Eastern, Central, Western, Mid-Western, and Far-Western). It has a diverse, multi-ethnic, multi-lingual population with over 125 social groups based on caste, ethnicity, religion, and language (Bennett, Dahal, & Govindasamy, 2008). Main groups are the Hindu caste groups, *Janajati*, and religious minorities (including Muslim) (Bennett, 2005). The country is ranked 11th of the most earthquake-prone countries in the world, and is presently still recovering from the impacts of the 2015 earthquakes. While Nepal is currently one of the poorest countries worldwide, it aspires to become a middle-income country by 2030. Nepal's Human Development Index, indicative of a country's overall social and economic performance (e.g., health, education, and living standards), was 0.602 in 2019, ranking Nepal 142nd out of 189 countries. The country has made notable progress in areas of population health, nutrition, and education. It is undergoing a rapid demographic transition, which leads to a demographic dividend (economic growth), resulting from the declines in fertility and mortality and changes in age group structures. For instance, the Nepal Demographic Health Surveys (NDHS) showed that life expectancy has increased from 62 years in 2000 to 71 years in 2020, the expected years of schooling is currently 12.8, and the total fertility rate fell from 2.3 births per woman in 2016 to 1.9 in 2020 (MoH, New ERA, & ICF, 2017; United Nations Population Fund, 2017). International labor migration to support livelihoods, particularly male-out migration, is common with at least three out of four households reporting at least one family member had migrated in the last 10 years. Male-out migration has led to shifting household dynamics and gender roles through the increase of the number of female-headed households (Gartaula, Visser, & Niehof, 2012)

Despite considerable progress in human development indicators, wide inequalities and disparities exist between communities and geographical areas. Only 48% of households are food secure all year round, particularly in rural areas, and undernutrition remains a silent crisis. Although decreasing, a third of children under five years are stunted. Children from mountain districts, from poorer households, food-insecure households, and those born to mothers with low educational attainment, have higher risks of being stunted, or underweight (MoH et al., 2017). Amongst adolescents, who make up a quarter of the total population, malnutrition remains a pressing and overlooked issue. Data on adolescent nutrition reveal relatively high prevalence rates of stunting and underweight for both adolescent girls and boys. NDHS data showed that in 2016, 30% of girls aged 15-19 were

thin, compared to 37% of boys. Undernutrition was more profound in the lowland plains (*Terai*) than in mountainous and hilly agroecological zones (MoH et al., 2017; Nepali, Simkhada, & Davies, 2019). Especially alarming is the sky-high and still rising prevalence rate of anemia among women, which has increased from 35% in 2011 up to 41% in 2016. This percentage is even higher for young women and girls aged 15-19 (44%), and in the *Terai* region (MoHP, et al., 2018). Nepal's Adolescent Nutrition Survey indicated that 71% of male, and 59% of female adolescents were underweight (BMI less than 18.5) (Aryal et al., 2016). Results however vary with geographical location, socio-economic factors (e.g., ethnicity, gender, wealth), and age (Aryal et al., 2016).

Deeply rooted patriarchal norms and caste-based discrimination are still perpetuated by institutional traditions and sociocultural norms in Nepal, despite bans or regulating policies. Such norms and practices disproportionally affect girls. For instance, *chaupadi*, a practice that confines girls to animal sheds during menstruation because of impurity beliefs is still practiced in Western Nepal and puts girls' lives in danger. The encountering and accumulation of disadvantages during adolescence directly impact health and wellbeing, human capital and autonomy, and life opportunities, particularly of girls. This is reflected in early, forced marriage and unwanted pregnancies, skewed access to education, unequal access to employment, and limited decision-making power (UNPF, 2017). Moreover, the unequal intra-household food allocation practices that deprive girls of essential nutrients (DeRose, Das, & Millman, 2000; Harris-Fry et al., 2018), and the unequal access to healthcare according to age, sex, and/or birth order, still persist (Godha, Hotchkiss, & Gage, 2013; Koolwal, 2007). In terms of education, the gender gap is closing, but girls are still more likely to drop out of secondary school due to marriage, school failure, or economic reasons. NDHS data shows a trend away from early marriage, but 27.1% of girls marry between 15-19 years, compared to only 6.4% of boys. Among girls aged 15-19, 17% have begun childbearing, a percentage which has not decreased since 2011. By the age of 19, 36% of girls have given birth to a child, often within two years of marriage. Related, only 15% of married girls aged 15-19 use a modern method of contraception, resulting in high (32%) unmet need (MoH et al., 2017).

The *Suaahara II* "Good Nutrition" program

The empirical part of this study is embedded within the United States Agency for International Development (USAID)-funded large-scale multisectoral integrated nutrition program, *Suaahara II* "Good Nutrition" (*SII*) in Nepal, which runs from 2016 to 2021 in Nepal. The program is led by Helen Keller International (HKI) and aims to reduce the prevalence of stunting, wasting, and underweight among children under five years of age, and to reduce the prevalence of anemia among women and children between 6-59 months of age (HKI, 2017). In addition, the program is dedicated to work with adolescent girls, to

improve their understanding of nutrition, hygiene, and reproductive health issues. *SII* has a unique adolescent-focused learning agenda with the aim to design and implement evidence-based interventions to improve adolescents' awareness, knowledge, skills, and capabilities related to health and nutrition and diets (Gyawali et al., 2019). The program is implemented in 42 out of 77 districts across all three agro-ecological zones of residence – mountains, hills, and lowland plains – and the five development regions in Nepal (see Figure 1.3).

As part of the annual monitoring and evaluation work, annual household surveys are conducted each year (except for 2020 due to the COVID-19 pandemic) surveying approximately 3654 households from 16 randomly selected districts in the *Terai*, hills, and mountains of Nepal (see Figure 1.3, survey districts indicated by stars). In 2017, baseline data was collected from 1093 adolescent girls (10-19 years) with the aim to collect data for informing interventions specifically aimed at adolescent girls (Cunningham, Pries, Erichsen, Manohar, & Nielsen, 2020). While the annual household surveys were cross-sectional, from 2017 onwards the same girls participating in 2017 were followed over time, resulting in a rich Adolescent Girls Panel data set. For this specific thesis, data from the second and third waves of data collection, in 2018 and 2019, were used. Data collection in these rounds included, besides socio-demographic and economic indicators, also anthropometric measurements (i.e., height, weight), hemoglobin assessments, 24-hour dietary food recalls, and an aspirations module unique to this study.

A qualitative component - with a from the panel randomly drawn sub-sample of adolescent girls - was conducted in two districts in Western-Nepal in 2018 (see Figure 1.3., red star). The two selected districts were Nawalpur (province 4, hills) and Parasi (province 5, plains), previously known as Nawalparasi, but split since 2016 (see Figure 1.4, study sites circled). These districts were selected as more than half of Nepal's population lives in the *Terai*. In this region, early marriage, particularly in areas bordering India is common. Moreover, secondary school dropout, food insecurity, and undernutrition are common challenges (Marphatia et al., 2020; MoH et al., 2017).

Thesis outline

This thesis is divided into two parts. **Part I**, chapters 2 and 3, contributes to the literature on adolescent undernutrition in LMICs, focusing mainly on the context-specific drivers of adolescent undernutrition as indicated by thinness, stunting, and micronutrient deficiencies, as well as the consequences of adolescent undernutrition during adolescence. This part departs from a bio-ecological perspective (Bronfenbrenner, 1979) and focuses on both adolescent boys and girls. **Chapter 2** provides a comprehensive systematic literature review, which systematically synthesizes available evidence on the drivers of undernutrition

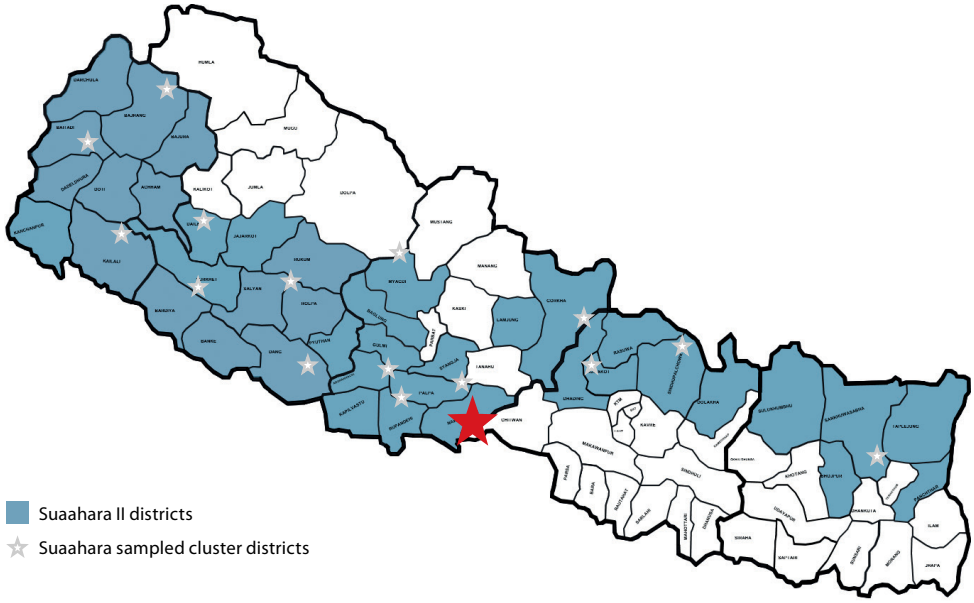


Figure 1.3. ***Suaahara II*** program (in blue) with survey districts (starred). Source: HKI, 2017.

Figure 1.4. Qualitative study districts. Parasi (left) and Nawalpur (right), with study sites circled. Adapted from: Creative Commons Parasi and Nawalpur by P. Bhattarai licensed under CC BY-SA 4.0

at several levels and micronutrient deficiencies, and which effects (consequences) poor nutrition has throughout adolescence in the context of LMICs. It thereby aims to identify knowledge gaps in the adolescent nutrition literature. Based on findings of this literature review, **Chapter 3** investigates and tests which sociocultural and economic factors are associated with adolescent undernutrition in the specific context of Nepal, and whether there are differences between younger (10-14 years), and older (15-19 years) adolescents. Data from this chapter are from the Nepal Adolescent Nutrition Survey 2014.

Part II, chapters 4 to 6, dives into the understudied domain of adolescent girls' aspirations, and associations between aspirations and a range of nutritional indicators throughout adolescence. Part II is framed within human ecology and life course theory and is solely focused on adolescent girls in Nepal. Chapters are based on empirical research conducted from 2018 to 2019 in Nepal, which was carried out under the umbrella of the *Suaahara II* Good Nutrition Program, and the adolescent learning agenda. **Chapter 4** reports on the non-nutritional individual, household-, and community-level factors associated with adolescent girls' aspirations in domains of education, occupation, family formation (marriage, having children), as well as in relation to the perceived importance of health and nutrition, as proxies of aspirations in these domains, using cross-sectional data from one wave (2018) of the *SII* Adolescent Girls Panel Survey. **Chapter 5** is framed within a life course perspective and dives deeper into the role of the less-easily in survey captured factors, including (hidden) feelings, important others, and gendered socio-cultural norms that shape girls' life aspirations in two selected survey districts in Nepal. In **Chapter 6,** two waves from the *SII* Adolescent Girls Panel Surveys (2018-2019) are used to estimate whether nutritional and dietary diversity indicators are associated with adolescent girls' aspirations in the key life domains of education, occupation, marriage, and fertility, and second, to estimate whether changes in malnutrition are associated with changes in girls' aspirations (between 2018 and 2019). In the final chapter, **Chapter 7**, the main findings are first summarized per chapter. Next, findings are integrated to answer the research questions and discussed in light of relevant theory and research. Methodological considerations and suggestions for further research are presented. Finally, important implications for policy and practices that aim to contribute to help adolescents reach their full development potential are proposed.

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Chapter 2

Sociocultural and economic determinants and consequences of adolescent undernutrition and micronutrient deficiencies in LLMICs: a systematic narrative review

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Abstract

Adolescent undernutrition is a persisting public health problem in low- and lower middle-income countries (LLMICs). Nutritional trajectories are complexly interrelated with socio-cultural and economic (SCE) trajectories. However, a synthesis of the SCE determinants or consequences of undernutrition in adolescents is lacking. We undertook a narrative review of published literature to provide a narrative overview of the SCE determinants and consequences associated with undernutrition among adolescents in LLMICs. We identified 98 articles from PubMed, SCOPUS, and CAB-Abstracts on determinants and consequences of undernutrition as defined by stunting, underweight, thinness, and micronutrient deficiencies. At the individual level, significant determinants included age, sex, birth order, religion, ethnicity, educational and literacy level, working status, and marital status. At the household level, parental education and occupation, household size and composition, income, socioeconomic status, and resources were associated with undernutrition. Only a few determinants at the community/environmental level, including residence, sanitation, school type, and seasonality, were identified. The consequences of adolescent undernutrition were mostly related to education and cognition. This review underscores the importance of the broad range of context-specific SCE factors at several levels that influence adolescent nutritional status and shows that further research on SCE consequences of undernutrition is needed.

Introduction

The world faces the largest cohort of adolescents, aged between 10 and 19 years old, ever (Patton et al., 2016; WHO, 2005). Around 90% of these adolescents live in Low- and Middle-Income Countries (LMICs). As a result of this youth "bulge", LMICs are faced with the question of how to harness this demographic dividend, which occurs during a window of opportunity created by a shift to fewer dependent people relative to working-age individuals (Lin, 2012). Adolescents are the future workforce, leaders, and bearers of the next generation. Improvement of their health and developmental outcomes through nutrition is currently seen as (another) second window of opportunity for "catch-up" growth (WHO, 2014). Investing in adolescent nutrition improves not only children's health and developmental outcomes, but also those of their offspring, and consequently entire societies (Black et al., 2013). However, development and research programs in LMICs often focus on the first 1000 days, the first five years, or on women in their reproductive age since interventions in these life stages are widely believed to break intergenerational cycles of malnutrition, improving birth and pregnancy outcomes (Bhutta et al., 2013; Black et al., 2008).

The life stage of adolescence is characterized by rapid biological growth, in which the social, economic, and cultural context of adolescents is decisive (Patton & Temmerman, 2016; Patton et al., 2016; Sawyer et al., 2012). Many children in LMICs enter adolescence thin, stunted, anemic, and/or micronutrient deficient (Thurnham, 2013). Throughout adolescence, nutrition is complexly interrelated with social, cultural, and economic trajectories including education, family formation (e.g., marriage and fertility), and labor participation (National Research Council & Institute of Medicine, 2005); disadvantages in these trajectories may influence nutritional status or the other way around. While the attention is shifting towards adolescent nutrition in international development and research (Sawyer et al., 2012), evidence concerning SCE characteristics in relation to nutrition throughout adolescence is dispersed, highlighting a research gap in this area.

Additionally, there is a dearth of research on the SCE consequences of undernutrition during adolescence, although the effects of undernutrition during childhood on adult outcomes are well known. For instance, the relations between early childhood nutrition and cognition, learning, or educational achievements (Biesalski, 2016; Freeman, Klein, Kagan, & Yarbrough, 1977; Glewwe, Jacoby, & King, 2001; Maluccio et al., 2009), as well as between early childhood nutrition and economic productivity, wages, marriage, and fertility (Hoddinott et al., 2011; Hoddinott, Maluccio, Behrman, Flores, & Martorell, 2008) are well established. But there is a paucity of data on the effects of poor nutrition during adolescents' transitions into adulthood, and how their nutritional status is affected by their everyday life context.

To our knowledge, no reviews exist that summarize the SCE determinants and consequences of undernutrition during adolescence in LMICs. Nonetheless, Viner et al. (2012) reviewed the social determinants of health in adolescents but did not specifically focus on nutrition or LMICs. Reviews including adolescent nutrition mostly focus on the determinants of overnutrition (Keino, Plasqui, Ettyang, & van den Borne, 2014; Mistry & Puthussery, 2015; Popkin, Adair, & Ng, 2012; Rahman, Islam, & Alam, 2014; Rivera et al., 2014) or on the co-occurrence of stunting and overweight (Keino et al., 2014), which is particularly interesting in light of the global nutrition transition (Popkin et al., 2012). A recent series of reviews on adolescent nutrition take into account eating patterns and behavioral patterns during adolescence but do not discuss the "social contexts that directly or indirectly affect adolescent nutrition" in LMICs which may include structural factors at a broader societal level, but also at the level of households and communities (Das et al., 2017, p. 29; Lassi, Moin, Das, Salam, & Bhutta, 2017; Salam, Das, Lassi, & Bhutta, 2016a; Salam et al., 2016b). Similarly, although some studies focused on the effects of iron deficiencies on cognitive development in children (Grantham-McGregor, 1995; Grantham-McGregor & Ani, 2001), no reviews focus on the SCE determinants or outcomes of adolescents' micronutrient status. The focus of existing reviews on adolescents has mostly been on the effect of micronutrient supplementation (Chiplonkar & Kawade, 2012; Lassi et al., 2017; Lohner et al., 2012; Vatanparast & Whiting, 2006).

In light of the challenge to unlock the potential of adolescents through improved nutrition, a synthesis on what affects, and which effects poor nutrition has throughout adolescence in a particular context is essential to tackle this challenge. Especially in LMICs where adolescents lag behind in several life domains, such a comprehensive picture could further inform research and context-specific programs that aim to understand and improve the health and developmental outcomes of adolescents. With this review, we aim to fill the research gap by providing a narrative overview of the SCE determinants and consequences associated with protein-energy undernutrition and micronutrient undernutrition/deficiencies among adolescents in low and lower-middle income countries (LLMICs). Such a review may help to understand and improve efforts directed towards optimizing adolescent health and nutrition. Specific research questions are: (1) what are the SCE determinants of undernutrition and indexes of nutritional status during adolescence in LLMICs; (2) what are the SCE determinants of micronutrient status and deficiencies during adolescence in LLMICs; and (3) what are the SCE consequences of undernutrition and micronutrient deficiencies during adolescence in LLMICs? We focus on LLMICs because undernutrition remains the greatest concern and rates are only slowly declining (Popkin et al., 2012); for instance, more than a quarter of adolescent girls are reported to be underweight in 11 LLMICs and anemia is a severe public health problem among adolescent girls in 15 out of 21 LLMICs (UNICEF, 2012).

Methods

Undernutrition encompasses both micronutrient deficiencies and macronutrient or protein-energy malnutrition. However, for the purpose of this review, the term *undernutrition* refers to stunting, underweight, and thinness, while nutritional status index(es) refers to the Z-scores of height-for-age (HA), weight-for-age (WA), weight-for-height (WH), and BMI-for-age (BA). Micronutrient status and related deficiencies included in this review are: vitamins A, C, D, B_{12}, iron, hemoglobin (Hb) status, anemia, iodine, zinc, folic acid, and calcium; these were selected based on evidence of the common micronutrient deficiencies during adolescence (WHO, 2006).

Search method

A comprehensive search strategy was developed by using a variety of search terms for retrieving relevant literature. Two separate searches were performed between April and May 2017, one focused on undernutrition, the other on micronutrient deficiencies. Search queries built on five layers with relevant search terms. The first layer referred to "adolescence", as defined by the WHO (10–19 years) (WHO, 2014). The second layer included LLMICs in South and East Asia, Latin America, and Sub Saharan Africa (66 countries) derived from the World Bank list of economies (see Supplementary Table 2.1) (World Bank, 2017). The third layer included SCE aspects related to trajectories of labor participation, family formation, and education (e.g., marriage, cognitive skills, literacy, time use, household structure, and gender). The fourth layer referred to "associations" (e.g., determinants, factors, outcomes, consequences, and interrelations) since we aimed for studies that specifically focused on associations instead of prevalence rates only. The final layer differed for the two searches. In the "undernutrition" search, terms related to undernutrition (i.e., undernutrition, underweight, WA, stunting, HA, thinness, WH, and BA) were used, while for the micronutrient deficiencies search, these terms were replaced by micronutrients and deficiencies including hidden hunger, (iron deficiencies) anemia, iodine, folate, folic acid, vitamins A, B_{12}, C, and D, serum retinol, zinc, and calcium. Search queries were adapted to the requirements of the specific databases: PubMed, Scopus and CAB Abstracts. Searches were limited to English/Dutch only and as from 1990 onwards. In Scopus, we applied limits on document type, and in PubMed, we used MeSH terms for nutrition and adolescence and limited the search to humans. In total, 2554 papers were found for undernutrition, while 685 papers were found for micronutrient deficiencies.

Screening protocol

After duplication removal, a total of 2788 papers were screened on the basis of title and abstract. Quantitative empirical research and working papers were considered for

inclusion when they showed associations between the variables of interest. Cohort and longitudinal, cross-sectional, and intervention studies were considered for inclusion. Papers were excluded when they focused on diet associations with diseases or other issues (e.g., addictions, helminth infections, anorexia, diabetes, and blood pressure), unhealthy adolescents or migrants, biochemical processes, lifestyle/behavior (e.g., snacking, body image, and physical activity), or prevalence only. Studies including a broader age range or just part of the 10–19 years' range were excluded when there were no age-specific results (e.g., sample 6-12 should include specific data for 10–12 years). When a paper only reported differences between sexes without explanation or not taking into account any other variables, we rejected the paper. Qualitative research, methodology papers, review papers, editorials, and intervention studies without baseline information were excluded. Although we included terms as overweight and obesity in the queries, studies focusing on overnutrition were considered only when they included undernutrition as well. A full-text screening was performed on a total of 248 papers, after which 141 studies were rejected based on criteria mentioned above, or when the authors were not able to retrieve the full texts after having requested the papers from authors or research organizations (n = 18). Afterward, a manual search was performed in which bibliographies of eligible papers and relevant reviews were screened using the same procedure described above. Furthermore, we asked an external researcher to screen and add to this final list, and we checked our own databases for relevant papers (n = 20).

Transparency assessment

Finally, 111 papers underwent a transparency check in which they were graded against seven methodological criteria in order to assess interpretability: research aim or hypothesis, data collection methods, sampling plan and size, analysis method, conclusions, and limitations were either available (score 2), partly available (score 1) or missing (score 0). Almost a third of the papers scored at least one zero, but nine papers were excluded because they scored low (1 or 0) on multiple indicators. A total of 57 and 45 papers were included in this review for undernutrition and micronutrient deficiencies, respectively. Figure 2.1 provides an overview of the screening process based on the PRISMA criteria (Moher et al., 2009).

Data extraction and analysis

Papers were thoroughly read and coded deductively as well as inductively using Atlas Ti for the undernutrition part after which results were transferred to an Excel sheet. For the micronutrient part, data was extracted into an Excel sheet directly. We recorded information on study design, methods, analysis, outcome measures, and all associations (significant and nonsignificant) between undernutrition/micronutrient deficiencies. Then, the two sheets were merged, and findings were cross-checked and discussed by the researchers. Missing

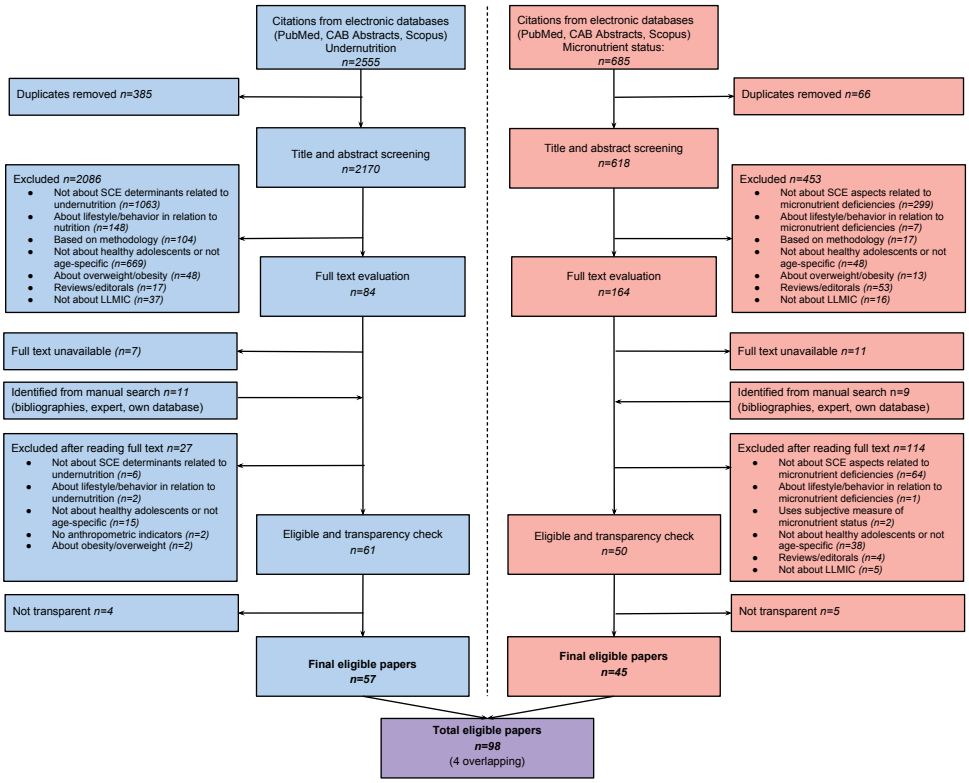

Figure 2.1. PRISMA flow diagram of the screening process, with undernutrition and micronutrient status combined

data or contradictory data were corrected, and papers were assigned a specific code. Data were entered in four tables, the first including a general overview of characteristics for studies on determinants (see Supplementary Table S2.3) and consequences (see Supplementary Table S2.2) and focus of the final list of papers; this table also includes all SCE variables studied. Next, two tables were made in which all significant associations (positive/negative) were reported. Table 2.1 reports on the SCE determinants of undernutrition (categorical) and micronutrient deficiencies (categorical), while Table 2.2 includes SCE determinants of nutritional status index (HAZ, BAZ, WAZ, and WHZ) and micronutrient status (continuous). Within this categorization, determinants were categorized per level and clustered by domain (education, labor, household composition, etc.). Herein, we departed from Bronfenbrenner's' human ecological model (1979) and Dahlgren and Whitehead's (1991) social determinants of health model and acknowledge that an individual's nutritional status is positioned within, and influenced by, a broader system of SCE contexts that are played out at several levels. Table 2.3 reports the consequences of undernutrition/nutritional status index and micronutrient deficiencies/status.

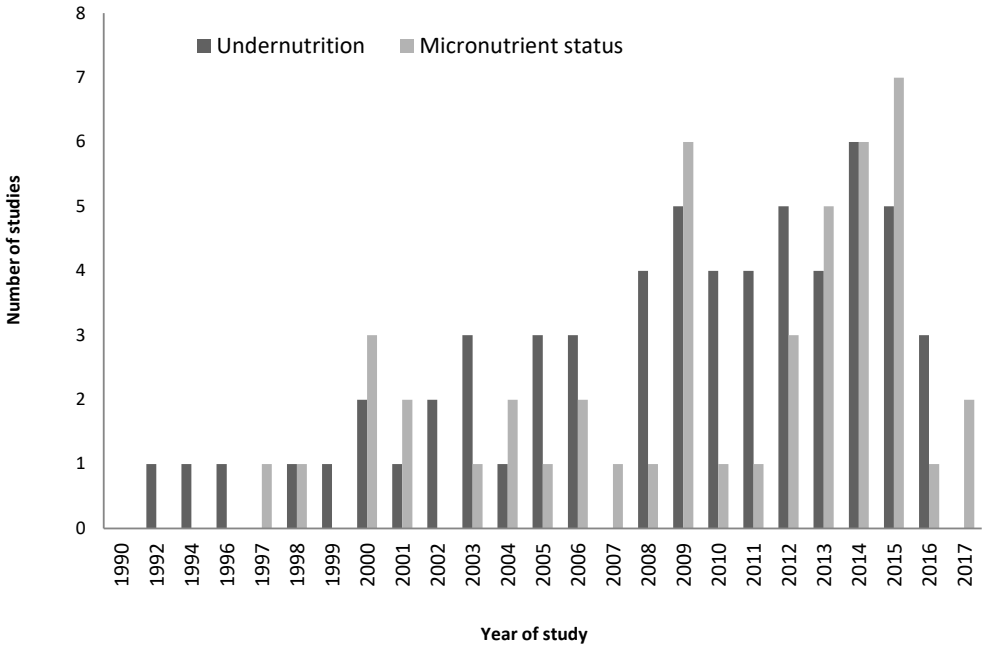

Figure 2.2. Number of published studies on the SCE determinants of undernutrition and micronutrient status of adolescents in LLMICs between 1990 and 2017.

Results

Due to the high heterogeneity of outcome measures, the diverse range of study methods, and the lack of transparent methodological descriptions, we could not conduct a meta-analysis. Hence, we focused on the breadth of the studies and synthesized the findings using a narrative approach. Starting with an overview of the papers, we then discuss findings for the two separate searches.

General characteristics

Our sample shows an increase in the number of papers on adolescent nutrition, with a rapid increase after 2008 and again 2013 that might reflect the increasing interest in adolescent undernutrition and micronutrient status, especially after the launches of the 2008 and 2013 Lancet series on maternal and child nutrition (see Figure 2.2). Most of the published articles in our sample on adolescent undernutrition and micronutrient status focus on both males and females (57.7%). However, research on adolescent females only (38.2%) has been of particular interest in comparison to males (4.1%). A majority of the publications on undernutrition and micronutrient status of adolescents originate from India. Most of the

publications (n = 28) from sub-Saharan Africa focused on undernutrition with less than a half of these publications focusing on adolescents' micronutrient status. We found only two studies originating from LLMICs in Latin America, both of which were on undernutrition. Most of the reviewed studies were cross-sectional in design. The fewer longitudinal studies we found (10.3%) studied mainly associations with adolescent undernutrition and nutrition status index, rather than micronutrient status.

Determinants of undernutrition and nutritional status indexes

In this section, the results on SCE determinants of adolescent undernutrition and nutritional status indexes are summarized per level. Acknowledging the different levels of data analysis, we differentiated between studies focusing on the relation between determinants of undernutrition as indicated by stunting, wasting, and thinness (categorical), and between determinants of nutritional status index (continuous) as indicated by height for age (HAZ), weight for age (WAZ), weight for height (WHZ), and BA, in which the latter two were grouped together under WHZ. Although in all studies height and weight measurements were taken, more studies first classified the study population into categories of nutritional status using height and weight indexes and then assessed the associations with SCE aspects, rather than directly analyzing growth index in relation to determinants (36 versus 31, respectively). Stunting and HA were more often used in relation to variables than other indicators or indexes. For the majority of the studies, the WHO/NCHS reference standards were used in which Z-score cut-off points of < –2 SD (standard deviation) were used to classify measurements into undernutrition. Other classifications used were BMI percentiles (WHO), sometimes converted to chronic energy deficiency, or US-CDC reference standards. In general, determinants and consequences significantly associated with undernutrition and nutritional status indexes can be found mostly at the adolescents' individual and household level (see Table 2.1).

Table 2.1. Determinants of adolescent undernutrition and micronutrient deficiencies

	UNDERNUTRITION						MICRONUTRIENT DEFICIENCIES													
	Stunting		Underweight		Thinness		Vit A		Vit D		Iron def		Anemia		Iodine		Zinc		Folic	
	+	-	+	-	+	-	+	-	+	-	+	-	+	-	+	-	+	-	+	-
INDIVIDUAL LEVEL																				
Determinants																				
Sex																				
F									m35		m14		m14 m39	m30	m31				m21	
M	u47 u12 u36 u2 um3 u4 u31 um1 u16 u33		u49 u44 u43 u36 u2 um3 u33		u4 u42 u31 u6 u13 u16 u27 u48 u53								m22							
Age (F/M)	u49 m19 u51	um1	u49		u13	u42 u31 u15 u53			m23				m1 m30 m33						m21	
F	u41	u25 u7			u41								m9-10 m12	m29 m38						
M	u48												m22	m36						
Birth order	u38		u38		u6															
Ethnicity														m9 m11-12						
Religion (Muslim and Hindu versus Christian)	u36				u4									m9 m11-12, m26						

	UNDERNUTRITION						MICRONUTRIENT DEFICIENCIES													
	Stunting		Underweight		Thinness		Vit A		Vit D		Iron def		Anemia		Iodine		Zinc		Folic	
	+	-	+	-	+	-	+	-	+	-	+	-	+	-	+	-	+	-	+	-
Marital status (married vs. unmarried)													m9 m12							
Labor																				
Workload						u41														
Working status (working versus not-working)	u44	u4	um3			u4					um3		m19				um3		um3	
Education																				
Attendance		u40 u38																		
Drop-out											um3			m1						
Enrolment		um2 u20		um2	u13								m20							
Literacy level		u41												m26						
Educational level		u4				u7 u4								m9 m19 m25 m34						
No footwear													m38							
HOUSEHOLD LEVEL																				
Parental occupation		u44 u36		u44																
Maternal		u39		u36										um4 m19 m25						
Paternal		u40 um3 u31 um4 u39				um3 u46								m26 m39						
Parental education		u39 u48				u4 u53														

	UNDERNUTRITION						MICRONUTRIENT DEFICIENCIES													
	Stunting		Underweight		Thinness		Vit A		Vit D		Iron def		Anemia		Iodine		Zinc		Folic	
	+	-	+	-	+	-	+	-	+	-	+	-	+	-	+	-	+	-	+	-
Maternal		u48 u11 u51 u4		u11 u52		u46		m37						m12						
Paternal		u33 u4		u33		um3 u46								m39						
SES		u16 u48 m19		u2		u7 u16 u25								m9- m10 m12 m21						
Income		um3 u4 um1 u39		u15		u50 u4 u19 u27 um3		um1				m22		m22 m28						
Resources (land, cattle, latrine, no. of living rooms, rented versus own, housing type, access to piped water)		u44 um3 u33 um4 u49		u44 u33		um3 u53 m30								m26						
Household composition																				
No. of siblings	u36 u39		u36 u38		u38															
No. of servants		u40																		
No. of wives/ polygamy	u36 u49																			
No. of sisters/women	u40																			
Living with guardian					u6															
Size	u11 u4 u31 m33 u39		u11 u49		u51 u4								m39							
Type of family (joint versus nuclear)	u44				u7									m19						

	UNDERNUTRITION						MICRONUTRIENT DEFICIENCIES													
	Stunting		Underweight		Thinness		Vit A		Vit D		Iron def		Anemia		Iodine		Zinc		Folic	
	+	-	+	-	+	-	+	-	+	-	+	-	+	-	+	-	+	-	+	-
Food insecurity	u32 u51		u51		u51 u13								um4							
COMMUNITY LEVEL																				
WASH		u51		m30										m19 m30						
Residence																				
Rural (versus urban)	u36 u30 u4 u31 um4		u43 u36 u30		u30 u4 u15					m23			um4	m8-9 m12	m24					
Geographical zone														m9 m20	m6					
School type (public or poor versus private or rich)	u50 u36 u48 u4		u50 u36		u50								m36							
Scheduled caste (Dalit)	u49																			
Environmental																				
Season (other versus summer)									m23											
Before rain (versus after rains)													m29							
Harvest (versus hunger)							m24				m24	m24	m24						m24	

Table 2.2. Determinants of adolescent nutritional status index (z-score) and micronutrient status

	NUTRITIONAL INDEX						MICRONUTRIENT STATUS															
	H/A		W/A		W/H (BMI/A)		Vit A		Vit C		Vit D		Iron		Hb		Iodine		Ca		Folic	
	+	-	+	-	+	-	+	-	+	-	+	-	+	-	+	-	+	-	+	-	+	-
INDIVIDUAL LEVEL																						
Determinants																						
Sex																						
F	m17	u28 u35	u52		u52											m17 m21						m21
M	m31	u4 u5 u47		u47		u1 u4		m31			m35											
Age (F/M)	m17 m31	u1 u47 um4		u1 u47	u26	u1		m16	m16		m35	m27			m17	m26						
F		u3 u29 u41	u52	u9 u29	u1 u3 u52	u41	m2								m11							
M		u26		u26	u1 u26 u4		m4								m4							
Birth order																m7						
Ethnicity	u10 u38																					
Religion (Muslim and Hindu versus Christian)		u26		u26																		
Labor																						
Working status (work versus not-working)	u4				u4																	
Time spent in heavy work (carrying heavy goods)	u53																					
Education																						

	NUTRITIONAL INDEX						MICRONUTRIENT STATUS															
	H/A		W/A		W/H (BMI/A)		Vit A		Vit C		Vit D		Iron		Hb		Iodine		Ca		Folic	
	+	-	+	-	+	-	+	-	+	-	+	-	+	-	+	-	+	-	+	-	+	-
Attendance	u21 u22 u34 u37		u34 u37		u34 u37																	
Enrollment	u22 um2														um2							
Literacy level															m11							
Educational level	u4 u24		u24		u4						m27										m40	
Migration to urban area	u22				u22																	
HOUSEHOLD LEVEL																						
Parental occupation																						
Maternal															m4							
Paternal															m4							
Parental education					u4																	
Maternal	u3 u17		u17		u3 u17																	
Paternal	u3		u3 u33				m4; m5								m34							
Parental literacy																						
Maternal															m11							
Paternal															m11							
SES	u24 u29 u33 u34 m19		u22 u24 u29 u33 u34		u34						m32								m32		m40	
Income	u4 u26		u26		u4 u27		m5		m22				m22		m11 m22				m22			
Per capita food expenditure	u17		u17		u17		m 4-5															

	NUTRITIONAL INDEX						MICRONUTRIENT STATUS															
	H/A		W/A		W/H (BMI/A)		Vit A		Vit C		Vit D		Iron		Hb		Iodine		Ca		Folic	
	+	-	+	-	+	-	+	-	+	-	+	-	+	-	+	-	+	-	+	-	+	-
Resources (land, cattle, latrine, no. of living rooms, rented versus own, housing type, access to piped water, and electricity)	u33 u35				u35										m3 m11							
Household composition																						
No. of siblings		u33																				
No. of servants																						
No. of wives/ polygamy	u29		u29																			
Size		u4				u4		m16		m16				m41		m7						m40
Migration			u9		u9																	
Food insecurity		u8																				
COMMUNITY LEVEL																						
Residence																						
Rural (versus urban)		u4 u29 u30 u43		u30 u43		u4 u30 u34												m24				m24
Hills (versus lowland)		u52																				
Slum (versus non-slum)		u23				u23																
Geographical zone													m24		m11		m6					
School type (public or poor versus private or rich)		u36; u4		u43; u36																		
Scheduled caste (Dalit)																m11						
Season																						

	NUTRITIONAL INDEX						MICRONUTRIENT STATUS															
	H/A		W/A		W/H (BMI/A)		Vit A		Vit C		Vit D		Iron		Hb		Iodine		Ca		Folic	
	+	-	+	-	+	-	+	-	+	-	+	-	+	-	+	-	+	-	+	-	+	-
Season (other versus summer)												m27										
Harvest (versus hunger)								m24								m24		m24				m24

Table 2.3. Consequences of adolescent undernutrition and micronutrient status

A

	Nutritional status index						Micronutrient status	
	HAZ		WAZ		WHZ		Zinc	
Outcomes	+	-	+	-	+	-	+	-
Non-cognitive skills *(Self-efficacy, educational aspirations, self-esteem)*	u18							
Cognitive skills *(Mathematics, language, verbal comprehension, memory, reaction time, intelligence)*	u14; u21						m13	
Educational performance	u1		u1		u1, u34			
School attendance	u37; u21		u37					
Age at marriage				u45				

B

	Undernutrition						Micronutrient deficiency			
	Stunting		Underweight		Thinness		Iron deficiency		Anaemia	
Outcomes	+	-	+	-	+	-	+	-	+	-
Cognitive skills *(Mathematics, language, verbal comprehension, memory, reaction time, picture completion test, intelligence)*		u21, m31; m15						m34		
Educational performance		u1		u1		u1				m19; m38

Individual level

At the adolescents' individual or micro level, several demographic determinants were identified as risk factors or predictors of stunting, underweight, and thinness. Mixed results were found regarding sex, with many studies reporting non-significant differences. Interestingly, studies reporting significant associations showed that boys were often worse off in terms of stunting and HAZ (Adesina, Peterside, Anochie, & Akani, 2012; Assefa, Belachew, & Negash, 2015; Ayogu, Nnam, Ibemesi, & Okechukwu, 2016; Ayoola et al., 2009; Bosch, Baqui, & van Ginneken, 2008; Dapi, Janlert, Nouedoui, Stenlund, & Håglin, 2009; Lanerolle-Dias, Silva, Lanerolle, Arambepola, & Atukorala, 2012; Melaku, Zello, Gill, Adams, & Shi, 2015; Mondal, Biswas, & Bose, 2012; Omigbodun et al., 2010; Sellen, 2000); underweight and WAZ (Adesina, 2012; Lanerolle-Dias et al., 2012; Mondal et al., 2012; Omigbodun et al, 2010; Raj, 2009; Rao, Balakrishna, Laxmaiah, Venkaiah, & Brahmam, 2006; Sellen, 2000; Venkaiah, Damayanti, Nayak, & Vijayaraghavan, 2002) and thinness or WHZ (Acham, Kikafunda, Oluka, Malde, & Tylleskar, 2008; Assefa et al., 2015; Bamidele, Olarinmoye, Olajide, & Abodunrin, 2011; Cordeiro, Wilde, Semu, & Levinson, 2012; Dapi, et al., 2009; Khongsdier, Varte, & Mukherjee, 2005; Melaku et al., 2015; Rahman & Karim, 2014; Sellen, 2000; Yetubie, Haider, Kassa, & Fleming, 2010). Only three studies in Ghana, Ethiopia, and Cambodia found that height or WAZ was lower for girls when compared with boys (Lardner et al., 2015; Mulugeta et al., 2009; Perignon et al., 2014). Age was often reported to influence undernutrition. Four studies found that stunting increased with age in general, and in particular for boys (Friedman et al., 2005; Senbanjo, Oshikoya, Odusanya, & Njokanma, 2011; Venkaiah et al., 2002; Wolde, Berhan, & Chala, 2015). The opposite was found for thinness that decreased with age in four studies (Dang et al., 2010; Melaku et al., 2015; Rahman & Karim, 2014; Yetubie et al., 2010) compared with only one study (Cordeiro et al., 2012) that showed an increase. When looking at nutritional status indexes, studies showed similar, but also more varied results. For instance, while HA decreased significantly with age during adolescence, for both boys and girls (Acham et al., 2008; Ahmed, 1998; Khongsdier & Mukherjee, 2003; Leslie & Pawloski, 2010; Rah et al., 2009; Sellen, 2000; Teji, Dessie, Assebe, & Abdo, 2016), here more studies (Ahmed et al., 1998; Leslie & Pawloski, 2010; Rah et al., 2009) reported that HA and WA in girls decreased more compared with boys. Birth order was only in one study associated with underweight and stunting (Panter-Brick, Todd, & Baker, 1996). Religion was in three studies (Assefa et al., 2015; Khongsdier & Mukherjee, 2003; Omigbodun et al., 2010) associated with stunting, thinness, and decreased HA and WA, while ethnicity was only associated with HAZ in two studies (Benefice, Monroy, Jimenez, & Lopez, 2006; Panter-Brick et al., 1996). Migration from a rural to an urban area in Senegal was positively associated with HAZ and WHZ (Garnier, Simondon, Hoarau, & Benefice, 2003). Finally, two studies reported the adverse effects of poor personal hygiene

practices on stunting and underweight (Mahmud et al., 2013; Wolde et al., 2015). Regarding the labor trajectory, working and especially workload was associated with undernutrition (Lanerolle-Dias et al., 2012; Rao et al., 2006). However, a study in Nepal showed that HA was positively associated with time spent in heavy work (Yamanaka & Ashworth, 2002), and an Ethiopian study found that working was positively associated with HA and WHZ (Assefa et al., 2015).

Education is often mentioned in relation to nutritional status. School attendance and enrolment, educational and literacy levels were in general negatively associated with stunting, underweight, and thinness (Assefa et al., 2015; Barman, Mahanta, & Barua, 2015; Beasley et al., 2000; Fentiman, Hall, & Bundy, 2001; Panter-Brick et al., 1996; Pawloski & Kitsantas, 2008; Rah et al., 2009), and positively with HA, WA, and WHZ (Assefa et al., 2015; Beasley et al., 2000; Fink & Rockers, 2014; Garnier et al., 2003; Joshi, Rikimaru, & Pandey, 2005; Mukudi, 2003; Omwami, Neumann, & Bwibo, 2011). One Tanzanian study, however, found that school nonenrolment was associated with increased thinness explaining this by the fact that parents often perceived thin adolescents as physically not being ready to attend school (Cordeiro et al., 2012).

Household level

At the household level, factors related to parental characteristics, household economic status and resources, household composition, and family type were often found to be associated with undernutrition. Generally, parental occupation was associated with lower stunting, underweight, and thinness (Lanerolle-Dias et al., 2012; Melaku et al., 2015; Omigbodun et al., 2010; Patimah, Arundhana, Royani, & Thaha, 2016; Pawloski & Kitsantas, 2008; Rao et al., 2006; Teji et al., 2016), but not with nutritional status indexes. Interestingly, paternal occupation was more often (n = 6) associated with stunting and thinness, when compared with maternal occupation, which was only in two cases protective against thinness and stunting (Omigbodun et al., 2010; Patimah et al., 2016). Parental education was, in general, associated with better nutritional status; however, in contrast to parental occupation, here especially, maternal education was negatively associated with stunting and underweight (Assefa et al., 2015; Bhattacharyya & Barua, 2013; Senbanjo et al., 2011; Wolde et al., 2015) and positively with HAZ, WAZ, and WHZ (Dasgupta, Saha, & Nubé, 2008; Mondal et al., 2012; Roba, Abdo, & Wakayo, 2016).

Within the economic domain, household economic status and socio-economic status (SES) were commonly associated with nutritional status. Household and per capita income were negatively associated with stunting, underweight, and thinness (Assefa et al., 2015; Ayogu et al., 2016; Dang et al., 2010; Ene-Obong, Ibeanu, Onuoha, & Ejekwu, 2012; Khongsdier et al., 2005; Lanerolle-Dias et al., 2012; Patimah et al., 2016; Wickramasinghe et al., 2004) and to a lesser extent positively with HAZ, WAZ, and WHZ (Assefa et al.,

2015; Dasgupta et al., 2008; Khongsdier & Mukherjee, 2003; Khongsdier et al., 2005). One study showed that per capita food expenditure was positively associated with all nutritional status indexes (Dasgupta et al., 2008). Likewise, SES, defined by a wide variety of indicators, was in 15 cases negatively associated with undernutrition or positively with nutritional status indexes (Adesina et al., 2012; Barman et al., 2015; Dapi et al., 2009; Friedman et al., 2005; Garnier et al., 2003; Joshi et al., 2005; Joshi, Likhar, Agarwal, Mishra, & Umashankar, 2014; Leslie & Pawloski, 2010; Mondal et al., 2012; Mukudi, 2003; Senbanjo et al., 2011). Household resources, including land holdings, possession of cattle, the number of living rooms, rented versus owned home, and housing type were negatively associated with undernutrition indicators (Lanerolle-Dias et al., 2012; Mahmud et al., 2013; Mondal et al., 2012; Rao et al., 2006; Teji et al., 2016; Yetubie et al., 2010) or, to a lesser extent, positively with HA and WHZ (Mondal et al., 2012; Mulugeta et al., 2009). The lack of latrines (leading to open air defecation) and having a hand pump (instead of running water) was associated with BAZ (Mahmud et al., 2013; Mulugeta et al., 2009).

For household composition in relation to adolescent nutrition, several indicators were used. Significant associations were to a greater extent found for indicators of undernutrition than nutritional status indexes. Generally, household size was positively associated with undernutrition (Assefa et al., 2015; Ayoola et al., 2009; Bhattacharyya & Barua, 2013; Mahmud et al., 2013; Melaku et al., 2015; Patimah et al., 2016; Venkaiah et al., 2002), but only once with status indexes (Assefa et al., 2015). The number of siblings was in four studies positively associated with undernutrition (Lanerolle-Dias et al., 2012; Omigbodun et al., 2010; Panter-Brick et al., 1996; Patimah et al., 2016). This was more the case for girls, or when there were more girls in a household (Pawloski & Kitsantas, 2008). Only one study found a similar association with HAZ (Mondal et al., 2012). Polygamy, or the number of wives in a household, was positively associated with stunting (Omigbodun et al., 2010; Senbanjo et al., 2011), while a study in Mali showed how this was negatively associated with HAZ and WAZ (Leslie & Pawloski, 2010). Living with guardians instead of own parents was associated with thinness only in one study (Bamidele, Olanrinmoye, Olajide, & Abodunrin, 2011), and an increasing number of servants in a household was associated with decreased prevalence of stunting (Pawloski & Kitsantas, 2008). Furthermore, two studies showed that adolescents living in joint families were more likely to be stunted (Rao et al., 2006) or thin (Barman et al., 2015). Similar to migration at the individual level, adolescents living in households who migrated from a rural to an urban area in Senegal had higher WHZ and WAZ than those who did not migrate (Benefice, Cames, & Simondon, 1999). Finally, food insecurity at the household level had a negative impact on adolescent undernutrition (Miyoshi, Phommasack, Nakamura, & Kuroiwa, 2005; Wolde et al., 2015). One study from Ethiopia showed that only in girls decreased HAZ was significantly

associated with food insecurity (Belachew, Hadley, Gebremariam, Kasahun, & Kolsteren, 2013).

Community level

We found only a few determinants that focused on community-level factors. In general, rural residence, living in the hills versus lowlands, or living in slum areas were associated with undernutrition and status indexes (Assefa et al., 2015; Dang et al., 2010; Izutsu et al., 2006; Maiti et al., 2011; Melaku et al., 2015; Mukudi, 2003; Omigbodun et al., 2010; Raj et al., 2009; Teji et al., 2016; Yamanaka & Ashworth, 2002). Furthermore, school type was associated with undernutrition, with adolescents attending public, instead of private schools, showing higher rates of undernutrition or poor nutrition (Assefa et al., 2015; Omigbodun et al., 2010; Raj et al., 2009; Senbanjo et al., 2011; Wickramasinghe et al., 2004). Living in a scheduled caste community was in one Indian study associated with stunting (Venkaiah et al., 2002).

Determinants of micronutrient status and deficiencies

In this section, the results on SCE determinants of adolescent micronutrient status and deficiencies are outlined. Generally, most of the reviewed studies on micronutrient status examined Hb status (n = 40) and iron status (n = 13). The determinants of vitamin A status were examined by 10 articles, while those of vitamin D status were examined by five articles. Few articles (≤ 5) reported on the determinants of folate, zinc, calcium, iodine, vitamin C, and vitamin B_{12} status. The statistical analysis procedure was commonly on the determinants of micronutrient deficiencies with logistic regression (n = 21) or simply bivariate analysis with chi-square (n = 8). Only two studies used a combination of both categorical (deficiencies) and continuous (status) outcome methods in the statistical analyses.

Individual level

Similar to undernutrition, mixed results were found regarding sex, with many studies reporting nonsignificant differences. Nevertheless, four studies showed that female sex was associated with a higher risk of anemia (Choe et al., 2001; Tesfaye, Yemane, Adisu, Asres, & Gedefaw, 2015), iron deficiency anemia (IDA) (Choe et al., 2001) and lower Hb levels (Friedman et al., 2005; Jani et al., 2015). Similarly, in India, when compared with adolescent boys, adolescent girls were more likely to be folate deficient (Jani et al., 2015) and vitamin D deficient (Sahu et al., 2009). Another study in Cambodia reported female sex as a risk factor for iodine deficiency, but male adolescents were in this study reported to have a lower retinol binding protein concentration and were more likely to have a marginal vitamin A status compared to their female peers (Perignon et al., 2014). Surprisingly, in a multicountry survey in Lakeside Tanzania, Mozambique, Ghana, Malawi, and Indonesia

(Hall et al., 2009), 12-14 years adolescent boys were more likely to be anemic than girls, and a study in Ethiopia also reported female sex to be protective of anemia (Mahmud et al., 2013).

Generally, increasing age was found to be a risk factor for anemia (Mahmud et al., 2013; Rakesh et al., 2015), vitamin D deficiency (Kim, Oh, Namgung, & Park, 2014), and folate deficiency (Jani et al., 2015) among male and female adolescents. Likewise, studies in Nigeria (Ene-Obong, Odoh, & Ikwuagwu, 2003), India (Laxmaiah et al., 2013), and South Korea (Lee et al., 2014) found increasing age to be inversely associated with plasma retinol, Hb and serum 25(OH)D, respectively, for both sexes. Among adolescent girls, four Indian studies reported increasing age as a determinant of anemia (Ahankari, Myles, Fogarty, Dixit, & Tata, 2017; Bharati, Shome, Chakrabarty, Bharati, & Pal, 2009; Biradar, Biradar, Alatagi, Wantamutte, & Malur, 2012; Chellan & Paul, 2010). However, increasing age was in Kenya (Leenstra et al., 2004) and Ethiopia (Teni, Shiferaw, & Asefa, 2017) protective of anemia for adolescent girls, while in Indonesia (Soekarjo et al., 2001) protective for adolescent boys. Also, serum vitamin C, serum 25 (OH)D and Hb status were in Nigeria (Ene-Obong et al., 2003), India (Sahu et al., 2009), and the Philippines (Friedman et al., 2005), respectively, positively associated with increasing age. Among Bangladeshi adolescent girls (Ahmed, Hasan, & Kabir, 1997) and boys (Ahmed, Rahman, Noor, Akhtaruzzaman, & Hughes, 2006), age was positively associated with serum retinol as well as Hb status. Except in one study on Hb status from Nigeria, birth order was seemingly not an important determinant of poor micronutrient status (Ayogu, Okafor, & Ene-Obong, 2015).

Only four studies examined the effect of working status or workload on micronutrient status, with two of the studies concluding that working girls had a higher risk of anemia and iron and zinc deficiency compared with their nonworking peers (Gupta, Pant, Kumari, & Gupt, 2013; Lanerolle-Dias et al., 2012). Similarly, only a few (n = 5) of the reviewed studies examined the effect of marital status on micronutrient status, and this was generally on anemia. Two studies concluded that being married was related to a higher risk of anemia for adolescent girls (Bharati et al., 2009; Chellan & Paul, 2010).

Late school enrollment (Hall et al., 2009) and dropping out of school (Lanerolle-Dias et al., 2012) were seemingly risk factors for anemia and iron deficiency (ID) respectively. However, Ahankari et al. found dropping out of school to be protective of anemia among India adolescent girls (2017). Adolescent literacy and a higher educational level were generally protective of anemia (Bharati et al., 2009; Gupta et al., 2013; Kulkarni, Durge, & Kasturwar, 2012; Laxmaiah et al., 2013; Rani & Suryaprabha, 2013). Similarly, literacy (Bulliyya, Mallick, Sethy, & Kar, 2007) and a higher educational (Thoradeniya, Wickremasinghe, Ramanayake, & Atukorala, 2006) level were positively associated with Hb and folate status, respectively. Nevertheless, educational level was once found to be

inversely associated with serum 25(OH)D among South Korean adolescents (Lee et al., 2014).

Also, there were differences in the risk of anemia by religion and/or caste in India (Bharati et al., 2009; Bulliyya et al., 2007; Chellan & Paul, 2010). Personal hygiene was in two studies found to be protective of anemia in India and Ethiopia (Gupta et al., 2013; Mahmud et al., 2013). Finally, one study in Ethiopia found that footwear was protective of anemia among adolescent girls (Teni et al., 2017).

Household level

At the household level, a higher paternal education level was associated with a lower risk of anemia in Ethiopia (Tesfaye et al., 2015), higher Hb status in India (Rani & Suryaprabha, 2013), as well as a higher serum retinol status in Bangladeshi adolescents (Ahmed et al., 2006; Ahmed et al., 2009). Equally, a higher maternal education level was reportedly associated with a lower risk of anemia (Chellan & Paul, 2010) and vitamin A deficiency (VAD) (Soekarjo et al., 2004) in India and Indonesia, respectively. Paternal and maternal literacy were also found to positively predict a higher Hb status among Indian female adolescents (Bulliyya et al., 2007). Furthermore, a better maternal (Gupta et al., 2013; Kulkarni et al., 2012; Teji et al., 2016) and paternal (Laxmaiah et al., 2013; Tesfaye et al., 2015) occupation status were both protective of anemia among Indian and Ethiopian adolescents. Likewise, paternal and maternal occupational status were positively associated with Hb status in Bangladeshi adolescents (Ahmed et al., 2006).

Additionally, a higher SES was protective of anemia (Bharati et al., 2009; Biradar et al., 2012; Chellan & Paul, 2010; Gupta et al., 2013) and positively associated with serum calcium (Puri et al., 2008) and folate (Thoradeniya et al., 2006) status, yet inversely associated with a higher serum 25(OH)D (Puri et al., 2008). Generally, a higher family income was associated with a lower risk of anemia (Kim et al., 2014a; Lee et al., 2015), ID (Kim et al., 2014a), and VAD (Ayogu et al., 2016). Likewise, family income was positively associated with serum retinol (Ahmed et al., 2009), serum ferritin (Kim et al., 2014a), and Hb status (Bulliyya et al., 2007; Kim et al., 2014a). Dietary intake of Ca and vitamin C was also reportedly higher with increasing household income level among South Korea adolescent girls (Kim et al., 2014b). A unit increase in per capita expenditure on food was positively associated with a higher serum retinol among adolescent boys (Ahmed et al., 2006) and girls (Ahmed et al., 2009) in Bangladesh.

Overall, a larger family size was a risk factor for anemia (Tesfaye et al., 2015), and inversely associated with serum retinol and vitamin C status (Ene-Obong et al., 2003) besides serum ferritin (Tupe, Chiplonkar, & Kapadia-Kundu, 2009), Hb (Ayogu et al., 2015), and folate status (Thoradeniya et al., 2006). Bangladeshi adolescents living in their parent's houses (Ahmed, Khan, Islam, Kabir, & Fuchs, 2000), as well as Indian adolescents

living in a household with electricity (Bulliyya et al., 2007), were found to have a higher Hb status. Moreover, adolescent girls living in households with latrines were at a lower risk of anemia than those in households without latrines (Laxmaiah et al., 2013). Remarkably, the prevalence of anemia was in one study significantly higher among adolescents living in nuclear families compared with their peers in extended or joint families; this was contrary to the association found between family type and stunting/thinness (Gupta et al., 2013). Finally, food insecurity was in one case reported to be associated with anemia (Teji et al., 2016).

Community level

Surprisingly, residing in a rural community compared with an urban community was protective of anemia in Uganda and India (Barugahara, Kikafunda, & Gakenia, 2013; Bharati et al., 2009; Chellan & Paul, 2010), as well as vitamin D deficiency (Kim et al., 2014b) in South Korea. Only one study found that Ethiopian girls living in rural areas had higher rates of anemia (Teji et al., 2016). Additionally, rural Mozambican adolescent girls had a higher serum folate status when compared with their peers from urban areas; however, rural girls were in this study more at risk of iodine deficiency (Korkalo, Freese, Alfthan, Fidalgo, & Mutanen, 2015). Significant variations by geographical location in the prevalence of anemia, iodine deficiency, serum ferritin, Hb, and urinary iodine status were also observed (Ara et al., 2000; Bharati et al., 2009; Bulliyya et al., 2007; Hall et al., 2009; Korkalo et al., 2015). Among South Korean adolescents, seasons other than summer were associated with a higher risk of vitamin D deficiency (Kim et al., 2014b) or a lower serum 25 [OH]D level (Lee et al., 2014). Equally, the risk of anemia was significantly higher before the rainy season in Kenya (Leenstra et al., 2004), while the harvest season in Mozambique was associated with a higher risk of VAD and folate deficiency in all areas (city, coastal, and inland) (Korkalo et al., 2015). Lastly, significant variations by season in the prevalence of anemia and ID were found in Mozambique, but these variations were dependent on the residing area (Korkalo et al., 2015).

Consequences of undernutrition and poor micronutrient status

We found only 12 papers that reported on the SCE consequences of adolescent undernutrition (Acham et al., 2008; Chiplonkar & Kawade, 2014; Crookston, Forste, McClellan, Georgiadis, & Heaton, 2014; Dercon & Sánchez, 2013; Dissanayake, Kumarasiri, Nugegoda, & Dissanayake, 2009; Fink & Rockers, 2014; Gupta et al., 2013; Mukudi, 2003; Omwami et al., 2011; Perignon et al., 2014; Riley, 1994; Teni et al., 2017). Most of these studies focused on educational outcomes. A study by Dercon and Sanchez (2013) showed how noncognitive skills such as self-efficacy, educational aspirations, and self-esteem are positively associated with HAZ, using data from the Young Lives multicountry

cohort study. Data from the same study (Crookston et al., 2014) and three other studies (Dissanayake et al., 2009; Fink & Rockers, 2014; Perignon et al., 2014) associated cognitive skills negatively with stunting. School performance (e.g., grade attainment) was worse when adolescents had a low HAZ (stunted) (Acham et al., 2008; Crookston et al., 2014; Dissanayake et al., 2009; Fink & Rockers, 2014), low WAZ (underweight) (Acham et al., 2008), and low WHZ (thin) (Acham et al., 2008; Mukudi, 2003). School attendance improved with a higher HAZ (Fink & Rockers, 2014; Omwami et al., 2011) and WAZ (Omwami et al., 2011). At the micronutrient level, two studies found an inverse association between anemia and grade attainment (Gupta et al., 2013; Teni et al., 2017), as well as IDA and cognitive skills such as Raven's Coloured Progressive Matrices among Cambodian male adolescents (Perignon et al., 2014). Another study provided significant evidence that memory and scores on Raven's progressive matrices test (intelligence) were positively associated with zinc level, while reaction time was negatively associated with zinc levels (Chiplonkar & Kawade, 2014). Finally, a somewhat older study from Bangladesh associated age at first marriage with weight, showing that greater body weight was associated with earlier age of marriage, even when this effect was adjusted for height, age at menarche, and socioeconomic factors. The author suggests that "better-nourished women are more attractive mates owing to their physical appearance and/or better health" (Riley, 1994, p.94).

Discussion

This review is to our knowledge one of the first attempts to capture the wide spectrum of SCE determinants and consequences of adolescent undernutrition and micronutrient deficiencies in LLMICs. We aimed to provide an overview of the SCE determinants of undernutrition and growth (RQ1) as well as micronutrient status and deficiencies during adolescence (RQ2). However, we found most determinants influencing undernutrition and micronutrient deficiencies at the individual and household level, which were mostly comparable for the two indicators of nutritional status. Indeed, such factors are well known to determine health across the life course and cultures (Viner et al., 2012). We identified age, sex, birth order, religion, educational and literacy level, working and marital status, and personal hygiene as proximal, individual-level determinants of undernutrition and micronutrient deficiencies in adolescents. Determinants identified at the household level included parental education and occupation, family/household structure and size, household income, food security status, SES, and resources or assets within the household. Surprisingly, only a few determinants at the broader community level were identified, which included geographical location, place of residence (urban versus rural), community and

school type, as well as seasonality; however, most of these determinants seem to relate to the physical and economic environment. This denotes the lack of research on the influences of the broader social, cultural, or political context on adolescent nutritional status, and supports the current consensus to address the "major systematic, policy, cultural, and environmental barriers in the achievement of improved nutritional health for adolescent girls" but also boys (Krebs et al., 2017).

Likewise, we found a lack of studies looking at consequences in the domains of education, labor, and family formation (RQ3) of poor nutrition during adolescence in general, highlighting a pressing research gap. Most studies on consequences focused on the associations between adolescent undernutrition or micronutrient status and cognitive skills or educational attainment. Overall, we found evidence from three cohort studies that linear growth retardation or chronic undernutrition in adolescents is associated with poorer cognitive skills and educational performance (Crookston et al., 2014; Dercon & Sánchez, 2013; Gupta et al., 2013). These findings suggest that the adverse effects of malnutrition on educational performance are not only limited to childhood, but also manifest during adolescence. Similarly, cognitive skills and educational performance were positively associated with micronutrient status, although evidence was mostly cross-sectional, which makes it impossible to establish causal relations. Improvements in school attendance were also observed with an increase in HAZ, but again, the observed association was cross-sectional. We thus cannot conclude that better-nourished adolescents attend school more regularly, or state that these adolescents have a better nutritional status. In the domain of family formation, we found only one study that showed how nutritional status affected age at marriage, with heavier girls marrying earlier than lighter girls. Possible explanations offered were the correlations between weight and development of secondary sex characteristics or the cultural image that girls with normal weight (versus underweight) are perceived healthier or more attractive (Riley, 1994).

Figure 2.3 summarizes the determinants and consequences of adolescent undernutrition and micronutrient deficiency that were derived from the papers. In Figure 2.3, we hypothesize that the community-level factors exert an influence on the household characteristics that intend to affect the individual-level determinants of nutrition. Under each larger concept are specific determinants that were found to influence the nutrition of adolescents in LLMICs significantly. We could not find determinants at the broader societal level that might affect adolescent nutritional status, indicating a research gap.

Age and sex

The WHO distinguishes between early (10–14 years) and late (15–19 years) adolescence. We included studies with subjects within this age range, but based on the numerous definitions on 'adolescents' we came across, consensus on its definition seems to be lacking

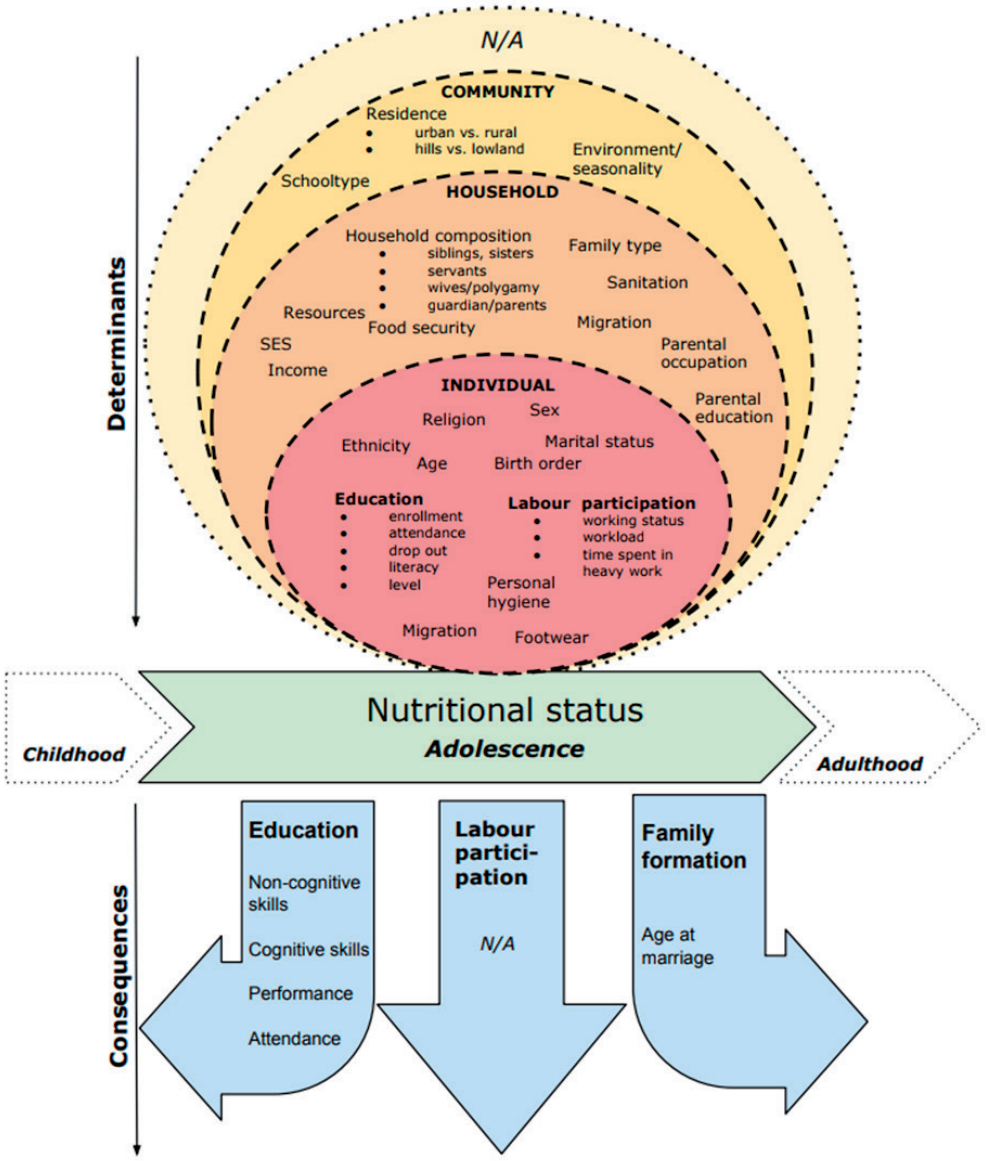

Figure 2.3. Hypothetical framework summarizing the determinants and consequences of adolescent undernutrition and micronutrient deficiencies in LLMICs

with boundaries between being an adolescent or adult somewhat blurred (West, 1997). Particularly in studies targeting women of reproductive age, often, late adolescent girls are included without referring to adolescence at all.

Unfortunately, from our sample, we could not conclude which determinants were most crucial at what ages (late versus early adolescence) or for which sex. In general, we found mixed results, significant and nonsignificant, on the effects of age on nutritional status. Although nutrition differences vary with growth spurt timings (Allen & Gillespie, 2001), a majority of the studies with significant associations between age and micronutrient status or stunting (and HA) in particular supported increasing age as a risk factor, while the prevalence of thinness seemed to decrease with age. This could support evidence that while stunted adolescents (particularly when entering adolescence stunted) might not be able to catch up or compensate for growth sufficiently, especially adolescent girls are better able to improve their body mass (WH) throughout adolescence (Allen & Gillespie, 2001; Kurz & Johnson-Welch, 1994; Martorell, Khan, & Schroeder, 1994). However, evidence of catching up growth during adolescence is still limited (Allen & Gillespie, 2001; WHO, 2006).

Similarly, sex differences in undernutrition were inconsistent. However, most studies reporting on sex differences showed that boys were significantly more likely to be stunted and underweight than girls during adolescence; this is in line with previous studies in Asia and Sub-Saharan Africa (Keino et al., 2014; WHO, 2006) that often relate this to boys' later and prolonged growth spurt (Bosch et al., 2008). In our sample, some authors hypothesize that the finding is related to the work activity hypothesis that refers to the "combined effects of increased energy expenditure and reduced presence at mealtimes", for instance, because of work or school (Sellen, 2000, p. 359). In addition, Dapi et al. (2009) attribute the differences to cultural practices that lead to better nutritional intake for girls, but also reason that because girls are often involved in cooking and shopping, they might eat in between meals and during cooking. Studies reporting higher rates of undernutrition in girls often attributed this to gender discrimination and unfavorable intra-household food allocation practices, especially in cases where households had little income or were food insecure. Particularly in South Asia, women are more disadvantaged in accessing food (DeRose, Das, & Millman, 2000). This is supported by a review of intra-household food allocation that shows that inequities are more likely in food insecure or poor households, although this also depends on other factors such as religion, household size, social status, and women's bargaining power (Harris-Fry et al., 2017). For instance, a study in the far west corner of Nepal showed that adolescent girls ended up second last, or last in case of daughters-in-law, in the household serving order, which could have influenced their nutritional status, especially in food insecure households (Madjdian & Bras, 2016). Unequal treatment may thus result when households face extreme circumstances, leading to discrimination against vulnerable women (Duflo, 2012). Regarding micronutrient deficiencies, the opposite effect was found. Here female sex proved to be a risk factor, particularly for low iron status and anemia. This is in line with other studies (Kurz & Johnson-Welch, 1994) and additionally explained by the increased iron requirements caused by the female growth spurt, menarche,

and blood loss during menstruation (Black et al., 2008; Chaparro, 2008; WHO, 2004). Also, when compared to boys, the iron status of girls tends to worsen upon slowing down of growth (Allen & Gillespie, 2001). Although there were mixed results for the effect of age on micronutrient status, a majority of the studies with significant associations between age and micronutrient status supported increasing age as a risk factor for poor micronutrient status (Ene-Obong et al., 2003; Jani et al., 2015; Kim et al., 2014b; Laxmaiah et al., 2013; Lee et al., 2014; Mahmud et al., 2013; Rakesh et al., 2015) for both sexes - notably anemia among adolescent girls (Ahankari et al., 2017; Bharati et al., 2009; Biradar et al., 2012; Chellan & Paul, 2010) - which may be related to the increased nutrient requirements with the growth spurt. Another explanation, which was not mentioned by any of these studies and can only be shown by including individual dietary intakes, may relate to pro-male food allocation processes in which girls are allocated fewer micronutrient-rich foods than boys. Data from the Young Lives cohort point toward such a pro-boy gap, showing how "disparities between mid-adolescent boys and girls are driven by the increased likelihood of boys to consume protein- and vitamin-rich foods" (Aurino, 2017, p.109).

Family and fertility

Although some of the studies excluded adolescent married girls from their sample (Ahankari et al., 2017; Ara et al., 2000; Kulkarni et al., 2012), several Indian studies showed that married adolescent girls were at higher risk of anemia. In these contexts, marriage during adolescence often leads to early conception, which poses girls at increased risk due to the already increased demands of iron during adolescence (Thurnham, 2013). Marrying young also means leaving the natal home and moving in with in-laws, a transition that often leads to a change in social status and access to food, which may negatively impact nutritional status (Chellan & Paul, 2010).

Birth order has been cited as an important determinant of malnutrition among infants and young children showing for instance that earlier-born children (lower birth order) were favored in terms of intra-household food allocation practices, particularly in challenging circumstances (Behrman, 1988; Horton, 1988). Moreover, some studies show that the poorer nutritional status of later born children might be due to already depleted maternal stores caused by multiple pregnancies (Singh, Nair, Grubesic, & Connell, 2009). However, except for three studies (Ayogu et al., 2015; Bamidele et al., 2011; Panter-Brick et al., 1996), we did not find much evidence on the associations between birth order and adolescent nutritional status. It may be that, over time, its effect is diluted. For instance, Horton (1988) observed that later-born children are born when per capita resources are smaller as total household income and assets do not increase concomitantly with family size. Thus, the effect of increasing birth order in adolescence may be masked by poor living conditions and its resultant effect of poor dietary intake. Although our sample shows inconsistent

findings, results from a Brazilian birth cohort showed that during adolescence, firstborns were heavier and taller than later-borns, due to their higher sensitivity to catch up growth (Wells et al., 2011).

In contrast, family size, as well as the number of siblings, were often mentioned as risk factors for poor nutritional status. Larger families spend extra resources in meeting their nutrition and health needs thereby putting a strain on already limited resources. The resultant effect may be decreased dietary diversity or intake affecting nutritional status. In such circumstances, vulnerable groups in the household including adolescents may be at a higher risk of malnutrition. The association with the number of siblings was especially found in studies on girls. The authors attribute this to unequal feeding practices and household food distribution (Patimah et al., 2016). Bird (2013), in her review on the intergenerational transmission of poverty, found that children with more siblings tend to be more malnourished as resources are directed to the youngest or older children, with stronger effects in poor households. Regarding family type, the prevalence of anemia was in one study significantly higher among adolescents living in nuclear families compared with their peers in extended or joint families (Gupta et al., 2013), which suggests the relative importance of family support in the prevention of anemia. Viner et al. (2012) argued that family connectedness is one of the most critical factors that protect against poor health outcomes in adolescence. On the contrary, stunting and thinness were highly prevalent in Indian joint families, which could be explained by the effects of family size or lower social status of adolescent girls within these families. Interesting is the link between stunting and polygamy that was found in two Nigerian studies. The authors attribute the higher rates of stunting mainly to poverty and increased household size. The combined effects of polygamy, which occurs more often in low SES groups, and low earning capacity might affect nutritional status (Omigbodun et al., 2010). However, the authors recommend further research as there might be other underlying mechanisms explaining differences in undernutrition.

Religion and ethnicity

The role of religion and ethnicity in determining nutritional status is quite ambiguous. Within India, the differences in anemia were context-specific, and no particular religion or caste was notably at a higher risk. The differences were mostly attributed to differences in cultural dietary patterns and, or socioeconomic conditions that vary with religion, or caste groups. Likewise, within the same country, variations by geographical location were partly attributed to disparities in diet and prevalence and incidence of infections and diseases. Although an Indian study found that the prevalence of stunting was higher in adolescents who belonged to the *Dalit* (scheduled caste) community without providing an explanation, Omigbodun et al., who found that Muslim adolescents were worse off in

comparison to Christian adolescents in terms of stunting and thinness, argue that religion might act "indirectly in situations where practices within certain social strata would lead to deprivation" (2010, p.670).

Education and occupation

The majority of studies were conducted in a school setting. This design implies that the prevalence of undernutrition is underestimated if non-enrolled adolescents, who might be more vulnerable and disadvantaged in several life domains, are excluded. Indeed, studies by de Lanerolle-Dias et al. (2012) and Hall et al. (2009) showed that female school dropouts and adolescents who dropped out in early adolescence, or enrolled later in school, were notably more vulnerable to undernutrition, both in terms of macro- and micronutrients and despite the same level of nutritional knowledge. Possible explanations include the additional burden that outside-school labor activities place on nutritional status, the relation with SES and household income, and exposure to school nutrition interventions (Assefa et al., 2015). On the contrary, Ahankari et al. (2017) found that school drop-outs had a lower risk of anemia compared with enrolled girls. They argued that non-enrolled girls were generally engaged in agricultural-related employment, with earnings more likely to be spent on nutritional foods that may have improved their Hb. A similar effect was found in other studies where having a job and workload was associated with HAZ and WHZ (Assefa et al., 2015). Reverse causation, in which undernutrition constrains workload, might be a possible explanation (Yamanaka & Ashworth, 2002). However, two studies also concluded that working girls had a higher risk of anemia, iron, and zinc deficiency compared to their non-working peers (Gupta et al., 2013; Lanerolle-Dias et al., 2012), showing that the additional small income generated by working girls may not always have a positive effect on their nutritional status (Makoka & Masibo, 2015).

The studies underscore the importance of adolescent education and literacy level as well as parental education and literacy level in reducing the risk of undernutrition, (mainly for stunting) and micronutrient deficiencies. Generally, education and/or literacy may improve healthier behavior practices and nutritional status via increased awareness and knowledge. Only one study showed how adolescent educational level was inversely associated with serum 25(OH)D (Lee et al., 2014). Similarly, another study found SES inversely related to serum 25(OH)D (Puri et al., 2008), but both associations were attributed to unhealthy lifestyle and sedentary behavior, a change in practices that is likely to emerge as part of the nutrition transition in LMICs.

Parental education was positively associated with nutritional status; particularly stunting seemed to decrease. However, most studies showed an association between maternal education and improved nutrition. This finding is in line with studies on children's nutritional status, indicating that maternal education reduces the odds of particularly

stunting (Makoka & Masibo, 2015). However, Vollmer et al. (2017) found that maternal and paternal education were equally important in reducing childhood undernutrition. It may be that better-educated parents are more likely to have better-paying jobs. Parental occupation was indeed associated with better nutritional status. In contrast to education, we found that paternal occupation was more often associated with better nutrition, even though women's increased earning opportunities result in a different allocation of resources in favor of nutrition through improved bargaining power (Duflo, 2012). Additionally, occupation may increase household income and/or SES, which were both consistently linked with a lower risk of undernutrition and micronutrient deficiency. Similarly, studies showed that households with more resources lowered the risk of poor nutritional status. Overall, household resources are indicative of SES or income level. Higher SES is generally associated with higher purchasing power and consequently improved household access to diverse foods (Harris-Fry et al., 2015; Kiboi, Kimiywe, & Chege, 2017; Thorne-Lyman et al., 2010). However, again, a complete consensus on the definition of SES is lacking (Bradley & Corwyn, 2002). It is usually measured by determining education, income, occupation, or a composite of these dimensions (Winkleby, Jatulis, Frank, & Fortmann, 1992). Filmer & Pritchett (2001) recommended the use of household durable assets index for SES, but in our sample, the concept was interchangeably based on education and/or occupational status, land size, household income, type of school attended (government or private), or (per capita) income. Only seven authors used a more comprehensive description of SES based on these recommendations, which make it complex to generalize the effect of SES on adolescent nutritional status. Moreover, as Bradley and Corweyn state, "the relations between particular SES indicators and health factors may be quite complex", with the associations appearing less steep in more egalitarian contexts (2002, p.374). Nonetheless, we found that "SES" was generally positively associated with adolescent nutritional status. This is to be expected in LMICs and supported by previous research on the "nutrition pathway", which shows that inadequate dietary intake results from low SES, leading to poor nutritional status and delayed growth (Bradley & Corwyn, 2002).

Environment and community

At the community level, particularly place of residence and environmental factors were found significantly associated with malnutrition. Mainly, studies showed that adolescents in rural areas were worse off in terms of stunting, thinness, and underweight. However, contrary to the generally held notion that the risks of micronutrient deficiencies are higher in rural than urban communities, several studies showed that residing in a rural community was protective of anemia, vitamin D deficiency, and associated with a higher folate status. Although most studies did not explain the rural-urban variation, this is in line with the literature on the rural-urban divide. In Sub-Saharan Africa for instance, it was found that

urban-rural differentials are persistent when controlled for SES, but also that this gap is narrowing in more countries due to the increase of urban malnutrition, and widened in a few countries because of the decline of urban malnutrition (Fotso, 2007). Indeed, rapid urbanization has resulted in an explosion of poor urban settings that house large numbers of adolescents, with increased health risks for young people in such settings (UN, 2008).

Finally, the observed seasonal variations in micronutrient status were in part attributed to seasonal variation in the availability and access to food, notably, the micronutrient-rich food. Several studies have indeed shown seasonality variations in dietary intake (Abizari, Azupogo, Nagasu, Creemers, & Brouwer, 2017; Arsenault et al., 2014; Becquey et al., 2012; M'Kaibi, Steyn, Ochola, & Du Plessis, 2015). The implication of the finding may be that interventions that aim to improve the nutritional status of adolescents in the context of LMICs need to recognize the role of seasonality on nutritional status to incorporate initiatives to prevent undesirable seasonal declines in nutrient intake and consequently nutritional status.

Limitations

Despite a thorough set up of this systematic review, certain limitations should be considered when interpreting our findings. First, the set of eligible papers revealed a high heterogeneity in outcome measures, selected SCE variables, data collection methods, levels of data analysis, and study setting. This made it infeasible to conduct a meta-analysis within the scope of this review. For instance, although underweight and thinness refer to the same for adolescents and are defined by BAZ < –2SD (de Onis et al., 2007), some of the reviewed authors defined thinness using WH, while others also defined underweight with WA but these were mostly articles published before the recommendations of de Onis and the WHO in 2007.

Also, most of the studies were cross-sectional in design and thus, inferences of possible associations are speculative, and the results are limited to describing co-occurrences. Furthermore, the review is based on primary, quantitative studies only. We acknowledge that SCE determinants and even consequences of undernutrition might be derived from qualitative studies as well. However, we found these studies to be rare, while at the same time considering them highly important in order to consider the adolescents' own perspectives on growing up and nutrition in relation to SCE aspects. Such studies would yield, for instance, valuable insights into empowerment, decision-making processes, agency, and social status within households, which might influence their nutritional status. Although we attempted to consider gray literature as much as possible by conducting extensive electronic and manual searches in three databases, bibliographies, expert advice, and own databases, we cannot be certain we captured all relevant gray literature. Finally, eligible papers undergo quality appraisal in order to ensure trustworthiness and adequate

interpretation of findings (Delaney, Tamás, Crane, & Chesterman, 2016). However, besides that this would require having access to all available supplementary and process-related information, such an appraisal was impossible due to the heterogeneity of methods and number of papers. Nonetheless, we undertook a transparency check to ensure that the eligible studies were clear in their objective, sampling plan and size, data collection, statistical methods, conclusions, and limitations.

Implications

This review shows that despite increasing interest in adolescent nutrition, few studies take into account adolescents' complex everyday-life contexts and their entire pathways of transitions into adulthood. Most studies focus on single-factor determinants at the household and individual level, while factors at the community and broader societal level which are the root causes, deserve more attention. The magnitude and direction of associations were found to be context specific. Thus, interdisciplinary, longitudinal research on and *with* adolescents that focuses on the interrelations between context-specific life trajectories is vital in order to truly understand the transition into adulthood and thereby optimizing health and other developmental outcomes.

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Chapter 3

Sociocultural and economic determinants of stunting and thinness among adolescent boys and girls in Nepal

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Abstract

Despite the increasing interest in the determinants of adolescent undernutrition in low and middle-income countries, a comprehensive multilevel overview at the country-level is often missing. Using the nationally representative 2014 Nepal Adolescent Nutrition Survey, this study aims to provide a comprehensive overview of individual-, household-, and community-level sociocultural and economic determinants that influence stunting and thinness of adolescent boys and girls aged 10-19 years in Nepal. Multivariate logistic regression models were used to estimate the associations between multiple individual, household, and community determinants and stunting and thinness among 3,773 adolescents (1,888 boys and 1,885 girls). The prevalence rates of both stunting and thinness mark suboptimal nutritional status and an inadequate growth environment of Nepali adolescents. Results highlight the importance of paternal occupation and education, household income, number of earning members, geographical residence, caste/ethnicity, and nutritional knowledge associated with stunting, with higher odds for male and older adolescents. Paternal occupation, education, household income, geographical region, caste/ethnicity and nutrition knowledge were associated with thinness, with higher odds for males and younger adolescents. Findings underscore the importance of involving adolescents, their parents, and their communities in interventions. Such interventions should not only be aimed at improving adolescent nutrition but also at optimizing adolescents' growth environment for better health and development. Further research should focus on context-specific causal pathways and mechanisms through which sociocultural and economic determinants influence nutritional outcomes within broader societal, cultural, and political settings. A longitudinal approach, including a range of dietary and nutrition indicators would allow understanding how and when the relative importance of these factors change during adolescence.

Introduction

Adolescence is a crucial phase in human development where rapid social, biological, and psychological development takes place (WHO, 2014). During this phase, adolescents (aged 10 to 19, as defined by the WHO) adopt more-defined social roles and lay the foundation for their futures (Sawyer et al., 2012; Sawyer, Azzopardi, Wickremarathne, & Patton, 2018). Adequate nutrition during this stage is essential for optimal growth and development and may affect the health of future generations (Black et al., 2013). Neglecting the health of adolescents might impair earlier investments in maternal and child health (Resnick, Catalano, Sawyer, Viner, & Patton, 2012). Although adolescent nutrition has recently gained more attention (Akseer, Al-Gashm, Mehta, Mokdad, & Bhutta, 2017) research has mostly focused on 15- to 19-year old girls (Salam et al., 2016). Studies including boys and 10- to 14-year old adolescents are limited (The Lancet, 2015). Moreover, although in higher-income countries the interest in the determinants of adolescent nutrition has increased over recent decades, relatively little is known about the determinants of adolescent nutrition in low- and middle-income countries (LMICs). Furthermore, studies on adolescent nutrition have mostly focused on the effects of single determinants of nutritional status, such as food supplementation, media exposure, nutrition education, and parental education (Chau, Burgermaster, & Mamykina, 2018; Lassi, Moin, Das, Salam, & Bhutta, 2017; Singh, 2014), while only a few studies have tried to obtain a comprehensive overview of the sociocultural and economic determinants. Such a comprehensive overview is fundamental because human health and development, including nutritional status, are not only influenced by biological traits and the immediate setting, but also by underlying factors, broader environments, and the interconnections between environments (Dahlgren & Whitehead, 1991). Suboptimal growth due to, among others thing but not limited to, infant and child malnutrition and poor health might lead to linear growth retardation during childhood and adolescence and consequently short stature or stunting. Stunting is therefore a marker, rather than an outcome, of undernutrition and has been associated with impaired development, disease, and loss of economic productivity (Leroy & Frongillo, 2019). Underweight, or thinness, more directly indicates nutrition deprivation (Best, Neufingerl, Van Geel, van den Briel, & Osendarp, 2010; Black et al., 2013), and is associated with reduced bone density and muscle strength, and delayed pubertal maturation (Sellen, 1998). Identifying the relative contributions of individual-, household-, and community-level determinants of adolescent stunting and thinness would allow policymakers to design integrated public health interventions targeting several levels. This is all the more necessary since the positive effect of one level can be cancelled out by determinants at another level (Dahlgren & Whitehead, 1991).

This study was inspired by a framework resulting from a systematic review in which the evidence on the multilevel determinants of adolescent undernutrition and micronutrient

deficiencies in LMICs were charted (Madjdian, Azupogo, Osendarp, Bras, & Brouwer, 2018). This framework includes a broad range of sociocultural and economic determinants at the individual, household, and community level. The present study aimed to test this model empirically and address the above-identified knowledge gaps using data from the 2014 Nepal Adolescent Nutrition Survey (NANS). The main research question was: which individual-, household-, and community-level sociocultural and economic factors influence stunting and thinness of adolescent boys and girls aged 10-19 years in Nepal? To answer this research question, NANS data were used, including a wide range of individual, household, and community characteristics of adolescent boys and girls aged 10-19 years (Aryal et al., 2016).

Nepal has a geographically diverse landscape with three agro-ecological zones: Mountains (*Himal*); Hills (*Pahad*); and Plains (*Terai*). Only seven percent of the population resides in the Mountains area, where access to transport and communication facilities is limited (NPCS, 2012). In comparison, about 43% of the population lives in the Hills (NPCS, 2012). The southern part of Nepal, the *Terai*, is relatively flat and while it only comprises 23% of the total land area of Nepal, 50% of the population lives here (NPCS, 2012). At the time of the survey, Nepal was administratively divided into five development regions, 14 zones, and 75 districts restructured into seven provinces and 753 urban and rural municipalities after the promulgation of the new constitution in 2015.

Nepal is a multi-ethnic and multi-lingual country. In total, there are 126 different castes and ethnic groups and 123 spoken languages, with *Nepali* being the official language and mother tongue of 44.6% of the population. Most of the population (81.3%) is Hindu, followed by Buddhist (9%), and Muslim (4.4%) (NPCS, 2012). Like other South Asian countries, Nepal's society largely remains patriarchal with prevailing inequalities in household decision-making processes according to gender, generation, and age. Son preference and arranged and early marriages (below 18) remain commonplace (MoH et al., 2017; Yeung, Desai, & Jones, 2018).

Nepal is considered to be at stage four of the nutrition transition (Subedi, Marais, & Newlands, 2017). This transition is related to an increase in the national income level, population growth, migration, urbanization, reduced fertility and mortality rates, and increasing life expectancy. Furthermore, the prevalence of underweight among children has decreased over the last 40 years, while rates of overweight, obesity, and non-communicable diseases among women are increasing (Subedi et al., 2017). Stunting (32.0% and 32.1%) and thinness (23.3% and 14.0%) among boys and girls aged 10-19 are, however, still a larger concern than overweight and obesity (4.8% and 4.3%) (MoHP et al., 2018). Large differences exist in life expectancy, nutritional status, access to health care, and education between ethnicities and ecological zones (MoHP et al., 2018), making Nepal an interesting country to consider.

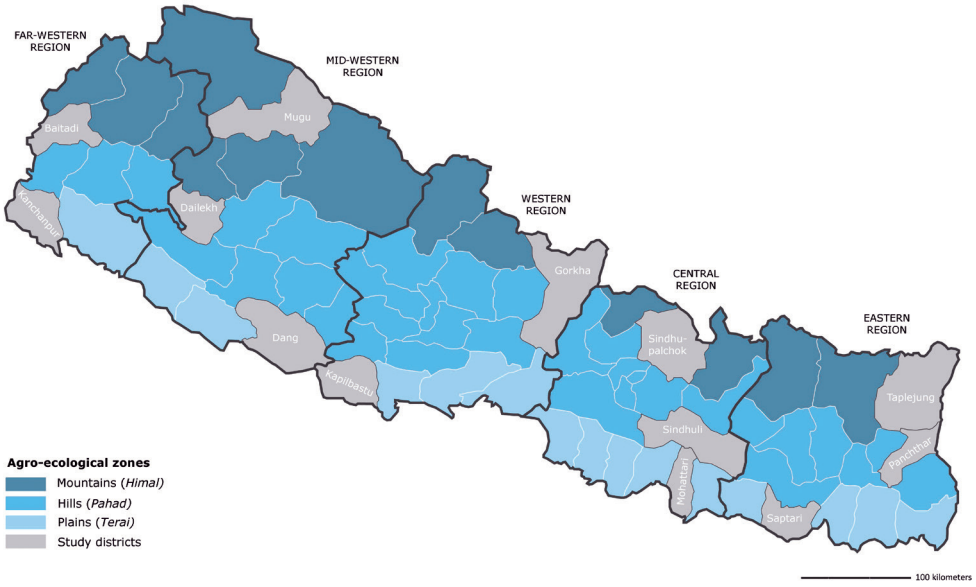

Figure 3.1. Study districts selected for the 2014 Nepal Adolescent Nutrition Survey depicted in grey.

Methods

Data

Data from the 2014 Nepal Adolescent Nutrition Survey (Aryal et al., 2016) were used. This survey aimed to explore the nutritional status of a nationally representative sample of 3773 adolescents (1888 boys and 1885 girls) aged 10-19 years in Nepal. The cross-sectional survey included demographic, socioeconomic, and health characteristics, as well as anthropometric measurements. It was administered to the adolescents by trained enumerators. The sample was obtained by multi-stage cluster sampling in which agro-ecological (Mountains, Hills, and *Terai*) and administrative (Eastern, Central, Western, Mid-Western, and Far-Western) stratification were taken into account. In the first sampling stage, the 13 study districts (see Figure 3.1) of the 2011 Nepal Demographic and Health Survey (NDHS) were used to obtain a representative sample of the agro-ecological and administrative strata. In the second stage, the Village Development Committees (VDCs) in rural areas or municipalities in urban areas, home to each selected district, were pooled and thirty VDCs were sampled by probability proportionate to size (PPS) from each ecological stratum. In the third stage, 21 male and 21 female adolescents were randomly selected from each sampled VDC or municipality. The sample size was weighted by the appropriate sample weights to obtain nationally representative results comparable to the 2011 NDHS to correct the data for the cluster survey design.

Measures

Dependent variables

The dependent adolescent nutrition variables were the dichotomous variables short stature or stunting, indicated by height-for-age z-scores (HAZ), and underweight or thinness, indicated by BMI-for-age z-scores (BAZ). The HAZ indicates linear growth and is a broader marker of "the inadequacy of the environment to which children have been exposed" (Leroy & Frongillo, 2019, p. 201). Stunting (the failure to reach linear growth) is indicated by HAZ less than -2 SD from the population median. Hence, stunting is used as an indicator of a deficient growth environment, which includes, but is not limited to, nutrition (Leroy & Frongillo, 2019). Thinness, as indicated by BAZ less than -2 SD from the population median, reflects nutritional status and is therefore a more direct indicator of (acute) undernutrition (de Onis, Blossner, & WHO, 1997). HAZ and BAZ were calculated based on the 2007 WHO growth references using WHO AnthroPlus software (de Onis et al., 2007). BAZ less than -5 or BAZ higher than 5 and HAZ less than -6 or HAZ higher than 6 were considered as inconsistent and unlikely and therefore coded as missing values (de Onis et al., 2007). Due to missing data or inconsistencies in height or weight, 52 adolescents (1.4% of the total sample) were excluded from the analysis on stunting and 61 adolescents (1.6% of total sample) from the analysis on thinness.

Independent variables

The independent variables were selected based on previous research on the determinants of nutritional status in LMICs and in Nepal specifically. They were derived from the child nutritional status literature and the review by Madjdian et al. (2018). The variables were divided into three groups: individual, household, and community determinants (Table 3.1). A small majority (53.1%) of the sample was female. The age of the adolescents ranged from 10 to 19 years and the mean age of the sample was 13.92 years. Adolescents were split into young (10 to 14 years, 60.0%) and older (15 to 19 years, 40.0%) age groups. Only 1.8% of the sampled adolescent boys and 3.6% of the adolescent girls were married. Of these married adolescents, 21.0% resided in the Central Mountains area, 19.1% in the Mid-Western Hills, and 12.1% in the Western Plains (*Terai*). Religion was categorized as Hindu or non-Hindu. The majority (83.2%) of adolescents were Hindu. The caste/ethnicity categorization (six groups) was based on the STEPS Survey Nepal 2013 categorization (Aryal et al., 2014). 39.8% of adolescents were *Brahmin/Chhetri* (Upper Caste), followed by disadvantaged *Janajati* (31.7%), *Dalit* (12.5%), disadvantaged non-*Dalit Terai* castes (9.7%), relatively advantaged *Janajati* (5.7%), and religious minorities (1.6%). The last group mainly included Muslim adolescents (95%). Footwear was coded '1' if adolescents reported wearing shoes when going outside and '0' otherwise. Wearing shoes was common among the majority of adolescents (96.9%). Almost half of the adolescents had nutrition

knowledge, which was determined by asking the adolescents whether they knew about nutrition (1) or not (0).

Household determinants included household size (numbers of members, including the respondent), ranging from two to 32 with an average of 6.41. Paternal and maternal education indicated the highest level of education completed by the father or mother. A distinction was made between no formal education, pre-primary or primary (grades 1-5) education and higher than primary education, including secondary education (grade 6-12) and beyond (university). Overall, 23.8% of the fathers and 67.5% of mothers had no formal education. Paternal occupation was divided into four sectors: government or private sector (including non-governmental organizations), agriculture, foreign employment (meaning that the father worked outside Nepal) and other paid employment, including business, daily wage (indicating that income was dependent on day-to-day and often seasonal work), retirement, and 'other', comprising all occupations that did not fit into the aforementioned classification. More than two-fifths of the fathers were engaged in agriculture, followed by other paid employment (including business, daily wage, retirement, and other) and foreign employment (28.5% and 14.3% respectively). Of the mothers, 67.7% were engaged in household labor (homemakers), followed by agriculture (22.8%) and other paid employment (9.5%). Monthly household income was used as a proxy for resources available to the household. The following categorization, as defined in the survey, was used: ≤5000 NPR, 5001-10,000 NPR, and ≥10,001 NPR. The adolescents were almost evenly distributed among these groups. The average number of earning members in the household, indicating the number of members who contributed to the monthly household income, was 1.42. The main source of drinking water was piped water (either from a public tap or at home), which was available in almost three-fifths of the households. The remaining two-fifth retrieved their water from a river/pond, well, or pump. About 68.3% had fixed flush toilets at home.

Community determinants included development (administrative) region, with Central taken as the reference category, accounting for the highest percentage of respondents in the sample. Due to the regionally stratified sampling design, adolescents were quite evenly distributed among the agro-ecological zones (Mountains, Hills, and *Terai*). The *Terai* was taken as reference category, being home to a small majority of adolescents.

Statistical analyses

Data were analyzed using IBM SPSS Statistics 23. Dummy variables were created for all categorical variables. Multivariate logistic regressions were performed to determine the strength of the association between the potential predictors and stunting and thinness outcomes (model 1). Due to substantial differences in the prevalence rates of stunting and thinness between boys and girls and young and older adolescents and expected differences between determinants, separate regression models were estimated for boys (model 2), girls

Table 3.1. Distribution of Nepalese adolescents by background characteristics, 2014 Nepal Adolescent Nutrition Survey

	All adolescents				Boys				Girls			
	Total	Stunted	Thin		Total	Stunted	Thin		Total	Stunted	Thin	
	n (%)	*n* (%)	*n* (%)	Mean (SD)	*n* (%)	*n* (%)	*n* (%)	Mean (SD)	*n* (%)	*n* (%)	*n* (%)	Mean (SD)
Individual determinants												
Sex												
Male	1769 (46.9)	572 (32.4)	243 (13.7)									
Female	2003 (53.1)	555 (27.7)	142 (7.1)									
Age (years)				13.92 (2.303)				13.97 (2.293)				13.86 (2.311)
15–19	1508 (40.0)	492 (32.6)	111 (7.4)		1059 (59.9)	261 (36.7)	78 (10.9)		1204 (60.1)	232 (29.0)	34 (4.2)	
10–14	2263 (60.0)	635 (28.1)	274 (12.1)		709 (40.1)	312 (29.4)	165 (15.6)		798 (39.9)	324 (26.9)	108 (9.0)	
Marital status												
Married	104 (2.8)	39 (37.6)	2 (1.9)		32 (1.8)	9 (26.2)	0 (0.6)		72 (3.6)	31 (42.8)	2 (2.5)	
Unmarried	3667 (97.2)	1088 (29.7)	383 (10.4)		1736 (98.2)	564 (32.5)	243 (14.0)		1931 (96.4)	524 (27.2)	140 (7.3)	
Religion												
Non-Hindu	634 (16.8)	197 (31.1)	50 (7.9)		307 (17.4)	111 (36.1)	27 (8.8)		326 (16.3)	86 (26.5)	23 (7.1)	
Hindu	3138 (83.2)	930 (29.6)	335 (10.7)		1462 (82.6)	461 (31.6)	216 (14.8)		1676 (83.7)	469 (28.0)	119 (7.1)	
Ethnicity												
Dalit	473 (12.5)	162 (34.2)	51 (10.8)		215 (12.2)	76 (35.1)	29 (13.3)		258 (12.9)	86 (33.4)	23 (8.8)	
Disadvantaged *Janajati*	1195 (31.7)	311 (26.0)	79 (6.6)		549 (31.1)	170 (31.0)	52 (9.5)		646 (32.3)	140 (21.7)	27 (4.2)	
Disadvantaged non-*Dalit Terai*	364 (9.7)	125 (34.2)	78 (21.4)		191 (10.8)	59 (30.9)	58 (30.4)		174 (8.7)	66 (37.8)	20 (11.6)	
Religious minority	59 (1.6)	28 (48.5)	15 (26.3)		36 (2.1)	18 (49.3)	7 (20.1)		22 (1.1)	10 (47.1)	8 (36.5)	
Relatively advantaged *Janajati*	215 (5.7)	60 (27.8)	3 (1.4)		115 (6.5)	30 (26.2)	3 (2.5)		100 (5.0)	30 (29.7)	0 (0.0)	
Upper Caste	1465 (39.8)	442 (30.2)	158 (10.8)		662 (37.4)	219 (33.1)	94 (14.2)		803 (40.1)	223 (27.7)	64 (8.0)	
Footwear outside												
Yes	3653 (96.9)	1085 (29.7)	365 (10.0)		1725 (97.5)	559 (32.4)	238 (13.8)		1928 (96.3)	525 (27.3)	126 (6.6)	
No	118 (3.1)	43 (36.1)	20 (17.1)		43 (2.5)	13 (30.0)	5 (10.5)		75 (3.7)	30 (39.6)	16 (20.9)	
Nutrition knowledge												
Yes	1858 (49.3)	481 (25.9)	135 (7.3)		890 (49.7)	239 (26.9)	79 (8.9)		968 (48.3)	242 (25.0)	56 (5.8)	
No	1913 (50.7)	646 (33.8)	250 (13.1)		890 (50.3)	333 (37.9)	164 (18.6)		1035 (51.7)	313 (30.3)	86 (8.3)	
Household determinants												
Household size				6.41 (2.536)				6.23 (2.517)				6.57 (2.543)
Paternal education												
No formal education	896 (23.8)	297 (33.2)	90 (10.0)		473 (26.8)	144 (30.4)	62 (13.1)		423 (21.1)	153 (36.2)	28 (6.6)	
Pre-primary or primary	1149 (30.5)	382 (33.3)	114 (9.9)		577 (32.6)	232 (40.9)	83 (14.7)		572 (28.6)	150 (26.2)	31 (5.4)	
Higher than primary	1726 (45.8)	448 (25.9)	181 (10.5)		718 (40.6)	196 (27.5)	98 (13.8)		1008 (50.3)	252 (25.0)	84 (8.3)	

	All adolescents				Boys				Girls			
	Total	Stunted	Thin		Total	Stunted	Thin		Total	Stunted	Thin	
	n (%)	*n* (%)	*n* (%)	Mean (SD)	*n* (%)	*n* (%)	*n* (%)	Mean (SD)	*n* (%)	*n* (%)	*n* (%)	Mean (SD)
Maternal education												
No formal education	2544 (67.5)	803 (31.6)	246 (9.7)		1245 (70.4)	421 (33.8)	168 (13.5)		1299 (64.9)	382 (29.4)	78 (6.0)	
Pre-primary or primary	618 (16.4)	187 (30.2)	67 (10.8)		295 (16.7)	97 (33.0)	41 (13.8)		323 (16.1)	89 (27.5)	26 (8.1)	
Higher than primary	609 (15.1)	138 (22.6)	72 (11.9)		229 (12.9)	54 (23.4)	34 (14.9)		380 (19.0)	84 (22.2)	38 (10.1)	
Paternal occupation												
Government or private sector	521 (13.8)	145 (27.8)	43 (8.3)		246 (13.9)	78 (31.8)	30 (12.1)		276 (13.8)	67 (24.2)	14 (5.0)	
Foreign employment	538 (14.3)	152 (28.2)	77 (14.3)		197 (11.2)	63 (31.9)	41 (20.9)		341 (17.0)	89 (26.1)	36 (10.5)	
Business, daily wage or retirement	1075 (28.5)	363 (33.8)	104 (9.5)		539 (30.5)	185 (34.3)	67 (12.5)		536 (26.8)	178 (33.3)	36 (6.8)	
Agriculture	1637 (43.4)	468 (28.6)	161 (9.9)		787 (44.5)	247 (31.3)	105 (13.3)		850 (42.5)	221 (26.0)	56 (6.6)	
Maternal occupation												
Agriculture	859 (22.8)	248 (28.9)	65 (7.6)		358 (20.2)	115 (32.0)	40 (11.3)		501 (25.0)	133 (26.6)	25 (5.0)	
Other paid employment	360 (9.5)	103 (28.5)	25 (6.9)		165 (9.3)	56 (34.1)	12 (7.4)		195 (9.7)	46 (23.7)	13 (6.4)	
Homemaker	2552 (67.7)	777 (30.4)	295 (11.6)		1246 (70.4)	401 (32.2)	191 (15.3)		1307 (65.2)	375 (28.7)	105 (8.0)	
No. earning household members				1.42 (0.604)				1.37 (0.583)				1.46 (0.619)
Monthly household income (NPR)												
≤5000	1052 (27.9)	358 (34.1)	109 (10.3)		545 (30.8)	186 (34.1)	77 (14.2)		507 (25.3)	173 (34.0)	31 (6.1)	
5001–10,000	1356 (36.0)	408 (30.1)	166 (12.3)		618 (35.0)	211 (34.2)	96 (15.5)		738 (36.9)	197 (26.7)	70 (9.5)	
≥10,001	1362 (36.1)	361 (26.5)	110 (8.1)		605 (34.2)	175 (28.9)	70 (11.5)		757 (37.8)	186 (24.6)	41 (5.4)	
Source of drinking water												
Pump, tank, river/pond or well	1582 (41.9)	489 (30.9)	224 (14.1)		777 (43.9)	258 (33.2)	144 (18.5)		804 (40.2)	231 (28.7)	80 (9.9)	
Piped or public tap	2190 (58.1)	638 (29.1)	161 (7.4)		991 (56.1)	314 (31.7)	99 (10.0)		1198 (59.8)	324 (27.1)	62 (5.2)	
Type of latrine												
No flush toilet	1194 (31.7)	394 (33.0)	155 (13.0)		589 (33.3)	215 (36.6)	99 (16.8)		606 (30.2)	178 (29.5)	56 (9.2)	
Flush toilet	2577 (68.3)	733 (28.5)	230 (8.9)		1180 (66.7)	357 (30.2)	144 (12.2)		1397 (69.8)	377 (27.0)	86 (6.2)	
Community determinants												
Region												
Eastern	771 (20.4)	180 (23.3)	73 (9.5)		349 (19.7)	91 (26.0)	44 (12.6)		422 (21.1)	89 (21.1)	29 (6.9)	
Central	1288 (34.2)	406 (31.5)	130 (10.1)		612 (34.6)	205 (33.5)	82 (13.4)		676 (33.8)	201 (29.7)	48 (7.1)	
Western	484 (12.8)	157 (32.4)	69 (14.2)		221 (12.5)	80 (36.2)	41 (18.7)		263 (13.1)	77 (29.2)	28 (10.5)	
Mid-Western	710 (18.8)	250 (35.2)	63 (8.9)		351 (19.8)	130 (37.0)	44 (12.7)		359 (17.9)	120 (33.4)	19 (5.3)	
Far-Western	518 (13.7)	135 (26.0)	49 (9.5)		236 (13.3)	205 (33.5)	31 (13.2)		282 (14.1)	68 (24.1)	18 (6.4)	
Agro-ecological zone												
Mountains (*Himal*)	1211 (32.1)	414 (34.2)	86 (7.1)		581 (32.9)	218 (37.5)	51 (8.8)		630 (31.4)	196 (31.1)	35 (5.6)	
Hills (*Pahad*)	1228 (32.6)	321 (26.1)	92 (7.5)		540 (30.5)	165 (30.6)	63 (11.6)		688 (34.4)	156 (22.6)	29 (4.2)	
Plains (*Terai*)	1332 (35.3)	393 (29.5)	207 (15.6)		648 (36.6)	189 (29.2)	129 (20.0)		685 (34.2)	204 (29.7)	78 (11.4)	

Table 3.2. Weighted prevalence of stunting and thinness among adolescents

	All adolescents				Boys				Girls				10–14 years				15–19 years			
Indicator	*n*	%	Mean	SD	*n*	%	Mean	SD	*n*	%	Mean	SD	*n*	%	Mean	SD	*n*	%	Mean	SD
HAZ			-1.45	1.09			-1.46	1.14			-1.44	1.05			-1.33	1.15			-1.62	0.97
Stunted*	1127	29.9			572	32.7			555	28.1			635	28.3			492	33.1		
Not stunted	2599	68.9			1176	67.3			1423	71.9			1605	71.7			993	66.9		
Total	3726	100			1748	100.0			1978	100.0			2240	100			1485	100		
BAZ			-0.70	1.06			-0.86	1.11			-0.56	1.00			-0.74	1.12			-0.64	0.97
Thinness**	385	10.2			243	14.0			142	7.2			274	12.3			111	7.5		
No thinness	3332	88.4			1498	86.0			1834	92.8			1959	87.7			1373	92.5		
Total	3717	100			1741	100.0			1976	100.0			2233	100.0			1484	100.0		

*p<0.01; **p<0.001.

(model 3), younger (10-14 years, model 4) and older (15-19 years, model 5) adolescents. Predictors were checked for multicollinearity using Variance Inflation Factors. The results of the multivariate logistic regression are presented using odds ratios (OR) and 95% confidence intervals (CI). Different levels of statistical significance $p<0.05$, $p<0.01$, and $p<0.001$ are discerned and goodness-of-fit tests are presented.

Results

Prevalence of stunting and thinness

Figure 3.2 presents distributions of HAZ and BAZ by sex and age group. Stunting (HAZ<-2SD) was prevalent in almost a third of the study population (Table 3.2). The prevalence among adolescent boys was 32.7% (mean HAZ -1.46 ± 1.16) compared with 28.1% (mean HAZ -1.44 ± 1.05) in girls. Stunting was more prevalent in older (33.1%, mean HAZ -1.62 ± 0.97) than younger (28.3%, mean HAZ -1.33 ± 1.15) adolescents (Figure 3.2a). Thinness (BAZ<-2SD) was less pronounced and affected only a tenth of the total study population. Thinness was prevalent in 14.0% of boys compared with 7.2% of girls (Table 3.2). Figure 3.2b shows that the mean BAZ of girls was closer to 0 than the mean BAZ of boys. In contrast to stunting, thinness was more frequent in the younger age group (12.3%, BAZ -0.74 ± 1.12) than in the older age group (7.5%, BAZ -0.64 ± 0.97) (Table 3.2).

Determinants of stunting

Binary multivariate logistic regression models were estimated to assess the effects of the selected determinants on stunting over normal stature. The presented ORs show the odds of being stunted compared with not being stunted for each specific determinant while keeping the other determinants constant. The results presented in Table 3.3 show that in the total population, boys and older adolescents had higher odds of stunting (OR=1.17; $p<0.05$ and OR=1.58; $p<0.001$, respectively). The increased odds of stunting in the male population were only found in the older age group (OR=1.35; $p<0.05$) and the increased odds in the older age group were found among both boys (OR=2.05; $p<0.001$) and girls (OR=1.30; $p<0.05$). In the total population, adolescents from the disadvantaged *Janajati* group had lower odds of stunting (OR=0.70; $p<0.01$). This association was also found for girls and younger adolescents (OR=0.62; $p<0.01$ and OR=0.66; $p<0.01$, respectively). The disadvantaged non-*Dalit Terai* group showed increased odds of stunting in the total, female, and older adolescent populations (OR=1.50; $p<0.05$, OR=2.00; $p<0.01$ and OR=1.76; $p<0.05$, respectively). Among religious minorities, increased odds of stunting were found in the total and younger age groups (OR=2.42; $p<0.01$ and OR=3.80; $p<0.01$, respectively). Nutrition knowledge decreased the odds of stunting in all groups. The largest decrease, of 48% ($p<0.001$), was found among boys.

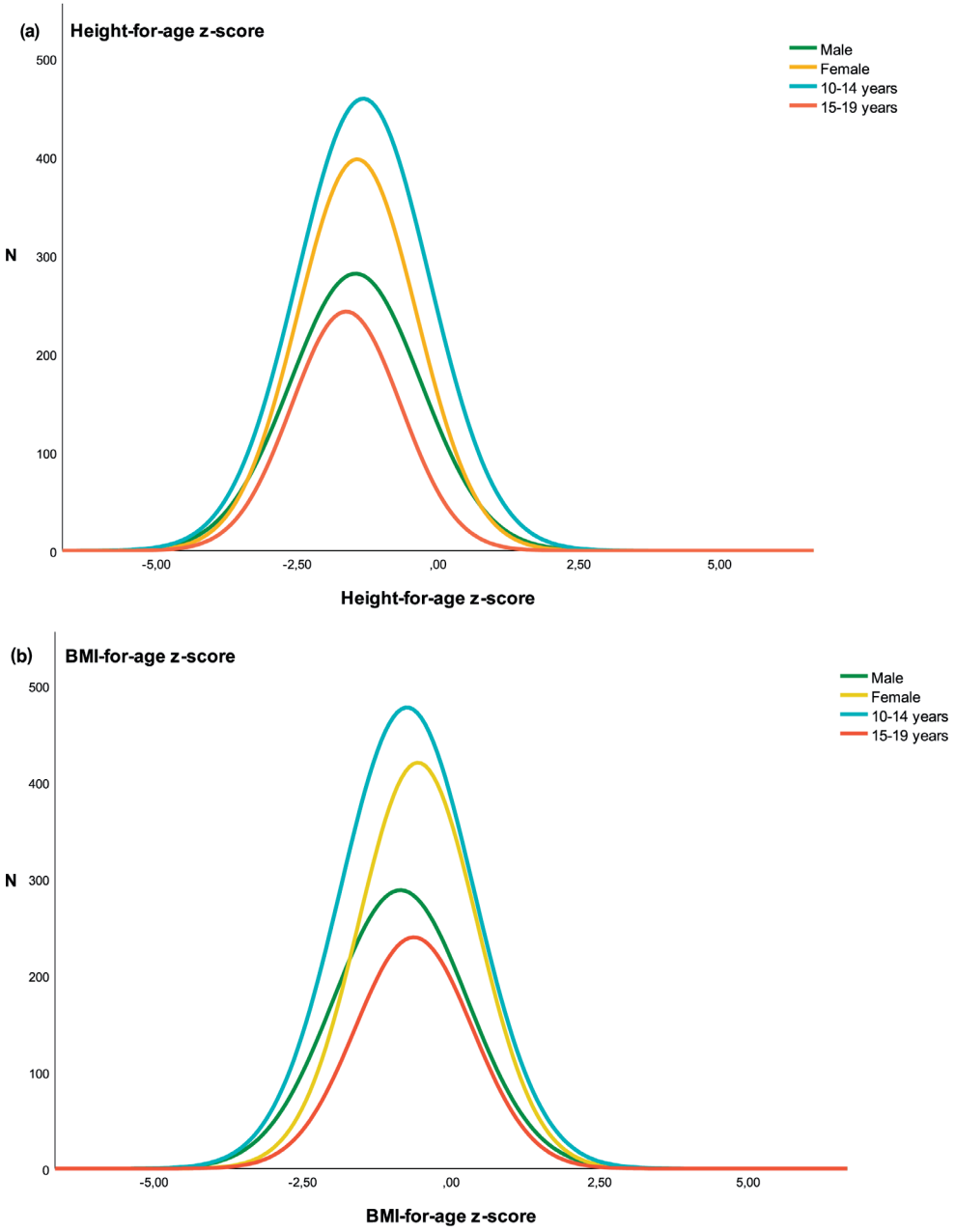

Figure 3.2. Sex- and age-specific distribution of a) stunting and b) thinness

At the household level, every additional household member increased the odds of stunting among boys by 7% ($p<0.01$). Paternal pre-primary or primary education, compared with no formal education, increased the odds of stunting among boys (OR=1.56; $p<0.01$), while it decreased the odds of stunting among girls (OR=0.72; $p<0.05$). Paternal education beyond primary decreased the risk of stunting among all adolescents, girls, and the younger adolescent subgroups (OR=0.81; $p<0.05$, OR=0.66; $p<0.01$, and OR=0.73; $p<0.05$). As for paternal education, paternal occupation in business, daily wage, or retirement increased the odds in the total, female, and older population (OR=1.35; $p<0.01$, OR=1.46; $p<0.01$ and OR=1.72; $p<0.001$, respectively). An increasing number of earning members in the household was associated with a decreased likelihood of stunting in the total, male, and younger age groups. The largest decrease was found in adolescent boys (OR=0.62; $p<0.001$). Furthermore, a monthly household income below 5000 NPR compared with a monthly income above 10,001 NPR increased the odds of stunting in the older adolescent population (OR=1.52; $p<0.01$).

At the community level, residing in the Mid-Western development region was associated with higher stunting odds (OR=1.62; $p<0.001$), while residing in the Eastern region was associated with decreased stunting odds (OR=0.67; $p<0.001$). In the separate models, residing in the Mid-Eastern region increased the odds of stunting in adolescent boys (OR=1.55; $p<0.05$) and girls (OR=1.61; $p<0.01$), while residence in the Eastern region decreased the odds among younger adolescents (OR=0.64; $p<0.01$). Residence in both the Western and Mid-Western regions increased the odds in older adolescents (OR=2.04; $p<0.001$ and OR=2.16; $p<0.001$). Additionally, adolescent boys living in the Mountain and Hill areas were 2.28 ($p<0.001$) and 1.58 ($p<0.05$) times more likely to be stunted compared with adolescent boys living in the *Terai*, while adolescent girls living in the Hills, were less likely to be stunted (OR=0.63; $p<0.05$). Similarly, young adolescents residing in the Mountains showed increased odds of stunting (OR=2.39; $p<0.001$).

Table 3.3. Adjusted odds ratios (aOR) and 95% confidence intervals (CIs) of stunting by individual, household and community determinants

	Model 1 (Total)	Model 2 (Boys)	Model 3 (Girls)	Model 4 (10–14 years)	Model 5 (15–19 years)
	aOR (95%CI)	aOR (95%CI)	aOR (95%CI)	aOR (95%CI)	aOR (95%CI)
Individual determinants					
Sex (Ref.=Female)					
Male	1.17 (1.01; 1.35)*			1.04 (0.86; 1.27)	1.35 (1.07; 1.70)*
Age (Ref.=10–14 years)					
15–19 years	1.58 (1.34; 1.86)***	2.05 (1.62; 2.60)***	1.30 (1.03; 1.64)*		
Marital status (Ref.=Unmarried)					
Married	1.13 (0.74; 1.74)	0.57 (0.25; 1.30)	1.51 (0.90; 2.53)	0.61 (0.22; 1.70)	1.36 (0.82; 2.26)
Religion (Ref.=Hindu)					
Non-Hindu	1.18 (0.91; 1.53)	1.10 (0.75; 1.62)	1.17 (0.81; 1.70)	1.08 (0.77; 1.51)	1.4 (0.92; 2.16)
Caste/ethnicity (Ref.=Upper Caste)					
Dalit	1.10 (0.86; 1.41)	1.03 (0.71; 1.50)	1.19 (0.84; 1.68)	1.06 (0.76; 1.47)	1.16 (0.78; 1.73)
Disadvantaged *Janajati*	0.70 (0.56; 0.88)**	0.79 (0.56; 1.10)	0.62 (0.45; 0.86)**	0.66 (0.49; 0.90)**	0.77 (0.53; 1.11)
Disadvantaged non-*Dalit Terai*	1.50 (1.07; 2.10)*	1.09 (0.66; 1.80)	2.00 (1.24; 3.23)**	1.50 (0.95; 2.38)	1.76 (1.04; 2.97)*
Religious minority	2.42 (1.26; 4.66)**	2.23 (0.91; 5.46)	2.63 (0.94; 7.31)	3.80 (1.66; 8.73)**	1.40 (0.46; 4.23)
Relatively advantaged *Janajati*	0.84 (0.60; 1.17)	0.70 (0.43; 1.12)	1.01 (0.62; 1.64)	0.78 (0.50; 1.24)	0.93 (0.56; 1.54)
Footwear outside (Ref.=No)					
Yes	0.75 (0.5; 1.12)	0.98 (0.49; 1.97)	0.74 (0.44; 1.24)	0.70 (0.44; 1.12)	0.90 (0.38; 2.1)
Nutrition knowledge (Ref.=No)					
Yes	0.65 (0.55; 0.76)***	0.52 (0.41; 0.66)***	0.77 (0.61; 0.97)*	0.60 (0.48; 0.74)***	0.74 (0.57; 0.95)*
Household determinants					
Household size	1.02 (0.99; 1.06)	1.07 (1.02; 1.12)**	0.99 (0.95; 1.04)	1.03 (0.98; 1.07)	1.02 (0.97; 1.07)
Paternal education (Ref.=No formal education)					
Pre-primary or primary	1.08 (0.88; 1.32)	1.56 (1.18; 2.07)**	0.72 (0.53; 0.96)*	0.93 (0.71; 1.22)	1.25 (0.92; 1.70)
Higher than primary	0.81 (0.66; 1.00)*	0.91 (0.67; 1.24)	0.66 (0.49; 0.88)**	0.73 (0.55; 0.97)*	0.93 (0.68; 1.28)
Maternal education (Ref.=No formal education)					
Pre-primary or primary	1.08 (0.88; 1.33)	1.03 (0.76; 1.38)	1.09 (0.81; 1.47)	1.13 (0.86; 1.48)	0.96 (0.68; 1.35)
Higher than primary	0.90 (0.71; 1.15)	0.84 (0.57; 1.24)	0.89 (0.65; 1.24)	0.88 (0.65; 1.20)	0.88 (0.58; 1.34)

	Model 1 (Total)	Model 2 (Boys)	Model 3 (Girls)	Model 4 (10–14 years)	Model 5 (15–19 years)
	aOR (95%CI)	aOR (95%CI)	aOR (95%CI)	aOR (95%CI)	aOR (95%CI)
Paternal occupation (Ref.=Agriculture)					
Government or private sector	1.13 (0.88; 1.46)	1.28 (0.89; 1.83)	1.06 (0.74; 1.52)	1.00 (0.71; 1.41)	1.30 (0.89; 1.90)
Foreign employment	1.16 (0.91; 1.50)	1.20 (0.81; 1.79)	1.20 (0.86; 1.68)	1.00 (0.72; 1.38)	1.42 (0.95; 2.14)
Business, daily wage or retirement	1.35 (1.12; 1.63)**	1.18 (0.90; 1.54)	1.46 (1.11; 1.92)**	1.15 (0.90; 1.47)	1.72 (1.28; 2.32)***
Maternal occupation (Ref.=Homemaker)					
Agriculture	1.11 (0.91; 1.36)	1.19 (0.88; 1.59)	1.14 (0.86; 1.52)	1.15 (0.88; 1.51)	1.16 (0.85; 1.58)
Other paid employment	1.15 (0.87; 1.53)	1.40 (0.93; 2.09)	0.99 (0.66; 1.49)	1.31 (0.91; 1.87)	1.16 (0.71; 1.90)
No. earning household members	0.81 (0.70; 0.94)**	0.62 (0.50; 0.78)***	1.01 (0.82; 1.26)	0.67 (0.54; 0.84)***	0.96 (0.77; 1.19)
Monthly household income (Ref.=≥10,001 NPR)					
≤5000 NPR	1.24 (1.00; 1.53)	1.05 (0.77; 1.44)	1.31 (0.97; 1.77)	1.05 (0.79; 1.41)	1.52 (1.11; 2.09)**
5001–10,000 NPR	1.11 (0.92; 1.33)	1.01 (0.76; 1.33)	1.08 (0.84; 1.40)	1.16 (0.90; 1.49)	1.05 (0.79; 1.39)
Source of drinking water (Ref=Piped or public tap)					
Pump, tank, river/pond or well	1.05 (0.82; 1.34)	1.27 (0.90; 1.81)	0.78 (0.54; 1.11)	1.11 (0.82; 1.52)	0.92 (0.61; 1.37)
Type of latrine in house (Ref.=Flush toilet)					
No flush toilet	1.14 (0.96; 1.36)	1.22 (0.95; 1.56)	1.01 (0.79; 1.30)	1.09 (0.87; 1.37)	1.20 (0.92; 1.57)
Community determinants					
Region (Ref.=Central)					
Eastern	0.67 (0.53; 0.84)***	0.79 (0.57; 1.10)	0.60 (0.43; 0.83)**	0.64 (0.47; 0.85)**	0.70 (0.48; 1.00)
Western	1.28 (0.98; 1.67)	1.33 (0.90; 1.98)	1.30 (0.89; 1.90)	0.90 (0.62; 1.28)	2.04 (1.34; 3.11)***
Mid-Western	1.62 (1.28; 2.04)***	1.55 (1.10; 2.19)*	1.61 (1.15; 2.25)**	1.34 (0.99; 1.82)	2.16 (1.48; 3.15)***
Far-Western	1.10 (0.83; 1.46)	0.98 (0.64; 1.49)	1.20 (0.81; 1.78)	1.04 (0.72; 1.50)	1.32 (0.84; 2.06)
Agro-ecological zone (Ref.=Plains)					
Mountains (*Himal*)	1.86 (1.36; 2.52)***	2.28 (1.45; 3.57)***	1.28 (0.82; 2.01)	2.39 (1.60; 3.57)***	1.29 (0.78; 2.15)
Hills (*Pahad*)	1.07 (0.81; 1.43)	1.58 (1.04; 2.39)*	0.63 (0.42; 0.96)*	1.38 (0.94; 2.03)	0.77 (0.49; 1.21)

*p<0.05; **p<0.01; ***p<0.001.

Model 1: Hosmer and Lemeshow χ^2 16.55 (p=0.08); Nagelkerke R^2 0.08.

Model 2: Hosmer and Lemeshow χ^2 3.44 (p=0.90); Nagelkerke R^2 0.12.

Model 3: Hosmer and Lemeshow χ^2 18.52 (p=0.02); Nagelkerke R^2 0.09.

Model 4: Hosmer and Lemeshow χ^2 5.86 (p=0.66); Nagelkerke R^2 0.10.

Model 5: Hosmer and Lemeshow χ^2 10.37 (p=0.24); Nagelkerke R^2 0.10.

Determinants of thinness

Table 3.4 shows the relationship between sociocultural and economic determinants and thinness of adolescents. The binary logistic regression model shows that adolescent boys were 2.32 (p<0.001) times more likely to be thin than girls. This association was confirmed in the separate age group models where younger and older boys were 2.07 (p<0.001) and 3.12 (p<0.001) times more likely to be thin than girls their age. In model 1, the older age group had a lower likelihood of thinness (OR=0.72; p<0.05) compared with the younger age group. This association was only found for girls (OR=0.54; p<0.01). Being married decreased the mean chance of thinness (OR=0.22; p<0.05) in the total population. This association was not found in the separate models. Disadvantaged *Janajatis* showed lower thinness odds in all models. The largest decrease was found amongst older adolescents (OR=0.30; p<0.01). Adolescents belonging to a religious minority showed increased odds of thinness (OR=1.28; p<0.001). Model 2 showed lower odds for relatively advantaged *Janajati* boys (OR=0.15; p<0.01), while model 3 showed decreased odds of thinness (OR=0.38; p<0.001) among disadvantaged *Janajati* girls. Among younger adolescents, lower odds were found for relatively advantaged *Janajati* (OR=0.15; p<0.01), while the older age group showed decreased odds for *Dalit* (OR=0.42; p<0.05). Wearing footwear outdoors was associated with lower thinness odds for girls only (OR=0.37; p<0.01). The likelihood of thinness was lower among adolescents with nutrition knowledge in all models, except for girls. The largest decrease was found in adolescent boys (OR=0.45; p<0.001).

At the household level, adolescents whose mothers attained beyond primary education were 1.52 times (p<0.05) more likely to be thin than adolescents whose mothers had no formal education. This effect was also found in the younger adolescent subgroup (OR=1.60; p<0.05). Paternal foreign employment increased the odds of thinness by 47% (p<0.05) in the total and 74% (p<0.05) in the male population. Among young adolescents, paternal occupation in business, daily wage or retirement decreased the odds by 38% (p<0.01) compared with agricultural occupation. A decrease of 37% in thinness was found in older adolescents with every additional earning household member. A monthly household income of 10,000 NPR or below increased the odds of thinness compared with a monthly income of 10,001 NPR or above. While a monthly family income below 5000 NPR increased the likelihood of thinness in the older population (OR=1.96; p<0.05), a monthly family income between 5001 and 10,000 NPR increased the risk of thinness in all models.

At the community level, residing in the Mid-Western and Far-Western development regions was associated with decreased odds of thinness (OR=0.68; p<0.05 and OR=0.59; p<0.05, respectively). This effect was only found for boys and for older adolescents residing in the Far-Western region (OR=0.53; p<0.05 and OR=0.33; p<0.01, respectively). Additionally, decreased odds of thinness (OR=0.44; p<0.05) were found for older adolescents residing in the Western development region compared with their counterparts in the Central region.

Table 3.4. Adjusted odds ratios (aOR) and 95% confidence intervals (CIs) of individual, household, and community determinants of thinness

	Model 1 (Total)	Model 2 (Boys)	Model 3 (Girls)	Model 4 (10–14 years)	Model 5 (15–19 years)
	aOR (95%CI)	aOR (95%CI)	aOR (95%CI)	aOR (95%CI)	aOR (95%CI)
Individual determinants					
Sex (Ref.=Female)					
Male	2.32 (1.84; 2.94)***			2.07 (1.57; 2.74)***	3.12 (1.97; 4.95)***
Age (Ref.=10–14 years)					
15–19 years	0.72 (0.56; 0.94)*	0.84 (0.61; 1.17)	0.54 (0.34; 0.84)**		
Marital status (Ref.=Unmarried)					
Married	0.22 (0.05; 0.90)*	0.05 (0.00; 3.97)	0.38 (0.08; 1.78)	0.30 (0.05; 1.88)	0.19 (0.02; 2.04)
Religion (Ref.=Hindu)					
Non-Hindu	1.02 (0.65; 1.60)	0.86 (0.46; 1.58)	1.28 (0.64; 2.56)	0.90 (0.55; 1.50)	1.18 (0.41; 3.43)
Caste/ethnicity (Ref.=Upper Caste)					
Dalit	0.74 (0.51; 1.08)	0.66 (0.40; 1.10)	0.89 (0.49; 1.61)	0.89 (0.57; 1.38)	0.42 (0.19; 0.92)*
Disadvantaged *Janajati*	0.46 (0.32; 0.65)***	0.51 (0.32; 0.81)**	0.38 (0.22; 0.67)***	0.53 (0.35; 0.79)**	0.30 (0.14; 0.62)**
Disadvantaged non-*Dalit Terai*	1.01 (0.66; 1.55)	1.36 (0.77; 2.40)	0.62 (0.30; 1.29)	1.14 (0.67; 1.93)	0.74 (0.35; 1.56)
Religious minority	1.28 (0.56; 2.94)***	0.85 (0.27; 2.72)	2.17 (0.60; 7.86)	0.86 (0.30; 2.48)	2.61 (0.53; 12.84)
Relatively advantaged *Janajati*	0.11 (0.03; 0.35)	0.15 (0.05; 0.51)**	0	0.15 (0.04; 0.49)**	0.01 (0.00; 5.22)
Footwear outside (Ref.=No)					
Yes	0.74 (0.44; 1.27)	2.12 (0.75; 5.99)	0.37 (0.19; 0.72)**	0.86 (0.46; 1.61)	0.39 (0.12; 1.23)
Nutrition knowledge (Ref.=No)					
Yes	0.61 (0.47; 0.78)***	0.45 (0.32; 0.62)***	0.96 (0.63; 1.47)	0.66 (0.48; 0.90)**	0.48 (0.30; 0.76)**
Household determinants					
Household size	1.04 (1.00; 1.09)	1.05 (0.98; 1.12)	1.04 (0.96; 1.12)	1.03 (0.98; 1.09)	1.09 (0.99; 1.19)
Paternal education (Ref.=No formal education)					
Pre-primary or primary	1.24 (0.90; 1.71)	1.41 (0.94; 2.11)	1.07 (0.60; 1.92)	1.42 (0.96; 2.09)	1.08 (0.57; 2.04)
Higher than primary	1.16 (0.84; 1.61)	1.11 (0.73; 1.71)	1.19 (0.69; 2.05)	1.03 (0.69; 1.54)	1.57 (0.87; 2.82)
Maternal education (Ref.=No formal education)					
Pre-primary or primary	1.22 (0.89; 1.68)	1.07 (0.71; 1.61)	1.41 (0.84; 2.37)	1.39 (0.96; 2.00)	0.79 (0.39; 1.60)
Higher than primary	1.52 (1.08; 2.14)*	1.42 (0.88; 2.31)	1.61 (0.96; 2.71)	1.60 (1.06; 2.39)*	1.58 (0.79; 3.15)

	Model 1 (Total)	Model 2 (Boys)	Model 3 (Girls)	Model 4 (10–14 years)	Model 5 (15–19 years)
	aOR (95%CI)	aOR (95%CI)	aOR (95%CI)	aOR (95%CI)	aOR (95%CI)
Paternal occupation (Ref.=Agriculture)					
Government or private sector	0.86 (0.57; 1.28)	1.14 (0.68; 1.92)	0.62 (0.31; 1.23)	0.70 (0.42; 1.14)	1.62 (0.76; 3.45)
Foreign employment	1.47 (1.03; 2.10)*	1.74 (1.07; 2.85)*	1.24 (0.72; 2.15)	1.33 (0.87; 2.03)	1.42 (0.70; 2.90)
Business, daily wage or retirement	0.87 (0.65; 1.16)	0.97 (0.67; 1.42)	0.71 (0.43; 1.17)	0.62 (0.43; 0.88)**	1.65 (0.94; 2.90)
Maternal occupation (Ref.=Homemaker)					
Agriculture	1.07 (0.77; 1.49)	1.16 (0.76; 1.77)	1.11 (0.63; 1.94)	1.05 (0.71; 1.56)	1.12 (0.57; 2.19)
Other paid employment	0.78 (0.48; 1.26)	0.53 (0.27; 1.05)	1.36 (0.67; 2.77)	0.72 (0.40; 1.27)	0.92 (0.34; 2.51)
No. earning household members	0.81 (0.64; 1.04)	0.83 (0.60; 1.14)	0.70 (0.46; 1.05)	0.92 (0.68; 1.24)	0.63 (0.41; 0.99)*
Monthly household income (Ref.=≥10,001 NPR)					
≤5000 NPR	1.38 (0.98; 1.95)	1.52 (0.97; 2.37)	1.26 (0.70; 2.26)	1.29 (0.85; 1.95)	1.96 (1.02; 3.74)*
5001–10,000 NPR	1.71 (1.28; 2.27)***	1.51 (1.03; 2.21)*	2.03 (1.27; 3.25)**	1.52 (1.07; 2.15)*	2.45 (1.43; 4.22)**
Source of drinking water (Ref.=Piped or public tap)					
Pump, tank, river/pond or well	0.94 (0.64; 1.40)	0.99 (0.61; 1.62)	0.83 (0.41; 1.69)	0.70 (0.43; 1.13)	1.83 (0.88; 3.83)
Type of latrine at the house (Ref.=Flush toilet)					
No flush toilet	1.17 (0.91; 1.52)	1.25 (0.90; 1.74)	1.16 (0.74; 1.81)	1.30 (0.95; 1.78)	0.80 (0.48; 1.33)
Community determinants					
Development region (Ref.=Central)					
Eastern	0.76 (0.54; 1.05)	0.77 (0.49; 1.20)	0.82 (0.48; 1.41)	0.77 (0.51; 1.15)	0.72 (0.38; 1.36)
Western	0.95 (0.65; 1.38)	0.79 (0.48; 1.30)	1.28 (0.70; 2.33)	1.43 (0.91; 2.25)	0.44 (0.21; 0.91)*
Mid-Western	0.68 (0.47; 0.98)*	0.68 (0.42; 1.08)	0.75 (0.40; 1.42)	0.73 (0.47; 1.14)	0.56 (0.28; 1.12)
Far-Western	0.59 (0.39; 0.90)*	0.53 (0.30; 0.92)*	0.67 (0.34; 1.31)	0.76 (0.46; 1.26)	0.31 (0.14; 0.69)**
Agro-ecological zone (Ref.=Plains)					
Mountains (*Himal*)	0.43 (0.27; 0.69)***	0.40 (0.22; 0.73)**	0.47 (0.21; 1.09)	0.47 (0.27; 0.82)**	0.22 (0.08; 0.60)**
Hills (*Pahad*)	0.48 (0.31; 0.74)**	0.67 (0.38; 1.17)	0.28 (0.13; 0.60)**	0.31 (0.18; 0.54)***	0.91 (0.42; 1.98)

*Table notes: *p<0.05; **p<0.01; *** p<0.001.*

Model 1: Hosmer and Lemeshow χ^2 10.32 (p=0.24); Nagelkerke R^2 0.15.

Model 2: Hosmer and Lemeshow χ^2 18.44 (p=0.02); Nagelkerke R^2 0.15.

Model 3: Hosmer and Lemeshow χ^2 18.52 (p=0.02); Nagelkerke R^2 0.16.

Model 4: Hosmer and Lemeshow χ^2 16.47 (p=0.04); Nagelkerke R^2 0.13.

Model 5: Hosmer and Lemeshow χ^2 10.99 (p=0.20); Nagelkerke R^2 0.25.

Similarly, adolescents residing in the Mountains or Hills had a lower risk (OR=0.43; $p<0.001$ and OR=0.48; $p<0.01$ respectively) of thinness compared with their counterparts living in the *Terai*. This association was also found for boys living in the Mountains (OR=0.40; $p<0.01$), girls residing in the Hills (OR=0.28; $p<0.01$), young adolescents residing in the Mountains and Hills (OR=0.47; $p<0.01$ and OR=0.31; $p<0.001$, respectively) and older adolescents residing in the Mountains (OR=0.22; $p<0.01$).

Discussion

This study provides a multi-level overview of the wide range of sex- and age-specific individual-, household-, and community-level sociocultural and economic determinants that influence the odds of stunting and thinness among adolescent boys and girls aged 10-19 years in Nepal. Findings show a widespread prevalence of both stunting and thinness among Nepali adolescents leading to the conclusion that many of them grow up in a deficient growth environment or might suffer from inadequate diets. Generally, boys were found to be more at risk of stunting and thinness than girls. Stunting increased with age, while thinness odds decreased with age. Male sex, older age, belonging to a religious minority, paternal occupation in business, daily wage, retirement or other, and living in the Mid-Western and Mountain areas were among the main risk factors for stunting. Belonging to a disadvantaged *Janajati* caste/ethnicity, paternal education beyond primary education, higher number of household earning members, nutritional knowledge, and living in the Eastern development region were protective against stunting. Male sex, belonging to a religious minority, a low household income, maternal education beyond primary education, and paternal foreign employment were the main factors associated with increased odds of thinness. Older age, being married, identifying as disadvantaged *Janajati*, living in Mid-Western or Far-Western regions, and Hills and Mountains regions, and having nutritional knowledge, decreased the risk of thinness in most populations.

In line with previous studies based on DHS data from South Asia, the male sex has been associated with higher odds of both stunting and thinness (Benedict, Schmale, & Namaste, 2018). Higher thinness odds might be explained by boys' increased energy expenditure due to more participation in labor activities, possibly in combination with school enrolment. Girls might be at lower risk due to increased involvement in cooking, during which they might be able to consume more food (Madjdian et al., 2018; Yamanaka & Ashworth, 2002). However, stunting indicates more than nutrition deficiencies, but also links to a multitude of factors, including a low-quality diet, poor health status, and environmental and societal challenges. Because these factors have not all been captured in this survey, it goes beyond the scope of this study to explain why adolescent boys, and in particular

older boys, have higher odds of stunting than girls. Explanations provided in the literature range from biological to sociocultural, including different puberty growth spurt onsets, childhood feeding practices, boys' greater risk of morbidity and mortality in early life, and societal influences due to gender inequality (Svefors et al., 2019). Further research could thus benefit from including indicators such as energy expenditure and adolescent time use.

Age was found to be associated with stunting among both boys and girls in Nepal. This finding does not corroborate previous literature showing that a generally declining stunting trend during adolescence results from catch-up growth at later age, which compensates for earlier-age growth deficits (Astatkie, 2020; Gausman, Kim, & Subramanian, 2019). The present study also did not find a significantly higher prevalence of stunting among boys compared with girls, which has been previously explained by boys not having reached their full height due to a later onset of puberty than girls who generally have reached their full height (Sawyer et al., 2018). However, stunting is influenced by prenatal, infant and childhood experience and fluctuates during childhood and adolescence. Hence, both recovery and growth faltering or stunting persistence may take place (Dewey & Begum, 2011; Sawyer et al., 2018). It is likely that adolescents who were already stunted during childhood, have a higher probability of growing into stunted adults, while non-stunted adolescents have lower stunting odds in adolescence or adulthood (Astatkie, 2020; Gausman et al., 2019). Another explanation could be that adolescents in the younger age group had lower stunting prevalence rates in early life and childhood than the older group. However, due to the cross-sectional design of this survey, it was not possible to determine causality or discern whether growth is inhibited during late adolescence. Additionally, it is important to note that the growth references commonly used to determine undernutrition face challenges related to ethnic and racial differences, as well as variations in growth spurts and potential and body composition and might thus overestimate stunting prevalence (Tumilowicz, Beal, Neufeld, & Frongillo, 2019). On the contrary to increased stunting with age, older age was associated with decreased odds of thinness in girls only. Although household 'serving orders', where for instance Hindu adolescent girls are served last during meals, still exist (Madjdian & Bras, 2016; Morrison et al., 2018), it is also plausible that older girls receive more food when being prepared for marriage and pregnancy (Harris-Fry, Shrestha, Costello, & Saville, 2017).

The positive association between nutrition knowledge and nutritional status found in all groups, except for girls for thinness (OR=0.96; p=0.84) could be explained by nutrition knowledge being a driver for healthier food choices. Moreover, it might create a spill-over effect by, for instance educating parents about nutrition. The study findings are in line with a previous study among Bangladeshi adolescent girls aged 13-18 years, which found no association between the awareness of increased nutrient requirements during adolescence and stunting or thinness in girls (Alam, Roy, Ahmed, & Ahmed, 2010). The

absence of an effect of nutrition knowledge on thinness in this study could be explained by the fact that girls are more involved in food preparation and cooking from an early age, and underestimate their knowledge, or that girls have less agency than their male counterparts, who might be better able to act on their knowledge when it comes to food- and health-related decision-making. Assuming nutritional knowledge is partly gained at school, it might also be related, particularly in the older age group, to lower (secondary) school completion rates. Out-of-school girls are 'less reached' by educational programs (Alam et al., 2010). Although the gender gap in primary and secondary education in Nepal is narrowing, many girls are at risk of dropping out of, or skipping, school due to financial or social reasons. Unfortunately, data on adolescents' educational attainment are missing. Nutrition knowledge could also be seen as a proxy of socioeconomic or educational status, which might explain its association with stunting (Akhter et al., 2018). These results should be interpreted with caution as nutrition knowledge was self-reported and it does not explain what kind of knowledge this involves exactly.

Studies from Nepal repeatedly reported health and nutrition disparities between caste/ethnic groups. Inequalities are probably caused by disadvantaged groups' lower socioeconomic position, resulting in decreased access to resources and higher vulnerability to poor health outcomes, but could also be attributed to different food consumption patterns (Adhikari, 2010). The present study showed mixed results and should be interpreted with caution. First, it could be questioned whether caste/ethnicity is a stand-alone predictor of undernutrition as Nepal's multitude of religious, ethnic, and caste-bound practices overlap, making it difficult to identify with one specific caste/ethnic group. Second, it is likely that a combination of wealth, education, and caste/ethnicity determine an individual's position and vulnerability to poor health outcomes (Adhikari, 2010). Third, as discussed earlier, the growth reference used might not be fully able to discern ethnic and racial differences in body composition (Tumilowicz et al., 2019). The study found some associations between caste/ethnicity and stunting and thinness, for both adolescent boys and girls. Adolescents from the disadvantaged non-*Dalit Terai* caste/ethnic group had increased stunting odds, despite the finding that living in the Hills or Mountains increased stunting odds compared with living in the *Terai*. However, this corresponds with national data on lower use of health services and poorer health outcomes among *Terai* caste/ethnic groups (Ghimire, et al., 2019). Disadvantaged *Janajati* adolescents were less likely to be thin and stunted compared with Upper Caste adolescents. This is in line with previous research that reported lower odds of thinness among *Janajati* women aged 15-49 (Pandey, Dhakal, Karki, Poudel, & Pradhan, 2013). The *Janajati* classification of Pandey et al. (2013) included the same ethnicities and castes as this study's disadvantaged *Janajati* classification, as well as *Thakali and Gurung* castes/ethnicities, which were included under relatively advantaged *Janajati*. Relatively advantaged *Janajati* adolescent boys and younger adolescents were less

likely to be thin, which might be mediated by wealth. In the present sample, 42.5% of relatively advantaged *Janajati* boys had a monthly household income of 10,001 NPR or more, compared with 34.2% in the total male population. This group included the *Newar* caste/ethnicity, which represents a socioeconomically advantaged caste/ethnic group with a generally better health status (Adhikari, 2010; Bennett, Dahal, & Govindasamy, 2008). Religious minority adolescents showed higher risks of thinness, while younger adolescents belonging to a religious minority had higher stunting odds compared with the Upper Caste. In the study sample, 54 out of 59 adolescents identifying as religious minority were Muslim. Although these results should be interpreted with caution given the small representation of religious minorities in the sample (1.6 %), in Nepal, Muslims are known to make less use of health services and have poorer health outcomes (MoH et al., 2017). Additionally, the religious practice of fasting (*Roza*) from dawn to dusk during Ramadan, which leads to changes in meal schedules and meal types, might result (particularly for girls and combined with already existing unequal food allocation) in reduced food intake and weight loss leading to higher odds of thinness (Poh, Zawiah, Ismail, & Henry, 1996). Another strand of literature suggests that pre-birth exposure to Ramadan (maternal fasting) negatively influences the stature and body mass of religious Muslims during childhood (Karimi, 2018) and adolescence (Kunto & Mandemakers, 2019).

The absence of an effect of latrine type or source of drinking water and stunting and thinness might be explained by the large effect of household income. Wearing shoes outside was associated with lower odds of thinness in girls, which is in line with evidence on the association between footwear and soil-transmitted helminth infections leading to undernutrition, or vice versa (Amare et al., 2013). Similar results have been found in the context of anemia prevalence amongst adolescents in Nepal (Chalise et al., 2018). This finding could also be confounded by poverty. Hence, not (being able to) wear shoes could be a proxy indicator of economic status.

Household income was one of the main contributors to stunting and thinness in all groups. This is in line with previous research linking higher household income or wealth with access to high-quality food and health care services and less exposure to health risks (Bashir & Schilizzi, 2013; Nepali, Simkhada, & Davies, 2019; Sreeramareddy, Ramakrishnareddy, & Subramaniam, 2015; Victora et al., 2003; Vollmer, Harttgen, Kupka, & Subramanian, 2017). A greater number of earning household members was associated with decreased odds of stunting in all but the female and older population. The study outcomes suggest a pro-male bias that could be explained by the 'buffer hypothesis', assuming that in the context of poverty and food insecurity, women and older household members buffer men and younger household members from the adverse effects of, for instance, food insecurity by eating less (Hadley, Lindstrom, Tessema, & Belachew, 2008; Harris-Fry et al., 2017; Moffitt & Ribar, 2018). An increasing number of earning members might lead to a higher household income

and thus more resources to invest in food, health, and care (Bashir & Schilizzi, 2013), thereby lowering the risk of stunting. However, no data were available on the work status of adolescents or adolescents' relation to the additional earning members. Such information would be helpful to understand whether there is a food allocation bias favoring those who contribute to household income, which in this context is probably boys, who are more often engaged in paid work and school than girls (Dercon & Singh, 2013; Harris-Fry et al., 2017; Morrison et al., 2018). Nevertheless, the clear association between economic indicators and stunting and thinness points to the need to improve household access to, and availability of, food and other more underlying but related factors and assets, such as health care.

While for both boys and girls poverty was an important determinant of stunting, the relative importance of parental education differed for boys and girls and by age group. Generally, higher paternal education was protective against stunting in girls and younger adolescents. Maternal education was to a lesser extent associated with stunting or thinness. For instance, maternal education beyond primary increased the odds of thinness in younger adolescents. Hence, while most studies have found a positive association between maternal education and especially girls' nutritional status through increased knowledge and use of health services, higher household income and increased decision-making power (Aslam & Kingdon, 2012; Dancer & Rammohan, 2009; Hasan, Soares Magalhaes, Williams, & Mamun, 2016; Kunto & Bras, 2018; Rahman, Saima, & Goni, 2015), this study's findings suggest that paternal education is equally, or even more, important than maternal education. The absence of a protective effect of maternal education could be caused by women's work outside the household, thereby transferring feeding and caring tasks to others (Reed, Habicht, & Niameogo, 1996). Some studies have pointed out that maternal occupation might result in less contact time including adverse child feeding and care practices (Kunto & Bras, 2018), leading to a negative effect on growth of children. Nevertheless, the present findings are in line with a recent study from Nepal that found that, while maternal secondary education or higher was a significant contributor to stunting in under-five children in 1996, it lost significance in 2016. This was explained by the fact that the gender gap in education decreases with many women being educated, thereby reducing the effect of maternal education (Angdembe, Dulal, Bhattarai, & Karn, 2019). The present findings are also in line with previous research among Indian adults that showed that male, but not female, education reduced the risk of being underweight (Siddiqui & Donato, 2017). In Nepal's predominantly patriarchal society, men are often decision-makers and are able to influence decisions related to food, health, and care (Morrison et al., 2018). A systematic review investigating differences in parental educational levels on child nutritional status concluded that paternal education is equally important for nutritional status of children as maternal education, although the mechanisms might differ (Vollmer, Bommer, Krishna, Harttgen, & Subramanian, 2017). The association of boys' higher odds

of stunting with paternal pre-primary or primary education might be due to mediation by household income. For instance, 40.5% of the boys' fathers who completed pre-primary or primary education worked in daily wage and business, or were retired, possibly resulting in an unstable income, compared with 30.5% in the overall male population. Further research is needed to understand through which pathways parental education affects the nutritional status of adolescents in order to tailor interventions aimed at improving nutritional status of adolescents involving both mothers and fathers.

Parental occupation was found to be associated with stunting and thinness, most likely because of associated incomes. Paternal occupation in business, daily wage, or retirement, related to lower and more unstable incomes, increased girls' and older adolescents' odds of stunting. At the same time, it decreased the odds of thinness in younger adolescents. Again, these outcomes could be explained by the buffer hypothesis (Hadley et al., 2008; Harris-Fry et al., 2017; Moffitt & Ribar, 2018). Furthermore, paternal foreign employment was found to be associated with increased odds of thinness in boys and in the total population. This is surprising, because male-out migration is a strategy to improving household economic status (Ratha, Mohapatra, & Scheja, 2011). However, adolescents' work burden outside the house (e.g., in agriculture or other activities) might increase because of their father's absence. For instance, evidence from Mexico suggests that adolescent boys intensify their work outside the house when their fathers migrate, which may lead to increased energy expenditure, absence during mealtimes, and eventually to thinness (Antman, 2011; McKenzie & Rapoport, 2011). Moreover, older adolescents seem to be affected more by paternal occupation, possibly because they take up more responsibilities either in addition to, or instead of going to school.

At the community level, residence in the *Terai* appears to increase thinness odds in adolescents. This might be explained by dependency on imported and purchased food, which is highly susceptible to seasonal availability of food and price fluctuations (Krishnamurthy et al., 2013). When comparing stunting prevalence over the years, the *Terai* made the least progress in reducing stunting, potentially due to higher population density and lack of basic health and education services (Nepali et al., 2019). Mountain residence as a risk factor for stunting in all but girls and older adolescents, might be explained by a lack of conditions required for healthy growth, including household food security, care, and health from an early age (Krishnamurthy et al., 2013). Similar to a recent study on stunting in Nepal, residence in the Mid-Western region, the least developed and geographically most isolated region, showed higher stunting odds among all but the younger adolescents, possibly associated with the lack of infrastructure, health services and sanitation, social exclusion, and high rates of male out-migration (Nepali et al., 2019).

The findings of this study could support integrated and context-specific public health interventions to improve adolescent health and present an opportunity for solid

policymaking to facilitate a healthy transition into adulthood. Stunting and thinness may lead to the failure of realizing adolescents' social, economic, and developmental potential, which is why it is essential to consider both immediate and underlying determinants across the lifespan and focus on environmental, societal, and equity issues. Stunting in particular needs careful interpretation as it is not merely an indicator of undernutrition, and nutrition interventions alone will not improve the nutrition and health status, including stature, of present and future adolescents and generations (Leroy & Frongillo, 2019). Multi-component interventions should also address empowerment and gender equality and involve girls, boys, their parents, schools, and communities, while considering household determinants and cultural variation. Moreover, this study's findings show clear differences in determinants of stunting and thinness between younger and older adolescents. Thus, it is vital that we acknowledge that adolescence is indeed a period of rapid development and that interventions should be tailored to specific age groups.

Methodological limitations of this study relate first of all to its cross-sectional design, which did not allow conclusions about causality to be drawn. Secondly, the extended number of independent variables and the relatively small population of around 3700 adolescents increase the likelihood of type I errors, incorrectly showing the differences between groups. Third, self-report might have led to response bias, particularly in the case of parental education and occupation questions. Fourth, despite the multi-cluster sampling design, the study population might not fully represent all Nepalese adolescents. For instance, the low percentage of married adolescents in this study (1.8% boys and 3.6% girls) differs from national DHS 2016 data (6.4% boys and 27.1% girls aged 15 to 19) (MoH et al., 2017). The difference might be explained by the fact that NANS intended to solely sample unmarried adolescents. However, some married adolescents were interviewed by mistake. Finally, although anthropometric data and the 2007 growth reference are commonly accepted and frequently used as indicators of undernutrition in the adolescent population, they have their limitations, particularly in the context of cross-sectional data, as was recently highlighted by Tumilowicz et al. (2019).

There were also limitations related to challenges in determining the actual prevalence estimates in the study population due to ethnic and racial variations and differences in growth spurts and potential and body composition. To fully understand age- and sex-specific differences, data on biological maturation and the adolescent growth spurt, such as age of menarche and peak height velocity, are essential, as there might be variability between our study population and the reference population in terms of growth trajectories (Tumilowicz et al., 2019). The WHO cut-offs might be problematic, especially for older adolescents as growth in both height and weight can continue into late adolescence, which may result in an overestimation of stunting among boys compared with girls. Moreover, the study's thinness prevalence of girls might be underestimated due to sex differences in

BAZ SD scores. Hence, in order to assess and combat adolescent undernutrition and to determine intervention points, additional nutritional indicators, such as dietary intake and quality, are important, but data are limited (Tumilowicz et al., 2019). Moreover, proxies of nutritional status, including distal and proximate determinants such as environmental and macro-level factors related to agriculture, infrastructure, health services, and food systems, as well as social and cultural norms and practices that favor girls or boys, younger or older adolescents, are vital in order to better understand and address regional and age- and sex-specific differences between stunting and thinness (Tumilowicz et al., 2019; WHO, 2018). Such research would be ideally based on longitudinal data and adopting a life course perspective to explore the mechanisms and causal pathways through which sociocultural and economic determinants influence adolescent nutrition within their everyday-life setting.

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Chapter 4

Unravelling adolescent girls' aspirations in Nepal: status and associations with individual-, household-, and community-level characteristics

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This chapter is under review as:
Unravelling adolescent girls' aspirations in Nepal: status and associations with individual-, household-, and community-level characteristics.

Abstract

Adolescents' aspirations have potential to influence their present and future well-being. Limited knowledge exists on adolescent girls' aspirations and their determinants, particularly in low-income contexts. Using cross-sectional data, collected in 2018 in Nepal, within the *Suaahara II* Adolescent Panel Survey, (n=840), adolescent girls' aspirations in several domains - education, occupation, marriage, fertility, health, and nutrition – were described. Regression models were estimated to explore associations between individual, household and community characteristics and these aspirations overall and separately for younger (10-14 years) and older (15-19 years) girls. Her age, school attendance, and self-efficacy, as well as household wealth, caste/ethnicity, size, and agro-ecological zone of residence were significantly associated with aspirations, although effect sizes and significance varied by aspiration domain and age group. Findings underscore the curtailing effect of poverty on aspirations and the dynamic nature of aspirations. Initiatives to foster girls' aspirations must address both individual and contextual factors.

Introduction

Adolescence (ages 10-19 years), a time of rapid change in several life domains, has gained increased interest, particularly in low- and middle- income countries (LMICs) where roughly 90% of the world's adolescents live (Sawyer, Azzopardi, Wickremarathne, & Patton, 2018; UN, 2019). As part of non-cognitive and socio-emotional skill development, adolescence is a key time for the development of aspirations (Gottfredson, 1981). Aspirations influence behavioral choices and exposure to factors and thus, may be important drivers of life outcomes, including health and wellbeing, nutrition, reproductive health, labor participation, and education (Hart, 2016; Lybbert & Wydick, 2018; Massey, Gebhardt, & Garnefski, 2008; Mathur, Malhotra, & Mehta, 2001; Wang, Chen, Tang, Lee, & Jian, 2011; Wu, Shek, & Leung, 2016).

The development of girls' aspirations related to education, occupation, family formation (i.e., marriage, fertility), health, and nutrition is dynamic and influenced by girls' capacity to aspire and a range of internal and external factors (Harper, Jones, Ghimire, Marcus, & Bantebya, 2018; Santhya et al., 2017). So far, however, research on the nature, scope and drivers of adolescent girls' aspirations lacks in four areas. First, most studies are characterized by small sample size or focus on specific sub-groups, such as married or older adolescents (Massey et al., 2008), rather than all adolescents, preventing comparisons between stages of adolescence. Second, only a few studies on aspirations have been conducted in low-income contexts and studies from South-Asia, in particular, are scarce (Massey et al., 2008). Third, the majority of studies focus on educational and occupational aspirations, but not on aspirations in other important life domains including family formation and one's health and nutritional wellbeing (Croll, Attwood, & Fuller, 2010; DeJaeghere, 2018; Massey et al., 2008; Nurmi, 1991; Pasquier-Doumer & Brandon, 2015). Fourth, studies are commonly devoted to single factors associated with aspirations, such as age, ethnicity, socio-economic status, or non-cognitive personal traits, but evidence on the relative importance of individual, household, and community drivers is scant (Flouri, Tsivrikos, Akhtar, & Midouhas, 2015; Massey et al., 2008).

This paper aims to contribute to the growing body of knowledge on adolescent girls' aspirations and their drivers by assessing six domains of aspirations and exploring individual, household and community factors as drivers of these aspirations, using Nepal as a research setting. In Nepal, undernutrition, early marriage and childbearing, incomplete schooling, unequal work opportunities, and limited decision-making power within and outside households remain significant challenges for Nepalese adolescent girls (UNPF, 2017). For instance, in primary and secondary education, Nepali girls lag behind boys in terms of learning outcomes and access to and enrolment in quality education (CBS, 2015; NIRT, 2016). Limited labor market opportunities, combined with household poverty or

social pressure, might encourage girls to marry rather than continue their studies (Boyden, Dawes, Dornan, & Tredoux, 2019). A recent review on girls' psychosocial wellbeing in Nepal showed that many girls felt depressed, sad, lacked confidence, or felt they could not cope with their current living situation (Cunningham & D'Arcy, 2017). Yet, limited evidence exists on Nepalese adolescent girls' aspirations in education, occupation, marriage, fertility, health and nutrition; drivers of these aspirations; and how these differ during different stages of adolescence. Such knowledge is essential to inform programs and policies to support girls in reaching their full potential.

Using data from the *Suaahara II* adolescent panel survey, we measure Nepalese adolescent girls' aspirations in several key life course domains - education, occupation, marriage, fertility, health, and nutrition -, estimate associations between differing aspiration domains and a range of individual, household, and community factors, and estimate variations in these associations between younger (ages 10-14) and older (ages 15-19) adolescent girls.

Conceptualizing aspirations

In this study, we use Hart's definition of aspirations as "future-oriented, driven by conscious and unconscious motivations" and "indicative of an individual's or group's commitments towards a particular trajectory or end point" (Hart, 2016, p. 326). This definition assumes that individuals desire to do well and that aspirations do not develop in isolation (Hart, 2016; Ray, 2006). It moreover acknowledges the role of human agency, the dynamic nature of aspirations, and the influence of internal and external factors.

This study also draws upon Appadurai's capacity to aspire theory that notes how one's capacity to aspire is not equally distributed across society but rather shaped by context (Appadurai, 2004). Thus, poverty is theorized to be one of the biggest external constraints; people born in poverty aspire less (Appadurai, 2004). Agency, one's freedom to "pursue goals with influence beyond oneself and that one has reason to value" is inherently linked to the capacity to aspire (DeJaeghere, 2018; Hart, 2016; Hart & Brando, 2018, p. 294; Ray, 2006). Particularly during adolescence, girls' sense of agency fluctuates, which may influence the freedom to use resources and their aspirations. The extent to which they are able to do so, also depends on context-specific opportunities and restrictions in girls' everyday lives (Dalton, Ghosal, & Mani, 2016; Nussbaum, 2001; Sen, 2005). Aspirations are dynamic and likely to change throughout adolescence, following certain life events, and transitions (Massey et al., 2008). For instance, early marriage and subsequent school drop-out change one's social status and often affect a girl's later participation in the workforce (Maertens, 2013). Other structural, socio-cultural and economic factors may either hinder or enable aspirations (Harper et al., 2018). The remainder of this section expands on the individual, household, and community factors that likely influence adolescent girls' aspirations in the context of Nepal.

Individual factors and aspirations

Individual factors that may relate to girls' aspirations include her age and life events, such as leaving school or becoming a mother, self-efficacy and decision-making power (DeJaeghere, 2018; Favara, 2017; Massey et al., 2008). Girls in LMICs often see their worlds and dreams narrowing during early adolescence (Harper et al., 2018). Two reviews showed that with increasing age, girls tend to become more pessimistic and adjust their aspirations downwards to reflect reality or other's expectations (Massey et al., 2008; Nurmi, 1991). A qualitative study in the plains of Nepal found that adolescent girls aged 10-15 years, generally felt submissive and were unable to express their preferences, hindering growth and articulation of aspirations (Samuels, Ghimire, Tamang, & Uprety, 2017).

Important life events often imply social transitions. For instance, menarche signifies a transition from being a girl to becoming a woman, often marking marital readiness. Although the legal age of marriage is 20 years, about 37% of Nepalese girls marry before age 18 and first pregnancy follows often within one or two years (MoH, New ERA, & ICF, 2017). In Nepal's predominantly patriarchal society, the need to conform to socially-expected roles and norms connected to a girl's new status leads them to reconsider their aspirations (Buchmann & Steinhoff, 2017; Cunningham & D'Arcy, 2017; DeJaeghere, 2018; Ghimire, Samuels, & Wagle, 2013). Contrarily, school enrolment may delay the pressure to marry, in turn influencing marital and childbearing aspirations (Rai, Adhikari, Acharya, Kaiser, & Kohrt, 2017). Marriage and motherhood might change one's occupational aspirations, for instance when husbands or in-laws limit girls' decision-making power (Beaman, Duflo, Pande, & Topalova, 2012).

Self-efficacy is a psychological dimension of agency and seen as an important regulator of aspirations (Bandura, 1993). Indicating the extent to which a girl feels in charge of her (future) life, self-efficacy has been positively associated with occupational (Bandura, Barbaranelli, Caprara, & Pastorelli, 2001) and educational aspirations (Dercon & Krishnan, 2009; Dercon & Singh, 2013), but less so with other aspirations such as those related to her diet or health. Limited agency in these areas might reduce perceived importance of, and access to health and nutrition (Harris-Fry, Shrestha, Costello, & Saville, 2017; Madjdian & Bras, 2016). Decreased self-efficacy results in a sense of fatalism or hopelessness lowering aspirations and in turn, negatively impacts human development (Bernard, Dercon, & Taffesse, 2011). This is of concern in the context of Nepal, where many girls still report low self-efficacy (Cunningham & D'Arcy, 2017; Cunningham, Pries, Erichsen, Manohar, & Nielsen, 2020). Similarly, girls' decision-making power related to their lives either fosters or restricts aspirations (Winter, 2016).

Household factors and aspirations

Poverty has been extensively studied in relation to aspirations. Evidence is, however, conflicting. The 'poverty of aspirations' hypothesis suggests that poverty is the main reason for having no or low aspirations. Living in poverty, it is suggested, reduces hope, which results in a so-called 'aspirations failure'. This failure, or a fatalistic attitude, may reinforce poverty (Appadurai, 2004; Ray, 2006). Others, however, argue that poorer children's aspirations are as high as, or even higher than children from wealthier households (Massey et al., 2008; Tafere, 2014; Treanor, 2012). A qualitative study on aspirations of adolescent girls (ages 15-19) in Jumla, a remote mountain district in Far-Western Nepal, highlighted poverty as the main barrier to educational aspirations, even more so for marginalized or socially-excluded groups (Rai et al., 2017).

Living within larger families may generate conflicts, as limited household resources are divided amongst more members. A cross-sectional study in India showed that girls (15-24 years) with fewer siblings preferred a small family size (Santhya & Zavier, 2017). Prior studies have also found associations between other proxies of socio-economic status, such as parental occupation and educational levels, and adolescents' aspirations (Desforges & Abouchaar, 2003; Jodl, Michael, Malanchuk, Eccles, & Sameroff, 2001). Moreover, in Nepal the increase in female-headed households due to male emigration for work is accompanied by shifts in identity, agency, and labor division (Rajkarnikar & Ramnarain, 2020). While these households tend to be economically worse off than male-headed households, they have also been associated with higher female bargaining power within households, leading to better health, nutritional, and educational outcomes of children, sometimes despite poverty (Chudgar, 2011; Gartaula et al., 2017; Khalid & Martin, 2017). As a consequence Nepalese girls' aspirations may be changing, as the context is changing. Other factors such as caste/ethnicity may affect aspirations via internalized values that perpetuate inequalities (Hart, 2016). In Nepal, where caste/ethnicity have long been linked to access and socio-economic disparities, caste/ethnicity might be an important determinant of aspirations (Gottfredson, 1981).

Community factors and aspirations

The community (place) in which adolescents grow up affects their aspirations (Massey et al., 2008). In Nepal, opportunities for education, labor participation, family formation, and access to health care and nutritious foods differ by geography. In addition to Nepal's hundreds of caste/ethnic and linguistic groups, communities span from lowland plains to some of the tallest mountains in the world. Moreover, the country is facing rapid urbanization. These and other differences create variation in access to information and health care, educational services, and markets (Pokharel, 2015). Within-country differences in girls' aspirations are therefore highly likely.

Methods

Data and sample

Data for this study were drawn from an Adolescent Girls' Panel collected under the USAID-funded *Suaahara II* project, representative of 42 of Nepal's 77 districts where this integrated nutrition program is implemented. The cohort study aims to chart the lives of 1093 adolescent girls, who were 10-19 years in 2017, as they transition through adolescence and into adulthood. Multi-stage cluster sampling, with probability proportional to size sampling techniques, was used to select districts (n=16), one rural and urban municipality per district (n=32), three wards per municipality (n=96), and two clusters per ward (n=192). For the last stage, a household census was conducted in each cluster, and from the census, 19 households with a child 0-5 years were randomly selected (n=3648). If an adolescent girl (10-19 years) resided in the household, she was invited to participate in the survey (n=837). Some of the participants (n=256) randomly selected for interview as part of the mother's questionnaire were also of adolescent age (15-19 years). These adolescents (n=1093) were all combined as a cohort to be followed annually (Cunningham et al., 2020). For this paper, we use data from the first follow-up survey (July 2 - September 14, 2018), as this wave was the first to include a module on adolescent aspirations. Trained female enumerators collected data in each adolescent's home, using survey questionnaires that had been pilot-tested, translated and back translated, and programmed on mobile phones using Open Data Kit (ODK). In this wave, 975 out of 1093 adolescent girls aged 10 to 21 participated. The loss to follow-up rate of 11% can be mostly attributed to migration, usually for education, marriage, or work. We excluded those who were 20-21 years and no longer adolescents (n=131) and who did not answer the aspirations questions (n=4). Our total analytical sample is 397 younger adolescent girls (10-14 years) and 443 older adolescent girls (15-19 years) (Total n=840).

Measures

Dependent variables

Study outcomes cover aspirations on six life course domains: education, occupation, marriage, fertility, health, and nutrition. Questions were adapted from existing surveys or methods that have been used previously for aspiration or goal assessment, including the Young Lives study component on educational and occupational aspirations (Johnston, 2008), the Aspiration Index for health and nutrition aspirations (Kasser & Ryan, 1996), and the Demographic and Health Surveys (DHS) for family formation aspirations (DHS Program, 2015). Questions focused on aspirations in the absence of any constraints (i.e., "imagine you could study for as long as you wanted...") and at that specific moment in time. Questions were tailored to the girls' specific life situations through skip patterns. For

example, out-of-school girls were not asked about their educational aspirations, married girls were not asked about their aspired age of marriage, and mothers were not asked about their aspired age of having a first child. Among the six domains, "don't know" was allowed as a response for educational, occupational, and health- and nutrition- related aspirations. We excluded girls with uncertain or undecided marital (n=48) or fertility aspirations (n=299) and those who wished for no children (n=10) in specific models related to those outcomes. Table 4.1 provides an overview of the dependent variables, their respective categorizations, and sample sizes.

Independent variables

Our independent variables include individual-, household-, and community-level characteristics. Individual characteristics included the girls' age group, school-going status, maternal status, self-efficacy, and decision-making power. Binary variables were created for age (10-14 years vs. 15-19 years), school status (in- vs. out-of-school), and maternal status (mother vs. not a mother). Self-efficacy scores were measured using the New General Self-Efficacy Scale (Chen, Gully, & Eden, 2001). This eight-items scale was found to be reliable for both age groups (α= 0,81 and α=0,82 respectively). Decision-making was measured with questions relating to her input in decisions regarding attending school, going out of the house and engaging in the community, and food consumption and health care. Binary variables were created (none or some input vs. input into most or all decisions) due to low frequencies in the none or some input categories.

Household characteristics included size, economic status, caste/ethnicity, and food security, as well as the household head's sex, and level of education. Household size was measured as a continuous variable and captured the total number of people that were usually resident in the household. Household economic status was measured by calculating total equity scores, using the NDHS 2016 equity tool which sums the number of consumer goods owned (television(s), cupboard(s), table(s) and fan(s)), source of energy for cooking, and quality of housing materials (roof, floor, and wall) (DHS Equity Tool, 2016). Caste/ethnicity included three categories: socially excluded (i.e., *Dalit*, *Muslim*, disadvantaged *Janajati*); upper caste (i.e., *Brahmin* and *Chettri)*, and others (i.e., *Newar*, *Gurung*, *Thakali*, non-*Dalit terai* caste). Household food security was measured using the Household Food Insecurity Access Scale; a binary variable was created (food secure vs. food insecure) (Coates, Swindale, & Bilinsky, 2007). The sex of the household head was created as a binary variable (male vs. female) and his/her level of (formal) education categorized into none, some primary (grade 1-5), or at least some secondary (class 6 or beyond).

Community characteristics included a categorical variable for agro-ecological zone of residence (mountains, hills, and plains) and a binary variable to denote whether the community was disadvantaged or not, based on a previous classification by the Government

Table 4.1. Dependent variables: definitions, survey questions, and sample sizes

Aspirations	Question	Answer options	Classification	Sample
Education*	Imagine you could study for as long as you liked, until what grade/level would you wish to be in school?	1-10: Class 1-10 (SLC/SEE) * 11: Class 11 12: Class 12 (+2) 13: Bachelors 14: MSc or higher 15: Stop now 98: Don't know	0= ≤class 12 (Ref) (1-12, 15, 98) 1= >class 12 (13-15)	Only school-going girls (n=630)
Occupation**	Imagine you could do whatever you would like to do, what (type of) job would you like to have in your future?	1: Agriculture/fishery 2: Education 3: Health professional 4: Housewife 5: Business, sales 6: IT 8: Government job 9: Service work 10: Industry/plant work 11: Engineer 12: No job/unemployed 14: Artist/handicraft 15: Beautician 16: Tailor 96: Other (specified & categorized) 98: Don't know	0=no job, skill-level 1 and 2 (Ref) (1, 4, 9-10, 12, 14-16, 98) 1=skill-level 3&4 (2, 3, 5, 6, 8, 11)	All girls (n=840)
Marriage	Imagine you could marry whenever you wished, at what age would you like to get married?	Age in years 98: Don't know	Scale (x to y)	Only unmarried girls excluding those with uncertain/undecided aspirations (n=613)
Fertility	Imagine you could have your first child whenever you wished, at what age would you wish to have your first child?	Age in years 98: Don't know	Scale (x to y)	Only girls without a child(ren) excluding those with uncertain/undecided aspirations or those who did not wish to have children (n=381)
Health	How important is it for you to be physically healthy?	1: Not important at all 2: Not really important 3: Neutral 4: Somewhat important 5: Very important 98: Don't know	0=Else (1-4, 98) (Ref) 1=Very important (5)	All girls (n=840)
Nutrition	How important is it for you to eat nutritious food?	1: Not important at all 2: Not really important 3: Neutral 4: Somewhat important 5: Very important 98: Don't know	0=Else (1-4, 98) (Ref) 1=Very important (5)	All girls (n=840)

** According to Nepal's new Education Act, the Secondary Education Examination (SEE), previously SLC (School Leaving Certificate), is taken in the 10th grade, and before joining higher secondary or intermediate level education (12th grade). ** According to the Nepal Standard Classification of Occupations (NSCO)(CBS, 2001)*

of Nepal as category 3A, 3B and 4 (versus 1 or 2), due to its remoteness, food insecurity, and other factors (GoN, 2008).

Analyses

Analyses were conducted using STATA v.15 (StataCorp). Descriptive analyses of sample characteristics and bivariate analyses, including unadjusted Chi-square and Pearson's correlation tests to detect significant differences in all aspirations by the independent variables were done (Table 4.2). Logistic and linear regressions were conducted, using dummy variables for all categorical independent variables. Binomial logistic regressions were estimated for educational and occupational aspirations and linear regression for fertility and marital aspirations (Table 4.3). No regression analyses were run for health and nutrition aspirations, as about 90% of girls reported very high health and nutrition aspirations and this would have resulted in quasi-complete separation issues. We also included regression analyses by age group (younger vs. older girls) for educational, occupational, and marital aspirations (Table 4.4). We did not estimate differences between the two age groups for fertility aspirations as the majority (69%) of younger girls reported to be uncertain/undecided about their fertility aspirations. Variance inflation factors (VIF) were calculated and no multicollinearity was found between independent variables. Regression models were adjusted for clustering at the primary sampling unit. Regression results are reported as adjusted odds ratios (aOR), controlling for other independent variables in the model for binary logistic regressions, and unstandardized regression coefficients (*B*), as well as standardized beta coefficients for continuous variables, with 95% confidence intervals for linear regressions. Statistical significance was considered at $p<0.05$, $p<0.01$ and $p<0.001$ levels.

Ethics

Prior written informed consent and parental assent (for girls under 16 years of age) were obtained. Ethical approval was obtained from the Nepal Health Research Council (No. t97/ZO1B).

Results

Sample description

Survey participants were, on average, 15 years old, with slightly more girls in the older age group (52.7%). Almost none of the girls had children (82.1%) and the majority were in-school (75.0%). Self-efficacy scores ranged from 15 to 40, with an average score of 30.7.

Table 4.2. Descriptive and correlation statistics

			Educational aspirations		Occupational aspirations		Marital aspirations		Fertility aspirations		Health aspirations		Nutrition aspirations	
Total observations		*840*	*630*		*840*		*613*		*381*		*840*		*840*	
			Beyond class 12 (vs. lower than class 12)		*Professional-skilled job (vs. no, or less-skilled job)*		*Mean age*		*Mean age*		*Important (vs. not important)*		*Important (vs. not important)*	
N % or/ mean (SD)			369 (58.6)	*p*	617 (73.5)	*p*	22.3 (2.3)	*p*	24.3 (2.7)	*p*	758 (90.2)	*p*	872 (90.1)	*p*
Age group	Young	397 (47.3)	201 (52.2)	<0.000	331 (83.4)	<0.000	22.0 (2.3)	0.003	24.5 (2.7)	0.178	356 (89.7)	0.601	348 (87.7)	0.057
	Older	443 (52.7)	168 (68.6)		286 (64.6)		22.6 (2.3)		24.1 (2.7)		402 (90.7)		406 (91.6)	
Maternal status	Not a mother	690 (82.1)	365 (58.6)		558 (80.8)	<0.000	n/a		n/a		624 (90.4)	0.680	616 (89.3)	0.318
	Mother	150 (17.9)	n/a		59 (39.3)		n/a		n/a		134 (89.3)		138 (92.0)	
School status	In-school	630 (75.0)	369 (58.6)		536 (85.1)	<0.000	22.3 (2.3)	0.162	24.6 (2.6)	<0.000	569 (90.3)	0.893	566 (89.8)	0.895
	Out of school	210 (25.0)	n/a		81 (38.6)		21.8 (1.9)		22.1 (2.6)		189 (90.0)		188 (89.5)	
School decision-making input	None to some some input	307 (36.5)	52 (45.2)	0.001	n/a		n/a		n/a		n/a		n/a	
	A lot of input	533 (63.5)	317 (61.6)		n/a		n/a		n/a		n/a		n/a	
Going out decision-making input	None to some some input	750 (89.3)	n/a		561 (74.8)	0.011	n/a		n/a		n/a		n/a	
	A lot of input	90 (10.7)	n/a		56 (62.2)		n/a		n/a		n/a		n/a	
Health decision-making input	None to some some input	257 (30.6)	n/a		n/a		n/a		n/a		222 (86.4)	0.012	n/a	
	A lot of input	583 (69.4)	n/a		n/a		n/a		n/a		536 (91.9)		n/a	
Food decision-making input	None to some some input	489 (58.2)	n/a		n/a		n/a		n/a		n/a		424 (86.7)	0.001
	A lot of input	351 (41.8)	n/a		n/a		n/a		n/a		n/a		330 (94.0)	
Self-efficacy	Score	30.5 (4.6)	31.8 (4.3)	<0.000	31.0 (4.5)	<0.000	22.3 (2.3)	0.008	24.3 (2.7)	0.109	30.6 (4.6)	0.093	30.7 (4.6)	0.008
Caste/ethnicity	Socially-excluded	442 (52.6)	173 (54.2)	0.007	307 (69.5)	0.021	22.2 (2.4)	0.689	24.3 (2.7)	0.324	397 (89.8)	0.753	387 (87.5)	0.069
	Brahmin/ Chettri	327 (38.9)	168 (65.9)		254 (77.7)		22.4 (2.3)		24.5 (2.7)		298 (91.1)		303 (92.7)	
	Other	71 (8.5)	28 (50.0)		56 (78.9)		21.9 (2.1)		23.4 (2.6)		63 (88.7)		64 (90.1)	
Household size	Number	6.2 (3.0)	6.1 (2.7)	0.212	6.2 (2.7)	0.094	22.3 (2.3)	0.089	24.3 (2.6)	0.071	6.2 (3.0)	0.767	6.1 (3.0)	0.448
Household wealth	Score	-0.15 (1.16)	0.02 (1.24)	<0.000	-0.1 (1.12)	0.043	22.3 (2.3)	<0.000	24.3 (2.6)	0.010	-0.1 (1.2)	0.001	-0.1 (1.2)	0.029
Head of household sex	Female	392 (46.7)	125 (42.8)	0.513	246 (84.2)	0.586	22.3 (2.3)	0,741	24.6 (2.8)	0.025	262 (89.7)	0.641	257 (88.0)	0.158
	Male	448 (53.3)	202 (59.8)		290 (85.8)		22.2 (2.3)		24.0 (2.6)		307 (90.8)		309 (91.4)	
Head of household highest education completed	No (formal) education	355 (42.3)	133 (52.8)	0.040	205 (81.4)	0.098	22.2 (2.4)	0.207	24.0 (2.8)	0.100	225 (89.3)	0.755	222 (88.1)	0.423
	Primary	221 (26.3)	105 (60.3)		153 (87.9)		22.3 (2.3)		24.3 (2.5)		159 (91.4)		160 (91.9)	
	Secondary or higher	264 (31.4)	131(64.2)		178 (87.2)		22.4 (4)		24.6 (2.7)		185 (90.7)		184 (90.2)	

Table 4.2. Continued

			Educational aspirations		Occupational aspirations		Marital aspirations		Fertility aspirations		Health aspirations		Nutrition aspirations	
Total observations		*840*	*630*		*840*		*613*		*381*		*840*		*840*	
			Beyond class 12 (vs. lower than class 12)		*Professional-skilled job (vs. no, or less-skilled job)*		*Mean age*		*Mean age*		*Important (vs. not important)*		*Important (vs. not important)*	
Household food security	Secure	322 (38.3)	240 (62.0)	0.027	336 (86.8)	0.121	22.5 (2.3)	0.004	24.4 (2.7)	0.400	358 (92.5)	0.019	353 (91.2)	0.150
	Insecure	518 (61.7)	129 (53.1)		200 (82.3)		21.9 (2.4)		24.1 (2.7)		211 (86.8)		213 (87.7)	
Agro-ecological zone	Mountains	122 (14.5)	65 (61.9)	0.494	98 (80.3)	0.166	22.0 (2.4)	0.034	24.2 (2.8)	0.940	109 (89.3)	0.064	112 (91.8)	0.645
	Hills	426 (50.7)	184 (59.6)		310 (72.8)		22.2 (2.3)		24.4 (2.6)		376 (88.3)		379 (89.0)	
	Terai	292 (34.8)	120 (55.6)		209 (71.6)		22.5 (2.3)		24.2 (2.8)		273 (93.5)		263 (9012)	
Disadvantaged community	Yes	272 (32.4)	103 (51.0)	0.008	164 (81.2)	0.060	22.5 (2.3)	0.001	23.8 (2.6)	0.020	242 (88.9)	0.392	234 (86.0)	0.014
	No	568 (67.6)	266 (62.1)		372 (86.9)		21.8 (2.3)		24.5 (2.7)		516 (90.8)		520 (91.5)	

*Table notes: *n/a indicates excluded from analysis*

Table 4.3. Regression results for educational, occupational, marital, fertility, health, and nutrition aspirations

Aspirations		**Education**		**Occupation**		**Marriage**			**Fertility**		
		N	**> class 12 (1) vs. ≤class 12 (0)**	**N**	**Professional skilled job (1) vs. No/low skilled job (0)**	**N**	**Age**		**N**	**Age**	
Total observations		630		840		613			381		
			aOR (95% CI)		aOR (95%CI)		Unstd. B (95% CI)	Std. Beta (95%CI)		B (95% CI)	Beta
Age Group (ref=10-14 years old)	*15-19 years*	245	1.73 (1.19-2.53)**	443	0.89 (0.55-1.42)	255	0.52 (0.16-0.88)**	0.52 (0.16-0.88)**	195	-0.04 (-0.51-0.43)	-0.04 (-0.51-0.43)
Maternal status (ref=not a mother)	*Mother*	n/a	n/a	150	0.92 (0.46-1.79)	n/a	n/a	n/a	n/a	n/a	n/a
School status (ref=out of school)	*In-school*	n/a	n/a	630	7.64 (4.20-13.92)***	575	0.45 (-0.20-1.10)	0.45 (-0.20-1.10)	339	2.20 (1.17-3.22)***	2.20 (1.17-3.22)***
Self-efficacy	*Total score*	630	1.06 (1.02-1.11)**	840	1.04 (1.00-1.08)*	613	0.03 (-0.02-0.07)	0.03 (-0.02-0.07)	381	0.02 (-0.05-0.09)	0.09 (0.23-0.42)
Caste/ethnicity (ref=socially-excluded)	*Brahmin/ Chettri*	255	1.68 (1.13-2.49)**	327	1.41 (0.96-2.06)	244	0.22 (-0.16-0.61)	0.22 (-0.16-0.61)	153	-0.08 (-0.63-0.46)	-0.08 (-0.63-0.46)
	Other	56	0.66 (0.34-1.29)	71	1.33 (0.68-2.59)	59	-0.50 (-1.21-0.21)	-0.50 (-1.21-0.21)	36	-0.74 (-1.80-0.31)	-0.74 (-1.80-0.31)

Aspirations			Education		Occupation		Marriage			Fertility	
		N	> class 12 (1) vs. ≤class 12 (0)	N	Professional skilled job (1) vs. No/low skilled job (0)	N	Age		N	Age	
School decision-making input (ref=none to some input)	*A lot of input*	515	1.44 (0.88-2.34)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Going out decision-making input (ref=none to some input)	*A lot of input*	n/a	n/a	90	0.97 (0.57-1.64)	n/a	n/a	n/a	n/a	n/a	n/a
Health decision-making input (ref=none to some input)	*A lot of input*	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Food decision-making input (ref=none to some input)	*A lot of input*	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Household size	*Total number*	630	0.97 (0.91-1.03)	840	1.00 (0.92-1.09)	613	-0.03 (-0.09-0.02)	-0.10 (0.26-0.70)	381	-0.01 (-0.12-0.10)	-0.03 (0.36-0.30)
Household head highest completed level of education (ref=no (formal) education)	*Primary*	174	1.31 (0.83-2.05)	221	1.46 (0.91-2.34)	168	-0.01 (-0.49-0.47)	-0.01 (-0.49-0.47)	130	0.23 (-0.48-0.93)	0.23 (-0.48-0.93)
	Secondary or higher	204	1.27 (0.85-1.91)	264	1.24 (0.82-1.89)	189	-0.04 (-0.49-0.41)	-0.04 (-0.49-0.41)	120	0.34 (-0.33-1.01)	0.34 (-0.33-1.01)
Household head sex (ref=male)	*Female*	292	0.95 (0.64-1.40)	392	0.89 (0.61-1.29)	272	-0.04 (-0.42-0.34)	-0.04 (-0.42-0.34)	166	0.49 (-0.04-1.02)	0.49 (-0.04-1.02)
Household food security (ref=food-insecure)	*Food secure*	387	1.20 (0.81-1.77)	518	1.31 (0.88-1.94)	371	0.24 (-0.15-0.64)	0.24 (-0.15-0.64)	230	-0.04 (-0.62-0.53)	-0.04 (-0.62-0.53)
Household wealth	*Total score*	630	1.56 (1.25-1.95)***	840	1.30 (1.07-1.56)**	613	0.41 (0.22-0.60)***	0.48 (0.26-0.70)***	381	0.39 (0.09-0.70)**	0.46 (0.10-0.81)**
Agro-ecological region (ref=hills)	*Mountains*	105	1.54 (0.88-2.70)	122	1.41 (0.70-2.83)	100	0.21 (-0.43-0.86)	0.21 (-0.43-0.86)	58	0.34 (-0.49-1.18)	0.34 (-0.49-1.18)
	Terai	216	0.55 (0.34-0.91)*	292	0.66 (0.42-1.01)	208	-0.03 (-0.53-0.47)	-0.03 (-0.53-0.47)	137	-0.36 (-1.09-0.37)	-0.36 (-1.09-0.37)
Disadvantaged community (ref=no)	*Yes*	202	0.65 (0.42-1.01)	272	0.78 (0.51-1.20)	204	-0.32 (-0.81-0.15)	-0.32 (-0.81-0.15)	112	-0.33 (-0.94-0.28)	-0.33 (-0.94-0.28)
(Pseudo) R^2			0.182		0.30		0.10	0.0		0.13	

*Table notes: CI or SD in parentheses; ***significant p<0.001; **significant p<0.01; *significant p<0.05; n/a indicates not included in analysis*

Table 4.4. Regression results for educational, occupational and marital aspirations split by age group

Aspirations		Education >class 12 (1) vs. ≤class 12 (0)				Occupation Professional skilled-job (1) vs. No/low skilled job (0)	
		N	10-14	N	15-19	N	10-14
Observations		385		245		397	
			aOR (95% CI)		aOR (95% CI)		aOR (95%CI)
Age Group (ref=10-14 years old)	15-19 years	n/a	n/a	n/a	n/a	n/a	n/a
Maternal status (ref=no children)	Mother	n/a	n/a	n/a	n/a	n/a	n/a
School status (ref=out of school)	In-school	n/a	n/a	n/a	n/a	385	8.22 (2.44-27.72)***
Self-efficacy	Total score	385	1.10(1.05-1.16)***	245	0.98 (0.92-1.06)	397	1.06 (1.00-1.12)*
Caste/ethnicity (ref=socially-excluded)	Brahmin/ Chettri	147	1.63 (0.98-2.70)	108	2.05 (1.07-3.93)*	148	1.24 (0.64-2.41)
	Other	36	0.72 (0.29-1.79)	20	0.81 (0.29-2.27)	39	1.35 (0.57-3.20)
Input school-related decisions (ref=no/limited input)	Input in decisions	303	1.54 (0.86-2.75)	212	1.35 (0.58-3.15)	n/a	n/a
Input in going out & engage in community (ref=no/limited input)	Input in decisions	n/a	n/a	n/a	n/a	10	0.76 (0.14-4.18)
Input in own health care (ref=no/limited input)	Input in decisions	n/a	n/a	n/a	n/a	n/a	n/a
Input in food consumption (ref=no/limited input)	Input in decisions	n/a	n/a	n/a	n/a	n/a	n/a
Household size	Total number	385	0.93 (0.87-1.00)*	245	1.05 (0.93-1.18)	397	0.93 (0.87-1.00)*
Household head highest completed level of education (ref=no formal education)	Primary	103	0.85 (0.46-1.56)	71	2.43 (1.10-5.37)*	103	1.89 (0.77-4.61)
	Secondary or higher	130	1.17 (0.69-1.98)	74	1.28 (0.64-2.55)	130	1.06 (0.50-2.24)
Household head sex (ref=male)	Female	191	0.94 (0.56-1.59)	101	0.96 (0.50-1.83)	196	0.80 (0.47-1.36)
Household food security (ref=food-insecure)	Food secure	235	1.42 (0.88-2.31)	152	0.95 (0.47-1.91)	240	0.91 (0.49-1.72)
Household wealth	Total score	385	1.40 (1.04-1.88)*	245	1.96 (1.44-2.66)***	397	1.28 (0.97-1.75)
Agro-ecological region (ref=hills)	Mountains	53	1.34 (0.70-2.57)	52	2.08 (0.71-6.10)	55	1.78 (0.63-5.07)
	Terai	134	0.67 (0.36-1.24)	82	0.36 (0.16-0.80)**	138	0.68 (0.36-1.28)
Disadvantaged community (ref=no)	Yes	123	0.69 (0.42-1.14)	97	0.49 (0.21-1.12)	128	0.66 (0.36-1.20)
(Pseudo) R^2			0.19		0.18		0.14

*Table notes: CI or SD in parentheses; ***significant p<0.001; **significant p<0.01; *significant p<0.05; n/a indicates not included in analysis*

		Marriage Age					
N	**15-19**	**N**	**10-14**		**N**	**15-19**	
443		358			255		
	aOR (95%CI)		Unstd. B (95% CI)	Std. Beta (95% CI)		Unstd. B (95% CI)	Std. Beta (95% CI)
	n/a	n/a	n/a	n/a	n/a	n/a	n/a
443	1.05 (0.47-2.34)	n/a	n/a	n/a	n/a	n/a	n/a
245	9.28 (4.57-18.85)***	349	0.02 (-1.47-1.51)	0.02 (-1.47-1.51)	226	0.77 (0.11-1.43)*	0.77 (0.11-1.43)*
443	1.02 (0.96-1.08)	358	0.02 (-0.04-0.07)	0.08 (0.18-0.34)	255	0.02 (-0.05-0.09)	0.09 (0.23-0.42)
179	1.54 (0.94-2.53)	136	0.30 (-0.16-0.76)	0.30 (-0.16-0.76)	108	0.11 (-0.50-0.72)	0.11 (-0.50-0.72)
32	1.64 (0.62-4.39)	34	-0.77 (-1.66-0.13)	-0.77 (-1.66-0.13)	25	-0.08 (-0.96-0.80)	-0.08 (-0.96-0.80)
n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
80	1.06 (0.57-0.98)	n/a	n/a	n/a	n/a	n/a	n/a
n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
443	1.07 (0.96-1.19)	358	-0.06 (-0.13-0.01)	-0.17 (0.37-0.03)	255	0.01 (-0.09-0.10)	0.03 (0.25-0.31)
118	1.30 (0.71-2.37)	93	-0.22 (-0.37-0.81)	-0.22 (-0.37-0.81)	75	-0.37 (-1.14-0.39)	-0.37 (-1.14-0.39)
134	1.45 (0.85-2.47)	115	0.32 (-0.24-0.88)	0.32 (-0.24-0.88)	74	-0.55 (-1.29-0.18)	-0.55 (-1.29-0.18)
196	0.98 (0.59-1.63)	172	0.13 (-0.37-0.63)	0.13 (-0.37-0.63)	100	-0.30 (-1.06-0.46)	-0.30 (-1.06-0.46)
278	1.65 (0.95-2.88)	216	-0.01 (-0.54-0.56)	-0.01 (-0.54-0.56)	155	0.48 (-0.12-1.08)	0.48 (-0.12-1.08)
443	1.33 (1.02-1.73)*	358	0.44 (0.19-0.69)***	0.51 (0.22-0.80)***	255	0.37 (0.07-0.67)*	0.43 (0.08-0.78)
67	1.19 (0.51-2.77)	51	0.22 (-0.54-0.98)	0.22 (-0.54-0.98)	49	0.11 (-0.79-1.02)	0.11 (-0.79-1.02)
154	0.59 (0.32-1.08)	120	0.14 (-0.50-0.83)	0.14 (-0.50-0.83)	88	-0.34 (-1.01-0.34)	-0.34 (-1.01-0.34)
144	0.90 (0.51-1.59)	119	-0.56 (-1.15-0.04)	-0.56 (-1.15-0.04)	85	0.03 (-0.62-0.68)	0.03 (-0.62-0.68)
	0.35		0.12	0.12		0.07	0.07

Almost two-thirds (63.5%) of the girls perceived they had input in most or all education-related decisions and slightly more (69.4%) for decisions related to their own health, whereas only about one in ten (10.7%) reported input into most or all decisions for going out of the house, and less than half (41.8%) for food consumption. Half of the girls belonged to the socially-excluded caste/ethnic groups (52.6%). Total equity scores ranged from -1.64 to 2.68 with a mean of -0.16. Household size ranged from 1 to 37, with a mean total number of household members of 6. About one-third (38.3%) of the households were food insecure. Slightly more than half (53.3%) of the household heads were men and almost half (42.3%) of the household heads had never attended or not completed primary school. Half of the girls resided in the hills (50.7%), 14.5% in the mountains and 34.8% in the plains. One third of the girls were living in areas classified as a disadvantaged community (32.4%) (see Table 4.1).

Educational aspirations

More than half of the girls (58.6%) aspired to study beyond grade 12. Aspirations for studying beyond class 12 were more prevalent among older adolescent girls ($p<0.001$), with input into school-related decisions ($p<0.001$), and higher self-efficacy ($p<0.001$), as well as those belonging to upper caste ($p<0.01$) higher economic status ($p<0.001$), food secure ($p<0.05$) households with highly educated household heads ($p<0.05$) and from advantaged communities ($p<0.01$).

In the fully adjusted logistic regression model, age, self-efficacy, caste/ethnicity, and wealth were positively associated with educational aspirations, whereas residing in the plains was negatively associated. Older girls had 1.7 times greater odds of aspiring to study beyond class 12, compared to younger girls ($p<0.01$;1.18-2.52). Also, for every unit increase in a girl's total self-efficacy score, the odds were 1.1 times higher that she aspired to study beyond class 12 ($p<0.01$; 1.02-1.11). The odds of aspiring to study beyond class 12 were 1.7 times higher among girls belonging to the upper caste/ethnicity groups than those from the socially-excluded groups ($p<0.01$; 1.13-2.49) and 1.6 times higher with every unit increase (meaning at least 2 additional household assets/structural improvements) in household economic status ($p<0.000$; 1.25-1.95). Finally, the odds of aspiring higher than class 12 were 0.6 times lower among girls living in the lowland plains *(Terai)* compared to those residing in the hills ($p<0.05$; 0.34-0.91).

For younger adolescent girls', self-efficacy, household size, and wealth were associated with her educational aspirations. The odds of aspiring to study beyond class 12 were 1.1 times greater for each unit increase in her self-efficacy score ($p<0.001$; 1.05-1.16) and 1.4 times higher with every unit increase in household equity score ($p<0.05$; 1.04-1.88). On the other hand, the odds of aspiring to study beyond class 12 were 0.9 times lower with every additional household member ($p<0.05$; 0.87-1.00). For older girls, household economic

status was also associated with educational aspirations, but other determinants included: caste/ethnicity, household head education, and agro-ecological zone of residence. The odds of aspiring to study beyond class 12 were 2.1 times greater among upper caste/ethnic group ($p<0.05$; 1.07-3.93), and 2.5 times greater if the household head had completed primary education versus no education ($p<0.05$; 1.10-5.37). Odds increased by 2.0 for every unit increase in total equity score ($p<0.001$; 1.44-2.66). Older girls living in the *Terai* versus in the hills, had 0.4 lower odds of aspiring to study beyond class 12 ($p<0.01$; 0.16-0.80).

Occupational aspirations

While three out of four girls aspired to a job that required professional or higher formal education, a quarter aspired to have no job, or a job requiring lower or no (formal) education. Aspirations for occupations requiring higher education were more prevalent among girls who were older ($p<0.001$), without children ($p<0.001$), school-going ($p<0.001$), with input into decisions about their mobility ($p<0.05$), and higher self-efficacy scores ($p<0.001$), as well as among those belonging to households from upper caste/ethnic groups ($p<0.05$) and with higher economic status ($p<0.05$).

In the fully adjusted logistic regression model, only school status, self-efficacy, and household economic status were significantly associated with occupational aspirations. School-going girls had 7.6 times higher odds than out-of-school girls to aspire to an occupation requiring higher education ($p<0.000$; 4.2-13.9). The odds of aspiring for occupations requiring higher education were only 1.04 times greater with every unit increase in girls' self-efficacy score ($p<0.05$; 1.0-1.08) and 1.3 times higher with every unit increase in total equity score ($p<0.01$; 1.07-1.56).

School status was highly associated with aspiring for occupations with higher educational requirements in models for both younger and older adolescents. The odds of having such aspirations were 8.2 ($p<0.001$; 2.44-27.72) and 9.3 ($p<0.001$; 4.58-18.85) times higher among in-school versus out-of-school girls, among younger and older girls respectively. For younger adolescent girls, self-efficacy and household size were also associated with occupational aspirations. With every unit increase in a girl's total self-efficacy score, she had 1.1 times greater odds of aspiring for a job with higher educational requirements ($p<0.05$; 1.00-1.12), and with every additional household member, these odds were 0.9 lower ($p<0.05$; 0.87-1.00). For older adolescent girls, in addition to going to school, household economic status had a positive association with occupational aspirations requiring higher education. With every unit increase in wealth score, girls had 1.3 times greater odds of aspirations for occupations with higher educational requirements ($p<0.05$; 1.02-1.73).

Marital aspirations

The aspired age of first marriage for unmarried girls ranged from 15 to 32 years, with a mean aspired age of marriage of 22 years. Girls who were older ($p<0.01$), with higher total self-efficacy scores ($p<0.01$), and from households with better economic ($p<0.001$), and food security status ($p<0.01$), in the lowland plains or hills compared to the mountains ($p<0.05$), and from disadvantaged communities ($p<0.001$) aspired to marry at later ages ($p<0.01$).

In the fully adjusted multiple linear regression models, only age group and household economic status were significantly associated with marital aspirations. Being an older adolescent was associated with aspiring to marry at half a year later *(*B=0.52, $p<0.01$; 0.16-0.88) and each unit increase in the household's equity score was also associated with nearly a half year increase in aspired age of marriage (B=0.41, $p<0.000$; 0.22-0.60) .

For younger girls, only household economic status was significant, which was associated with nearly a half year increase in aspired age of marriage (B=0.44, $p<0.001$; 0.19-0.69). Among older girls, household economic status was associated with a one third year increase in aspired age of marriage (B=0.37, $p<0.05$; 0.07-0.67), and going to school was associated with a half a year increase in aspired age of marriage (B=0.41, $p<0.000$; 0.22-0.60).

Fertility aspirations

Less than half of the girls (43.3%) had undecided fertility aspirations and 1.5% did not wish to have any children. Among those with fertility aspirations, the preferred age of having a first child ranged from 18 to 35 years of age, with a mean age of 24. Later aspired ages of having a first child were more prevalent among school going girls ($p<0.001$), as well as among girls from households with greater economic status ($p<0.01$), female-headed households ($p<0.05$), and living in more advantaged communities ($p<0.05$).

In the fully adjusted models, only school status and household economic status were associated with girls' aspired age of having a first child. Going to school was associated with aspiring to have a first child more than 2 years later compared to not attending school (B=2.2, $p<0.000$; 1.17-3.22). Every unit increase in household wealth was associated with a more than one third increase in aspired age of having a first child (B=0.39, $p<0.01$; 0.09-0.70).

Health and nutrition aspirations

Almost all adolescent girls indicated they perceived health and nutrition as very important: 90.2% and 89.8% respectively. Higher health aspirations were more prevalent among girls who had input in health-related decisions-making ($p<0.05$), who came from households that were economically better off ($p<0.001$), as well as food secure ($p<0.05$). Higher nutrition aspirations were also more prevalent among girls that had input in food-related decision-

making ($p<0.001$), higher self-efficacy scores ($p<0.01$), and from households with better economic status ($p<0.05$) and residing in advantaged communities ($p<0.05$).

Discussion

This study assessed adolescent girls' (10-19 years) aspirations in several life domains - education, occupation, marriage, fertility, health, and nutrition - and estimated associations between various individual, household, and community characteristics with each of these aspirations, overall, and separately for younger (10-14 years) and older (15-19 years) girls in Nepal. More than half of the girls aim to continue their studies beyond grade 12; three-quarters of the girls aspire a job requiring professional or higher formal education; aspired ages of marriage and fertility were above the national and global recommendations of 20 years; and almost all girls perceived health and nutrition as very important in their lives. We found variation in which individual, household, and community factors were associated with aspirations by domain, and that determinants of aspirations in a specific domain differed between younger and older girls.

Findings confirm that girls' capacity to aspire is not homogeneously distributed (Appadurai, 2004; Favara, 2017), although not consistently. Household wealth was strongly associated with girls' aspirations in education, occupation, fertility, and marriage. This finding implies that when a household acquires more assets or improves their housing conditions, aspirations could increase. Although a few studies conducted in LMICs, including Nepal, found that girls kept relatively high aspirations especially related to education, but also careers and family life throughout adolescence and despite poverty (Mathur et al., 2001; Tafere, 2014; Winter, 2016), our findings are consistent with evidence on hopelessness, fatalism and lower aspirations among poorer populations (Appadurai, 2004), and literature on the psychology of aspirations and the culture of poverty (Appadurai, 2004; Dalton et al., 2016; Lewis, 1966). A poor girl is more likely to internalize feelings of hopelessness and has lower aspirations. It is also highly likely that these girls entered adolescence already having accumulated (intergenerational) disadvantage (Winter, 2016). When poverty distracts from setting goals for the future, this leads to a so-called poverty trap. Age-specific findings imply however that wealth did not (yet) influence younger girls' occupational aspirations. Their aspirations may be unrealistically high (Nurmi, 1991) and, it is likely that, at this stage, aspirations are shaped without paying too much attention to the ability and reality to realize aspirations, and are influenced by others in their aspiration window, such as peers (Gottfredson, 1981; Ray, 2006). The potential intergenerational cycle of low aspirations and poverty reinforcing each other, especially visible for older girls, is an unfortunate dynamic (Ray, 2006). Findings suggest that to foster, particularly older girls' aspirations, economic

opportunities, social protection, high-quality education, and other initiatives that address underlying poverty and other context-specific factors are needed.

We found no significant associations between girls' aspirations and the head of the households' sex, household food security, or living in a disadvantaged area, suggesting limited influence of household and the community factors. Girls from the upper caste/ethnic group, however, had higher odds of aspiring to study beyond class 12. This association mattered more for older girls, and relates to the fact that while secondary school enrolment is now the norm in Nepal, the most disadvantaged girls still face barriers to education (LeVine, 2019). This finding stresses the importance of prioritizing girls from socially-excluded groups vis-a-vis education investments, as well as understanding and addressing socio-cultural barriers that hinder girls from lower caste/ethnic groups to aspire to higher education. Where the head of a household completed at least primary education, girls' educational aspirations were higher, possibly through higher parental encouragement and support, which is in line with findings from previous studies (Gao & Eccles, 2020).

Findings particularly highlight that aspiration formation is dynamic (Gottfredson, 1981; Winter, 2016). Whilst adolescence is commonly referred to as a distinct period from child- or adulthood, we show that aspirations vary by stages of adolescence. In contrast to other studies that show a (negative) adjustment of aspirations over time (Dornan, Lives, & Pells, 2014; Favara, 2017), aspirations seemed to increase with age in Nepal. Older girls aspired for higher educational levels and later ages of marriage than younger girls. This may reflect changing norms surrounding girls' expected life trajectories, or that girls' achievements so far enabled them to aspire higher. Results should be interpreted with caution as we did not interview out-of-school girls, or mothers about their corresponding (past) aspirations. While childhood and early adolescence are characterized by being present-oriented with little interest in the future, during adolescence goal-setting capacity increases (Nurmi, 1991; Sawyer et al., 2012). Younger girls discuss different goals, needs and aspirations than older adolescent girls. It is thus unsurprising that the younger girls did not think about marriage and fertility as much as the older girls. Younger girls' potentially unrealistically high occupational aspirations, on which household economic status did not seem to have an effect, may also relate to their inability to think about their life that far down the road.

Findings underscore the role of schools in shaping aspirations. Staying in school and thereby delaying marriage might lead to higher educational, as well as marital and fertility aspirations. School participation broadens girls' horizons and is a major determinant of aspirations in several life domains, which seems to become even more important as girls grow older (Naafs & Skelton, 2018). Schools have the potential to play a role in aspiration formation and goal setting by, for instance, providing realistic and tailored information. Although girls' secondary school enrolment has never been higher in Nepal, the next steps are to ensure quality education, to help girls pursue further education, and to create

educational and training opportunities for out-of-school- and married girls as well. These findings also imply interrelations between aspiration domains, and although beyond the scope of our current study, future research could further examine these interrelations.

Despite being known as building blocks of aspirations, self-efficacy, and girls' perceived input in decision-making in key life domains, both reflecting the extent to which a girl feels able to influence her own life, were only modestly associated with, only educational and occupational aspirations. Our findings, are in line with previous studies showing self-efficacy as one of the key determinants of these aspirations in particular (Bandura et al., 2001; Roy, Morton, & Bhattacharya, 2016). However, we find that self-efficacy matters mostly for younger girls. It is therefore vital to invest in and raise socio-emotional skills from early ages onwards. Low self-efficacy in this age group, might lead to an aspirations gap, which implies that when the gap between a girl's current living situation and her aspiration becomes too big, it will lead to a feeling of unreachable goals, frustration, or hopelessness (Ray, 2006).

Strengths, limitations, and future research

Our study advances previous research in multiple ways. First, this is to our knowledge the first empirical study in South-Asia, or in any low-income context, that examines the nature and determinants of a range of girls' aspirations in several important domains. We, however, relied on separate measures to estimate aspirations, and used a non-standardized proxy for health and nutrition aspirations (perceived importance). While we assumed high perceived importance to lead to higher aspirations, the high rates of high perceived importance (90%) left us unable to estimate regression models. In this respect, further research should invest in exploring and validating ways to measure adolescents' aspirations in health and nutrition. Second, our study used a large dataset that is close to being nationally representative. Additionally, the dataset included the entire adolescent range of 10 to 19 years, whereas most studies focus on a specific age- or life stage; the disaggregated analyses provides a more nuanced picture of aspirations and how determinants of aspirations differ between younger and older girls. However, for our age-group-specific models, the sample sizes become relatively small, and there may not be power to detect significance for all factors. Moreover, while we acknowledge that the transition into adulthood is not linear and aspirations are likely shaped over time, the cross-sectional design prevents us from assessing this time variation or establishing causality. Therefore, future reporting from this longitudinal study and other similar research will better enable a life course perspective. Finally, despite including proxies of social influence (i.e., household head's highest completed level of education, household head sex), and decision-making power which could be a result of gendered norms, aspirations are shaped in interaction with others and are influenced by prevailing socio-cultural norms in communities (Hart, 2016; Ray, 2006).Therefore, we

recommend future research to include a more direct measure of prevailing socio-cultural norms in communities, as well as consider the importance of others and social processes that may influence girls aspirations.

Conclusion

Adolescence is a period wherein concerns about one's future are greater than in any other developmental phase (Sirin, Diemer, Jackson, Gonsalves, & Howell, 2004), and when aspirations can be powerful drivers of adolescent wellbeing and human development. Our findings underscore the need to foster and invest in the development of aspirations throughout different stages of adolescence and consider context-specific and structural factors. Herein, heterogeneity among adolescent girls should be acknowledged and further researched, including differences between younger and older girls, school-going girls and out-of-school girls, married and unmarried girls, adolescent mothers and those without children, and those from advantaged and disadvantaged socio-economic backgrounds in order for aspirations to become road maps to help girls thrive.

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Chapter 5

“Like a frog in a well”. A qualitative study of adolescent girls’ life aspirations in Western Nepal

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This chapter is under review as:
“Like a frog in a well”. A qualitative study of adolescent girls’ life aspirations in Western Nepal

Abstract

Adolescents' aspirations are important for a healthy transition into adulthood. Knowledge about girls' aspirations and their formation in a low-income context is scant. Framed within life course theory, this qualitative study aimed to understand adolescent girls' life aspirations, with a specific focus on school, work, family life, health and diets, and explore how aspirations are shaped within girls' everyday life context, in Nawalpur and Parasi, two districts in the plains of Western Nepal. Data collection involved interviewing 17 adolescent girls (11-19 years), using creative elicitation techniques: timeline drawing and network mapping. Thematic analyses revealed unique aspiration profiles of younger, older, and married adolescent girls. While younger girls were present-oriented and aspired high, older girls balanced aspirations with reality and in turn, adjusted their aspirations. Married women had mostly resigned themselves to their present lives and transferred their lost aspirations onto their children. Findings underscore how girls' internal feelings, others in their daily lives, gendered norms, and structural factors, related to different domains of aspirations, during different stages of adolescence. Results give direction to integral policies and programs that aim to sustain and grow adolescent girls' aspirations at specific stages of adolescence.

Introduction

Adolescence is a powerful time of change due to rapid physical, psychosocial, and cognitive growth (National Research Council and Institute of Medicine, 2005; Sawyer et al., 2012), including the development of aspirations (Nurmi, 1991). Aspirations are future-oriented desires or intentions for one's possible self, driven by (un)conscious motivations. They are important for a healthy transition into adulthood as they can steer choices and behavior, thereby laying the foundation for human development (Bandura, 2001; Hart, 2016; Sawyer et al., 2012; Sirin, Diemer, Jackson, Gonsalves, & Howell, 2004). Adolescents' aspirations have been associated with their psychological wellbeing, educational attainment (Favara, 2017), vocational outcomes (Ross, 2019), and healthy behavior including healthy nutrition and lifestyles (Bandura, 2001; Wang, Chen, Tang, Lee, & Jian, 2011; Wu, Shek, & Leung, 2016).

Despite great interest, adolescence remains however a poorly understood life stage. In a low-income context, aspirations and their development within everyday life, are particularly understudied. Few studies focus on occupational, educational or reproductive health, but thereby overlook other, often interrelated aspirations in areas of marriage, fertility, health, and diets. Research gaps particularly exist in the areas of adolescent diets and health (Cunningham, Pries, Erichsen, Manohar, & Nielsen, 2020). Moreover, studies on aspirations often focus on specific age- or population groups (e.g., married, or 15-19-year old's), or adolescence as one homogenous group, ignoring the diversity among adolescents. Finally, most evidence on aspirations is based on quantitative survey data, but because structural and underlying drivers of aspirations, as well as the role of others is less-easily measured quantitatively, these areas are under researched.

To support adolescent girls in reaching their full potential (Patton et al., 2016), as well as engaging them in decision-making and integral programming, a broader perspective on their aspirations, including how, when, and by whom these aspirations are shaped, is essential. Framed within a life course perspective and based on a qualitative study involving participatory elicitation methods, this paper aims to: a) advance the understanding of adolescent girls' aspirations related to school, work, family life, food, and health; and b) explore factors that influence adolescent girls' aspirations. Our study is situated in Nepal, where persistent societal and gendered norms and underlying structural factors are known to restrict girls' capabilities in several life domains (Cunningham & D'Arcy, 2017; Janzen, Magnan, Sharma, & Thompson, 2017; Mathur, Malhotra, & Mehta, 2001; Sekine & Hodgkin, 2017), potentially influencing their aspirations. For instance, poverty, but also caste-ethnicity divides, run deep in Nepal, and girls from upper caste/ethnic groups and wealthier families tend to have higher aspirations than those who are socially excluded, or from less wealthier families, due to unequal availability of opportunities (Madjdian et al.,

under review). Moreover, events such as menarche, marriage, and parenthood, result in changing social roles and are accompanied by new expectations and societal norms, which can affect aspirations in other life domains. Becoming an adolescent girl or a wife/daughter-in-law, for example, often has consequences for their diets and health (Harris-Fry et al., 2018; Madjdian & Bras, 2016).

The remainder of this paper first conceptualizes aspirations within the life course perspective, after which we describe our methods and findings. In the last section we discuss findings and provide directions for programs, policies and research.

Conceptualizing aspirations within the life course perspective

Since aspirations are shaped within an everyday-life context and unfold as girls progress through adolescence (Hart, 2016), the life course perspective offers a useful lens to study aspirations. Whilst the life course itself is defined as a "sequence of socially-defined events and roles that an individual enacts over time" (Giele & Elder, 1998, p. 22), we position adolescence on a developmental continuum, acknowledging its dynamic nature, rather than treating it as one distinct life stage (Green, 2017). In this section, the four main themes of the life course perspective are described in relation to adolescents' aspirations: the interplay of human lives and historical time, timing of lives, linked lives, and human agency (Elder, 1998).

First, life trajectories and aspirations related to school, work, family formation (marriage, having children), health and food are all interrelated and embedded within time and geographical place (Elder, 1998; Naafs & Skelton, 2018). For instance, one's access to health or the food security status in a region, opportunities for higher education and in the labor market, or societal changes may increase opportunities or restrictions to develop adolescents' aspirations, over time.

Second, aspirations are determined by early influences in childhood and continue to develop throughout adolescence, also referred to as timing of lives (Elder, 1998). Adolescence is characterized by biological, psychological and social transitions, and the sequence of certain events at certain ages, such as leaving school or marriage, often leads to a change in social roles across time, culture, and place. Aspirations, in turn, may shift, as one's own expectations or external constraints are changing during adolescence (Green, 2017; Nurmi, 1991).

Third, human lives are connected through social relations, networks, and with the wider world, also referred to as linked or interdependent lives (Elder, 1998). During adolescence, parents, families and friends become particularly important and mutually influence each other (Green, 2017). Relationships influence aspirations and behavior through expectations, support, control, or being a role model. For instance, there is strong evidence that parental expectations or aspirations for children are related to their children's,

particularly educational aspirations (Kirk, Lewis-Moss, Nilsen, & Colvin, 2011). The idea of linked lives resembles well with Ray's (2006) theory on the aspirations window which implies that an adolescent girl may draw her aspirations from the lives of individuals in her everyday life. In this sense, role models may be particularly important which is for instance shown by an experimental study by Beaman and colleagues (2012) in India, in which girls' occupational aspirations were raised upon seeing a village led by a female. Moreover, several studies have reported the positive influence of peers on one's educational aspirations (Davies & Kandel, 1981; Habraken, 2018) and dietary choices (Sapkota, 2017).

Finally, individuals shape their own lives through human agency: the "choices and actions they take within the opportunities and constraints of history and social circumstance" (Elder 2007, p. 182). The extent to which an adolescent girl can exert agency, the ability to develop and act upon ideas of what she would like to achieve (Markus & Nurius, 1986), is however not just based on her current wishes, but also relates to her past, social relations and structural factors. In line with the notion of human agency is Appadurai's (2004) "capacity to aspire." He argues that aspirations always form in "interaction and in the thick of social life" and that the capacity to aspire is dependent on social, cultural and economic experiences. While aspirations can be high, external factors such as poverty, but also 'social locations' such as caste/ethnicity, may affect aspirations (Gottfredson, 1981; Nurmi, 1987).

Materials and methods

Setting and sampling

This qualitative study was conducted among a subsample of the ongoing *Suaahara II* Adolescent Panel (n=1093) sample in Nepal. In two purposively selected neighboring districts in the Western region of Nepal – Nawalpur in the lowland plains (*Terai*) and Parasi in the hills - one panel survey cluster (community) in each district was purposively selected due to diversity in ethnic/caste group and ages of the adolescent girls in the panel. Among the 24 girls from these communities in the panel survey, 20 were randomly selected for inclusion in the qualitative sample. These districts were selected as over half of Nepal's population lives in the *Terai*; a region that is characterized by relatively high early marriage rates particularly in areas bordering India, secondary school dropout, food insecurity and undernutrition (Marphatia et al., 2020; MoH, New ERA, & ICF, 2017). Among the 20 selected girls, three did not participate due to a recent move to another district or (parental) refusal.

Data collection

Data collection took place during monsoon (June-July 2018). Interviews were led by a trained Nepali female interviewer. Training involved (back)translating interview guides,

extensive practice and pilot-testing with girls in the Kathmandu Valley and in Chitwan, an area adjacent to the study sites, after which final changes were made to the flow of the interview guide and practical use of elicitation methods. Interviews were held in girls' homes. Although all girls understood Nepali, in a few cases a translator assisted to ask questions in the girls' mother tongue (*Bhojpuri*, *Awadhi, Urdu,* or a blend). We used visual elicitation techniques including creating social network maps with peg dolls and drawing timelines. These methods are proven suitable for adolescents, especially for younger ones, and acknowledge adolescents as tellers of their own stories whilst decreasing hierarchical distance between interviewer and participant (Mannay, 2015; Thomson, 2009). Interview topics included who girls perceived to be important persons (network maps), life histories and aspired future lives (timelines), with a specific focus on aspirations related to school, work, family life, health, and food. Interviews were audio-recorded, and photos were taken of the creative outputs.

Ethical considerations

Written informed (parental, if younger than 16) consent/assent were obtained prior to the interviews and the study was clearly explained to girls, parents/caretakers and local officials by the researchers and local *Suaahara II* staff. Ethical approval for this study was obtained from the Nepal Health Research Council (No. t97/ZO1B).

Data management and analysis

After each interview, summaries were written and combined with researcher notes, which were discussed within the research team on location. Recordings were transcribed verbatim into Nepali script and then translated into English by a team of three translators. English transcripts were de-identified and checked for accuracy against Nepali transcripts, or audio-recordings in case of unclarity, by one independent translator. To ensure anonymity, pseudonyms were created.

Theoretical thematic analysis, driven by the research questions (i.e., exploring adolescent girls' aspirations for their own lives and how aspirations are shaped within an everyday life context) and life course theory, guided data analysis. Thematic analysis enables understanding of how girls make meaning of their own lives and aspirations, as well as the role of context and others in shaping these. Two researchers (DM and NS) present during data collection, read all interview transcripts and summaries, to become familiar with the data. DM and NS separately coded nine transcripts initially. Initial codes and notes were reviewed, after which codes were sorted into sub- and main themes. Next, DM and NS carefully compared the initial codes and (sub)themes and discussed deviant codes until agreement. A coding scheme was developed based on which the remaining eight interviews

were coded (DM). A few new codes emerged, and any unclear passages were discussed. This led to a revised final coding scheme, clustered into subthemes and five main themes which included: aspirations; feelings; perceived influence of others; gender norms; and structural barriers in relation to aspirations. During analysis, unique differences in aspirations and influences on aspirations between three group of girls emerged, namely younger unmarried girls, older unmarried girls, and married girls. Therefore, in a final step of analysis, we compared and reviewed the collated stories of the three groups against the (sub)themes.

Results

This section starts with an overview of the participant characteristics including the three groups of girls who shared similar stories and aspirations (see Table 5.1). Findings are then described for these three groups, structured by the five main themes.

Participant characteristics

The three groups were: unmarried, school-going girls, 11 to 14 years old (younger girls); unmarried and school-going girls, 15 and 16 years old (older girls); and married mothers 17 to 19 years old (young women). Although these mothers were sampled as adolescents, they did not identify as adolescents, but rather as young women. Except for one, these young women all lived in joint families. One of the woman's husbands was abroad. Half of the women had eloped (love marriage) and the others had an arranged marriage.

Aspirations at different life stages

When asking participants about their biggest dreams, all younger and older girls referred to a future job: becoming a doctor, nurse, or teacher. The younger girls were unable to explain, however, why they aspired for that specific job, nor what the job would entail. The older girls justified their aspirations:

> *"When my teacher would ask us what our "dreams" were, everyone would say they wanted to be a pilot, or an engineer or a doctor. But I would I say that I wanted to become a social worker ever since I was a kid. My teacher would ask me why. And I would tell her that there are many problems in our society such as discrimination based on gender, caste, religion, or economic status. These have been abolished to a certain extent, but we have not been able to get rid of them completely. I wish to get rid of them all because I think that every person's blood is red. I do not see the need to discriminate anyone for any reason." (Geetu, 16 years)*

Table 5.1. Participant characteristics

Pseudonym	Age	Urban/ rural	Religion	Caste/ ethnicity	Family type	School-status	Age at marriage	Children
Younger girls								
Amita	11	Rural	Hindu	Dalit	Joint	Yes	n/a	n/a
Arati	11	Rural	Islam	Muslim	Nuclear	Yes	n/a	n/a
Ansu	14	Rural	Hindu	Non-Dalit Terai	Joint	Yes	n/a	n/a
Devi	11	Urban	Hindu	Non-Dalit Terai	Nuclear	Yes	n/a	n/a
Padma	14	Urban	Hindu	Disadvantaged Janajati	Nuclear	Yes	n/a	n/a
Jamuna	13	Urban	Hindu	Brahmin/Chhetri	Joint	Yes	n/a	n/a
Older girls								
Reva	15	Rural	Hindu	Dalit	Joint	Yes	n/a	n/a
Daya	16	Rural	Islam	Muslim	Joint	Yes	n/a	n/a
Sharmila	15	Rural	Islam	Muslim	Joint	Yes	n/a	n/a
Geetu	16	Urban	Hindu	Dalit	Nuclear	Yes	n/a	n/a
Young women								
Riyana	18/19	Rural	Hindu	Non-Dalit Terai	Joint	No	17/18	1
Nisu	18/19	Rural	Hindu	Non-Dalit Terai	Joint	No	17/18	1
Isha	19*	Rural	Islam	Muslim	Joint	Never	12/13	1 (& pregnant)
Sarita	18	Urban	Hindu	Dalit	Nuclear	No		1
Susma	17	Urban	Hindu	Dalit	Joint	No	15	1
Lata	19	Urban	Hindu	Disadvantaged Janajati	Joint	No	15	2
Ganesa	18	Urban	Hindu	Disadvantaged janajati	Joint	No	16	1

**According to her timeline drawing, this participant may have been 16 years old.*

Most young women had difficulties talking about aspirations for themselves, and often related this to school dropout and marriage:

> *"My dream for the future? I don't think about it that way. It would have been better if I had studied more. I have a child now. I have to take her here and there. That's all for now. I don't dream of anything anymore. I can't think of anything, I just don't know what to dream of" (Susma, 17 years)*

Young women mostly referred to earlier aspirations they held, defined here as 'lost aspirations', because they felt they had failed to realize those and now transferred educational aspirations onto children, or sometimes younger siblings:

> *"I want to educate my child and make her independent. To do some job. I want to educate her and make her a better person, by making her independent. I want her to go abroad and work". (Sarita, 18 years).*

More intrinsic aspirations such as leading a happy life and becoming financially less dependent on others were commonly mentioned. Most young women wished to earn money, willing to take on any available work, such as tailoring, or working in people's fields to contribute to become more independent or generate an income to support their families:

> *"If my husband does not give me any money, I might or might not have money of my own. When my children have grown up, they might do whatever they want. If I had my own money, I would be able to do things." (Isha, 16 years).*

Another common aspiration was for husbands to migrate, to Gulf countries, or India, as it was perceived as a way out of poverty. One of the young women wished to migrate herself to support her family if her husband refused to migrate.

Education was perceived as an important goal by both younger and older girls. While younger girls wished to just study and were generally not thinking about their futures much, older girls clearly expressed their wish to stay in school and continue their education for as long as possible.

Marriage and having children did not automatically appear on younger and older girls' timelines. Most younger girls had not thought about marriage and had difficulties talking about this. None of the younger girls had thought about having children and further probing on this topic only resulted in long silences. In contrast to the younger girls, some older girls had thought about marriage although this topic still seemed to be difficult. Two mentioned a specific age (20 and 26 years), but the other two girls did not want to think (or talk) about marriage:

> *"I have not thought about marriage so far. I may think about it later. I have not even had a boyfriend yet! [Laughing] Other people are interested in these kinds of things, but I am not like that." (Geetu, 16 years)*

All except one of the older girls had thought about having children. Views of having a maximum of two children after marriage, were mainly linked to health:

> *"We have to be strong to give birth to a child, right? We must be perfect. After delivering the child, our child will also be fine. We will be healthy as well. I think I will give birth at the age of 27 or 28 because by the age of 50 years old our menstruation also stops and that's why I think this age is suitable". (Geetu, 16 years)*

The young women with one child expressed their wish for another child, especially when they had no son yet. However, waiting for their first-borns to 'stand on their own two feet'

(meant: going to school) before giving birth to another child, was highly preferred. One of the women who had two children and another who was pregnant with her second child, did not wish for more than two children as they believed it would be financially challenging for them and their families to care for more children.

Participants' timeline drawings did not include aspirations related to health or food, although such aspirations were voiced in relation to the other aspirations. However, when specifically asking about health aspirations, all girls consistently mentioned being clean, free from disease, able to work or help others, and having a balanced body (meant: "not too thin, not too heavy"). However, unlike the youngest girls, older girls and young women were better able to explicitly express their health aspirations. This was especially true for those who felt unhealthy. Moreover, older girls seemed more aware of their body shape, and some of them worried about being too thin and wished to gain more weight. Young women would often express their health aspirations in relation to health worries:

> *"No matter how much I eat, I seem to never be able to get fat. Seems like I have some disease! (Susma, 17 years).*

Interestingly, older girls perceived health as a prerequisite to reach goals by linking these to certain life outcomes. For instance, one girl drew an accident on her timeline, which caused her a hand injury, due to which she believed she would never be able to do the job she wished for. In addition to physical health, being free from 'tension' (stress) was mentioned by some older girls as essential for studying well and work*:*

> *"A healthy mind means making our mind focus on one thing at a time…(having) such thoughts in our minds make us feel free". (Daya, 16 years).*

Like health, dietary aspirations were not mentioned on the timelines until prompted in which most participants noted that a healthy diet was fundamental for a healthy future. Older girls were more aware than the younger girls of the nutritional benefits of certain foods. Traditional home-made foods such as *dal bhat tarkari* (rice with pulses and vegetables), preferably inclusive of animal-source foods such as meat, dairy, or eggs, were mentioned by all girls as part of dietary aspirations. Moreover, all girls, but particularly the younger and older girls, aspired to eat sour and spicy food, which were mainly linked to foods purchase outside the home. For the younger girls, foods from out of the home, such as *chat pat* (puffed rice with spices), *chow mein* (noodles), or *samosas* (fried stuffed pastry), *chow chow* (instant noodles), chocolate, ice cream and juice boxes, were preferred mostly because of their tastiness. Older girls also preferred such foods, but wished to balance it with homemade, healthier foods:

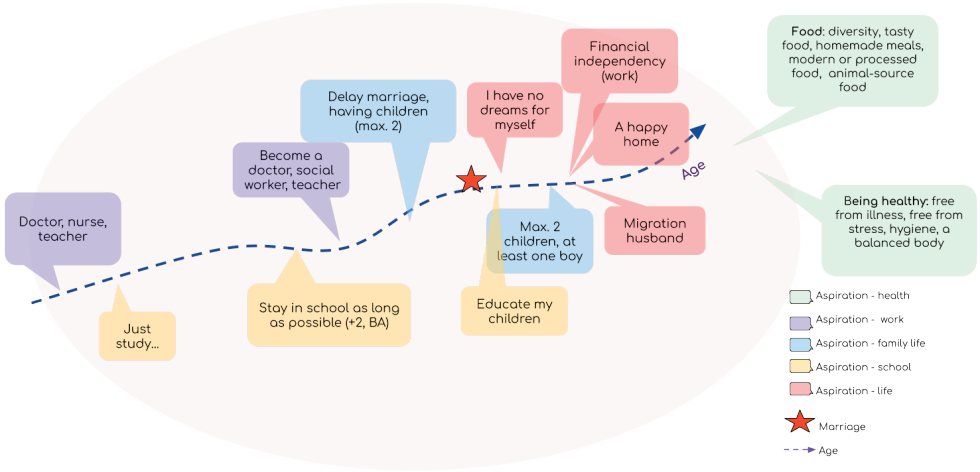

Figure 5.1. Aspirations Roadmap

> *"Well, if we eat the same food too much, it starts to lose its taste. Even sugar will then taste bitter if we eat too much of it" [...] "The foods that are prepared at home are good for us such as fruits, fish and meat, milk and green vegetables. But I think that we should also eat food outside of our home. (Geetu, 16 years)*

In comparison to the older girls, young women seemed even more concerned about eating nutritious foods, a gateway to keeping herself and her children healthy. Having a diversified, but primarily traditional diet, consisting of animal-source foods (e.g., meat and eggs) and vegetables was aspired the most. Although at times, young women were able to get (junk) food from outside their homes, most did not explicitly aspire for those foods as they were not perceived as beneficial to their health.

Figure 5.1 provides an aspirations roadmap in which different colors indicate aspirations in different domains and showcases how girls' aspirations shift upon growing older.

Feelings about aspirations

The youngest girls often expressed their determination and hopefulness. They felt able to realize or achieve their dreams, particularly those related to work, by studying hard, and focusing on school and homework. They did not necessarily keep their aspirations hidden from others and would for instance express their dietary aspirations with older family members: "*Sometimes I ask them (grandparents) to make chapattis and vegetables and at times I ask them not to make these foods over and over again [sighs]" Jamuna, aged 14*), or told their parents about their job aspirations. Younger girls felt confident they would be able to reach their goal, despite not being certain about how they could realize this: "*Yes, I will become a nurse, but I do not know what it takes to be a nurse" (Ansu, 14 years).*

Older girls' stories, however, were characterized by feelings of being trapped between their own aspirations and reality. They adjusted their job-related aspirations, according to what was perceived to be more realistic. Additionally, lack of knowledge on how to realize these aspirations, for instance what educational trajectory would lead to becoming a doctor or teacher, was commonly mentioned as a barrier to achieving one's aspirations. Older girls showed mixed feelings about whether they would be able to reach their goals as they started noticing barriers. Whilst some were hopeful, others lost confidence and seemed discouraged. A belief that their own determination would be important for achieving goals related to work, school, and health, was often mentioned: *"Well, money is not everything. I need to be able to raise my voice and act with courage as well, so that my words will be my weapon." (Geetu, 16 years)*

Because of perceived barriers, older girls commonly mentioned adjusting aspirations downwards. They often referred to childhood aspirations, but other options, perceived as more realistic, were mentioned as well. One girl mentioned her biggest wish was to become a doctor; as the interview continued, she started to talk about her 'back up' plan:

> *"Now, when I look at the problems in my house, I think I'd also like to become a teacher. When we complete our studies, I want to become a teacher. Half of the girls here are like my elder sisters. I want to become a Nepali teaching teacher" (Daya, 16 years)*

Older girls mentioned more short-term goals, often related to learning a skill, such as tailoring. Feelings about incompatibility of aspirations, or clashes between aspirations and expectations were common. Looming marriage was seen as a major barrier to school-related aspirations, even though some girls had hope they would be able to continue education after marriage. Loss of self-confidence also seemed to affect older girls' school aspirations. The fear of failing in school was mentioned by some, and especially the idea that leaving school equaled marriage, frightened some:

> *"I have never failed so far, but now I am scared that I might fail. I think that if I fail now, then I can't study further and that scares me" [...] "Like in our Muslim community, if I sit at home without doing anything then people start ask us about why I am not yet married" (Daya, 16 years)*

Young women commonly expressed hopelessness or resignation in relation to aspirations, which was often related to their perception of an unpredictable future and their dependence on husbands and in-laws:

> *"I am not hopeful about anything. Only when your husband earns, you can hope that you can buy this, and you can do that. If your husband is not at home, there's no hope" (Isha, 16 years).*

Aside from having difficulties expressing their own aspirations during the interviews, women noted that they did not often talk about their aspirations. The exception, to some extent, was discussions with husbands about dietary- and family-life related (e.g., contraceptive use) aspirations even though they believed he had the final say.

A sense of hopelessness was often related to feelings of disappointment, regret, or sadness of not realizing earlier aspirations. Lost aspirations included studying more, getting married later or not having eloped, and delaying childbirth. These life events, even though women had limited influences on decisions that had led to these events, and consequently their present lives, had not only forced women to give up on earlier aspirations, but also stopped them from thinking about other aspirations: *"What should I tell you? I just wish that I had married at the age of 24, 25, but nothing did go according to our wishes!" (Sarita, 18 years).* Marriage was seen as incompatible with studying and having children as holding women back from working:

> *"If I had studied, I would have gotten a job, but now I don't think I could get any job. That's why I have not even thought about this" (Nisu, 19 years).*

Others' influences on aspirations

Younger girls' network maps showed that parents were the most important persons in their lives, followed by friends, siblings, and teachers. Younger girls felt parents supported their studies and work aspirations. Fathers, specifically, were perceived as most important for realizing dreams. They motivated girls to do well at school and were a source of inspiration telling them about the world outside of their village. Parental expectations in this life phase were mainly focused on education and some household responsibilities. Younger girls expressed a feeling of dependency on their fathers in relation to their school and work-related aspirations as they were the main ones responsible for financing their education, which was also stressed by their mothers:

> *"My mother tells me that my father has gone abroad to earn money for us...So ... I must do well and become a nurse. This is why I think he is important to me." (Devi, 11 years)*

Parents, through owning decision-making power, were important for realizing aspirations:

> *"I asked her (mother) how much education she was going to give me. She said that she cannot give me more schooling after class 12, so..." (Arati, 11 years).*

Younger girls felt restricted, mainly by female elders, to eat desired foods, including snack food available outside of the house. Although some received pocket money from parents or caretakers, to buy food at school, most of these girls were told to avoid food from outside their homes, including snack foods and sour and sweet foods. Eating such foods, was associated with excessive bleeding during menstruation, disease-risks, or food safety concerns:

> *"We should not eat too much chatpat or mother will scold me. […] I am told not to eat foods from outside, because I might catch a cold. The foods near the roads are unhealthy as they might come in contact with smoke and dust. So, I am told not to eat those" (Jamuna, 14 years)*

Only one girl was not allowed to eat certain foods her brothers ate, including Horlicks (relatively expensive fortified milk drink), meat and milk. She also had to prepare her meals separately, leaving out *dal*, and save her school-provided meals for her younger siblings.
Peers and older girls/women from the village were important for younger girls' work-related aspirations. Friends would hold similar occupational aspirations (e.g., becoming a nurse), while some older girls and young women in the village served as role models. Peers were also important to dietary aspirations: younger girls commonly expressed aspiring to eat the same foods friends ate, outside of home and during school time:

> *"[Outside], I eat noodles, chatpat and so on. Chow mein. We have to go outside, to a shop. I go with my friends. My friends pay for my snacks [...]. We can get noodles, chow mein and samosas as well. We, friends, we always eat chatpat together" (Devi, 11 years)*

Older girls' network maps still pointed out the highly important role of fathers, especially in relation to realizing school- and job-related dreams:

> *"Like, my mother takes care of everything at home, right? But my father supports us financially. So, we rely on him. He fulfills our dreams, so we should always keep him near us". (Daya, 16 years).*

Older girls also mentioned receiving advice from elders (family or community) in relation to all life domains, ranging from how to behave at school, to food beliefs and health advice:

> *"My mother does not allow me to eat bananas, papayas and other fruit when I am menstruating because she says that it is a sin to eat those fruits during menstruation as they are supposed to be offered to the Gods [...] I do not think that it makes sense because*

it is not like that the fruits that I am eating will be offered to the Gods. I think what is important is that we should have a big heart. Only worshipping the Gods will never help you. It's better we give those foods to the poor people who do not have anything to eat. […] So, I eat it anyway. I used to think that it was true when I was a kid. But now, I understand everything". (Geetu, 16 years)

Like the younger girls' stories, fathers, often via mothers, had a major influence on older girls' school trajectories:

"I had to start going to a government school because she (mother) thought I was not able to study. Also, all the girls from the village study there" (Reva, 15 years).

In general, older girls felt that having supportive parents who showed confidence and trust in them to do well, at school, or life in general, was essential for them moving forward. Older siblings or sisters-in-law (if any) motivated them to pursue their dreams.

"When we were small, my sister used to tell me about the things I should do, and she would also tell me to study. My sister has not studied that much, that's why she wants me to study hard and be someone I wish to be. I have a middle big sister (in-law) as well, who has studied up to class 8. She failed in class 8 and left school forever." […] "He (brother) is the eldest person in our house. He has been taking care of us since my childhood. He tells me to study well. He also teaches us. My family wants me to become a doctor, they have dreamt about this. It's my dream as well, but because of our weak financial status, let's see how much I can study. He (brother) always tells me that he will earn money and send me to school so that I can become a doctor. 'you just study, don't worry about anything else'". (Daya, 16 years)

In joint families, the role of sisters-in-law of taking on household workload or mediating for older girls to take part in outside activities, became particularly important during this stage, where staying in school seemed to become one of older girls' priorities:

"We used to work here before she got married to my elder brother. There was another sister here before, she used to work here, but when my elder sister(in-law) came here, we didn't have to work at all. We faced many difficulties while studying. Now she works here, and helps others in our house so we get some free time to study and play" (Geetu, 16 years)

Older girls mentioned teachers, mostly, as a source of inspiration, motivation, and knowledge. Teachers knew how to reach goals, mainly related to school, work, food, and health:

> *"She (teacher) is like a mother to me, for teaching me and helping me grow. She always told me that we should be good. She used to joke about how we would have a hard time if we would ever become a teacher, because of students like us [laughs]. She wanted us to become successful in life, she helped us dream big". (Geetu, 16 years).*

For older girls, peers became even more important. Although older girls felt more restricted than younger girls to go out with friends, they referred to a feeling of freedom and being able to share their worries about their futures with others when doing so. Peers had moreover a positive influence on health and school-related aspirations. They made each other aware of healthy practices, such as maintaining hygiene, not getting involved in risky behaviors, and encouraging each other to study despite difficulties.

Older girls referred to restrictions and community pressure to adhere to certain norms as negatively influencing their aspirations. Parents would often express to older girls their concerns and warned them about going the wrong track or going astray 'like other girls', referring to those who quit school, eloped with boys, got pregnant, or misused substances. Pressure from family or communities for older girls to get married, was mentioned as an important barrier to have a non-arranged (love) marriage or at the age they wished. Girls also noted that upon marriage, their educational aspirations would be in the hands of their (future) in-laws and husbands: "*If I find a nice home after marriage, and if my husband tells me to continue school, only then I will continue studying" (Daya, 16 years).* Another barrier to aspirations was being talked down by others, for instance through discouraging girls to move forward, gossiping, or showing envy. As a result, particularly the older girls felt less confident or insecure about their capabilities.

Young women's network maps showed their husbands as the most (and sometimes only) important persons in their lives, followed by sisters- and brothers-in-law (if any), parents, and friends. Parents-in-law were mentioned by those living in joint families, but while two of them mentioned their mother-in-law took care of them like their own mothers, the other four women did not get along well with their mothers-in-law. Some women were able to share their sorrow and happiness with husbands and referred to them as the most supportive one in their lives. All felt dependent on their husbands. Husbands and parents-in-law were involved in most decisions related to health, work, family planning and food. Consequently, despite their own health worries, women felt forced by others to have a child soon after getting married, and, in order to avoid community gossiping, they felt they needed to prove they were able to conceive, as illustrated by an extreme case:

> *"My menstruation cycle was not good which is why I was not able to have a child. It used to cause me stomach pain and I got medicines for it. Then I got pregnant with this child. His mother told him about my situation and that he should get me checked up to see whether I could have a child. My husband's mother used to quarrel with me thinking I was not able to have a child. That I was barren. […] Now, she started saying that there is no reason for us to quarrel anymore. That there will be her grandson to take care of her in the future, she says I might not be her own blood, but her grandson is." (Isha, 16 years)*

Husbands, or in-laws when living in joint families, mostly decided what foods to eat and women had to ask husbands to bring home certain foods, such as meat. The only exception came from a woman living in a nuclear house, who felt in charge of what to eat. While some women felt their mothers-in-law were supportive of their dietary wishes, others were controlled heavily:

> *"I don't eat in front of them, even when I eat while hiding from them, they look at me through the window and check on me, what I am eating. That's why I sit on the bed and eat it there. If I don't have to eat, I cover it. They are very jealous" (Lata, 19 years).*

Most of the women who wished to work to support their families, had not talked about this with their families as they did not feel confident their in-laws or husbands would allow them to work:

> *"My husband tells me that he won't let me work as long as he's alive. He tells me that I should work in our own fields and that he will feed me with his earnings. I should not think about what to do, and how to do this, because I'm a wife" (Isha, 16 years).*

In relation to all aspirations, women mentioned female friends and relatives to be important. Food sharing with other women in times of need or scarcity was commonly mentioned, but also small financial help or loans from other women were mentioned as helpful to cover food- or health- related expenses, especially for their children.

Influence of gender norms

For the youngest girls, socio-cultural gender norms did not seem to be directly related to aspirations. However, these girls referred to a good *kishori* (adolescent girl) as behaving deferentially: being polite, living in harmony with others, taking care of younger siblings, and obeying elders. All girls were expected to do household work (e.g., cleaning, cooking) starting at age 8 or 9 and not to go outside too much:

> *"It would be best if she doesn't go to other houses even when they call her. She should stay home and practice knitting. They say that we should not go to other houses and, we should stay home." (Arati, 11 years)*

At the same time, young girls were expected to perform well at school. Household and school expectations sometimes clashed:

> *"I am worried about my school, my studies. [That] I won't be able to show my copies to the teachers at school who teach subjects on the day that I do not go [to school]. All my friends will be able to show their copies..., and, also, I won't be able to learn about the things they teach that day and miss out on homework. [...] I could not go to school today [because of working in fields] and can't show him my homework even though he specifically asked for it" (Arati, 11 years).*

While younger girls did not yet perceive such norms as a barrier to their aspirations, older girls perceived norms as restricting their aspirations. Respecting elders living in harmony with others, and even being subservient, were seen as important traditional values that resulted in having to ask for permission to study further or work and prevented speaking against elders' decisions:

> *"It is our tradition that my mother's brother decides for our marriage. In our Muslim community. After all, for example in our community, we can't get just married if we like each other. If someone does that, villagers and the community will betray us. They will talk badly about the girl, that she did this, and so on" (Daya, 16 years)*

Some of the older girls voiced their wish to work to save money for their own education or to support the household but were restricted from doing so as they were expected to commit to household work and not go outside. Being confined to home was associated with a feeling of being trapped and as a barrier:

> *"If I go visit new places with someone, then villagers tell my mother about this, behind my back. They then turn my mother against me. And then my mother would tell me there is nothing good about roaming around all the time and that I should study. If we (girls) had enough resources and power, we wouldn't have to fear anyone. We should also (be able to) visit places. But in this village, we can't go out visiting new places, places near to us. We are like a frog in a well in this village. That's how my village is" (Daya, 16 years)*

All girls, except for the young women, had negative associations with the word *kishorawastha* (adolescence), which started according to most interviewees upon the first menstruation. Being an adolescent girl was being associated with weakness, having a 'weaker heart' than boys and behaving bad, rebellious, or naughty:

> *"That word (adolescence) makes me angry, I feel the term is offensive, I don't like it. I think it's belittling, and it makes me angry. I get angry when someone calls me like that, people from my home and outsiders as well, they call me when they get angry with me. My father does not, my mother does. […] People think badly about it. They think that during adolescence they, boys and girls, are attracted to each other, people talk badly about them" (Sharmila, 15 years)*

Protecting both younger and older girls by telling them to avoid boys, was mostly related to parents' general fear that girls would elope with boys or engage in sexual behavior, disrespect elders, or get involved with bad friends. Ultimately, guarding girls' social reputation was associated with the idea that marriage is a girl's destiny. Making a mistake, would result in a girl's and therefore her family's broken reputation. This influenced girls' choices related to future aspirations such as their aspired age of marriage:

> *"My mother tells me to be careful not to be like others and go astray from the person I am supposed to be. She tells me that a girl is made like a pot made from mud which once broken is impossible to put together in one piece" (Geetu, 16 years).*

On the other hand, some older girls mentioned positive changes in traditional cultural practices related to their educational and marital aspirations. For instance, grandparents were referred to as having 'old-fashioned' views on keeping girls out of school or getting them married from about 12 years, whilst communities and parents have now had started to change their views and commonly suggest 20 years as the appropriate age of marriage from 12 years old to 20 years.

While younger girls had only started to learn about prevailing norms, and older girls were balancing between social norms, expectations and aspirations, young women had conformed to these norms and expectations. The young women living in joint families were mostly confined to their homes, while living in a nuclear unit resulted in a sense of freedom to move around which also led her to buy the food she wished for. Women furthermore referred to qualities of a good daughter-in- as being submissive and cooperative. They believed their duty was to share with, and help others, respect the household hierarchy, and to not show any form of greediness. This also included not talking about problems outside of the house which led women to self-silence or self-sacrifice for the family, for instance, through hiding their aspirations:

> *"We should not talk about household matters outside our homes. We should just take care of our husbands. We should not talk to other people about things happening here […] He (husband) tells me that I get jealous from seeing what other people have. He tells me he has been earning, but that we are just not able to save. He tells me I'm smart enough to know that I should not tell anyone about all those things, and that we will lose our respect if I do" (Isha, 16 years)*

Structural barriers to aspirations

Everyone mentioned a lack of money in relation to aspirations, although the extent to which it was a barrier, varied between the groups of girls. For the youngest girls, a lack of money was only related to buying junk food and school aspirations: *"Well, there could be a problem going to school if I lack school supplies" (Arati, 11 years).*

Older girls mentioned that their educational aspirations mostly depended on their household's financial status, or on that of their future husband's family. With education seen as the pathway to future jobs, girls also mentioned that they would have to move to bigger cities (e.g., Kathmandu) for further studies to become a doctor. Moreover, marital aspirations were negatively affected by persisting dowry practices, particularly in the Muslim community. Money was also seen as a means to afford nutritious food and fulfill dietary aspirations. For young women, having sufficient financial resources was a goal in itself to lead a happy life and feed their families:

> *"I am told to eat dal bhat, or rice and vegetables. It is not good to eat a lot of fish and meat. It means we must spend a lot of money. If there's money, I can eat meat with rice. If not, I should eat vegetables with rice. We have to spend a lot of money. If we had the money, we could have everything." (Isha, 16 years).*

Other structural forces mentioned, by mostly the older girls, in relation to aspirations were their village's geographical location and infrastructure. For instance, food availability and seasonality dictated what they were able to eat. Finally, for older girls, a lack of (quality) schooling opportunities in the area was mentioned as a barrier to educational and work aspirations.

Discussion

This paper aimed to provide a holistic understanding of adolescent girls' life aspirations, with a specific focus on school, work, family life, food, and health, as well as of how context and life experiences shape aspirations in Nepal. By framing aspirations within a life course

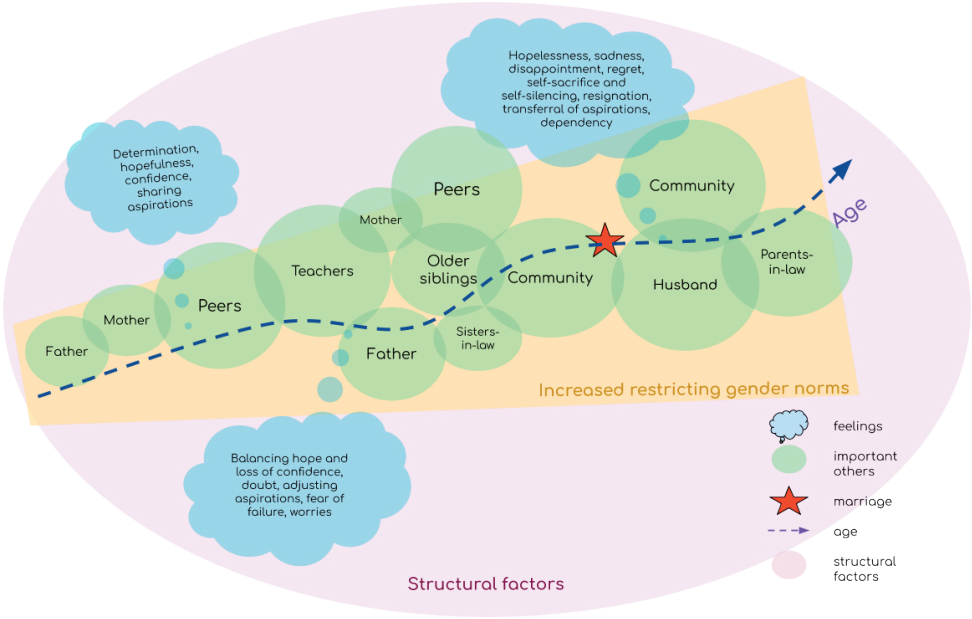

Figure 5.2. Roadmap of aspirations showing how feelings towards aspirations, important others', gender norms, and structural factors influence girls' aspirations

perspective and positioning adolescence on a developmental continuum, distinct narratives emerged between younger girls (11-15), older girls (15-17), and young women (married, 16-19). These narratives underscore the heterogeneity among adolescents. Findings advance previous studies, by going beyond socio-economic determinants of aspirations to show the influence of different factors and actors at different stages of adolescence. In Figure 5.2 a visual summary shows how girls' feelings (blue), important others (green), increasingly restrictive gender norms (yellow) and more structural factors such as financial status and geographical location (purple) influence girls aspirations throughout time, including the relative importance of these influences as indicated by size.

Younger girls had high levels of hope, optimism, and big dreams. These girls had mainly ambitious educational and occupational aspirations but were mostly focused on the present. Hence, thoughts about their future family life, underlying motivations for specific aspirations, and barriers to aspirations were largely absent from their narratives. Future-orientated thinking and seeing consequences of certain actions becomes stronger with age (Johnson, Blum, & Cheng, 2014; Nurmi, 1991). Older girls were balancing. They felt that their aspirations started to clash with reality, social expectations, and societal norms. Thus, they adjusted their aspirations, as has been documented by other studies in both low- and high-income contexts (Gutman & Akerman, 2008; Winter, 2016). Findings show

that staying and performing well in school was one of the most important aspirations of the older adolescent girls, not least because education prevents girls from marrying early (Marphatia et al., 2020). Young women voiced limited aspirations for themselves: they had resigned to their new lives upon marriage and shifted to aspiring for a better life for their families and children. Their stories were also filled with pessimism, sadness and shame about lost aspirations. The decrease in hopefulness and optimism over time is worrisome as pessimism, hopelessness and negative expectations towards the futures which have been associated with poorer mental health status (Johnson et al., 2014). Aspirations can be raised over time, but adjusting aspirations downwards may result in fatalism or 'aspirations failure' ultimately reinforcing inequalities including poverty (Dalton, Ghosal, & Mani, 2016).

Findings link to the four key elements of life course theory. First, adolescents' narratives underscore the interdependency of aspirations. Educational and occupational aspirations were related, and dietary aspirations were part of health aspirations. Interestingly, the latter two were often not talked about as part of life aspirations, but seen as fundamental for other life outcomes, or in relation to other aspirations, such as family formation, a finding that is in line with quantitative data on aspirations in Nepal (Madjdian et al., *under review*). Aspirations are embedded in time and place and influenced by structural factors, such as geographical location, higher education opportunities or food availability. For instance, living in areas with less infrastructure limited occupational and higher educational aspirations. Similarly, food environments limited dietary aspirations. Societal changes were mentioned as positively influencing educational and marital aspirations. Increased awareness on the importance of girls' education, or the detrimental effects of early or child marriage, have resulted in gender parity in primary school enrollment and a decrease in child marriage in Nepal (LeVine, 2019; MacQuarrie, Juan, & Fish, 2019). Despite progress, however, the combination of poverty, patriarchal norms, socio-cultural practices including dowry, and the social value of investing in girls and protecting their honor, is still deeply rooted in society and thereby influencing aspirations. In contrast to the large strand of literature on poverty and aspirations (Dercon & Krishnan, 2009; Mathur et al., 2001) and a previous study on the determinants of aspirations (Madjdian et al, *under review*), poverty did not emerge from their stories as the largest limiting factor for aspirations, except for in areas of further education and food.

Secondly, clear differences in aspirations between younger and older girls and younger women, highlight how life events (timing of lives) and related social transitions play an important role. While younger girls had not yet reached this stage, older girls had experienced events that led to a significant social transition and a change of aspirations. For instance, those who had health worries or who were involved in an accident, had explicit health aspirations. Young women regretted dropping out of school, marrying and having children early. Achieving financial independence and having a happy home was moreover stressed by young women, but taking care of children, combined with restrictive gender norms,

were barriers to working. Older, yet unmarried adolescent girls, kept high educational and occupational aspirations, and wished to delay marriage until achieving those aspirations. The expectation of marriage was seen as an event that would eventually force them to lower their aspirations in almost all life domains: in Nepal, marriage is interrelated with school dropout, and a handing over of decision-making power in several life domains to one's husband and in-laws (Sekine & Hodgkin, 2017).

Findings underscore the notion of linked lives in shaping aspirations. Our study advances the quite extensive evidence on the influence of others on one's aspirations by showing how different actors influence aspirations through different stages of adolescence. Younger girls had no difficulties expressing their aspirations but did not focus on others influencing or restricting those aspirations. Moreover, many younger girls drew their aspirations from those in their aspiration window (Ray, 2006), mostly peers or older girls (who served as role models) in the village. Despite parents being the most important persons in a younger girl's life, they did not perceive them as actively influencing most of their aspirations, other than expecting them to study and restricting them from eating certain foods, whereas older girls expressed the influence of others, including increased encouragement and motivation by older siblings, teachers, peers, and sisters-in-laws, but also discouragement by community members and restricting parental expectations. Young women's aspirations were dependent on husbands and parents-in-law, as they reported to have limited decision-making power which also resulted in them not expressing their feelings or aspirations.

Finally, increasingly restrictive gender norms affect human agency and aspirations. In Nepal's predominantly patriarchal society, gender norms and ideals surrounding being a good *kishori*, young woman, wife or daughter-in-law are reflected in restricted freedom or mobility outside homes, shyness, and limited decision-making power (Grossman-Thompson, 2016). Domestic seclusion and "social surveillance by parents and relative, and after she marries, by her in-laws and relatives" are meant to protect a girl's social honor, to prevent girls to elope with boys or engage in sexual activity (Grossman-Thompson, 2016, p. 43). Although younger girls were familiar with such norms and values, they did not directly seem to impact aspirations. Agency varied by age- or life-stage: younger girls felt they have less control over their futures than older girls and young women living with husbands and in-laws, may feel less in charge than unmarried girls. Older girls' aspirations were directly restricted by gender norms and the need to fulfill important values of putting family needs first, keeping harmony, and practicing selflessness. Resulting feelings of ambivalence, hiding, and not expressing aspirations, are in line with the construct of self-silencing or self-sacrifice. Women are expected to be subordinate, accept inequality in society and "pursuing one's own goal is superseded by a collectivist emphasis on family welfare and serving needs of family members" (Jack, Pokharel, & Subba, 2010, p. 147). Hence, silencing one's own needs and aspirations or sacrificing for others, such as for instance transferring educational aspirations onto children or putting aside one's fertility aspirations, are inherent to being a good woman.

Strengths and limitations

There are some potential limitations in this study that could be addressed in future research. First, our study was conducted in a specific region in Western-Nepal which makes findings less generalizable to other regions of Nepal. However, participants were randomly sampled and there was a high-response rate. Future research could study how aspirations differ across Nepal's diverse geographies. Second, in translation, from audio to Nepali script, and then to English, some data might have been lost. However, all translated interviews were carefully checked against the (*Nepali*) transcripts, and when unclear, discussed and checked against the audio recordings. Moreover, our participatory and creative approach to data collection allowed girls to be the tellers of their own stories, and thereby provided opportunities for the researcher to confirm or further deepen girls' responses while drawing and mapping, thereby decreasing risks of misinterpretation. Interviews were discussed right after and combined with notes into summaries which were used in the first step of data analysis. Also, because the researchers stayed near participants, any issues requiring clarification were easily resolved. Third, while findings show that aspirations differ by stage of adolescence, our data is based on girls' aspirations in one year, and we could thus not show how each individual's aspirations changed with time. By using timelines, however, we were able to discuss how past aspirations had changed, retrospectively. Future, longitudinal research could track the same girls over time and study how aspirations may change.

Implications

Aspirations are 'powerful engines of progress' by influencing behavior and choices and may facilitate a healthy transition into adulthood (Hart, 2016). Findings suggest opportunities for policies and programs to foster adolescent girls' aspirations at specific stages of adolescence and at several levels. First, allowing girls to talk about aspirations through for instance life skill programs, and creating community awareness on the importance of aspirations is a first step, but it is essential to involve others, from early adolescence onwards and throughout specific stages of adolescence. Findings underscore the importance of role models and their visibility in communities, but also how male members of the family, particularly fathers, brothers, or husbands influence aspirations. Future research on their perceptions and expectations towards adolescent girls' aspirations might further support such interventions. Teachers and schools have also an important role in motivating and teaching girls how to realize aspirations. Finally, structural changes, such as changes in socio-cultural and gendered norms, as well as creating opportunities for quality education, and for out of school and married girls, skill-training programs, are vital in order to sustain hopefulness, and grow girls' aspirations.

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Chapter 6

Nourishing Hope? Changes in malnutrition and changes in girls' aspirations - evidence from the *Suaahara II* Adolescent Girls Panel in Nepal

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This chapter is under review as:
Changes in malnutrition and changes in girls' aspirations - evidence from the Suaahara II Adolescent Girls Panel in Nepal

Abstract

Malnutrition is a pressing public health challenge in South-Asia with adverse consequences for adolescent girls' wellbeing and potentially their aspirations as drivers of developmental progress. This study aimed to investigate associations between changes in malnutrition and changes in girls' aspirations in key life domains. We analyzed two-period panel data from the *Suaahara II* Adolescent Girls Panel (10-19 years) in Nepal (2018-2019, n=613). Height, weight, blood samples, 24-hour dietary recalls, and indicators of girls' educational, occupational, marital, and fertility aspirations were collected. Height-for-age z-scores (HAZ), BMI-for-age z-scores (BAZ), hemoglobin concentration (Hb g/dL), and dietary diversity scores for women (DDS-W) were calculated. Through cluster-robust fixed-effects regressions, we examined whether changes in thinness (BAZ<-2 SD), anemia (Hb<115 g/L non-pregnant <11 years; Hb<120 g/L non-pregnant >12 years; Hb<110 g/L pregnant) and reaching minimum dietary diversity for women (MDD-W) were associated with changes in educational, marital, or fertility aspirations. A change from thinness to no thinness increased girls' aspired ages of having a first child by 2.77 years (SE 1.22, p=0.025). A change from anemia to no anemia increased girls' aspired years of education by 0.54 (SE 0.27, p=0.044). This association was stronger for post-menarche girls (b -0.62, SE 0.29, p=0.035). No associations were found between changes in MDD-W and any of the aspirations. Thinness and anemia were negatively associated with adolescent girls' aspirations in domains of fertility and education. Multisectoral integrated policies and programs that improve adolescent nutritional status and diets have the potential to foster adolescent girls' aspirations and thereby increase their future potential.

Introduction

Investing in adolescent health has the potential to generate a triple dividend for today's adolescents, their future, and the next generations through social, economic, and demographic benefits (Patton et al., 2016). Adolescence (ages 10-19) is characterized by rapid biological, physical, and psychosocial growth, and social status changes (Sawyer, Azzopardi, Wickremarathne, & Patton, 2018). During early adolescence (10-14 years) body mass increases, alongside physiological and behavioral changes, whilst late adolescence (15-19 years) is characterized by further growth and brain development. Due to increased nutritional requirements during the growth spurt and onset of puberty, adolescence is an important window of opportunity to maintain, reverse or recover from nutritional and growth deficits (Christian & Smith, 2018; Prentice et al., 2013).

Adolescent malnutrition persists as a public health challenge in low-income contexts like South Asia. Adolescent girls are particularly vulnerable, yet largely overlooked in nutrition programming. About one in ten is stunted, one in three is underweight, and more than half are anemic (Aguayo & Paintal, 2017). Adolescent malnutrition has been associated with, inter alia, adverse outcomes in cognition, human capital, schooling, earnings, and economic productivity (Madjdian, Azupogo, Osendarp, Bras, & Brouwer, 2018), but less with wellbeing and non-cognitive outcomes. Adolescence is also a pivotal time for the formation of aspirations. Aspirations, future-oriented desires for one's possible self, steer behavior and intentions and have been shown to be of vital importance for future outcomes and human potential (Hart, 2016). A lack of aspirations can lower investment in one's future-oriented behavior, or, when the gap between one's aspirations and current status becomes too wide, can foster a fatalistic attitude, that in turn serves to sustain or reinforce poverty (Dalton, Ghosal, & Mani, 2016).

Aspirations are dynamically influenced by a multitude of factors, such as one's self-efficacy, age, household wealth, geographic location, sociocultural context, and the influence of others (Hart, 2016). Only a few studies have specifically investigated associations between malnutrition and adolescent aspirations. These studies primarily focused on childhood height-for-age in relation to adolescent educational aspirations (Dercon & Sánchez, 2013; Pasquier-Doumer & Brandon, 2015). For instance, in India's Andhra Pradesh, a longitudinal study showed that childhood height-for-age scores at ages seven and eight were positively associated with adolescents' educational aspirations at age 11-12 years: every standard deviation increase in the height-for-age z-score increased educational aspirations by 5.1% (Dercon & Sánchez, 2013). In an experimental study involving iron supplementation to reduce anemia amongst school-going adolescents in Cajamarca, Peru, ages 11-19 years (n=219), iron supplementation resulted in a 16 per cent increase in adolescents' educational aspirations and perceived upward mobility (Chong, Cohen, Field, Nakasone, & Torero,

2016). In Australia, greater weight and specifically overweight was inversely associated with work-related aspirations, lack of marital aspirations and reproductive aspirations, and lower educational aspirations, amongst young women between 18-23 years of age (n=7815) (Ball, Crawford, & Kenardy, 2004).

While current research is mostly focused on socio-economic or psychological influences on aspirations, studies from low-income contexts also imply a causal effect of malnutrition on aspirations. However, without longitudinal data on aspirations as well as nutritional and dietary indicators, this remains unknown. To the best of our knowledge, there has been no research in a low-income context investigating associations between adolescent malnutrition over time and aspirations in multiple key life domains including education, occupation, and family formation. This paper therefore aims to investigate the associations and changes over a one-year period, between adolescent girls' nutritional and dietary diversity indicators and their aspirations in the domains of education, occupation, marriage, and fertility.

Methods

Data source and participants

We used data from the Adolescent Girls Panel, collected under *Suaahara II*, an USAID-funded integrated nutrition program in Nepal. The surveyed areas represent 42 program districts of Nepal's 77 districts. In 2017, multi-stage cluster sampling was used for the *Suaahara II* monitoring survey, in which 1093 adolescent girls and mothers participated. Since 2017, these adolescent girls have been followed on an annual basis (except for 2020 due to the COVID-19 pandemic). For a detailed overview of the sampling methods, we refer to Cunningham and colleagues (2020). For this study, we used the 2018 and 2019 panel data. In both periods, adolescent girls' aspirations in several life domains, 24-hour dietary recall data, anthropometry (height and weight), and hemoglobin levels were measured, in addition to a range of demographic and socio-economic factors. Surveys were conducted by trained female enumerators and standardized anthropometrists, using pilot-tested, (back) translated questionnaires programmed on mobile phones. Prior informed consent was obtained, as well as parental assent for girls under 16 years of age. Ethical approval was obtained from the Nepal Health Research Council (No. t97/ZO1B).

In 2018 and 2019, 975 and 958 respectively of the initial 1093 girls participated in the survey, representing attrition rates of 10.8% and 12.4% respectively. For analyses, we only included girls who participated in both years, and who were still classified as an adolescent in 2019 according to the World Health Organization (WHO) definition, thus aged between 10 and 20 years (228 months) (n=675). We further restricted our analyses to observations with complete data on nutritional indicators and data relevant to each type

of aspiration: only school-going girls for educational aspirations (n=559 in 2018, n=531 in 2019); occupational aspirations (n=613 in both years); only unmarried girls for marital aspirations (n=534 in 2018, n=526); and only those without children for fertility aspirations (n=324 in 2018, n=364 in 2019).

Measures

Aspirations

Aspiration indicators were adapted from other tools and studies (DHS Program, 2015; Johnston, 2008; Kasser & Ryan, 1996). Educational aspirations were measured by asking school-going girls to report their future aspired level of education, which was then converted into aspired years of education. "I don't know" answers were converted into current year of schooling (n=13 in 2018, n=15 in 2019). Occupational aspirations were measured by girls' reporting of their aspired future jobs, and then classified based on skill level (1-4) required, according to the Nepal Standard Classification of Occupation (CBS, 2001). A binary variable was created for no/low-skill (0-2) versus a higher-skilled job (3 or 4). "I don't know" answers were classified as (0-2), assuming low aspirations (n=37 in 2018, n=11 in 2019). Marital aspirations were measured by aspired year of marriage, and of unmarried girls only. We used age in years as a continuous outcome and excluded all "I don't know" responses (n=48 in 2019, n=26 in 2019). Fertility aspirations were measured by girls' aspired age of having a first child, only amongst girls without children. "I don't know" or "don't want" responses were excluded from the analyses (n=318 in 2018, n=253 in 2019).

Nutritional and dietary diversity indicators

Height was measured using a standard Shorr board. Weight was measured with an electronic on-site calibrated SECA digital scale. Both measurements were taken twice, and an average was used to increase precision. Height and weight measurements were converted into height-for-age (HAZ) and Body-Mass-Index-for-age z-scores (BAZ) using WHO AnthroPlus software. Next, HAZ and BAZ were dichotomized based on the 2007 WHO Growth Standard cut-off values, into stunting (HAZ< -2SD=1) or thin (BAZ< -2SD=1) (de Onis et al., 2007). Hemoglobin concentration (Hb) was measured using the HemoCue® Hb-301 photometer and corrected for altitude, measured using GPS (Garmin eTrex 30x). A binary variable was created to indicate anemia, based on the WHO anemia cut-off values: non-pregnant girls up to 11 years (Hb<115 g/L); non-pregnant girls 12 years and older (Hb<120 g/L); or pregnant girls (Hb<110 g/L) (WHO, 2011). The Dietary Diversity Score for Women (DDS-W) was calculated based on an open-ended 24-hour dietary recall (FAO & FHI360., 2016). Consumed food items were grouped into ten groups to calculate DDS-W: grains, white roots and tubers, and plantains; pulses (beans and lentils); nuts and seeds; dairy; meat, poultry, and fish; eggs; dark-green leafy vegetables; vitamin-A-rich fruits

and vegetables; other vegetables; other fruits. A binary variable was then created to denote whether girls obtained Minimum Dietary Diversity (for Women, MDD-W), defined as having consumed foods from at least five out of the ten food groups (FAO & FHI360, 2016).

Control factors

Potentially confounding factors were also included, such as adolescent girls' age (in completed years), marital status for occupational aspirations (0/1), school enrolment (0/1, not for educational aspirations), and her highest educational level reached (in years). Individual self-efficacy scores (0-40) were included, measured with the eight-item New General Self-Efficacy Scale (Chen, Gully, & Eden, 2001). This scale was reliable for both periods (α=0.81, α=0.80 resp.). Relative household wealth, categorized in five wealth quintiles (highest through lowest) (DHS Equity Tool, 2016), was calculated using the sum of a household's owned goods (television, cupboards, tables, fans), cooking energy source, and the quality of roof, floor, and wall materials. Household size (number of members), caste/ethnicity (*Brahmin/Chhetri*, socially-excluded, and others), agro-ecological zone of residence (lowland plains [*Terai*], hills, mountains), and the household head's education (in completed years) were also included. Menarche status (whether a girl has started menstruating=1) was included as an indicator of pubertal stage.

Data analysis

Statistical analyses were conducted with Stata SE v.15. Descriptive analyses were first conducted to describe the following: sample means, standard deviations (SD), socio-demographic factors, and proportions for all nutritional and dietary diversity indicators and aspirations, with differences over time, tested using paired-t and McNemar's tests for nutritional, dietary diversity, and aspiration indicators (see Table 6.1). Preliminary analyses (presented as supplementary Table S6.1 and Table S6.2) assessed cross-sectional associations between HAZ, BAZ, Hb, and DDS-W, and aspirations. Two-stage hierarchical binary logistic regressions for occupational aspirations were reported as adjusted odds ratios (aOR), and linear regressions for educational, marriage, and fertility aspirations were reported by unstandardized (*b*) and standardized () betas, for both periods separately. Adjusted R^2 scores were compared to see whether the addition of nutritional indicators contributed to improved models. All assumptions, including those of multicollinearity, were met.

The main analyses presented in this paper – associations between changes in malnutrition and changes in aspirations - include cluster-robust, two-period, fixed-effects, linear regressions, under the assumption that our nutritional predictors of interest and aspirations showed some variation over time (Allison, 2009). We excluded stunting as an indicator, since catch-up growth is less likely over the course of one year (Campisi, Carducci, Söder,

& Bhutta, 2018). Moreover, preliminary analyses showed minimal changes in occupational aspirations as an outcome. In our main models, we therefore only included the binary variables thinness, anemia, and MDD-W for the prediction of educational, marital, and fertility aspirations. Since the relationships among the predictors are complex, we conducted sensitivity analyses (available upon request) by estimating models with thinness, anemia, and MDD-W as individual predictors. Results in terms of significance levels and effect sizes were similar to the presented combined models. Standard errors were adjusted for clustering at the primary sampling unit. Statistical significance was considered at $p<0.05$, $p<0.01$, and $p<0.001$ levels. Pregnant girls were excluded from any analysis involving thinness (n=10 in 2019 only).

Results

Sample descriptives

Table 6.1 provides an overview of girls' aspirations, nutritional indicators, and socio-demographic covariates in 2018 and 2019. Girls' mean age was 13.8 years in 2018 and 14.8 years in 2019. Between the two years, the proportion of girls enrolled in school dropped from 91.2% to 86.6%, and mean years of schooling increased from 7.7 years to 8.5 years. The proportion of married girls increased to 10.3%, and five girls became mothers, increasing the percentage of mothers to 4.9% in 2019. In 2019, ten girls were pregnant, and the proportion of post-menarche girls increased from 60.4% to 78.0%. Half of the girls belonged to the upper ethnic/caste group, 39.2% belonged to the socially-excluded ethnic/caste group, and the remainder to other ethnic/caste groups. The majority of girls lived in the hills, 15.1% of girls lived in the mountains, and one-third in the *Terai*. Mean total self-efficacy score (0-40) increased from 30.72 to 31.49, and total household size dropped from 6.3 to 6.0.

Table 6.1. Sample description and differences between the two years

	2018		2019		Difference (2018-2019)	
	n	*Mean (SD) or % (n)*	*n*	*Mean (SD) or % (n)*	*n*	*Difference in mean or % (p-value)*
Aspirations (outcome)						
Aspired years of education	559	14.2 (2.79)	531	14.8 (2.53)	528	0.63 (<0.0001)
Aspired job: professional (vs. no/low-skilled)	613	75.7 (464)	613	71.6 (439)	613	4.07 (0.039)
Aspired age of first marriage	534	22.2 (2.28)	526	22.7 (2.52)	492	0.52 (<0.0001)
Aspired age of first child	324	24.3 (2.54)	364	24.9 (3.03)	231	0.52 (0.049)
Nutritional indicators (predictors)						
Height-for-age z-score (HAZ)	613	-1.45 (0.92)	613	-1.45 (0.86)	613	0.00 (0.68)
BMI-for-age z-score (BAZ)	613	-0.78 (0.99)	603	-0.70 (1.02)	603	0.08 (<0.0001)
Stunted (HAZ < -2SD)	613	27.90 (171)	613	26.75 (164)	613	1.15 (0.25)
Thin (BAZ < -2SD)	613	11.75 (72)	603	10.61 (64)	603	1.14 (0.16)
Adjusted hemoglobin concentration (g/dL)	613	12.61 (1.37)	613	12.65 (1.27)	613	0.04 (0.36)
Anemic	613	27.90 (171)	613	24.80 (152)	613	3.10 (0.11)
Dietary Diversity Score (range: 0-10)	613	4.2 (1.17)	613	4.4 (1.25)	613	0.18 (0.0031)
Not obtained Minimum Dietary Diversity (<5/10 food groups) (vs. MDD-W)	613	60.52 (371)	613	54.98 (337)	613	5.5 (0.031)
Covariates						
Age in years	613	13.8 (2.07)	613	14.8 (2.06)	613	1.0
Self-efficacy total score	613	30.72 (4.68)	613	31.49 (4.44)	613	0.77
Education years reached	613	7.7 (2.16)	613	8.5 (2.21)	613	0.8
Started menstruation	613	60.4 (370)	613	78.0 (478)	613	17.6
School-going	613	91.2 (559)	613	86.6 (531)	613	4.6
Married	613	5.6 (34)	613	10.3 (63)	613	4.7
Mother	613	4.1 (25)	613	4.9 (30)	613	0.8
Pregnant	613	0 (0)	613	1.6 (10)	613	1.6
Household wealth quintiles						
lowest	613	18.60 (114)	613	17.46 (107)	613	1.14
2nd lowest	613	25.61 (157)	613	22.68 (139)	613	2.93
middle	613	25.29 (155)	613	22.35 (137)	613	2.97
2nd highest	613	23.65 (145)	613	27.08 (166)	613	3.43
highest	613	6.85 (42)	613	10.44 (64)	613	3.59
Caste/ethnicity						
Brahmin/Chhetri	613	52.0 (240)	613	52.0 (240)	613	..
Socially-excluded	613	33.9 (319)	613	33.9 (319)	613	..
others	613	8.8 (54)	613	8.8 (54)	613	..
Household size (total number of members)	613	6.3 (2.89)	613	6.0 (2.78)	613	0.3
Household head highest completed years of education	613	3.9 (4.11)	613	3.9 (4.11)	613	..
Agro-ecological zone of residence						
mountains	613	15.0 (92)	613	15.0 (92)	613	..
hills	613	51.1 (313)	613	51.1 (313)	613	..
lowland plains (*Terai*)	613	33.9 (208)	613	33.9 (208)	613	..

Table Notes: For means: SD in parentheses. Differences in means or proportions between the two time periods were tested with paired t-tests and Mc Nemar's test for significance (p-values displayed).

Associations between nutritional and dietary diversity indicators and girls' aspirations

Results from the cross-sectional regression models for the prediction of educational, occupational, marital, and fertility aspirations, for 2018 and 2019 separately, are presented as supplementary materials (see Table S6.1 and S6.2). Findings from these models showed that in 2019 every SD increase in HAZ was associated with a 0.29 (one-third of a year) (p=0.027) increase in aspired years of education. Hb was positively associated with occupational aspirations: with every unit (g/dL) increase in Hb in 2019, the odds of aspiring for a professional skilled job were 1.20 higher (p=0.036). In 2019, Hb was positively associated with fertility aspirations. With every unit increase in Hb, girls' aspired age of having a first child increased with 0.41 years (p=0.0020). None of the nutritional predictors were associated with girls' aspired age of having a first child in 2018.

Changes in malnutrition and changes in girls' aspirations

Table 6.2 presents results from our fixed-effects models for educational, marital, and fertility aspirations. For our main analyses, we were interested in whether a shift from thinness, anemia, or not having obtained the MDD-W, to no thinness, non-anemic, or having obtained MDD-W, respectively, was associated with a rise in aspired years of education, first age of getting married, or having a first child.

Among school-going girls, a change from being anemic to not being anemic was significantly associated with a half-year (*b* -0.54, p=0.044) increase in aspired years of education. The model showed no main-effects of thinness or MDD-W on educational aspirations. Additionally, a change from pre-menarche to post-menarche was associated with more than a half-year of aspired education (*b* 0.66, p=0.030). For marital aspirations, none of the nutritional indicators - thinness, anemia, or MDD-W- nor any of the socioeconomic and demographic factors significantly predicted a change in a girl's aspired age of first marriage. However, among girls without children and with known fertility aspirations, a change from being thin to not being thin was associated with an increase in the aspired age of having a first child by almost three years (*b* -2.77, p=0.025). Neither anemia nor MDD-W were associated with girls' fertility aspirations. However, age (*b* 0.85, p=0.0020) and school status (*b* 1.52, p=0.0040) were both positively associated with girls' aspired ages of having a first child.

Table 6.2. Main effects of malnutrition on educational, marital, and fertility aspirations

	Aspired years of education			Aspired age of 1st marriage			Aspired age of 1st child		
	b	***SE***	***p***	***b***	***SE***	***p***	***b***	***SE***	***p***
Age in years	0.41	0.23	0.080	0.39	0.25	0.11	0.85	0.26	0.0020
School status									
Out-school	..	..	..	ref	..	..	ref	..	..
In-school	..	..	..	0.04	0.58	0.95	1.52	0.53	0.0040
Highest no. of years education	0.00	0.16	1.00	0.03	0.22	0.89	-0.28	0.16	0.089
Total self-efficacy score	0.01	0.03	0.74	0.03	0.03	0.26	-0.01	0.04	0.74
Menarche status									
not reached (pre) menarche	ref	..	..	ref	..	..	ref	..	..
Reached (post) menarche	0.66	0.30	0.030	0.14	0.29	0.64	-0.18	-0.40	0.66
Caste/ethnicity									
socially-excluded	ref	..	..	ref	..	..	ref	..	..
Brahmin/Chhetri	omitted	..	..	omitted	..	..	omitted	..	..
other	omitted	..	..	omitted	..	..	omitted	..	..
Household wealth quintiles									
lowest quintile	ref	..	..	ref	..	..	ref	..	..
2nd lowest quintile	0.06	0.34	0.85	0.06	0.32	0.85	0.39	0.43	0.37
middle quintile	0.02	0.41	0.96	0.04	0.45	0.94	0.36	0.73	0.62
2nd highest quintile	0.32	0.49	0.51	0.17	0.49	0.73	0.58	0.82	0.48
highest quintile	-0.06	0.57	0.91	0.12	0.64	0.85	0.80	0.86	0.36
Household size	0.00	0.09	0.99	-0.06	0.07	0.38	-0.03	0.09	0.74
Household head's highest education in years	omitted	..	..	omitted	..	..	omitted	..	..
Agro-ecological zone of residence									
Terai	ref	..	..	ref	..	..	ref	..	..
hills	omitted	..	..	omitted	..	..	omitted	..	..
mountains	omitted	..	..	omitted	..	..	omitted	..	..
Thinness (BMI-for-age z-score/BAZ)									
not thin (BAZ > -2SD)	ref	..	..	ref	..	..	ref	..	..
thin (BAZ < -2SD)	0.31	0.73	0.67	-0.50	0.74	0.50	-2.77	1.22	0.025
Anemia									
not anemic	ref	..	..	ref	..	..	ref	..	..
anemic	-0.54	0.27	0.044	0.17	0.23	0.46	0.29	0.34	0.40
Minimum Dietary Diversity Women (MDD-W) (≥5/10 food groups)									
obtained MDD-W	ref	..	..	ref	..	..	ref	..	..
not obtained MDD-W	-0.15	0.20	0.44	-0.24	0.19	0.20	-0.09	0.26	0.72
Constant	8.16	2.61	0.0020	16.03	2.68	<0.0001	13.89	4.22	0.0010

	Aspired years of education			Aspired age of 1st marriage			Aspired age of 1st child		
	b	*SE*	*p*	*b*	*SE*	*p*	*b*	*SE*	*p*
R^2	0.70	..	..	0.73	..	..	0.84	..	..
R^2-adj.	0.36	..	..	0.39	..	..	0.48	..	..
F / Wald chi^2	(12,178) = 2.37			(13,179) = 2.23			(13,171) = 2.54		
Prob>chi^2	p=0.0075	..	..	p=0.0099	..	..	p=0.0032	..	..
Observations	1087	..	..	1060	..	..	680	..	..
No. of Groups	562	..	..	568	..	..	452	..	..

Anemia and educational aspirations by pubertal stage

Because a change in menarche status was significantly associated with a change in a girl's aspired years of education, and the likelihood of anemia in Nepal is higher among older (15-19 year) adolescent girls, possibly due to increased iron requirements and blood loss associated with menarche (Ford et al., 2020), we conducted an additional analysis to test if the positive effect of anemia on educational aspirations (only) differed by menarche status. The fixed-effects models for pre-menarche versus post-menarche girls are presented as supplementary materials (see Table S6.3). The estimates for the post-menarche group showed a significant main effect of anemia on educational aspirations (*b* -0.62, p=0.035), while no main effects of anemia on educational aspirations were found in the pre-menarche group.

Discussion

This study aimed to study the associations between nutritional and dietary diversity indicators and adolescent girls' aspirations in Nepal, and investigated if changes in thinness, anemia, and MDD-W during adolescence were associated with changes in girls' aspirations. Our panel models showed first of all that girls who recovered from anemia between 2018 and 2019 reported higher educational aspirations in 2019. The disaggregated analyses for educational aspirations by menarche status showed that this finding was stronger for girls who had already entered puberty (as indicated by menarche), compared to those who were in the pre-pubertal stage. Secondly, findings showed that those who recovered from thinness reported higher aspired ages of having a first child.

Current evidence shows that iron, a building block of hemoglobin, is crucial for brain development (Grantham-McGregor & Smith, 2020). Whilst anemia is caused by a range of proximal as well as underlying factors including increased iron requirements,

low dietary intake, infections and inflammation, in Nepal iron deficiency remains a major cause of anemia, especially amongst girls (Ford et al., 2020). While most studies have focused on the effects of anemia on the socio-emotional or cognitive outcomes of infants, some studies have found positive relations between Hb and other phenomena including less anxiety, less depression, and less grade repetition during adolescence (Walker et al., 2007). The mechanism between anemia and aspirations may thus be moderated through other psychosocial influences or potentially stress levels. Nevertheless, findings underscore the importance of addressing anemia, whatever its cause, as it is a persisting problem in the context of Nepal, particularly amongst post-menarche adolescent girls (Ford et al., 2020). Additionally, cross-sectional findings showed that Hb was positively associated with occupational aspirations: girls with lower Hb levels were more likely to aspire to no-skill or low-skill jobs, compared to a job requiring higher education or professional skills, and had lower aspired ages for having a first child. This is particularly interesting, since it has been argued that well-nourished girls are more likely to delay marriage and thus their first pregnancy (Black et al., 2013). Hb increases can raise adolescent girls' aspirations, which can potentially result in better development outcomes. Future research, which includes specific indicators of iron-deficiency-anemia (i.e., ferritin levels), should further explore associations between changes in adolescent girls' diets to overcome anemia (if caused by poor diets), and thus investigate the mechanisms behind the relationship between anemia and aspirations.

Findings also suggest that thinness was associated with fertility aspirations. While this association is not directly obvious, since nutritional status can affect aspirations through several biological and social pathways, the fixed-effects models predicted that recovery from thinness was associated with an increased aspired age for having a first child. Generally, early marriage is associated with early childbearing, lower educational attainment, and school dropout in Nepal (Sekine & Hodgkin, 2017). Evidence from 23 countries in sub-Saharan Africa showed that early marriage was associated with lower risks of being underweight. In South Asia, however, this is less plausible insofar as differing socio-cultural norms that discriminate against women and girls may in fact lead to the opposite outcome (Harris-Fry et al., 2018). One possible mechanism explaining why underweight is associated with lower aspired ages for having a first child in this context may be a social one: (early) marriage often results in a social status transition, which leads to a possible decline in newlyweds' access to more, or higher-quality food. Conceiving a first child often increases a young woman's social position in the household, consequently leading to better (access to) nutritious food (Diamond-Smith, Shieh, Puri, & Weiser, 2020). Early marriage and childbearing may, however, compromise girls' health and has nutritional risks – including, for instance, the cessation of linear growth, or competition between the (unborn) child and nutrient requirements (Christian & Smith, 2018). If a girl's family formation aspirations

are predictive of actual practice, our finding stresses the importance of preventing both thinness and keeping girls in school, for empowering girls to raise their aspirations in terms of marrying age.

Findings from our study advance the – very limited published research on the link between malnutrition or poor diets and adolescent girls' aspirations in a low-income context. Whilst micronutrient deficiencies (e.g., iron, iodine, zinc deficiencies, or anemia) have been extensively associated with predominantly cognitive outcomes, studies on outcomes in the non-cognitive, or, socio-emotional domain, and particularly aspirations of adolescents, are scant (Grantham-McGregor & Smith, 2020; Madjdian et al., 2018). Much of the evidence on the relation between nutritional indicators and aspirations that comes from high-income contexts cannot be generalized to low-income contexts like South Asia. In our study, we attempted to move beyond the most frequently studied domain of educational aspirations by also including girls' family formation aspirations. Furthermore, our dataset allowed us to start exploring potential changes in nutritional and dietary diversity indicators over the period of two years in relation to aspirations, and after controlling for other important non-nutritional predictors of aspirations. Using fixed-effects regression models, we controlled for individual-level and time-invariant heterogeneity (Allison, 2009).

We recognize several methodological limitations. First, for our analyses related to family formation aspirations, our total analytical sample sizes became relatively small, due to the proportion of girls with uncertain aspirations. This can have caused low statistical power, affecting our models' ability to estimate effects, and, potentially biasing coefficients. Second, although the sample does span all of Nepal's development regions and agro-ecological zones, it cannot be considered nationally representative. Third, response bias may have arisen from asking girls the same questions in each wave, which in itself could have led to higher awareness regarding aspirations. However, we controlled for a range of factors that might affect aspirations, even though it is probably never possible to control for all unobserved factors. Moreover, fixed-effects models cannot control for all predictors. We are therefore careful about claims regarding causality. For the fixed-effects models, sample sizes reduced due to dropped cases for which there was no change in the dependent variables (aspirations), nor in nutritional predictors. For instance, while childhood HAZ has been shown to predict adolescents' educational aspirations (Dercon & Sánchez, 2013), zero changes in HAZ over time left us unable to test whether catch-up growth, or a recovery from stunting during adolescence affected girls' aspirations. Nonetheless, our cross-sectional models indicate that increases in HAZ were positively associated with educational aspirations. Considering that stunting, or linear growth faltering, often has its origins in (early) childhood, but consequences last throughout adolescence, this is an important area for further research. Likewise, we were not able to estimate models for occupational aspirations, as minimal changes resulted in poor model fit. Future research

would thus benefit from including more than two periods, time lags, or larger time gaps between periods. A final point of discussion relates to the use of dietary diversity indicators for adolescents. While DDS-W is validated for women of reproductive age, adolescent girls' nutritional needs are higher, and research has yet to confirm if this indicator and which food groups accurately reflect adolescent girls' macro- and micronutrient adequacy.

Despite the limitations, our findings have important implications for policies or programs that aim to improve adolescent girls' life trajectories, and consequently that of future generations. Aspirations are vital to girls' successful transition into adulthood. Nutrition and diets might play an important part in shaping an adolescent girl's aspirations, and thus, improving adolescent diets and investing in adolescent nutrition may nourish aspirations. Investing in nutrition and healthy diets for girls would be even more important at later pubertal stages, when the effects on aspirations could be stronger.

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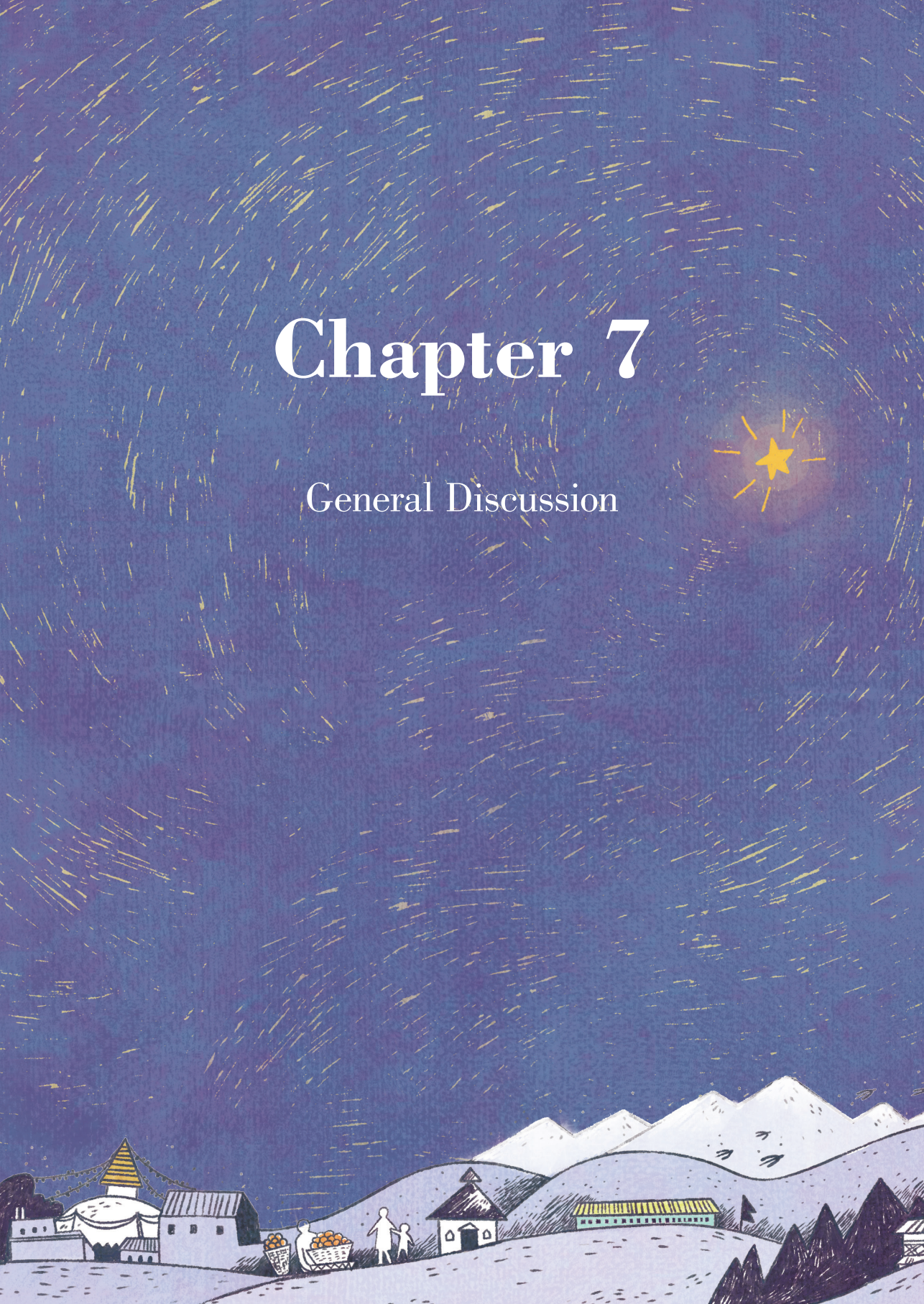
Chapter 7

General Discussion



Introduction

This study's overall aims were first to improve the understanding of the context-specific multilevel drivers of undernutrition during adolescence in LMICs and specifically, in Nepal, and to explore the nature of, and relationships between adolescent girls' aspirations in critical life domains of education, occupation, family formation, health and nutrition, and indicators of adolescent girls' nutritional status and dietary diversity. The study ultimately aimed to contribute to integrated efforts that optimize adolescent girls' nutritional and developmental outcomes in Nepal and beyond.

The research consisted of two parts. Framed within a bio-ecological perspective on human development, Part I consisted of two studies and centered around the sociocultural and economic (SCE) determinants, and consequences of undernutrition (stunting and thinness) during adolescence, in the context of LMICs, and in Nepal. Part II was grounded in human ecology and life course theory. This part consisted of three studies and was based on empirical research conducted in 2018 and 2019 that was carried out under the umbrella of the *Suaahara II (SII)* project in Nepal.

This chapter first summarizes the main findings of the thesis per chapter (2 to 6). Finally, the results are synthesized and interpreted considering theory. After methodological reflections, recommendations for future research are suggested. This final chapter ends with implications for practice to nourish adolescent development potential in LMICs, and specifically, in Nepal.

Summary of main findings

In this section, the main findings per chapter, and the five research objectives are described. Table 7.1 presents an overview of research objectives and main results per chapter.

Chapter 2 included a comprehensive systematic narrative literature review on the SCE determinants and consequences of adolescent undernutrition in low- and lower-middle-income countries (LLMICs), with a specific focus on stunting, thinness, and micronutrient deficiencies. The review aimed to synthesize the dispersed and often scattered evidence on SCE determinants of adolescent undernutrition in LLMICs and its consequences. Results revealed an increased global interest in adolescent nutrition research since 2008, most of which was based on cross-sectional data. Secondly, a schematic overview of the SCE determinants of undernutrition and micronutrient deficiencies at the individual, household, and community level, and its consequences during adolescence was presented. Most studies investigated factors at the individual- (e.g., age, sex, birth order, religion, education, working and marital status, hygiene) and household-level (e.g., parental education and occupation,

family composition, household income, food security, socio-economic assets). Few studies investigated broader societal and environmental factors at the macrolevel (limited to the physical and economic environment) in relation to undernutrition. Moreover, the paucity of studies on the consequences of poor nutrition in adolescence beyond educational attainment or cognition, such as adolescent wellbeing, was highlighted. These research gaps underscored the importance to account for adolescents' everyday lives in research on adolescent development. Findings motivated Part II of this study: to address a considerable research gap on the relationships between malnutrition and adolescent outcomes that are of importance for later health, wellbeing, and developmental outcomes, namely, aspirations.

In **Chapter 3**, the aim was to obtain a comprehensive multi-level overview of the SCE determinants of stunting and thinness in Nepal using secondary survey data from the Nepal Adolescent Nutrition Survey (Aryal et al., 2016). This study focused on the individual-, household-, and community-level factors that were hypothesized to be associated with stunting and thinness, amongst adolescent boys (n=1888) and girls (n=1885) aged 10-19 years (n=3773). The study advanced on the literature by providing sex- and age-disaggregated analyses (10-14 years vs. 15-19 years). Main findings revealed that stunting and thinness were highly prevalent in Nepal in 2014, indicating suboptimal environments for growth. A third of all adolescents were stunted and a tenth were thin. Prevalence rates of stunting and thinness were higher among boys than girls, thinness was more prevalent among younger adolescents, and stunting was more prevalent among older adolescents. For stunting, risk factors included sex, age, religion, caste/ethnicity, nutritional knowledge, parental occupation, parental education, household wealth, and geographical location. Thinness was associated with sex, age, marital status, religion, caste/ethnicity, household wealth, maternal education, and paternal occupation. The findings of this study provided a nuanced picture. Certain factors were more important for younger or older girls, or for boys compared with girls. For instance, higher paternal education lowered stunting risks of girls (aged 10-19), but age-disaggregated analyses revealed that this effect was stronger for younger girls (aged 10-14 years). Paternal low-skilled occupation increased girls' stunting odds, but not boys', implying a pro-male bias. This study's findings concluded that there is no one-size-fits-all approach for achieving nutritional goals. A holistic view on adolescent nutrition is vital to combating stunting and thinness and should consider differences between age groups and involve adolescents' growth environments including important others.

Chapter 4 was the first empirical study using cross-sectional data from the second round (2018) of the *SII* Adolescent Girls Panel (analytical sample *n*=840). The aim was to investigate the nature of adolescent girls' aspirations in the life domains of education, occupation, family formation, nutrition, and health in Nepal, as well as its determinants, and differences between age groups (10-14 years vs. 15-19 years). At the descriptive

level, the findings were rather positive. More than half of all school-going girls aspired to study beyond grade 12, three-quarters of girls aspired for a job requiring higher skills or education, and aspired ages of first marriage and having children were beyond the nationally recommended age of 20 years. Health and nutrition were perceived by most girls as important to very important in their lives. Zooming in, however, findings underscored that the capacity of girls to aspire was not homogenously distributed. Household wealth was a consistent predictor of all aspirations, except for younger girls (10-14 years), who generally held higher aspirations than older girls (15-19 years). Self-efficacy was another key factor associated with aspirations, although to a lesser extent. Findings suggested that other factors at the household or family level, such as the household head's level of education, or household size, had limited influence. We concluded that aspirations and determinants of aspirations varied with age and thus that growing up does not follow a linear process, and that education and preventing early marriage are key to fostering girls' aspirations.

Chapter 5 dived deeper into other more hidden determinants of adolescent girls' aspirations. This qualitative study was inspired by a life course perspective. With the aim to further advance a holistic understanding of girls' aspirations, we moved beyond the six aspirations that were captured in the Adolescent Girls Panel Surveys and that stood central in Chapter 4. In this qualitative study, 17 randomly selected adolescent girls from two districts in Western-Nepal participated. In-depth interviews included creative elicitation techniques of timeline drawings and network mapping exercises. Findings provided deeper insights into how, when, and by whom aspirations were shaped, within girls' everyday life context. Thematic analyses resulted in five main themes: girls' aspirations, internal feelings related to aspirations, the influence of others, influence of gendered norms, and structural barriers to aspirations. The youngest girls were mostly present-oriented, showed hopefulness, and held high aspirations despite not knowing how to realize these. Upon growing older, girls started navigating between aspirations and reality and expectations from others and society. This often resulted in adjusting aspirations downwards. Married girls showed more feelings of resignation and hopelessness in relation to their aspirations, held more collective aspirations (economically benefiting their families and children), and were more likely to transfer their lost, unachievable aspirations onto their children whilst self-silencing their own aspirations. Findings underscored the embedding of aspirations within time and place, as they change throughout adolescence, and upon specific life events, and social transitions. Network maps and girls' stories showed how aspirations were shaped under the social influence of important others, such as parents, peers, older siblings, teachers, and communities. Structural barriers and opportunities such as the availability of work or educational opportunities and financial means, or a lack thereof, impacted particularly older girls' aspirations. Finally, this chapter stressed the increasingly restricted gendered sociocultural norms, which negatively influenced girls' aspirations through diminished agency.

Chapter 6 bridged adolescent girls' nutrition and their aspirations in Nepal, under the hypothesis that well-nourished girls have higher aspirations. Using two-period panel data from the *SII* Adolescent Girls Panel Surveys in 2018 and 2019 associations between adolescent girls' nutritional and dietary diversity indicators and girls' aspired year of education, aspired job, aspired age of first marriage, and aspired age of having a first child were investigated. Findings revealed that changes from being thin to not being thin, and from being anemic to not being anemic, were associated with increased aspired ages of having a first child, and increased aspired years of education, respectively. When disaggregating analyses by menarche status, the association between anemia and educational aspirations only held for post-menarche girls. Additionally, cross-sectional analyses revealed that unit increases in height-for-age z-scores (HAZ) were positively associated with educational aspirations, and that unit increases in hemoglobin (Hb) were positively associated with aspiring for a job requiring higher education compared to no or a low-skilled job, and aspired ages of having a first child. No associations were found between dietary diversity and any of the aspirations. We concluded that good nutrition would have the potential to foster girls' aspirations.

Integration of findings

The results of this thesis contribute to fill a three-fold knowledge gap. First, this research provided insights into the context-specific knowledge on adolescents' nutritional trajectories alongside amongst others, changes in social status and gender roles during the transition into adulthood in LMICs, and specifically, in Nepal. Secondly, it contributed to the limited base of literature on adolescent girls' aspirations in the key life domains related to education, occupation, marriage, fertility, health, and nutrition, and, drivers of each of these aspirations, within an everyday-life context in Nepal. Finally, this study contributes to the thin base of the literature on associations between adolescent malnutrition and girls' aspirations in Nepal.

Four overarching conclusions can be drawn from the key findings of this thesis. First, neither adolescent nutrition nor adolescents' aspirations develop in isolation. To achieve nutritional goals and to be able to foster adolescents' aspirations, a comprehensive holistic perspective, which positions adolescence within a life course perspective, is vital. Growing up into adolescence is influenced by factors at multiple, often overlapping levels, namely the individual, household, community, and broader societal level.

Second, the life stage of adolescence does not follow a linear process. Adolescence is not just one uniform phase of the life course and thus, adolescents should not be considered as one homogeneous group. Findings revealed key differences in nutritional status and aspirations, between boys and girls, between younger (10-14 years) and older adolescents

Table 7.1. Summary of main findings

Chapter	Research objectives, methods, and main findings
2	**Objective:** To synthesize the evidence on the sociocultural and economic determinants and consequences associated with undernutrition and micronutrient deficiencies among adolescents (10-19 years) in LMICs. **Key findings:** • There is increased interest in research on adolescent undernutrition and its sociocultural and economic determinants, but limited research addresses the consequences of undernutrition during adolescence. • Most studies focus on the individual-level determinants of adolescent undernutrition. Commonly associated factors were age, sex, birth order, ethnicity, educational and literacy level, working status, and marital status. • Household-level factors commonly associated with undernutrition were parental education and occupation, household size and composition, income, socioeconomic status, and household resources. • Only few studies addressed the broader environmental (societal, cultural, economic, or political) determinants of undernutrition. • Studies on the consequences of undernutrition during adolescence are mostly focused on vocational or cognitive outcomes. • A framework on the SCE determinants at the adolescent's individual, household, community, and broader level, and consequences of adolescent undernutrition was developed, which revealed knowledge gaps.
3	**Objective:** To examine which sociocultural and economic factors influence undernutrition amongst adolescent boys and girls aged 10–19 years in Nepal. **Key findings:** • Prevalence of stunting and thinness amongst adolescents indicated suboptimal nutritional status and an inadequate growth environment of Nepali adolescents. • Factors associated with stunting were paternal occupation and education, household income, number of earning household members, agro-ecological zone of residence, caste/ethnicity, and nutritional knowledge. Stunting odds were higher for boys and older adolescents. • Factors associated with thinness were paternal occupation and education, household income, agro-ecological zone of residence, caste/ethnicity and nutrition knowledge. Thinness odds were higher for males and younger adolescents. • SCE factors associated with stunting or thinness differed between younger and older girls, and between boys and girls. • Findings underscored the importance of considering adolescents' everyday life context, involving adolescents, their parents and their communities in interventions that aim to improve adolescent nutrition as well as optimize adolescents' growth environment for better health and development.
4	**Objective:** To explore which (non-nutritional-related) individual, household, and community-level factors are associated with Nepalese adolescent girls' aspirations in domains of education, occupation, family formation, health and nutrition. **Key findings:** • Adolescent girls reported relatively high educational, occupational, and family formation aspirations, and high perceived importance of health and nutrition.

Chapter	Research objectives, methods, and main findings
	• Girls' age, school status, self-efficacy, household wealth, caste/ethnicity, household size, and agro-ecological zone of residence were associated with girls' educational, occupational, marital, and fertility aspirations. • Poverty is one of the key drivers of lower aspirations, but to a lesser extent for younger girls. • Findings underscore the dynamic nature of aspirations. Effect sizes and significance of associations varied by aspiration domain and age group, between girls in- versus out-of-school, married versus unmarried girls, mothers versus no mothers, and between those from disadvantaged versus more advantaged backgrounds. • It is vital to foster and invest in the development of aspirations throughout different stages of adolescence and consider context-specific and structural factors.
5	**Objective**: To advance the understanding of Nepalese adolescent girls' aspirations related to school, work, family life, food, and health, and explore factors that influence adolescent girls' aspirations. **Key findings:** • Girls' timelines and network maps showed three unique aspiration profiles which differed between younger, older, and married girls. • Younger girls (10-14 years) were mostly present-oriented and aspired high; older girls (> 15 years) started to balance aspirations with reality and expectations, often adjusting aspirations downwards; and married girls (>15 years) showed more resignation in relation to their aspirations, and were more likely to transfer their (lost) aspirations onto their children. • Main themes from the interviews included the role of girls' feelings, important others, gendered norms, and structural factors in shaping their educational, occupational, family formation, and health- and nutrition-related aspirations, and throughout adolescence. • Health and nutrition/dietary aspirations were not mentioned directly as aspiration, but were mostly fundamental, or seen as a prerequisite to other aspirations. • To grow girls' aspirations, it is important to break the silence related to girls' aspirations, to create awareness on the importance of aspirations whilst involving girls and their important others including male members of society and families. Findings also underscore the importance of schools, teachers, and role models.
6	**Objective:** To examine the associations between undernutrition and Nepalese adolescent girls' aspirations related to important life domains of education, occupation, and family formation, and to investigate if changes in malnutrition, were associated with changes in girls' aspirations over time. **Key findings:** • A shift from being thin to not being thin was associated with higher aspired ages of having a first child. • A shift from being anemic to not being anemic was associated with higher aspired years of education. This association only held for post-menarche girls when disaggregating analyses for educational aspirations. • HAZ was positively associated with aspired years of education. • Hb was positively associated with aspired occupation, and aspired ages of having a first child. • Good nutrition would foster adolescent girls' aspirations in key life domains and contribute to health and development outcomes throughout the life course.

(15-19 years), and according to critical turning points, such as marriage, dropping out of school, or the biological event of menarche. Throughout this thesis, the role of a girl's sense of agency with self-efficacy and decision-making power in several domains as proxy indicators, was used. Being a dynamic construct, agency also fluctuates throughout adolescence, and influences aspirations as well as adolescent nutrition accordingly.

Third, adolescent nutrition and aspirations are (in)directly and (un)consciously shaped in interaction with, and influenced by important others. While quantitative data implied a more indirect effect of social influences, the qualitative data revealed how important others directly influenced girls' aspirations, including those related to food and health.

Finally, main findings on the nutrition-aspirations nexus suggested that better-nourished healthy adolescent girls hold higher aspirations, which would lead to better health, wellbeing, and developmental outcomes in the long run. The remainder of this section reflects on these four integrated conclusions considering scientific literature and theory.

A holistic, integrated view on adolescent nutrition and aspirations is the only way forward

Recognizing drivers at several levels of the bio-ecological model has been increasingly acknowledged by scholars and those working on malnutrition (Reinhardt & Fanzo, 2014). Alongside increased interest in adolescent nutrition and the global momentum to combat malnutrition (Gillespie, van den Bold, & the Stories of Change Study Team, 2017), several studies and working groups have proposed and advocated for using such a holistic view for studies on adolescent development, including nutrition. See the UNICEF framework about the causes of child malnutrition (UNICEF, 2013), the framework by Keats and colleagues on adolescents' diets (2018), or the recently developed framework by Raza and colleagues on adolescents' food systems (2020). These frameworks are based on human ecology, socio-ecological or bio-ecological theories, and specify several layers, (i.e., individual, household, communal, broader societal or macro-environmental) and within those, factors that interact – directly or through other layers - with adolescents' nutritional status or diets.

Findings from this study showed that truly adopting a holistic approach is easier said than done. While understanding adolescent growth environments should ideally be inherent to understanding specific aspects of adolescent development, the determinants of undernutrition are often studied individually. An integrated approach, which also considers interactions between multi-level factors and within levels themselves, is highly informative, and thereby able to steer and inform actions to tackle issues related to undernutrition. Particularly the structural underlying or distal determinants of malnutrition, such as adverse sociocultural norms, which lead to social inequalities and poverty, remain largely invisible. This leads to a risk of failure to address such crucial components in highly-needed integrated interventions (Reinhardt & Fanzo, 2014). Stunting for example, or linear growth

faltering, is often associated with chronic undernutrition, or poor dietary intake. However, stunting is not only related to poor diets, but rather an indicator of growing up in a deficient environment (Leroy & Frongillo, 2019). This includes other dimensions related to access to health care, disease and infections, poverty, or food security challenges. Additionally, any explanation of inequality needs to be sought at several interacting levels of the bio-ecological model and across the life-course.

This challenge has also been presented by Bronfenbrenner, when he revised his original theory from 1979 on human development. He argued that for truly understanding human development, we must move beyond the individual level to also include more distal factors shaping development (Bronfenbrenner, 1995). Thus, for understanding and tackling undernutrition, not only its determinants and consequences, but also an understanding of the dynamic interdependencies between adolescents and environmental influences is vital. Interactions between the levels - in the bio-ecological model referred to as the mesosystem - are seldom studied, possibly due to its complexity and lack of data and indicators. The same relates to outcomes of undernutrition. To date, it remains largely unknown what the effects are of specific types or indicators of adolescent undernutrition, on less-tangible outcomes that impact health and development in the long run. Moreover, more research is needed to investigate what impacts who, during which stage of adolescence (i.e., according to pubertal stage or upon turning points), and what interventions may cause (unintended or indirectly) in other important life domains (Gillespie et al., 2017).

To address these concerns, we adopted a holistic approach (Bronfenbrenner, 1979; Dahlgren & Whitehead, 1991) in this study's chapters. We experienced first-hand the complicatedness of including factors beyond the individual and household level, into analyses of undernutrition (Chapter 3). This was partly due to a lack of data and measurements of broader indicators, but also because of complex interrelations between systems. As a result, most of our included indicators may still have been positioned (although sometimes overlapping with broader systems) within adolescents' micro- or exosystem layers. Measuring broader factors beyond adolescents' physical- and social environments, or interpersonal environments, and interactions between those, would imply including prevailing community norms.

In this study's findings (Chapters 3 and 4), poverty stood out as a key influencing factor regardless of other strong effects of age, sex, or self-efficacy, despite some studies questioning the negative effect of poverty on aspirations (Lybbert & Wydick, 2018). Although poverty turned out to be one of the major determinants of aspirations in our statistical models, poverty was less-often mentioned as a barrier to aspirations by the girls who participated in our qualitative study on aspirations. While poverty may still play a role in shaping aspirations, this confirms poverty as an invisible, structural barrier. The strong effect of poverty associations with undernutrition and aspirations highlights the need for

multidimensional approaches to development, including poverty-alleviation strategies. The results imply that even in the context of wide-spread or persisting poverty, it is not an option to ignore structural drivers of inequality. Especially considering that aspirations (Janzen, Magnan, Sharma, & Thompson, 2017) and malnutrition may actually exacerbate poverty through diminished human capital and aspirations failure, and thus fueling vicious cycles of deprivation. While the aim here is not to propose strategies to alleviate poverty as it is one of the greatest global challenges, it is important to consider poverty as multidimensional, context-dependent, and dynamic, rather than a catch-all term. A participatory qualitative multi-country study by Bray and colleagues on the meaning of poverty in the global North and South defines poverty as "suffering in body, mind, and heart" (2020, p. 4). Hence, for understanding and addressing poverty, we must go beyond monetary indicators. Acknowledging other structural dimensions of poverty would direct focus towards one's own capabilities including building resistance, overcoming struggles, pooling resources and assets, as well as a sense of empowerment (Bray et al., 2020). Nevertheless, besides the visibility and availability of opportunities (e.g., good nutrition, quality education, labor market opportunities, and so on) adolescents need to also be able to see and act on these opportunities, referring to the importance of human agency.

This research also advanced on previous literature on adolescent aspirations in LMICs by investigating aspirations in areas other than education, and through adopting a more holistic approach to what influences each of these aspirations. The qualitative study (Chapter 5) captured a range of factors influencing aspirations beyond the micro-level that were less captured by surveys. This study particularly revealed the – with age – increasingly important role of social influence and internal feelings regarding aspirations. This finding corroborates other studies on social influences on aspirations (Gutman & Akerman, 2008), but was not directly captured in the surveys.

While findings were supportive of an association between indicators of adolescent girls' nutritional status or diet quality and aspirations (Chapter 6), these findings should be interpreted within context. Aspirations are influenced by many aspects within everyday life contexts and broader society. For instance, besides nutritional indicators, models also showed a significant contribution of a girl's age, her years of education, and her household moving into a higher wealth quintile, for a change in her aspirations. These findings are in line with studies on the poverty of aspirations hypothesis, where poverty is seen as a key barrier to higher aspirations (Janzen et al., 2017), and studies that show how aspirations increase with age, particularly in higher-income contexts, as part of general adolescent development, positive experiences, or increased confidence levels (Bandura, Barbaranelli, Caprara, & Pastorelli, 2001; Shulman & Nurmi, 2010).

When viewing the conclusions of this thesis, and in the context of existing literature, we see the need to adapt our initial hypothesized model. For the structural or underlying

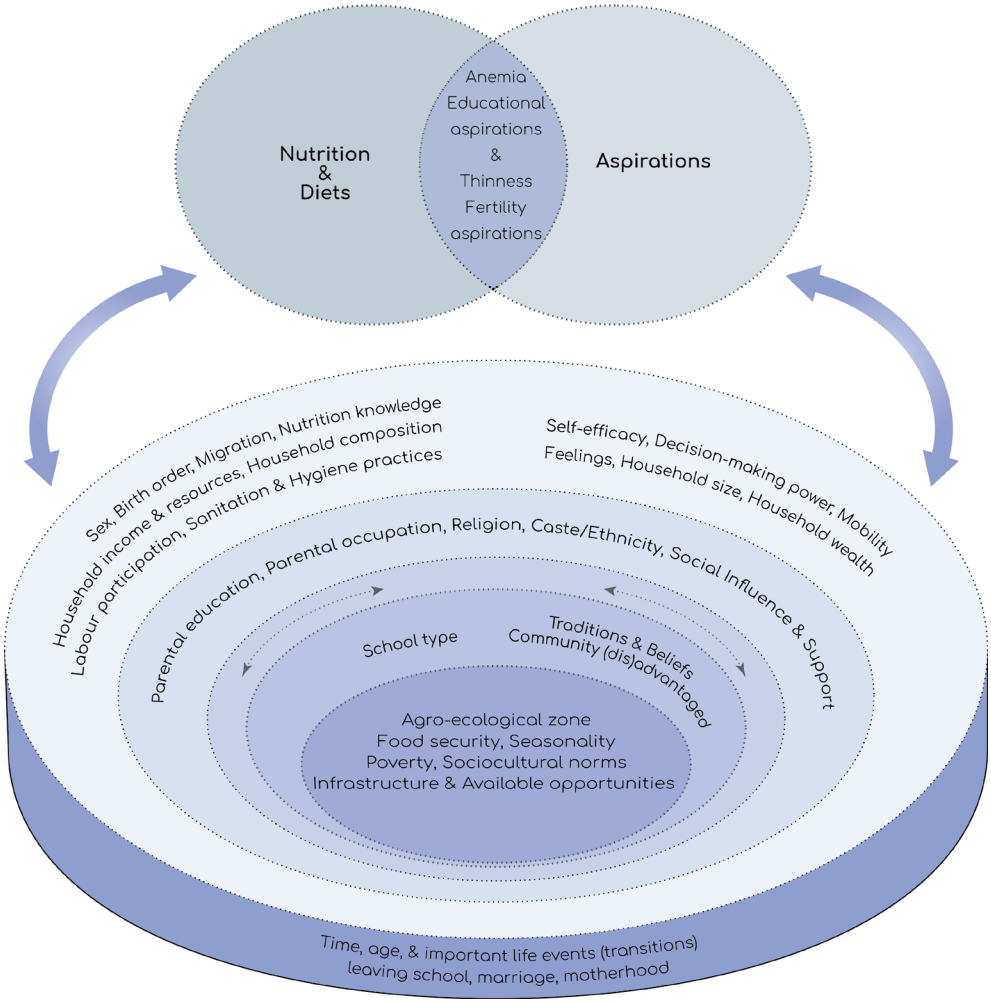


Figure 7.1. Bio-ecological model on adolescent nutrition and aspirations inside-out

factors to get a more prominent place in ecological models, and thus more attention to address these factors, an 'inside out model' was developed by Golden and colleagues (2015). This model places the underlying and more structural factors, or root causes, at the center of the model, rather than in the outer layer. As such it enables conceptualizing "the ways in which individuals, their social networks, and organized groups produce a community context" that fosters healthy development (Golden et al., 2015, p. 8S). In other words, structural factors such as poverty or sociocultural norms, are placed within nested contexts. Human capital, including agency and autonomy, gets a more prominent place on the outer layer. Based on the results of this thesis, and with the aim to push forward the adolescent

development agenda and momentum to combat nutrition, we have turned the theoretical framework - introduced in Chapter 1 of this thesis - inside-out (see Figure 7.1). Rather than traditionally placing the adolescent in the center, the structural underlying factors are at the heart of the model. This model also summarizes all findings from the five studies in this thesis. The model shows how different factors at the micro-, meso-, exo-, and macro levels overlap and interact, and which factors were found to influence adolescents' nutritional status and diets (on the left side) and aspirations (on the right side). It furthermore shows how the nutrition-aspirations nexus is embedded in, and influenced by a broader system.

Adolescence is not just one uniform phase of the life course

Research and programs often posit adolescents as one homogenous group, or adolescence as one linear life stage. Adolescence is, however, accompanied by several turning points and life events at specific ages, which result in differences between individual experiences, opportunities, and outcomes (Dornan & Woodhead, 2015; National Research Council and Institute of Medicine, 2005). This study's findings show that nutritional risks and aspirations differed greatly between age groups, sexes, or change with important life events. First, undernutrition prevalence rates differed between boys and girls, with prevalence and stunting prevalence rates being higher amongst boys compared to girls (Chapter 3). This finding was also highlighted by the literature review (Chapter 2), and may be explained by boys' later growth spurt, or higher undernutrition risks through higher susceptibility to infections (Benedict, Schmale, & Namaste, 2018; Svefors et al., 2019). However, girls are more likely to have worse nutritional status due to differing patterns of consumption (i.e., lower consumption) related to for instance restrictive sociocultural norms (Christian & Smith, 2018). Moreover, undernutrition is particularly detrimental for not only their future lives, but also that of their offspring (Black et al., 2008). This is one of the reasons why, in part II, the focus of this study was directed towards adolescent girls in Nepal.

Second, significant differences were found between younger and older adolescent girls' nutritional status, aspirations, and factors determining those (Chapters 3 and 4). Stunting, for instance, increased with age, a finding that did not corroborate previous literature showing an overall declining trend with age due to stunting recovery or catch-up growth (Prentice et al., 2013). Moreover, thinness decreased with age, a finding that was in line with other studies from LMICs (Candler, Costa, Heys, Costello, & Viner, 2017). Both are important observations that highlight the need for context-specific and age-disaggregated nutritional interventions.

As for aspirations, the qualitative study (Chapter 5) showed that aspirations were likely to be adjusted downwards over time and upon specific life events. This finding aligns with other studies that show that aspirations naturally decline over time, or are adjusted downwards to live up to expectations or reality, or perceived constraints, particularly in

low-income contexts (Gutman & Akerman, 2008). Results also showed that school-going girls' aspired level of educational aspirations, and unmarried girls' aspired ages of marriage, increased with age (Chapter 4). This may be since only school-going girls, or married girls were asked about their educational or marital aspirations. Overall, findings show that being able to delay marriage, or staying in school, may empower girls to raise their aspirations, because they are perceived to be realistic or achievable.

The qualitative study revealed that younger girls held higher, and sometimes even quite ambitious or overly high aspirations (Chapter 5). On the contrary, older girls started to balance aspirations with reality, or had lost their aspirations upon dropping out of school, marriage, or motherhood. Findings support the theory that early adolescence is often a time of being present-oriented and dreaming big, whilst late adolescence is characterized by navigating expectations and aspirations (Gottfredson, 1981). Findings also align with theories that posit that an individual's realistic aspirations will drive investment in one's future (Ray, 2006). Too big of a gap between what is possible and aspired might result in aspirational frustration or aspirations failure through lower levels of investment (Janzen et al., 2017; Ross, 2019). Hence, efforts to delay marriage and keeping girls in school are important to foster girls' aspirations. Findings moreover imply that it is vital, for older girls, to avoid an aspirations failure through education on realization of certain aspirations.

Within the adolescence life stage, turning points shape the phases of the nutrition-aspirations nexus. These turning points are essential to consider in any study on adolescent development (Buchmann & Steinhoff, 2017). A key finding of this study relates to the importance of staying in school. As discussed above, staying in school may foster girls' aspirations as well as good nutrition, through increased nutrition knowledge (when assumed to be gained in school-environments). Staying in school raised girls' fertility aspirations by two years, and odds of aspiring for a job requiring professional skills were more than seven times higher for girls who attended school compared to those who did not attend school at the time of the study (Chapter 4). Schools were important for girls' aspirations mainly through the support and motivation of teachers and contact with peers with similar aspirations. Schools have been shown to be of vital importance for fostering aspirations and broadening horizons, through peer and teacher support (Naafs & Skelton, 2018). The protective effect of schooling has also been reported in the fight against malnutrition, through the teaching of nutritional and health skills, school-feeding, or social protection programs (Global Nutrition Report, 2020). As a life stage, adolescence is important for adopting and steering to more positive and healthy behaviors. School environments including youth or girls clubs have been shown to support the development of life skills and promoting healthy behavior and diets (Marcus, Gupta-Archer, Darcy, & Page, 2017; Micha et al., 2018).

Study results suggest that staying in school is also important for raising educational aspirations, possibly through delaying upcoming marriage, and aspired ages of having a

first child. This aligns with studies that show that keeping especially older adolescent girls in school has been positively associated with later marriage, and thus, later childbearing (LeVine, 2019). In Nepal, while the gender gap in primary education has nearly closed, continuing secondary education and quality education remains a challenge for many girls (LeVine, 2019). Additionally, dropping out of school usually leads to marriage (LeVine, 2019)

The study's findings also indicated that menarche as a turning point could be important for the nutrition-aspirations linkage (Chapter 6). The onset of the first menstruation, often a landmark of puberty, partly explained the association between recovery from anemia and an increase in girls' educational aspirations. Combined with the finding on the drop in aspirations upon growing older, as well as a general trend that entry into adolescence now starts earlier (Sawyer, Azzopardi, Wickremarathne, & Patton, 2018), this finding is important considering that anemia prevalence rates remain a pressing issue amongst older adolescent girls and young women in Nepal (Chalise et al., 2018; Karki et al., 2016) and globally (Victora et al., 2021).

Closely related to the proposition that adolescence is not one single life phase within the life course is girls' sense of, or level of agency. Agency is one of many assets that support girls to find their way in a world that is subject to social change, especially during the transition into adulthood. It is related to aspiration formation, one's capabilities (Nussbaum, 2011), and the regulation of certain actions and behavior, within everyday-life contexts with its opportunities and restrictions (Bandura, 2001; DeJaeghere, 2018; Hart & Brando, 2018). In Rajasthan, India, a recent study showed how raising adolescent girls' life skills in school led to an improvement of future planning skills and (exercise of) agency (Edmonds, Feigenberg, & Leight, 2020). For Nepali girls, growing up is accompanied by social status changes, which often lead to changes in agency. Girls' low agency is still highly prevalent despite social changes. Low agency may result in having less say in decisions surrounding for instance marriage, schooling, having children, and consumption of food, or access to health. Despite societal changes, Nepal's traditional patrilineal society may result in lower agency, through the prevailing sociocultural norms, practices and traditions, which are often perpetuated by girls themselves (Samuels & Ghimire, 2013). Gender differences tend to widen in adolescence and are shaped by social norms and expectations surrounding social roles (Dornan, 2016; Kågesten et al., 2016). Consequently, this may influence girls' level of self-efficacy. Findings revealed the relative importance of self-efficacy and decision-making power to one's aspirations (Chapter 4), although the latter to a lesser extent. For instance, in contrast to other studies on aspirations (Bandura et al., 2001), girls' self-efficacy and level of decision-making power, only modestly contributed to the prediction of educational and occupational aspirations.

Nevertheless, findings showed that even minor increases in self-efficacy mattered for aspirations (Chapter 4). Self-efficacy and dependency on others for making decisions related to their future lives, was more clearly mentioned and captured as part of feelings towards girls' general life aspirations during the in-depth interviews (Chapter 5). This indicates that individual perspectives of girls are crucial for understanding needs and aspirations. In other words, adolescents themselves are the only experts of their lives (Dornan & Woodhead, 2015). This finding also implies that self-efficacy alone – even if it leads to increased agency or decision-making power - may not be enough to raise and act on aspirations, unless there is a supportive environment in which girls are able to exercise their agency. A study in the outskirts of Kathmandu and the lowland plains, comparing aspirations of adolescent girls and boys aged 14-24 showed that although having relatively wide aspirations, boys had more opportunities to act on aspirations (Mathur, Malhotra, & Mehta, 2001). In a study amongst children and adolescents aged 8-19 years who were followed over time in Ethiopia, a similar gender gap was found with girls aspiring less for education than boys. This effect was stronger for girls in the context of poverty (Favara, 2017); a reminder to not ignore the underlying, structural drivers of inequities.

The study's findings are in line with Sen's argument that poverty is a major barrier to one's capabilities, and that wellbeing in general is dependent on functionings – beings and doings - and capabilities (Sen, 2005). Capabilities, or potentials to achieve aspirations, are in addition to structural factors (e.g., cultural, social, historical) highly related to agency (Nussbaum, 2001). Indeed, when a girl is "*able to use her aspirations in such a way that she is able to achieve the functionings she wishes to have, she has used her agency to realize the capabilities available to her in order to enable her to live the life she most deeply wants to live*" (Conradie, 2013, p. 194). Hence, while low agency could lead girls to adjust their aspirations downwards (adaptive preferences), increasing agency, self-confidence, and sense of autonomy may only lead girls to adapt aspirations upward within the boundaries of societal and structural systems (Conradie, 2013).

Adolescent nutrition and aspirations are always shaped in interaction with important others

Social structures and networks shape adolescents' transition into adulthood. Results revealed the relative importance of several household-level factors, including parental educational and occupation, as determinants of adolescents' nutritional status. In comparing boys and girls, paternal education was protective against stunting for girls and contrarily, maternal education increased thinness odds of girls (Chapter 3). Whilst maternal education is highly relevant for interventions preventing undernutrition, particularly in programs targeting children under five, these findings also show the importance of engaging fathers in any efforts that aim to improve adolescent girls' nutritional and dietary status.

The literature on the returns of maternal or paternal education to greater nutritional benefits, especially for adolescents, remains however rather controversial. Commonly assumed is that maternal education has a stronger influence on child nutritional status through more-informed resource-allocation, as for instance shown by a study on the influence of maternal education on child nutritional status in Pakistan (Aslam & Kingdon, 2012), or on maternal education and empowerment on adolescent nutrition status in Indonesia (Kunto & Bras, 2018). A study on the nutritional returns of parental education for preschool children, using data from 56 developing countries, showed larger returns for mothers, compared to fathers (Alderman & Headey, 2017). Another study based on DHS data from 62 countries showed, however, a similar effect of maternal and paternal education on reducing childhood undernutrition (Vollmer, Bommer, Krishna, Harttgen, & Subramanian, 2017). This suggests that both the education of mothers and fathers plays an important part in achieving nutritional goals.

In relation to aspirations, it was shown that they are shaped in, what Appadurai refers to as, "the thick of life" (2004, p. 67). Social networks and social support are crucial for aspirations development. Findings particularly pointed towards the role of fathers herein, and the shift to husbands and parents-in-law, upon marriage (Chapter 5). Fathers were particularly important for unmarried, older girls' educational, and marital aspirations as fathers had the final decision in whether to continue schooling or when to get married. With age, girls' feeling of support alongside hope decreased, as their fathers' support for continuing education disappeared. Upon this transition, girls' older siblings, in specific brothers, or sisters-in-law, became more important. Whilst mothers were at least equally important to girls' aspirations, findings implied that in an environment with unfavorable gender norms, the role of male members of the family, and fathers may be even more decisive, even when girls have high aspirations themselves. These findings underscore the urgency for addressing adverse gender norms and engaging boys and men. Programs focused on transforming gender norms and expectations regarding the roles and behavior of girls can empower girls to aspire for their future lives and empower boys to help girls achieve their aspirations. The Choices project in Nepal, for instance, which aimed to improve gender equality by working with young adolescent girls and boys (10-14 year), showed promising results of more equitable gender attitudes and behavior amongst participants. Boys started to advocate with parents for girls, helped their sisters with household chores and homework, and had a more open attitude to girls as earners of the family rather than just bearers of the next generation (Lundgren, Beckman, Chaurasiya, Subhedi, & Kerner, 2013).

Additionally, for girls' aspirations, schools, teachers, peers, and siblings were important, depending on the adolescence stage. This is in line with the aspirations window theory: individuals are likely to synchronize their aspirations with those in their everyday life environment (Appadurai, 2004). Whilst this may also play out negatively (e.g., copying

fatalistic or pessimistic aspirations of others), girls often referred to older *didi's* (village 'sisters'), older siblings doing well, or villager teachers, to adjust their aspirations accordingly. This aligns with a study in India, where upon seeing female leadership in their villages, girls' aspirations raised (Beaman, Duflo, Pande, & Topalova, 2012). Findings here raise the implication that role models may be particularly important for older girls to foster aspirations.

In relation to adolescents' nutritional status and wellbeing, this study provided rich insights into what adolescent girls in different adolescence stages aspire to eat (Chapter 5). Additionally, interviews revealed who and what influenced girls' food-related aspirations. By focusing on the wishes of girls themselves in relation to food (largely overlooked in current research), and who or what plays a role in those wishes, this study provides valuable insights into adolescents' food environments and prevailing food beliefs. Amongst younger school-going girls, snacking foods (i.e., *chatpate* [puffed rice with spices] and *chowchow* or *chow mein* [noodles]) were mostly preferred because of tastiness, but also because of routine peer influence and pressure. Universally, peer influence is important during adolescence as an important period where identities and curiosity grow. A study in Indonesia showed that although amongst older girls (15-19 years) snacking with friends was related to solidifying social interactions and friendships, socializing, as well as a perceived need to adhere to social norms and being accepted by friends (Blum et al., 2019).

The decreasing role of caregivers as gatekeepers (Fox & Timmer, 2020) and increasing role of peers have been recently highlighted in a recent framework on adolescent diets in LMICs (Raza et al., 2020). In this study, even though almost all girls perceived good nutrition as highly important to their lives, older adolescent girls valued snacking food less and were discouraged to eat junk food by others in their environment. Adolescent mothers had shifted towards preferring to eat traditional foods, motivated by their wish to be a good mother and caring for their children, but were also more restricted in the foods they (wished) to eat. Findings also indicated that with age, some girls were not allowed to eat meat, dairy products, or eggs, a finding which has been supported by other studies on unequal intrahousehold-food allocation practices (Harris-Fry et al., 2018; Madjdian & Bras, 2016). These findings on food-related aspirations may be informative for research and programs looking for improving adolescents' nutritional status and diet quality.

The nutrition-aspiration nexus: good nutrition has potential to nourish girls' aspirations

This thesis is amongst the first that attempted to investigate the adolescent "nutrition-aspiration nexus", through connecting these two important building blocks of adolescent development. Even though scholars have made attempts to assess relationships between malnutrition and particularly cognitive and health outcomes, relationships between

nutrition and diets, and broader wellbeing, including non-cognitive outcomes and mental health, are seldomly explored. The rationale for studying this nexus grew from the thin base of literature from LMICs that showed - potentially causal - links between childhood HAZ, stunting, or iron deficiency, and adolescents' educational aspirations (Chong, Cohen, Field, Nakasone, & Torero, 2016; Dercon & Sánchez, 2013; Pasquier-Doumer & Brandon, 2015; Thangavelu, 2018). Other evidence came from high-income contexts where associations between older adolescent girls' BMI and aspirations related to occupations and family formation were studied (Ball, Crawford, & Kenardy, 2004), but it remained unknown whether weight indicators were associated with aspirations of adolescents in LMICs due to its different nutrition transitions phases (Subedi, Marais, & Newlands, 2017).

This thesis has provided support that good nutrition could enhance human capital and quality of life. Healthy weight and/or not being anemic can be buildings blocks of adolescent girls' aspirations. Analyses revealed significant associations between changes in thinness and anemia, and changes in fertility and educational aspirations, respectively, whilst controlling for other important time-varying factors including self-efficacy and household wealth (Chapter 6). In the preliminary cross-sectional analyses, estimations moreover showed positive associations between Hb and increased odds of aspired jobs which required higher (professional) education versus no aspired job or one that requires no or lower skills, and higher aspired ages of having a first child (Chapter 6). In line with previous research on the relations between childhood HAZ and educational aspirations (Dercon & Sánchez, 2013), this study supports associations between adolescent HAZ and educational aspirations. Considering HAZ as a broader indicator of development, this finding also supports this study's conclusions on the non-nutritional determinants, which in turn underscores that growing up in a poor or less supportive environment may lower a girl's aspirations. Dietary diversity was not associated with any of the aspirations. The findings of this study are particularly timely considering recently launched evidence by the new Lancet maternal and child nutrition series that shows that, despite some nutritional progress over the past decades, underweight, low stature, and anemia prevalence rates remain unacceptably high amongst girls and women in LMICs, particularly in South Asia (Victora et al., 2021).

Despite results providing support for the nutrition-aspirations nexus, this thesis makes a case for considering the nutrition-aspirations nexus in context. Good nutrition or healthy diets alone will not raise a girl's aspirations in and of themselves. Other factors at the individual level (e.g., self-efficacy, agency, or decision-making power), or within adolescents' everyday-life environment (e.g., important others), as well as broader structural factors (e.g., poverty or infrastructures) are prerequisites.

Interestingly, while it would have been impossible to investigate whether nutritional or dietary diversity status were associated with any of the girls' aspirations during in-

depth interviews, the qualitative results indirectly supported the nutrition-aspirations nexus findings. Upon talking about food and diet-related aspirations, and even though the younger girls wished to eat snack foods rather than traditional meals, all girls mentioned that healthy diets and having enough to eat were of great importance to their futures and for goal achievement. Although for many girls, except for mothers, questions about food and nutrition were perceived as the least interesting, food and health were believed to be fundamental to achieving aspirations. In other words, being able to consume healthy food and staying healthy were less seen as aspirations than as means to achieving goals. Hence, while in this study it was assumed that educational, occupational, and family formation aspirations carried the same importance as health- and nutrition-related aspirations, girls perceived health and nutrition aspirations as prerequisites for and underlying other aspirations.

In conclusion, good nutrition and healthy diets - alongside poverty eradication, addressing social inequalities, ensuring social support, and quality educational opportunities - are important building blocks for adolescent girls' aspirations as drivers of progress throughout the life course. Further research that revisits methods and indicators, to validate the results of this thesis, and that investigates the causal pathways remains important.

Methodological reflections

This study adopted a mixed-methods approach and included a wide range of methods, knowledge, and expertise from both nutrition science and sociology of health. A convergent parallel design was applied, in which qualitative and quantitative data were collected simultaneously, and in parallel with the *SII* panels survey in 2018. This allowed to triangulate and integrate data afterwards, and offered deeper insights in measured constructs (Creswell & Plano Clark, 2017). Additionally, the research components were largely independent, as implementation of one did not depend on the results of the other. The interdisciplinary take on this study in combination with theories on human development and life course sociology, was a major strength of the methodology, for the enabling of considering how time, social, biological, and cultural location affected adolescent nutrition and aspirations individually, as well as the relationships between these two concepts. While Part I of the study served as a foundation for the empirical work, the multiphase study design for Part II was developed in such a way as to enable drawing inferences from both quantitative and qualitative research methods to reach the research objectives. The study design was particularly well-suited to capturing the complexity of adolescents' lives over time.

The mixed-methods approach allowed to investigate the natural world as indicated by objective survey measurements, including measurements of height and weight, hemoglobin

concentration, and 24-hour recalls for calculating dietary diversity. Secondly, methods supported gaining a thorough understanding of the world as seen by adolescents themselves through in-depth interviews. The qualitative part of the study was envisioned to be participative through inviting girls to co-create data by means of timeline drawings and network mapping exercises with wooden peg dolls, to better facilitate sharing unique life stories (Mannay, 2015; Thomson, 2009). This method proved to be particularly useful for working with the youngest adolescents (younger than 15 years) as without the drawings and peg dolls, we would not have gotten into as much detail. At the same time, these methods considerably decreased the power and hierarchical distances between the interviewer and participant (Mannay, 2015).

The combination of methods, tools, and sources of evidence enabled triangulation and corroboration of findings whilst maximizing the strength of both approaches (Creswell & Plano Clark, 2017; DeCuir-Gunby & Schutz, 2016; Koelen, Vaandrager, & Colomér, 2001). It deepened the understanding of the role of the environment in shaping nutritional risks or aspirations, and into underlying processes, influences, challenges, and opportunities for improvements. This may ultimately facilitate achieving developmental goals (Koelen, et al., 2001). The empirical longitudinal data was able to account for transitions. These data showed that growing up follows a dynamic process, and that nutrition and aspirations change over time. The qualitative study shed more light on adolescents' experiences towards growing up in Nepal and provided a deeper understanding of the complex reality of aspirations within everyday life contexts. This method allowed for observing influences on aspirations that were not, or less-easily captured in the surveys.

Like all research, this thesis does not come without its limitations. A first limitation relates to one of the key findings from our systematic review. It was argued that longitudinal studies on adolescent health are rare, but essential for understanding the transition into adulthood, and thereby optimizing health and other developmental outcomes. Therefore, in chapter 6, longitudinal panel data was used. While longitudinal data are preferred over cross-sectional data, we were only able to include two subsequent years. These data did, however, show changes over time related to nutritional indicators as well as aspirations. However, the one-year time span was insufficient to capture changes over longer periods or run more complex models. Longer prolonged surveys, with longer timelines, or experimental designs, are recommended as they are better suited to detect any causality, or track changes in nutritional or other sociocultural and economic transitions into adulthood.

A second limitation relates to the use of selected indicators of nutritional status, dietary diversity, and aspirations. The study adds to previous literature by including a range of adolescent nutrition indicators, including HAZ, stunting, BAZ, thinness, Hb concentration, anemia, and dietary diversity scores. However, they relate to different layers of nutrition and diets and are complexly related. For instance, while HAZ and BAZ are

used as anthropometric measures of nutritional status, Hb and anemia are mainly indicators of micronutrient deficiencies and, if related to iron deficiency, iron deficiency anemia. Both may also reflect poor diets. Dietary diversity scores are indicators of nutrient adequacy or diet quality and a diversified diet is assumed to result in a lower likelihood of developing micro-nutrition deficiencies (Ruel, 2003). Hence, whilst dietary diversity and anemia are likely associated with forms of malnutrition, BAZ is a more direct indicator of immediate nutritional status, and HAZ can be one of the consequences of malnutrition (Leroy, Ruel, Sununtnasuk, & Ahmed, 2018). In a recent study on the challenges of undernutrition indicators during adolescence, the authors argued that racial and ethnic variation, body build, and different timing of growth spurts across populations may complicate assessing the true prevalence of undernutrition. Careful interpretation of indicators of particularly HAZ and BAZ was encouraged, since they may result in over- or under-estimation of thinness and stunting. These concerns also highlight the importance of further developing and validating indicators of adolescent nutrition status and diet quality in LMICs (Tumilowicz, Beal, Neufeld, & Frongillo, 2019). A similar issue relates to the use of DDS and MDD as indicators of dietary diversity for adolescents, which were in this study based on the scores for women (DDS-W and MDD-W). Whilst these indicators have been validated for women of reproductive age and children, consensus has not been reached on whether MDD-W (at least five out of ten food groups) is an appropriate score for children older than five years, or adolescents. Especially considering that adolescent girls' nutritional requirements may be higher than that of adult women (Das et al., 2017).

Third, while the study advances on previous research by including six key domains of aspirations, several methods and tools from existing research and child- and adolescent-health development literature were combined to indicate and measure such aspirations (DHS Program, 2015; Johnston, 2008; Kasser & Ryan, 1996). Validated tools to measure this entire set of aspirations during adolescence are still lacking. We are confident that the indicators of educational, occupational, and family formation aspirations are robust and straight-forward. However, for measuring health and nutrition aspirations, we relied on proxy measures of those aspirations, which eventually proved to be inefficient for several model estimations. Validation of a range of aspiration indicators is another direction for future research. Although our qualitative study provided some important insights into the interrelations between aspirations, future research could benefit from further exploring these interrelations. For instance, one's occupational aspirations are likely influenced by one's educational aspirations. Likewise, aspired ages of having a first child may be dependent on aspired age of marriage.

Fourth, throughout the study, a bio-ecological and life course approach was taken. The aim was to approach the life stage of adolescence as dynamic, in which it was assumed that multiple influences and events (turning points) shape transitions into adulthood (Blum,

Astone, Decker, & Mouli, 2014; Elder, 1998). This study advances on previous studies by focusing on the entire adolescent age range based on the WHO definition of adolescence (10-19 years) (WHO, 2014). With regards to the panel analyses, using this definition lead to a relatively large drop in sample size, since a proportion of the adolescent girls were older than 19 years in 2018 and 2019 and thus excluded from analyses. In addition, although not critical and inherent to longitudinal research, whilst the *SII* panel survey started with 1093 adolescent girls in 2017, in year 2018 and 2019, several girls (around 10%) were lost for follow-up. Another drop in sample size and limitation resulted from the exclusion of cases with uncertain aspirations for statistical analyses on family formation aspirations. Uncertain aspirations are rarely studied, even though they are highly interesting and could be indicative of future outcomes. The only evidence on uncertain aspirations comes from HICs, showing that uncertain occupational aspirations resulted in higher academic performance (Gutman & Schoon, 2012). This contradicted another study on the negative effects of uncertain educational aspirations on educational outcomes (Gutman, Schoon, & Sabates, 2012) and school engagement (Moulton, Flouri, Joshi, & Sullivan, 2018). Future avenues for research on aspirations in LMICs are to investigate the determinants of uncertain aspirations and the potential linkages with undernutrition. This could provide more insights into adolescent girls' lives in Nepal amidst rapid changes and uncertainties related to future lives.

A final limitation concerns the panel analyses for which it was impossible to assess whether stunting recovery during adolescence was associated with an increase in aspirations. This was because of the limited number of periods and the small time span between the two periods, for which theoretically, it was not expected to detect any changes in HAZ, and stunting (Campisi, Carducci, Söder, & Bhutta, 2018). Analyses were also limited to estimations for three aspiration domains only, because of minimal changes in occupational aspirations that left us unable to run robust models. Moreover, despite controlling for a range of (time-varying) factors associated with nutrition and aspirations, it was not possible to account for unobserved factors that may have mediated or moderated the associations. Finally, we were limited to using the nutritional indicators that were included in the Adolescent Girls Panel Surveys. In relation to the second limitation, and to better understand the evidence base on the nutrition-aspirations nexus, it is recommended to consider other indicators of nutrition or diets, including micronutrient deficiencies, such iron, zinc, iodine, and vitamin D, which have been associated with mental health or socio-emotional behaviors (Grantham-McGregor & Smith, 2020). Additionally, for further exploring the associations between anemia and educational aspirations, ferritin levels should be included to determine whether anemia is caused by iron-deficiency, or other causes.

Other directions for future research

In addition to the avenues for future research suggested in the methodological reflections above, the following entry points for future research on adolescent nutrition, adolescents' aspirations, or the adolescent nutrition-aspirations nexus are highlighted:

1. To enable tracing nutritional growth and aspiration development over time, out-of-school, yet unmarried, girls should be included in future research. These girls are often invisible, and a difficult to reach group, possibly restricted by parents, as experienced in our qualitative study. Another option to explore this group's aspirations, is through retrospective research.
2. Future research should investigate, through important others' perspectives, including peers, parents, and teachers, their respective influences on, and roles in shaping adolescent girls' aspirations, as well as nutritional and dietary status and behavior.
3. To further explore the adolescent nutrition-aspirations nexus, there is a need for including other (micro)nutritional biomarkers, as well as indicators of pubertal stage such as Tanner Stages (Tanner & Whitehouse, 1976). Currently used indicators of malnutrition derived from the WHO 2007 Growth Standards, such as thinness and stunting, have recently been subject of discussion and are prone to interpretation challenges (Tumilowicz et al., 2019). Particularly, challenges relate to racial or ethnic variation in growth spurt timings or body build (Tumilowicz et al., 2019). Moreover, indicators of diet quality or nutrient adequacy used in this study have been validated for the adult woman population. However, while several studies have used this as an indicator for the adolescent dietary quality, there is a need for standardized indicators of dietary quality for the adolescent population specifically.
4. To date, still very few studies focus on adolescent boys. In line with the central promise of the 2030 SDGs to *leave no one behind,* we strongly advocate for including boys in studies on adolescent development and to start seeing boys as the future fathers of our coming generations, next to the often-used argument of girls as future mothers.

Implications for policy and practice

Interventions are most effective if they address the specific needs of vulnerable groups in society. By generating insights into adolescents' transition into adulthood in Nepal, this research aimed to contribute to the nutrition agenda and improving the nutrition, wellbeing, and developmental outcomes of adolescent girls. The interdisciplinary nature

of the study facilitated gaining rich insights in risks and opportunities that girls encounter during the adolescence phase. Findings can inform future well-designed, multisectoral, and integrative interventions that adopt life-course and bio-ecological approaches to adolescent health and development. Five key implications for broader adolescent programming in low-income contexts and Nepal are proposed next.

1. Frame programs holistically and within a life course perspective

Findings of this research advocate for a holistic, multidimensional, and integrative approach to sustainably improve livelihoods of adolescents and the next generations. Such an approach is important to steer away from the current focus on microsystems, to addressing broader structural and more distal factors. Poverty-alleviation strategies are essential for the success of such programs. Likewise, improving diet quality or nutrient intake alone is not enough to achieve nutritional or aspirational goals. At the time of writing, the new Lancet series on Maternal and Child Nutrition was launched in which a new framework was proposed for combating malnutrition (Keats et al., 2021). The series highlighted that it is important to start addressing social inequalities as one of the root causes of undernutrition. So far, this has earned less attention than it deserved. It also advocated for including cross-cutting themes, such as health care and food system strengthening, agriculture, social protection, water, sanitation, and hygiene, and community mobilization as potential important strategies (Keats et al., 2021). A holistic view on adolescent development also implies adopting a life course approach (Buchmann & Steinhoff, 2017). It is essential to act on differences between adolescents and consider age, sex, marital status, school status, and maternal status when designing policies and interventions. Treating adolescents as one group, or adolescence as one life stage, will only result in leaving people behind. Findings of this study have shown that agency is an important asset to both nutrition as well as aspirations. However, solely raising adolescents' self-efficacy or sense of agency, may not be a solution to improve nutritional status, nor aspirations. Because agency works within the boundaries of adolescents' everyday life environments, life-skills programs should consider the limitations and opportunities in living environments, as well as the role of others. Moreover, such programs should be combined with addressing the more structural determinants as well.

2. Promote meaningful engagement of adolescents and their important others

To help adolescents flourish, it is vital to understand and prioritize their needs, hopes, and stories. It is important to work *with* adolescents, and engage them in designing, implementing and evaluating programs that aim to improve adolescent health and wellbeing. In addition to prioritizing adolescents as key stakeholders and engaging them in any effort that contributes to improving *their* wellbeing, it is important to also consider

the role of adolescents' important others. The study's findings showed that parents, older siblings (especially brothers), teachers, and peers play major roles in influencing nutrition, diets, as well as aspirations. Positive peer influences may empower girls. Hence, peer-to-peer approaches, visibility of female role models, positive change stories, and nutrition and aspirations champions can be of major value to programs. Additionally, for programs to succeed, community awareness must translate into supportive communities that empower girls to achieve equality and dream.

3. Start the conversation about aspirations

Opening the conversation about aspirations in a society where it is common for girls to self-silence (Jack, Pokharel, & Subba, 2010) might be one of the most important implications of this study. During data collection for this study, some of the participants spoke about their aspirations for the first time. Just talking about aspirations may empower girls to dream. One reason for this is that "the ability to aspire is one which improves with practice and repetition and diminishes with neglect" (Appadurai, 2004, p. 69). Thus, it is important to foster younger girls' high aspirations and also teach them how to realize these, and what it takes to get there. Moreover, supporting older girls who are at the turning point where they must start navigating between their own aspirations and societal or parental expectations and pressure is important.

4. Learn from positive stories of change

Learning from role models who have managed to navigate aspirations successfully may be highly valuable. For this, it is vital to focus on girls' assets and capabilities within the limits of their everyday life, rather than focusing on barriers only. Positive Deviance or Positive Youth Development approaches could support the development of interventions to improve nutrition or foster aspirations in collaboration with adolescents and communities (Benson, Scales, & Syvertsen, 2011; Marsh, Schroeder, Dearden, Sternin, & Sternin, 2004; Zeitlin et al., 1990). These asset-based approaches focus on what is available within communities and learn from successful outliers. Through mobilizing communities to find role models, and in combination with training programs, these approaches could serve as catalysts to raise community awareness and steer behavior change around adolescent nutrition. This could involve developing and facilitating training programs that support married or out of school girls grow and realize aspirations that are manageable and achievable upon becoming mothers or (newly)weds. Hands-on trainings can provide girls with options to also economically contribute to their households and become more independent, an aspiration many girls held.

5. Keep momentum for investing in adolescent nutrition, wellbeing, and development

Overall, findings of this study stress the need for pushing forward and scaling up investments in adolescent nutrition, wellbeing, and development. So far, as acknowledged at the time of writing (Clark et al., 2021), adolescents have been largely overlooked in programming. Global health challenges of adolescent malnutrition, anemia, or poor diet quality remain. For tackling these challenges and supporting adolescent development, investments in adolescent nutrition and health should be realized alongside investments in other important areas. As noted by Clark and colleagues in a call for action on adolescent wellbeing, it is not enough to just provide access to healthcare, education, or good food. They advocate for integrated programs including five areas of action: "health and optimum nutrition; connectedness, positive values, and contribution to society; safety and a supportive environment; learning, competence, education, skills, and employability; and agency and resilience" (Clark et al., 2021; Ross et al., 2020). The challenge, however, remains to translate these proposed and ambitious ways forward, into manageable and concrete programs.

Concluding remarks

This thesis sheds light on important aspects of adolescent development, as well as the relationship between these aspects. A holistic understanding of adolescent nutrition and aspirations means considering everyday-life environments, and broader relevant societal and structural factors. Several critical life points and social transitions influence adolescent girls' nutritional status as well as their aspirations. Adolescent nutrition and aspirations are always shaped in interaction with important others and under the influence of prevailing sociocultural gendered norms. Good nutrition and optimal growth environments have the potential to nourish hope, thereby opening up an important field of future research. Above all, this thesis aims to build a case for broadening the attention for and acting on the importance of good nutrition for adolescents, and to enable healthy environments for growing adolescents' aspirations. This will ultimately unlock future youth potential and drive longer-term positive health and developmental outcomes. Finally, especially in light of the current COVID-19 pandemic, prioritizing adolescents in this Nutrition Year of Action 2021, is more important than ever (Nutrition for Growth, 2020). The "time is to act is now", (Fore, Dongyu, Beasley, & Ghebreyesus, 2020) to prevent the loss of recent gains and the strides made by the global community towards improving health, nutrition, and wellbeing of young people and future generations.

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Supplementary Materials

Chapter 2

Supplementary Table S2.1. List of countries: World Bank classification of (Low- and Lower-Middle-Income Countries) (LLMICs).

Region	Countries
South/East Asia	Afghanistan, Bangladesh, Bhutan, Nepal, Sri Lanka, Pakistan, India, Cambodia, Indonesia, Kiribati, Korea, Lao PDR, Micronesia, Myanmar, Papua New Guinea, Philippines, Samoa, Solomon Islands, Timor-Leste, Tonga, Vanuatu, Vietnam
Sub-Saharan Africa	Benin, Burkina Faso, Burundi, Cabo Verde, Cameroon, Central Africa, Chad, Comoros, Congo, Cote d'Ivoire, Eritrea, Ethiopia, Gambia, Ghana, Guinea, Kenya, Lesotho, Liberia, Madagascar, Malawi, Mali, Mauritian, Mozambique, Niger, Nigeria, Rwanda, Senegal, Sierra Leone, Somalia, South Sudan, Sudan, Swaziland, Tanzania, Togo, Uganda, Zambia, Zimbabwe
Latin America	Bolivia, El Salvador, Guatemala, Haiti, Honduras, Nicaragua, Sao Tome & Principe

Supplementary Table S2.2. Consequences of undernutrition and micronutrient deficiencies assessed by reviewed articles

Ref	#	Authors	Outcome/consequence of undernutrition and micronutrient deficiency
[53]	u1	Acham et al. (2008)	Learning achievements (grade in school)
[131]	u14	Crookston et al. (2014)	Cognitive skills
[132]	u18	Dercon & Sanchez (2013)	Non-cognitive skills
[80]	u21	Fink & Rockers (2014)	Cognitive skills
[82]	u34	Mukudi (2003)	School performance and attendance
[83]	u37	Omwami et al. (2011)	School attendance
[133]	u45	Riley (1994)	Age at marriage
[134]	m13	Chiplonkar & Kawade (2014)	Cognitive performance [(simple-reaction-time (SRT), recognition-reaction-time (RRT), visual-memory, Raven's Progressive Matrices (RPM) test)] and taste acuity [(recognition-thresholds-for-salt (RTS))].
[135]	m15	Dissanayake et al. (2009)	Academic performance (marks for mathematics, science, Sinhala language and social science) and intelligence (Raven's Standard progressive matrices)
[116]	m19	Gupta et al. (2013)	Academic performance
[61]	m31	Perignon et al. (2014)	Cognitive performance (Raven's Coloured Progressive Matrices (RCPM), block design, picture completion, two standardized tests from the Wechsler Intelligence Scale for Children (WISC-III))
[111]	m38	Teni et al. (2017)	Academic performance (the average academic score in 2012 - 2013)

Supplementary Table S2.3. General characteristics of reviewed studies

General characteristics of study					Study population			Indicators of undernutrition and micronutrient deficiencies examined		Demographic, sociocultural and economic aspects (SCE) studied
Ref	**#**	**1st author**	**Country**	**Study design**	**Age**	**Sex**	**(n)**	**Undernutrition**	**Micronutrient status**	
[53]	u1	Acham et al. (2008)	Uganda	Cross-sectional	9-15	F/M	1003	HAZ, WAZ, BMI-for-age (percentile)		Sex, age
[42]	u2	Adesina et al. (2012)	Nigeria	Cross-sectional	10-19	F/M	960	HAZ, BMI /age (percentiles)		Sex, age, parental occupation and education, SES
[67]	u3	Ahmed et al. (1998)	Bangladesh	Cross-sectional	10-16	F	384	HAZ, BMI-age (percentiles)		Sex, age, household size, income, food expenditure, paternal education and occupation, SES
[44]	u4	Assefa et al. (2015)	Ethiopia	Cohort study	13-16	F/M	2084	HAZ, WHZ (BAZ), WAZ		Sex, age, residence, paternal education, school type, educational level, religion, fertility, occupation, household size, food insecurity
[49]	u5	Ayoola et al. (2009)	Nigeria	Cross-sectional	5-20	F/M	623	HAZ, BAZ		Sex, age, ethnicity
[55]	u6	Bamidele et al. (2011)	Nigeria	Cross-sectional	15-19	F/M	497	W/H (BMI-A (percentiles)		Sex, age, religion, parental occupation, parental education, birth order, marriage type, living with guardians/parents, number of siblings
[79]	u7	Barman et al. (2015)	India	Cross-sectional	15-19	F	300	HAZ, BAZ		Age, SES, family type, religion, literacy level, marital status, educational level, school enrolment
[93]	u8	Belachew et al. (2013)	Ethiopia	Cohort study	13-17	F/M	2084	HAZ		Sex, age, household income, food security, educational level, residence
[91]	u9	Benefice et al. (1999)	Senegal	longitudinal survey	12-14	F	406	HAZ, WHZ, WAZ		Age, migration
[72]	u10	Benefice et al. (2006)	Bolivia	Cross-sectional	0-15	F/M	460	HAZ, WHZ, WAZ		Sex, age, ethnicity
[85]	u11	Bhattachary-ya et al. (2013)	India	Cross-sectional	10-19	F	284	HAZ, W/H (BMI-age) percentiles		Age, literacy level, SES, household size, paternal education

Supplementary Table S2.3. General characteristics of reviewed studies

General characteristics of study					Study population			Indicators of undernutrition and micronutrient deficiencies examined		Demographic, sociocultural and economic aspects (SCE) studied
Ref	**#**	**1st author**	**Country**	**Study design**	**Age**	**Sex**	**(n)**	**Undernutrition**	**Micronutrient status**	
[40]	u12	Bosch et al. (2008)	Bangladesh	Cohort study	0-16	F/M	707	HAZ, BAZ and WAZ		Sex, age
[56]	u13	Cordeiro et al. (2012)	Tanzania	Cross-sectional	10-19	F/M	542	BMI-age and sex percentiles)		Sex, age, food security, religion, orphanage, school attendance/ enrolment, SES, resources
[131]	u14	Crookston et al. (2014)	Multi-Country	Cohort study	8-15	F/M	3375	HAZ		Sex, age, SES, parental education, both parents living in household, birth order, residence, household size
[65]	u15	Dang et al. (2010)	Vietnam	Cross-sectional	6-15	F/M	5640	W/H (BMI-age)		Sex, age, SES, residence
[47]	u16	Dapi et al. (2009)	Cameroon	Cross-sectional	12-16	F/M	581	W/H (BMI-age) H/A percentiles		Sex, age, SES
[86]	u17	Dasgupta et al. (2008)	India	Cross-sectional	7-16	M	2003	HAZ, WHZ (BMI-age) percentiles		Age, parental occupation, parental education, income, birth order, number of siblings, household size, religion, caste, family type
[132]	u18	Dercon & Sanchez (2013)	multi*	Cohort study	7-12	F/M	3300	HAZ		Age, sex
[89]	u19	Ene-Obong et al. (2012)	Nigeria	Cross-sectional	10-18	F/M	893	W/H, BAZ		Sex, age, SES, residence, income, literacy level
[78]	u20	Fentiman et al. (2001)	Ghana	Cross-sectional	0-18	F/M	4708	HAZ, WHZ, WAZ		Sex, age, parental education, household size, resources, religion, marital status, school enrolment
[80]	u21	Fink & Rockers (2014)	multi*	Cohort study	8-15	F/M	3604	HAZ		Sex, age, school attendance/ enrolment attainment, paternal education, household resources,
[73]	u22	Garnier et al. (2003)	Senegal	Cohort study	14-16	F	330	HAZ, WAZ, BAZ		Age, living with guardian or parents, birth order, education, migration, residence, SES, hygiene

General characteristics of study					Study population			Indicators of undernutrition and micronutrient deficiencies examined		Demographic, sociocultural and economic aspects (SCE) studied
Ref	#	1st author	Country	Study design	Age	Sex	(n)	Undernutrition	Micronutrient status	
[95]	u23	Izutsu et al. (2006)	Bangladesh	Cross-sectional	11-18	F/M	324	BAZ		Sex, age, residence, mental health, religion, ethnicity, educational status, literacy status, occupational status, household income and size
[81]	u24	Joshi et al. (2005)	Nepal	Cross-sectional	14-19	F	426	HAZ, BAZ, WAZ		Age, household resources, income, educational level, paternal education and occupation, work status SES
[90]	u25	Joshi et al. (2014)	India	Cross-sectional	10-19	F	200	(W/H) BAZ > CED		Age, SES
[69]	u26	Khongsdier et al. (2003)	India	Cross-sectional	3-18	M	1351	HAZ, BAZ, WAZ		Age, household income, occupation, resources, SES, religion
[57]	u27	Khongsdier & Mukherjee (2005)	India	Cross-sectional	9-16	F/M	1733	W/H, (BAZ > CED) percentiles		Sex, age, religion, household income, resources
[59]	u28	Lardner et al. (2015)	Ghana	Cross-sectional	5-12	F/M	411	WHZ (BMI-for-age (thinness), HAZ		Age, sex, residence
[68]	u29	Leslie & Pawloski (2010)	Mali	Cross-sectional	10-17	F	1157	HAZ, WAZ, BAZ		Age, no. women, number of servants, SES, distance to market, number people in urban area
[94]	u30	Maiti et al. (2011)	India	Cross-sectional	10-14	F	2545	HAZ, WAZ, BAZ		Age, residence
[45]	u31	Melaku et al. (2015)	Ethiopia	Cross-sectional	10-19	F/M	348	HAZ and BAZ		Sex, age, parental education, residence, household size, sanitation, resources, birth order, number of siblings, religion, paternal occupation
[92]	u32	Miyoshi et al. (2005)	Lao PDR	Cross-sectional	3-15	F/M	1075	HAZ, WHZ, WAZ, MUAC-for-height		Sex, age, SES, food security
[48]	u33	Mondal et al. (2012)	India	Cross-sectional	6-16	F/M	725	HAZ, WAZ		Sex, age, ethnicity, household income, paternal occupation, resources, no. siblings

Supplementary Table S2.3. General characteristics of reviewed studies

General characteristics of study					Study population			Indicators of undernutrition and micronutrient deficiencies examined		Demographic, sociocultural and economic aspects (SCE) studied
Ref	**#**	**1st author**	**Country**	**Study design**	**Age**	**Sex**	**(n)**	**Undernutrition**	**Micronutrient status**	
[82]	u34	Mukudi (2003)	Kenya	Cross-sectional	10-20	F/M	851	HAZ, WHZ, WAZ		Sex, age, residence, school type
[60]	u35	Mulugeta et al. (2009)	Ethiopia	Cross-sectional	10-19	F	211	HAZ, BAZ and percentiles		Age, residence, drinking water, latrines household resources, home gardening, food security
[41]	u36	Omigbodun et al. (2010)	Nigeria	Cross-sectional	10-19	F/M	1799	HAZ, WAZ, WHZ (BAZ)		Sex, age, school type, maternal occupation, number of siblings
[83]	u37	Omwami et al. (2011)	Kenya	RCT	5-15	F/M	554	HAZ, WHZ, WAZ		Sex, age, SES
[71]	u38	Panter-Brick et al. (1996)	Nepal	Cross-sectional	6-14	M	307	HAZ, WHZ, WAZ		Age, ethnicity, living with parents, household size, birth order, no. siblings
[84]	u39	Patimah et al. (2016)	Indonesia	Cross-sectional	14-18	F	601	HAZ, WAZ		Age, number of siblings, household size, pocket money, SES, paternal occupation, parental education,
[76]	u40	Pawloski et al. (2008)	Mali	Cross-sectional	10-17	F	1103	HAZ		Age, SES, household resources, food prices market, no. siblings/sisters, no. women, number of servants, residence, school attendance, paternal occupation
[70]	u41	Rah et al. (2009)	Bangladesh	Cohort study	12-19	F	665	HAZ, WHZ/BAZ percentile, WAZ		Age, SES, hygiene
[54]	u42	Rahman & Karim (2014)	Bangladesh	Cross-sectional	10-17	F/M	796	HAZ, BAZ/CED		Sex, age, parental occupation, education, income, household size, birth order, no. siblings, ethnicity
[52]	u43	Raj et al. (2009)	India	Cohort study	5-16	F/M	12129	W/H/BMI percentiles		Sex, age, school type, residence

General characteristics of study					Study population			Indicators of undernutrition and micronutrient deficiencies examined		Demographic, sociocultural and economic aspects (SCE) studied
Ref	#	1st author	Country	Study design	Age	Sex	(n)	Undernutrition	Micronutrient status	
[51]	u44	Rao et al. (2006)	India	Cross-sectional	10-17	F	12789	HAZ, WHZ, WAZ, BMI percentiles		Age, religion, family type, household size, occupancy, house type, household resources, occupation, per capita income, age at marriage, residence
[133]	u45	Riley (1994)	Bangladesh	longitudinal survey	10-20	F	1500	HAZ		Age, marital status, fertility
[87]	u46	Roba et al. (2016)	Ethiopia	Cross-sectional	15-19	F	726	HAZ, BAZ		Age, marital status, ethnicity, religion, parental education, school type, occupation, family size, household income, water and sanitation, income, use of pocket money, time use
[39]	u47	Sellen (2000)	Tanzania	cross-sectional	0-16	F/M	308	HAZ, WHZ, WAZ		Sex, age
[62]	u48	Senbanjo et al. (2011)	Nigeria	Cross-sectional	5-19	F/M	570	HAZ		Sex, age, residence, family type, household composition, school type, parental education, SES
[50]	u49	Venkaiah et al. (2002)	India	Cross-sectional	14-17	F/M	12124	HAZ, W/H (BMI percentiles)		Sex, age, religion, family type, household size, ethnicity, literacy level, occupation, household resources, occupation, income, marital status
[88]	u50	Wickramasinghe et al. (2004)	Sri Lanka	Cross-sectional	8-12	F/M	1266	HAZ, WHZ (BMI percentiles), WAZ		Sex, age, school type
[63]	u51	Wolde et al. (2015)	Ethiopia	Cross-sectional	7-14	F/M	450	HAZ, BAZ, WAZ		Sex, age, ethnicity, religion, parental occupation, parental education, household size, household income, household food security, personal hygiene
[75]	u52	Yamanaka &Ashworth (2002)	Nepal	Cross-sectional	6-17	F/M	237	HAZ, BAZ, WAZ		Sex, age, workload, food intake, time allocation

Supplementary Table S2.3. General characteristics of reviewed studies

General characteristics of study					Study population			Indicators of undernutrition and micronutrient deficiencies examined		Demographic, sociocultural and economic aspects (SCE) studied
Ref	**#**	**1st author**	**Country**	**Study design**	**Age**	**Sex**	**(n)**	**Undernutrition**	**Micronutrient status**	
[58]	u53	Yetubie et al. (2010)	Ethiopia	Cross-sectional	10-19	F/M	425	BMI percentiles (W/H)		Sex, age, marital status, household size, parental education, parental occupation, household income, household resources
[106]	m1	Ahankari et al. (2017)	India	Cross-sectional	13-17	F	1010		Hb	land holdings, no. of siblings), school dropout, religion, caste
[113]	m2	Ahmed et al. (1997)	Bangladesh	Cross-sectional	12-19	F	388		Hb, serum retinol and serum total protein	Education level, family size), household income age
[127]	m3	Ahmed et al. (2000)	Bangladesh	Cross-sectional	11-16	F	548		Hb, serum ferritin (SF), transferrin saturation (TS), TIBC, serum retinol	Age, parental education, parental occupation, family size, farmland size, household income, housing conditions
[114]	m4	Ahmed et al. (2006)	Bangladesh	Cross-sectional	11-16	M	381		Hb, serum retinol	Age, parental education, parental occupation, family size, per capital income, per capital expenditure
[121]	m5	Ahmed et al. (2009)	Bangladesh	Cross-sectional	12-15	F	225		Serum retinol, serum, α-tocopherol, plasma vitamin C, serum Zn, serum, Cu, total cholesterol and serum protein	Age, family size, family income, per capita food expenditure, parental education and occupation
[130]	m6	Ara et al. (2000)	Bangladesh	Cross-sectional	13-19	F	354		Urinary iodine (Spot urine)	Educational level, household asset index; land holding
[115]	m7	Ayogu et al. (2015)	Nigeria	Cross-sectional	10-15	F/M	303		Hb	Age, birth order, frequency of illness, family size, type of toilet in house
[128]	m8	Barugahara et al. (2013)	Uganda	Cross-sectional	11-14	F	109		Hb	Age, rural vs. urban residence
[107]	m9	Bharati et al. (2009)	India	Cross-sectional	10-19	F	177670		Hb	Age, marital status, urban vs. rural residence), ethnicity, religion, caste Standard of Living Index (SLI)
[108]	m10	Biradar et al. (2012)	India	Cross-sectional	10-19	F	840		Hb	Age and SES

General characteristics of study					Study population			Indicators of undernutrition and micronutrient deficiencies examined		Demographic, sociocultural and economic aspects (SCE) studied
Ref	#	1st author	Country	Study design	Age	Sex	(n)	Undernutrition	Micronutrient status	
[119]	m11	Bulliyya et al. (2007)	India	Cross-sectional	11-19	F	1937		Hb	Age, religion, community, literacy, family type (nuclear/ joint), parental literacy, family size, type of house, house electrification, sanitary latrine, household income
[109]	m12	Chellan & Paul (2010)	India	Cross-sectional	10-19	F	311793		Hb	Age, religion, residence, caste, marital status, birth order, maternal age, educational status, maternal education, standard of living
[134]	m13	Chiplonkar & Kawade (2014)	India	Cross-sectional	10-16	F	403		Hb, Plasma Zn (and erythrocyte Zn	Age, family size, parental education and occupation
[96]	m14	Choe et al. (2001)	South-Korea	Cross-sectional comparative	16-17	F/M	660		Hb, SF, TIBC, serum: iron, folic acid, B12 and immunoglobulin G antibody,	Age, parental education and occupation, type of house, Hollingshead index, household size, crowding index, and housing tenure (owned or rented)
[135]	m15	Dissanayake et al. (2009)	Sri Lanka	Cross-sectional comparative (iron deficient vs. iron sufficient students)	13-15	F/M	188		Hb, SF, serum Zn and T4	Birth order, occupational ambition, educational ambition, enthusiasm towards education, mental health status, problems at home, love affair, hours spent on studies, extra-curriculum activities, hours spent on extra-curriculum activities, distance to school, SES, parental education, parental occupation, availability of electricity
[103]	m16	Ene-Obong et al. (2003)	Nigeria	Cross-sectional	10-20	F/M	600		Plasma retinol and serum vitamin C	Age, sex, school type nutrition knowledge, household size
[64]	m17	Friedman et al. (2005)	Philippines	Cross-sectional	7-30	F/M	729	HAZ	Hb	Age, sex, SES

Supplementary Table S2.3. General characteristics of reviewed studies

General characteristics of study					Study population			Indicators of undernutrition and micronutrient deficiencies examined		Demographic, sociocultural and economic aspects (SCE) studied
Ref	**#**	**1st author**	**Country**	**Study design**	**Age**	**Sex**	**(n)**	**Undernutrition**	**Micronutrient status**	
[168]	m18	Geissler et al. (1998)	Kenya	Cross-sectional	13-18	F/M	156		Hb, SF, and WBC	Age, sex, parental education, parental occupation, source of income, family size
[116]	m19	Gupta et al. (2013)	India	Cross-sectional	10-19	F/M	406		Hb	Age, Sex, family type (nuclear or joint), religion, birth order, caste, hand washing SES, educational status, parental occupation and education
[100]	m20	Hall et al. (2009)	Multi-country	Cross-sectional	7-19	F/M	1400		Hb	Age, sex, school type, school grade, country, location within country, age-for-grade (index of late school enrolment)
[98]	m21	Jani et al. (2015)	India	Cross-sectional	10-17	F/M	244		Hb, red blood cell (RBC) folate,	Age, sex
[124]	m22	Kim et al. (2014)	South-Korea	Cross-sectional	10-18	F	1312		Hb, SF, full blood count (RBC, WBC, Hct),	Age, urban vs. rural residence household income
[102]	m23	Kim et al. (2014)	South-Korea	Cross-sectional	10-18	F/M	2062		25(OH)D	Age, sex, season, urban vs. rural residence
[129]	m24	Korkalo et al. (2015)	Mozambique	Cross-sectional	14-19	F	551		Hb, SF, serum selenium, plasma retinol, serum folate, and urinary iodine	Age, literacy, urban vs. rural residence
[117]	m25	Kulkarni et al. (2012)	India	Cross-sectional	10-19	F	272		Hb	Age, educational level, family type, SES, maternal occupation
[104]	m26	Laxmaiah et al. (2013)	India	Cross-sectional	10-19	F/M	6616		Hb	Age, sex, community (Scheduled Caste (SC) or Scheduled Tribes (ST)), maternal education, occupation household head, household size, sanitary latrine
[105]	m27	Lee et al. (2014)	South-Korea	Cross-sectional	12-18	F/M	1510		25(OH)D	Age, sex, season, educational level
[125]	m28	Lee et al. (2015)	South-Korea	Cross-sectional	10-20	F/M	1510		25(OH)D, Hb, SF, TIBC	Age, sex, annual household income

General characteristics of study					Study population			Indicators of undernutrition and micronutrient deficiencies examined		Demographic, sociocultural and economic aspects (SCE) studied
Ref	#	1st author	Country	Study design	Age	Sex	(n)	Undernutrition	Micronutrient status	
[110]	m29	Leenstra et al. (2004)	Kenya	Cross-sectional	12-18	F	648		Hb, SF, red cell indices (mean corpuscular volume (MCV), mean corpuscular hemoglobin (MCH), and mean corpuscular hemoglobin concentration (MCHC)	Age, residence, bed net use, parental schooling, and SES of caretaker,
[74]	m30	Mahmud et al. (2013)	Ethiopia	Cross-sectional	10-15	F/M	431	HAZ, BAZ	Hb	Age, sex, urban vs. rural residence personal hygiene, household size, latrine use, water source
[61]	m31	Perignon et al. (2014)	Cambodia	Cross-sectional	6–16	F/M	2443	HAZ	Hb, SF, transferrin receptor, RBP, serum Zn, urinary iodine	Age, sex, household income, educational status caretaker
[123]	m32	Puri et al. (2008)	India	Cross-sectional	6-18	F	3127		25(OH)D, serum Ca, P, alkaline phosphatase	Age, family type, time spent on outdoor activities, occupation of caretaker, SES household head
[101]	m33	Rakesh et al. (2015)	India	Cross-sectional	?	F/M	3200		Hb	Age, sex, school type (government or management),
[118]	m34	Rani & Suryaprabha (2013)	India	Cross-sectional	11-19	F	760		Hb	Age, urban vs. rural residence, educational status, marital status, parental occupation and education, religion
[99]	m35	Sahu et al. (2009)	India	Cross-sectional	10-20	F/M	121		25(OH)D, serum Ca, serum alkaline phosphatase	Age, season, family size
[112]	m36	Soekarjo et al. (2001)	Indonesia	Cross-sectional	12-15	F/M	6486		Hb,	Age, sex, school type (General or Islamic school), parental education
[122]	m37	Soekarjo et al. (2004)	Indonesia	RCT	12-15	F/M	3616		Hb, serum retinol	Age, sex, parental education
[111]	m38	Teni et al. (2017)	Ethiopia	Cross-sectional	10-19	F	442		Hb	Age, religion, mode of transport to school, marital status parents, sex household head, workload, number of days absent from home, parental education, availability of toilet at home

Supplementary Table S2.3. Continued

General characteristics of study					Study population			Indicators of undernutrition and micronutrient deficiencies examined		Demographic, sociocultural and economic aspects (SCE) studied
Ref	**#**	**1st author**	**Country**	**Study design**	**Age**	**Sex**	**(n)**	**Undernutrition**	**Micronutrient status**	
[97]	m39	Tesfaye et al. (2015)	Ethiopia	Cross-sectional	12-19	F/M	408		Hb	Age, sex, parental education and occupation, household size, monthly income
[120]	m40	Thoradeniya et al. (2006)	Sri Lanka	Cross-sectional	15-18.9	F	277		Hb, SF, serum folic acid, serum B_{12}, folate intake	Age, educational status, monthly income, household size, SES
[126]	m41	Tupe et al. (2009)	India	Cross-sectional	15-19	F	173		Hb, SF, nutrient intake	Age, daily workload, occupational status, household size
[46]	um1	Ayogu et al. (2016)	Nigeria	Cross-sectional	12-18	F/M	400	HAZ, BAZ	Hb, parked cell volume (PCV), serum retinol	Age, sex, family income, household size, parental occupation
[77]	um2	Beasley et al. (2000)	Tanzania	Cross-sectional	7-12	F/M	441	HAZ and WAZ	Hb	Sex, age, housing condition (type, ownership), SES and household possessions
[43]	um3	Lanerolle-Dias et al. (2012)	Sri Lanka	Cross-sectional/ RCT	15-19	F	600	BMI	Hb, SF, serum Zn, serum folate and vitamin B_{12}	Age, marital status, working status, household income, age/ level of dropping out of school
[66]	um4	Teji et al. (2016)	Ethiopia	Cross-sectional	10-19	F	547	HAZ, BAZ	Hb	Age, food security, residence, living with parents, paternal occupation, breadwinner, source of drinking water, parental education

Chapter 6

Supplementary table S6.1. Regression models (main-effects) for predicting educational (linear) and occupational (logistic) aspirations for 2018 and 2019 separately

	Aspired years of education (if in school)			**Aspired years of education (if in school)**			**Aspired job (professional skilled, vs. no-low skilled job)**			
	2018	2018		2019	2019		2018		2019	
	b [SE]	β *[SE]*	*p*	*b [SE]*	β *[SE]*	*p*	*aOR [CI]*	*p*	*aOR [CI]*	*p*
N observations	559	559		531	531		613		613	
Predictors										
Block 1: Control variables										
Age in years	-0.17 [0.08]	-0.54 [0.26]	0.038	-0.28 [0.08]	-0.86 [0.25]	0.0010	0.85 [0.72;1.00]	0.057	0.78 [0.66;0.91]	0.0020
School status (out-school=ref)	..	..	..	..	..	..	13.57 [3.03;60.73]	0.0010	14.36 [5.77;35.70]	<0.0001
Highest no. of years education	0.53 [0.08]	1.29 [0.19]	<0.0001	0.49 [0.07]	1.23 [0.18]	<0.0001	1.13 [0.96;1.32]	0.15	1.32 [1.14;1.53]	<0.0001
Marital status (unmarried=ref)	..	..	..	..	..	..	0.64 [0.15;2.80]	0.55	1.07 [0.36;3.17]	0.90
Total self-efficacy score	0.05 [0.03]	0.22 [0.13]	0.11	0.09 [0.02]	0.39 [0.10]	<0.0001	1.04 [0.99;1.10]	0.14	1.01 [0.96;1.07]	0.61
Caste/ethnicity (socially-excluded=ref)										
Brahmin/Chhetri	0.19 [0.25]	0.19 [0.25]	0.45	0.46 [0.21]	0.46 [0.21]	0.031	1.24 [0.76;2.03]	0.39	0.88 [0.54;1.43]	0.60
other	-0.56 [0.45]	-0.56 [0.45]	0.22	-0.22 [0.40]	-0.22 [0.40]	0.59	1.09 [0.54;2.22]	0.80	1.27 [0.59;2.75]	0.55
Household wealth quintiles (lowest=ref)										
2nd lowest	0.20 [0.36]	0.20 [0.36]	0.58	0.28 [0.34]	0.28 [0.34]	0.42	2.49 [1.30;4.79]	0.0060	0.87 [0.42;1.80]	0.72
middle	0.83 [0.36]	0.83 [0.36]	0.024	0.61 [0.35]	0.61 [0.35]	0.089	2.27 [1.14;4.51]	0.020	0.82 [0.41;1.65]	0.57
2nd highest	1.09 [0.42]	1.09 [0.42]	0.010	1.18 [0.40]	1.18 [0.40]	0.0030	2.26 [1.13;4.51]	0.021	1.12 [0.52;2.40]	0.77
highest	1.24 [0.54]	1.24 [0.54]	0.022	1.23 [0.41]	1.23 [0.41]	0.0030	3.44 [1.19;9.91]	0.022	1.27 [0.56;2.75]	1.00
Household size	-0.06 [0.04]	-0.16 [0.11]	0.16	-0.07 [0.04]	-0.19 [0.10]	0.073	1.02 [0.90;1.15]	0.76	1.01 [0.93;1.09]	0.89
Household head's highest education in years	0.03 [0.03]	0.13 [0.10]	0.21	0.00 [0.02]	0.01 [0.09]	0.91	1.02 [0.96;1.08]	0.50	1.05 [0.99;2.11]†	0.082
Agro-ecological zone of residence (*Terai*=ref)										
hills	0.45 [0.30]	0.45 [0.30]	0.14	0.36 [0.32]	0.36 [0.32]	0.24	1.24 [0.78;1.98]	0.36	1.04 [0.60;1.80]	0.88
mountains	0.66 [0.41]	0.66 [0.41]	0.11	1.38 [0.36]	1.38 [0.36]	<0.0001	1.19 [0.61;2.31]	0.62	1.21 [0.54;2.70]	0.64
Pseudo R^2	0.18	0.18	..	0.21	0.21	..	0.19	..	0.25	..
Block 2: Nutritional and dietary diversity indicators										
Age in years	-0.25 [0.10]	-0.77 [0.30]	0.011	-0.22 [0.08]	-0.69 [0.26]	0.0080	0.82 [0.68;0.99]	0.037	0.78 [0.65;0.95]	0.012
School status (out-school=ref)	..	..	..	..	..	..	15.10 [3.30;69.13]	<0.0001	14.76 [5.84;37.34]	<0.0001
Highest no. of years education	0.52 [0.08]	1.28 [0.20]	<0.0001	0.45 [0.07]	1.13 [0.18]	<0.0001	1.10 [0.93;1.30]	0.28	1.33 [1.14;1.54]	<0.0001

Supplementary table S6.1. Continued

	Aspired years of education (if in school)			Aspired years of education (if in school)			Aspired job (professional skilled, vs. no-low skilled job)			
	2018	2018		2019	2019		2018		2019	
	b [SE]	β *[SE]*	*p*	*b [SE]*	β *[SE]*	*p*	*aOR [CI]*	*p*	*aOR [CI]*	*p*
Marital status (unmarried=ref)	..	..	..	..	..	..	0.62 [0.14;2.67]	0.52	1.06 [0.36;3.09]	0.92
Total self-efficacy score	0.05 [0.03]	0.21 [0.13]	0.12	0.08 [0.02]	0.37 [0.12]	0.0010	1.04 [0.99;1.09]	0.16	1.01 [0.96;1.07]	0.66
Caste/ethnicity (socially-excluded=ref)										
Brahmin/Chhetri	0.26 [0.26]	0.26 [0.26]	0.33	0.45 [0.22]	0.45 [0.22]	0.039	1.29 [0.76;2.20]	0.34	0.86 [0.53;1.39]	0.53
other	-0.51 [0.46]	-0.51 [0.46]	0.28	-0.10 [0.40]	-0.10 [0.40]	0.79	1.11 [0.55;2.26]	0.76	1.26 [0.58;2.74]	0.57
Household wealth quintiles (lowest=ref)										
2nd lowest	0.16 [0.35]	0.16 [0.35]	0.65	0.30 [0.34]	0.30 [0.34]	0.38	2.25 [1.30;4.81]	0.0060	0.88 [0.42;1.83]	0.73
middle	0.77 [0.36]	0.77 [0.36]	0.032	0.64 [0.35]	0.64 [0.35]	0.069	2.26 [1.15;4.47]	0.019	0.80 [0.39;1.65]	0.55
2nd highest	1.04 [0.42]	1.04 [0.42]	0.014	1.20 [0.39]	1.20 [0.39]	0.0030	2.18 [1.09;4.35]	0.027	1.12 [0.53;2.40]	0.76
highest	1.17 [0.53]	1.17 [0.53]	0.029	1.18 [0.41]	1.18 [0.41]	0.0040	3.36 [1.14;9.90]	0.028	0.91 [0.35;2.33]	0.84
Household size	-0.06 [0.04]	-0.18 [0.11]	0.11	-0.07 [0.04]	-0.19 [0.11]	0.074	1.02 [0.91;1.16]	0.70	1.01 [0.94;1.09]	0.76
Household head's highest education in years	0.03 [0.02]	0.13 [0.10]	0.18	0.00 [0.02]	0.00 [0.02]	0.99	1.02 [0.96;1.08]	0.49	1.05 [0.99;1.10]	0.10
Agro-ecological zone of residence (*Terai*=ref)										
hills	0.53 [0.32]	0.53 [0.32]	0.10	0.37 [0.30]	0.37 [0.30]	0.22	1.07 [0.64;1.80]	0.80	0.87 [0.49;1.54]	0.63
mountains	0.78 [0.47]	0.78 [0.47]	0.10	1.23 [0.39]	1.23 [0.39]	0.0020	0.91 [0.41;2.01]	0.81	0.93 [0.40;2.17]	0.87
Height-for-age z-score (HAZ)	-0.06 [0.13]	-0.05 [0.12]	0.66	0.29 [0.13]	0.26 [0.11]	0.027	1.03 [0.82;1.29]	0.83	1.03 [0.81;1.31]	0.80
BMI-for-age z-score (BAZ)	-0.07 [0.13]	-0.07 [0.13]	0.56	-0.02 [0.12]	-0.03 [0.12]	0.83	1.05 [0.83;1.34]	0.68	1.10 [0.88;1.38]	0.41
Adjusted hemoglobin (g/dL)	-0.10 [0.10]	-0.14 [0.13]	0.31	-0.00 [0.08]	-0.00 [0.11]	0.97	1.15 [0.96;1.37]	0.14	1.20 [1.01;1.43]	0.036
Dietary Diversity Score Women (DDS-W)	0.07 [0.10]	0.09 [0.12]	0.46	0.15 [0.08]	0.19 [0.10]	0.074	1.02 [0.84;1.24]	0.84	1.01 [0.84;1.21]	0.91
Reached menarche (no=ref)	0.47 [0.32]	0.47 [0.32]	0.14	-0.12 [0.32]	-0.12 [0.32]	0.71	1.57 [0.87;2.82]	0.13	0.99 [0.45;2.20]	0.99
Hosmer-Lemeshow test	..	..	..	..	..	..	$\chi2$: 3.87(8) p=0.87		$\chi2$: 5.99(8) p=0.65	
Pseudo R^2	0.19	0.19	..	0.23	0.23	..	0.20		0.25	
Change R^2	0.01	0.01	..	0.02	0.02	..	0.01		0.01	

Table notes: For educational aspiration: unstandardized beta (b) and standardized beta coefficients (β) reported with SE in brackets. For occupational aspirations: aOR with CI in brackets reported. Standard errors clustered at the primary sampling unit.

Supplementary table S6.2. Linear regression models (main-effects) for predicting aspired ages of first marriage and a first child for 2018 and 2019 separately

	Aspired age of first marriage (if unmarried)						**Aspired age of first child (if no children)**					
	2018			2019			2018			2019		
	b [SE]	β *[SE]*	*p*	*b [SE]*	β *[SE]*	*p*	*b [SE]*	β *[SE]*	*p*	*b [SE]*	β *[SE]*	*p*
N observations	534	534		526	526		324	324		364	364	
Predictors												
Block 1: control variables												
Age in years	-0.05 [0.07]	-0.16 [0.22]	0.47	-0.17 [0.08]	-0.54 [0.25]	0.033	-0.19 [0.10]	-0.59 [0.33]	0.072	-0.30 [0.11]	-0.93 [0.35]	0.010
School status (out-school=ref)	-0.21 [0.61]	-0.21 [0.61]	0.73	0.35 [0.50]	0.35 [0.50]	0.49	1.44 [0.66]	1.44 [0.66]	0.031	2.00 [0.54]	2.00 [0.54]	<0.0001
Highest no. of years education	0.20 [0.07]	0.50 [0.18]	0.0050	0.32 [0.06]	0.80 [0.16]	<0.0001	0.15 [0.12]	0.36 [0.29]	0.21	0.27 [0.09]	0.69 [0.22]	0.002
Total self-efficacy score	0.01 [0.02]	0.05 [0.11]	0.64	0.08 [0.03]	0.36 [0.13]	0.0060	0.01 [0.04]	0.06 [0.06]	0.75	0.13 [0.03]	0.59 [0.14]	<0.0001
Caste/ethnicity (socially-excluded=ref)												
Brahmin/Chhetri	-0.07 [0.21]	-0.07 [0.21]	0.74	-0.28 [0.24]	-0.28 [0.24]	0.235	-0.24 [0.29]	-0.24 [0.29]	0.40	-0.25 [0.33]	-0.25 [0.33]	0.44
other	-0.78 [0.37]	-0.78 [0.37]	0.038	-0.65 [0.36]	-0.65 [0.36]	0.076	-1.07 [0.43]	-1.07 [0.43]	0.014	-0.02 [0.39]	-0.02 [0.39]	0.96
Household wealth quintiles (lowest=ref)												
2nd lowest	0.07 [0.31]	0.07 [0.31]	0.84	0.05 [0.31]	0.05 [0.31]	0.86	-0.08 [0.38]	-0.08 [0.38]	0.84	-1.18 [0.42]	-1.18 [0.42]	0.0060
middle	0.65 [0.32]	0.65 [0.32]	0.045	0.11 [0.35]	0.11 [0.35]	0.75	1.31 [0.51]	1.31 [0.51]	0.010	-0.84 [0.42]	-0.84 [0.42]	0.044
2nd highest	1.01 [0.37]	1.01 [0.37]	0.0070	0.72 [0.41]	0.72 [0.41]	0.085	0.73 [0.48]	0.73 [0.48]	0.14	-0.09 [0.47]	-0.09 [0.47]	0.85
highest	1.16 [0.49]	1.16 [0.49]	0.019	0.97 [0.44]	0.97 [0.44]	0.030	1.92 [0.68]	1.92 [0.68]	0.0050	0.13 [0.57]	0.13 [0.57]	0.83
Household size	-0.03 [0.03]	-0.09 [0.09]	0.31	-0.02 [0.04]	-0.06 [0.12]	0.63	0.02 [0.06]	0.06 [0.17]	0.71	-0.02 [0.06]	-0.05 [0.15]	0.76
Household head's highest education in years)	0.02 [0.03]	0.07 [0.10]	0.49	0.06 [0.03]	0.25 [0.12]	0.044	0.06 [0.04]	0.22 [0.15]	0.13	0.06 [0.04]	0.25 [0.15]	0.10
Agro-ecological zone of residence (*Terai*=ref)												
hills	-0.29 [0.25]	-0.29 [0.25]	0.26	0.16 [0.32]	0.06 [0.32]	0.60	0.06 [0.37]	0.06 [0.37]	0.87	-0.51 [0.38]	-0.51 [0.38]	0.18
mountains	-0.14 [0.38]	-0.14 [0.38]	0.71	0.91 [0.43]	0.91 [0.43]	0.036	0.36 [0.48]	0.36 [0.48]	0.46	0.33 [0.46]	0.33 [0.46]	0.47
Pseudo R^2	0.10			0.14			0.16			0.23		
Block 2: Nutrition and dietary diversity												
Age in years	-0.03 [0.08]	-0.09 [0.24]	0.72	-0.13 [0.09]	-0.42 [0.28]	0.14	-0.20 [0.12]	-0.62 [0.37]	0.093	-0.30 [0.12]	-0.95 [0.28]	0.013
School status (out-school=ref)	-0.21 [0.61]	-0.21 [0.61]	0.73	0.34 [0.52]	0.34 [0.52]	0.51	1.27 [0.70]	1.27 [0.70]	0.072	1.84 [0.55]	1.84 [0.55]	0.0010
Highest no. of years education	0.21 [0.07]	0.51 [0.18]	0.0050	0.31 [0.07]	0.78 [0.18]	<0.0001	0.17 [0.12]	0.42 [0.29]	0.15	0.30 [0.09]	0.76 [0.23]	0.0010
Total self-efficacy score	0.01 [0.02]	0.06 [0.11]	0.59	0.08 [0.03]	0.34 [0.13]	0.0090	0.01 [0.04]	0.05 [0.18]	0.78	0.13 [0.03]	0.59 [0.14]	<0.0001
Caste/ethnicity (socially-excluded=ref)												
Brahmin/Chhetri	-0.05 [0.21]	-0.05 [0.21]	0.81	-0.32 [0.26]	-0.32 [0.26]	0.22	-0.19 [0.30]	-0.19 [0.30]	0.53	-0.39 [0.34]	-0.39 [0.34]	0.25
other	-0.78 [0.38]	-0.78 [0.38]	0.042	-0.63 [0.37]	-0.63 [0.37]	0.086	-1.05 [0.43]	-1.05 [0.43]	0.016	-0.07 [0.40]	-0.07 [0.40]	0.86

Supplementary table S6.2. Continued

	Aspired age of first marriage (if unmarried)						Aspired age of first child (if no children)					
	2018			2019			2018			2019		
	b [SE]	β *[SE]*	*p*	*b [SE]*	β *[SE]*	*p*	*b [SE]*	β *[SE]*	*p*	*b [SE]*	β *[SE]*	*p*
Household wealth quintiles (lowest=ref)												
2nd lowest	0.08 [0.32]	0.08 [0.32]	0.79	0.06 [0.32]	0.06 [0.32]	0.84	-0.05 [0.39]	-0.05 [0.39]	0.91	-1.11 [0.43]	-1.11 [0.43]	0.011
middle	0.68 [0.33]	0.68 [0.33]	0.041	0.13 [0.35]	0.13 [0.35]	0.70	1.32 [0.52]	1.32 [0.52]	0.011	-0.84 [0.43]	-0.84 [0.43]	0.051
2nd highest	1.02 [0.38]	1.02 [0.38]	0.0090	0.72 [0.42]	0.72 [0.42]	0.086	0.76 [0.49]	0.76 [0.49]	0.13	-0.13 [0.48]	-0.13 [0.48]	0.79
highest	1.18 [0.50]	1.18 [0.50]	0.019	0.87 [0.45]	0.87 [0.45]	0.055	1.99 [0.68]	1.99 [0.68]	0.0040	-0.03 [0.61]	-0.03 [0.61]	0.97
Household size	-0.03 [0.03]	-0.08 [0.09]	0.39	-0.01 [0.03]	-0.04 [0.12]	0.75	0.01 [0.04]	0.04 [0.17]	0.81	-0.01 [0.05]	-0.02 [0.14]	0.86
Household head's highest education in years	0.01 [0.03]	0.06 [0.10]	0.57	0.06 [0.03]	0.23 [0.12]	0.066	0.06 [0.04]	0.24 [0.15]	0.11	0.06 [0.04]	0.23 [0.14]	0.12
Agro-ecological zone of residence (*Terai*=ref)												
hills	-0.34 [0.27]	-0.34 [0.27]	0.21	0.01 [0.32]	0.01 [0.32]	0.97	0.07 [0.39]	0.07 [0.39]	0.86	-0.80 [0.41]	-0.80 [0.41]	0.050
mountains	-0.22 [0.40]	-0.22 [0.40]	0.59	0.60 [0.44]	0.60 [0.44]	0.18	0.34 [0.53]	0.34 [0.53]	0.52	-0.32 [0.51]	-0.32 [0.51]	0.53
Height-for-age z-score (HAZ)	-0.06 [0.11]	-0.05 [0.10]	0.61	0.16 [0.13]	0.14 [0.12]	0.22	-0.21 [0.17]	-0.19 [0.15]	0.20	0.04 [0.18]	0.03 [0.16]	0.84
BMI-for-age z-score (BAZ)	0.20 [0.11]	0.20 [0.10]	0.057	0.09 [0.13]	0.09 [0.14]	0.51	0.08 [0.14]	0.08 [0.14]	0.55	0.07 [0.19]	0.07 [0.20]	0.73
Adjusted hemoglobin (g/dL)	-0.00 [0.08]	-0.00 [0.10]	1.00	0.16 [0.19]	0.20 [0.12]	0.082	-0.11 [0.10]	-0.15 [0.13]	0.26	0.41 [0.13]	0.52 [0.17]	0.0020
Dietary Diversity Score Women (DDS-W)	-0.04 [0.09]	-0.04 [0.10]	0.67	0.09 [0.09]	0.11 [0.11]	0.34	0.11 [0.11]	0.13 [0.14]	0.34	0.19 [0.13]	0.23 [0.16]	0.17
Reached menarche (no=ref)	-0.29 [0.29]	-0.29 [0.29]	0.32	-0.17 [0.39]	-0.17 [0.39]	0.66	-0.28 [0.40]	-0.28 [0.40]	0.49	0.23 [0.48]	0.23 [0.48]	0.64
Pseudo R^2	0.10			0.15			0.17			0.26		
Change R^2	0.0071			0.011			0.011			0.028		

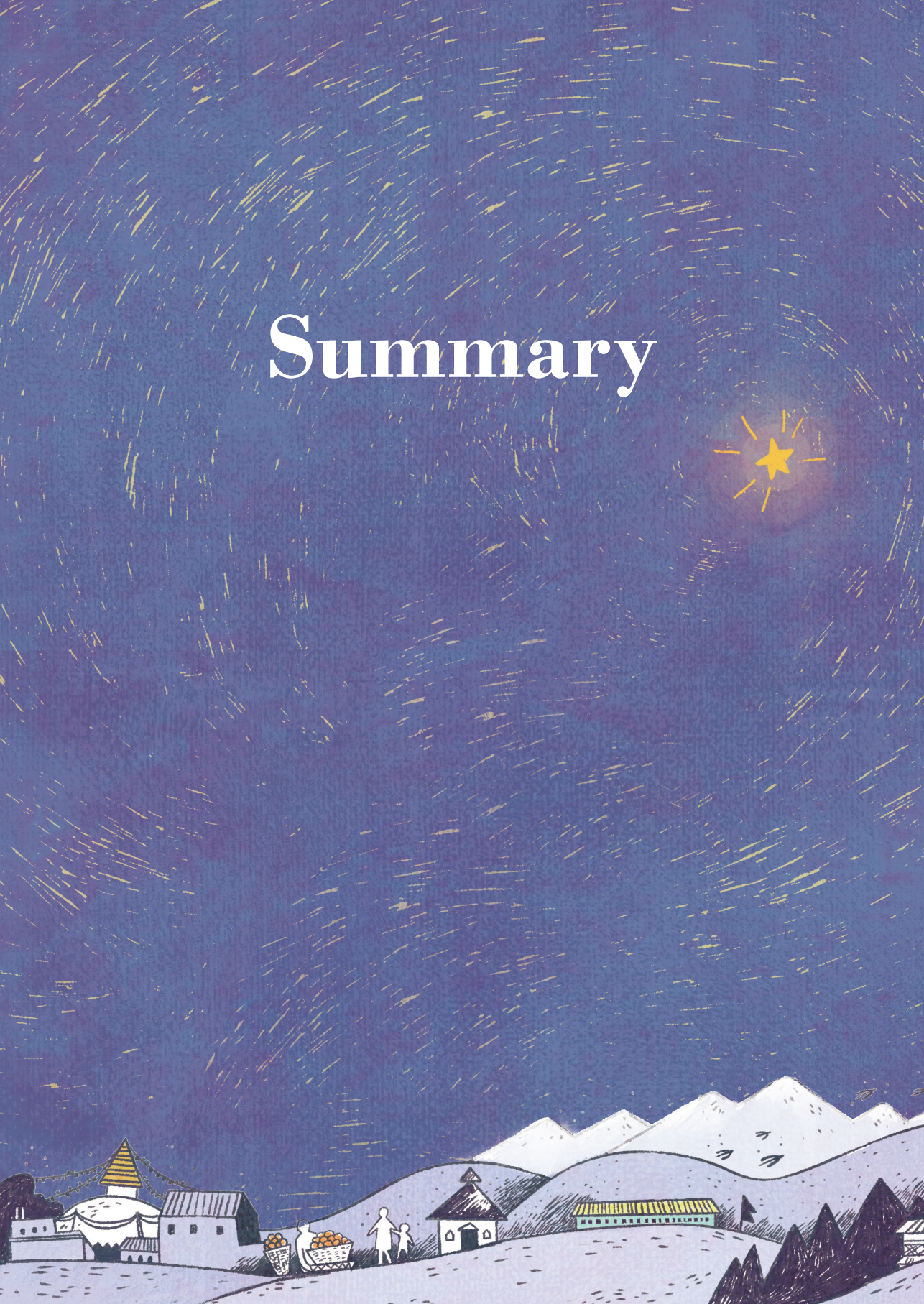
Notes: unstandardized beta (*b*) and standardized beta coefficients (β) reported with SE in brackets; Standard errors clustered at the primary sampling unit

Supplementary table S6.3. Main effects of nutritional and dietary diversity status on educational aspirations by menarche stage

	Aspired years of education Pre-menarche			**Aspired years of education Post-menarche**		
	b	SE	*p*	*b*	SE	*p*
Age in years	1.04	0.57	0.069	0.27	0.31	0.38
School status						
Out-school	..	..	..	..	..	..
In-school	..	..	..	..	..	..
Highest no. of years education	0.07	0.51	0.90	-0.08	0.23	0.72
Total self-efficacy score	0.01	0.04	0.80	-0.0030	0.04	0.93
Caste/ethnicity						
socially-excluded	omitted	..	..	omitted	..	..
Brahmin/Chhetri	omitted	..	..	omitted	..	..
other	omitted	..	..	omitted	..	..
Household wealth quintiles						
lowest quintile	ref	..	..	ref	..	..
2nd lowest quintile	1.12	0.54	0.040	-0.16	0.52	0.77
middle quintile	2.46	0.81	0.0030	-0.68	0.50	0.17
2nd highest quintile	3.10	0.91	0.0010	-0.24	0.62	0.70
highest quintile	2.19	0.12	0.054	-0.38	0.78	0.62
Household size	0.33	0.19	0.090	0.02	0.11	0.88
Household head's highest years of education	omitted	..	..	omitted	..	..
Agro-ecological zone of residence						
Terai	omitted	..	..	omitted	..	..
hills	omitted	..	..	omitted	..	..
mountains	omitted	..	..	omitted	..	..
Thinness (BMI-for-age z-score (BAZ))						
not thin (BAZ > -2SD)	ref	..	..	ref	..	..
thin (BAZ < -2SD)	0.15	1.08	0.89	1.16	0.60	0.054
Anemia						
not anemic	ref	..	..	ref	..	..
anemic	-0.07	0.82	0.93	-0.62	0.29	0.035
Minimum Dietary Diversity Women (MDD-W)						
obtained MDD-W	ref	..	..	ref	..	..
not obtained MDD-W	-0.08	0.57	0.89	-0.03	0.19	0.86
Constant	-3.32	5.02	0.51	12.02	3.18	<0.0001
R^2	0.78	..	..	0.75	..	..
R^2-adj.	0.32	..	..	0.35	..	..
F / Wald chi^2	(11, 128) =2.61	..	..	(11, 168) =1.64	..	..
Prob>chi^2	p=0.0050	..	..	p=0.092	..	..
Observations	373	..	..	714	..	..
No. of Groups	240	..	..	426	..	..

Table Notes: This table displays main-effects, fixed-effects estimates for educational aspirations split by menarche status. Cluster-robust standard errors at cluster primary sampling unit level in parentheses; ref = reference; R2 & Adj. R2 are calculated from OLS R-Squared adjusted for the number of regressors in the model (areg function STATA)

Summary



Background

The world currently faces the largest generation of adolescents (aged 10-19 years) in human history. This generation is growing up amidst unprecedented social, economic, and global health challenges. Adolescence is a dynamic life stage characterized by rapid physical, social, and psychological transitions and growth. During this stage, individuals start aspiring to future goals and lay the foundation for the rest of their life. Adolescents' aspirations are hypothesized to being drivers of well-being and development through, amongst others, steering positive and healthy behaviors. Nutrition is another building block of adolescents' health, well-being, and development today, throughout adulthood, and consequently, for future generations. Because of this potential, adolescence is increasingly recognized as an important window of opportunity to set the stage for future health and development. Investments in adolescent nutrition can enable catch-up growth, reverse nutritional deficits, and foster healthy behavior. Moreover, good nutrition may lead progress in areas of education, occupation, and family formation, potentially through aspirations. At present, adolescent malnutrition remains a pressing challenge in Low-and Middle-Income Countries (LMICs) and particularly in South-Asia. It prevents adolescents, and notably girls, from reaching their full developmental potential. The understanding, however, of the associations between nutrition and diets, and adolescents' broader well-being, including their aspirations for their future lives, remains limited.

Aim

This thesis aims to (i) improve the understanding of the context-specific drivers of undernutrition during adolescence in LMICs, and specifically in Nepal, and (ii) explore the nature of, and relationships between adolescent girls' aspirations in key life domains of education, occupation, family formation, health and nutrition, and indicators of nutritional status and dietary diversity. The study ultimately aims to contribute to integrated efforts that optimize adolescent girls' nutritional and developmental outcomes in Nepal, and beyond.

Methods

The research adopts an interdisciplinary mixed-methods research design. Part I, framed within bio-ecological theory of human development, focuses on the context-specific multi-level drivers of adolescent undernutrition (i.e., stunting, thinness, micronutrient deficiencies), as well as its consequences during adolescence in LMICs and in Nepal. This

part consists of a systematic literature review and a quantitative secondary data analysis of the Nepal Adolescent Nutrition Survey (chapters 2 and 3). Part II, inspired by human ecology and life course theory, delves into the understudied domain of adolescent girls' aspirations in key life domains of education, occupation, marriage, fertility, health and nutrition, and associations with a range of nutritional and dietary diversity indicators in Nepal (chapter 4 to 6). This part is based on mixed-methods empirical research conducted in Nepal from 2018 through 2019 and carried out under the umbrella of the *Suaahara II* (*SII*) Good Nutrition project (2017-2021).

Results

Chapter 2 presents a systematic narrative literature review on the sociocultural and economic (SCE) determinants, and consequences of adolescent undernutrition (stunting, thinness, and a selection of micronutrient deficiencies) in LMICs. A review of 98 included papers resulted in a comprehensive overview of SCE determinants of undernutrition at the adolescent's individual, household, and macrolevel. Generally, these studies provided no more than fragmented evidence on factors influencing undernutrition on both individual and household levels; such as age, sex, birth order, religion, educational attainment, working and marital status, or hygiene practices. Only a few studies investigated factors at the broader societal or environmental level, including seasonality or geographic residence. Even fewer studies investigated the consequences of undernutrition during adolescence. Studies were mostly limited to educational attainment or cognitive skills. This review provided a starting point for studying the associations between nutrition and aspirations.

Chapter 3 provides a comprehensive overview of the individual, household, and community (macro-level) SCE determinants of stunting and thinness amongst adolescents in Nepal. Analyzed data from the Nepal Adolescent Nutrition Survey 2014 (n=3773, 1888 boys, 1885 girls), showed suboptimal growth environments for adolescents in Nepal as indicated by total stunting (29.2%) and thinness (10.2%) prevalence rates. Stunting (too low height for one's age) was associated with the male sex, older age, marital status, religion, caste/ethnicity, nutritional knowledge, parental occupation and education, household wealth, and geographical location. Thinness (too low BMI for one's age) was associated with the male sex, younger age, marital status, religion, caste/ethnicity, household wealth, maternal education, and paternal occupation. Effect sizes differed between sexes and age groups leading to concluding that there is no one-size-fits-all solution for achieving nutritional goals. Moreover, the wide range of multilevel factors underscored to acknowledge adolescents' growth environments.

Chapter 4 investigates the nature of adolescent girls' aspirations in domains of education, occupation, marriage, fertility, health and nutrition, and their determinants at the individual, household and community-level. Data from the second round (2018) of the *Suaahara II* Adolescent Girls Panel (n=840) were disaggregated by age group, comparing younger (10-14 years) and older (15-19 years) girls. Over half of all (school-going) girls aspired to study beyond grade 12, three-quarter of all such girls aspired for a job requiring higher skills or education, and aspired ages of marriage and having a first child were beyond the nationally- recommended ages. Almost all girls perceived health and nutrition as important. Variation was found in factors that were associated with aspirations by domain, and determinants of aspirations in a specific domain differed between younger and older girls. The capacity to aspire was not homogeneously distributed. Household wealth consistently predicted girls' aspirations, except for younger girls' educational aspirations. Self-efficacy – the extent to which a girl felt in charge of her own life as a proxy of agency – modestly predicted aspirations. Other determinants included age, school-status, and caste/ethnicity, household size, household head highest completed level of education, and agro-ecological zone of residence (with girls residing in the lowland plains of Nepal, *Terai*, reporting lower aspired years of education). It was concluded that aspirations varied with age, and that keeping girls in school and preventing early marriage are key to fostering girls' aspirations.

Chapter 5 provides a deeper understanding of girls' aspirations for their future lives, and who and what exactly influenced their aspirations in Nepal. This study was based on 17 qualitative girl-led in-depth interviews complemented with creative elicitation methods (timeline drawings and network mapping exercise). These girls also participated in the *SII* Adolescent Girls Panel and were randomly selected from Nawalpur (in the hills) and Parasi (in the *Terai*) districts in Western-Nepal. Thematic analyses revealed three unique narratives shared by unmarried younger, unmarried older, or married adolescent girls (or young women). Whilst the youngest girls were mostly present-oriented and held ambitious aspirations without necessarily knowing how to realize these, older girls started navigating between their aspirations, reality, and societal expectations. This led to adjusting aspirations downwards. Married girls showed feelings of resignation and hopelessness in relation to their (past) aspirations and held mostly collective aspirations that would (economically) benefit their families. They transferred aspirations towards children or siblings, and self-silenced their own aspirations. Older girls also stressed structural factors such as work, and educational opportunities or financial constraints as barriers to aspirations. Findings highlighted how aspirations are embedded within time and place, and how they are shaped under the influence of important others (e.g., parents, peers, siblings) and communities. This chapter also underscored the increasingly restrictive role of gendered sociocultural norms on aspirations through lowering girls' agency.

Chapter 6 focuses on the "nutrition-aspirations nexus" by investigating associations between adolescent girls' malnutrition (indicated by thinness, anemia, and not obtaining minimum dietary diversity [meaning: consuming less than five out of ten food groups]) and aspirations. Under the hypothesis that well-nourished girls report "higher" aspirations, two rounds (2018-2019) of the *SII* Adolescent Girls Panel were analyzed. Key findings were that changes from being thin to not being thin, and changes from being anemic to not being anemic, were associated with increased aspired ages of having a first child, and increased aspired years of education, respectively. The association between anemia and educational aspirations only held for girls who had already experienced menarche (first menstruation) when splitting analyses by menarche status. Additionally, preliminary cross-sectional analyses revealed that height-for-age was positively associated with aspired years of education, and that hemoglobin concentrations were positively associated with aspiring for a job requiring higher education compared to aspiring for no or a low-skilled job, and aspired ages of having a first child. No associations between dietary diversity indicators and any of the aspirations were found. Overall, findings provided initial support for the hypothesis that good nutrition would have the potential to foster girls' aspirations.

In **Chapter 7** findings from all studies are integrated and four overarching conclusions can be drawn:

1. Neither nutrition nor aspirations develop in isolation. For understanding and working on adolescent nutrition, aspirations, or the nutrition-aspirations nexus, it is vital to consider factors holistically, within and beyond adolescents' everyday life environments. This includes factors at the micro-level (e.g., age, life stage, self-efficacy) through the macrolevel (e.g., poverty and availability of opportunities), as well as interrelations between the levels. To support this conclusion, an inside-out model of adolescent development is proposed. This model places the adolescent at the outer layer of a bio-ecological model and the macrolevel factors at the inner heart, in contrast to the traditional bio-ecological perspective.
2. Adolescence is not just one uniform phase of the life course. There are differences in nutritional status, aspirations, and associations between nutrition and aspirations, between age groups (younger versus older), according to specific turning points or life events (such as marriage or dropping out of school), or the biological event of menarche.
3. Adolescent nutrition and aspirations are always shaped in interaction with important others and under social influence. While the quantitative studies implied indirect effects of social influence, the qualitative study explained how aspirations are directly shaped under the influence of important others.
4. This thesis provides initial support for the hypothesis that good nutrition has the potential to nourish adolescent girls' aspirations. Despite this study's findings on

changes in thinness and anemia being associated with increased aspired years of education and ages of having a first child, this thesis advocates for considering these associations within adolescent girls' everyday life context. Good nutrition or healthy diets might not influence girls' aspirations unless combined with for instance poverty alleviation, cultivating social support, and addressing social inequality challenges.

Conclusion and implications

This study contributes to addressing research gaps on adolescent nutrition, adolescent girls' aspirations, and the nutrition-aspirations nexus. Based on findings, important avenues for research and programs that aim to foster adolescents' well-being and future development potential are presented. First, programs that are framed holistically and within a life-course perspective that work *with* adolescents are recommended. In this, persisting structural factors, such as poverty and social inequity must be addressed. Secondly, programs that promote meaningful engagement of adolescents and their important others are encouraged. It is essential to truly understand and prioritize adolescents' needs, hopes, and stories, and engage them and communities in the design, implementation, and evaluation of programs. Third, starting the conversation on aspirations, whilst recognizing the important role of communities and sociocultural norms, may foster younger girls' aspirations while supporting older girls who balance hope with reality, and address self-silencing which leads to the adjustment of the aspirations of older girls. Fourth, learning from positive stories of change, successful outliers or role models, may support the design of interventions that aim to improve adolescent nutrition or foster aspirations through focusing on assets and capabilities rather than risks only. Finally, it is of great importance to push forward and scale up investment in adolescent nutrition, well-being, and development whilst acknowledging the complexity of growing up into adulthood in LMICs, and specifically Nepal. Combined with optimal growth environments, good nutrition has the potential to nourish hope, ultimately unlocking adolescents' future potential.

Summary in Nepali/ Devnagari

सारांश

पृष्ठभूमि

मानव सभ्यताको इतिहासमा किशोरावस्थाको सबैभन्दा ठूलो पुस्ता (१०-१९ वर्ष उमेर)अहिले विश्वले सामना गरिरहेको छ। यो पुस्ता अभूतपूर्व सामाजिक, आर्थिक र विश्वव्यापी स्वास्थ्य चुनौतिहरूबिच हुर्किरहेकोछ। मानवीय जीवनचक्रमा किशोरावस्था एक गतिशील चरण हो । यस अवधिमा द्रुत शारीरिक, सामाजिक र मनोवैज्ञानिक विकास र परिवर्तन हुन्छन् । यो चरणमा किशोरकिशोरीहरु भविष्यका लागि सपनाहरु देख्न थाल्छन् र ती सपना प्राप्त गर्नको लागि जग निर्माण गर्दछन्। किशोरावस्थाका आकांक्षाहरूले अरुका अलावा सकारात्मक र स्वस्थ व्यवहारहरु विकास गर्दै हित र विकासको संवाहक हुने अनुमान गरिएको छ। किशोरकिशोरीहरूको स्वास्थ्य, हित र विकासको लागि पोषण अर्को महत्वपुर्ण जग हो जसले वयस्क अवस्था र परिणामस्वरुप भावी पुस्ताहरूलाई समेत प्रभावित गर्दछ । यही सम्भावनाको कारणले किशोरावस्थालाई भविष्यको स्वास्थ्य र विकासको लागि काम गर्ने महत्त्वपूर्ण अवसरको रूपमा लिन थालिएको छ । किशोरकिशोरीको पोषणमा लगानीले शारिरिक बिकासको गति बढाउँछ, न्युनपोषणलाई पुर्ति गर्न सघाउँछ र स्वस्थ व्यवहारलाई संवर्द्धन गर्दछ । यसका साथै राम्रो पोषणले स्वस्थ आकाँक्षा विकास गर्दै शिक्षा, व्यवसाय, र परिवार निर्माणको क्षेत्रमा प्रगति गर्न सघाउँछ। वर्तमानमा किशोरकिशोरी कुपोषण कम र मध्यम आय भएका मुलुकहरू (एलएमआईसि) र विशेष गरी दक्षिण-एशियामा एक प्रमुख चुनौतीको रूपमा रहेको छ। यसले मुलतः किशोरीहरूलाई आफ्नो पूर्ण सम्भावनामा पुग्नबाट रोक्छ । पोषण र आहारले किशोर-किशोरीहरूको बृहत हित र भावी जीवनको आकांक्षाहरूमा पार्ने प्रभावबारेको बुझाइ भने सिमित रहेको छ ।

उद्देश्य

यस शोधको उद्देश्य (क) न्युन तथा मध्यम आय भएका मुलुक र विशेष गरी नेपालमा किशोरावस्थाको अवधिमा कुपोषणको सन्दर्भमा विशिष्ट उत्प्रेरकहरूको बुझाइमा सुधार ल्याउने र (ख) शिक्षा, पेशा, परिवार निर्माण, स्वास्थ्य र पोषणजस्ता मुख्य विषयक्षेत्र र पोषण स्थिति र आहार विविधताका सूचकहरुसित किशोरीहरुको आकाँक्षाको प्रकृति र सम्बन्धबारे अन्वेषण गर्ने। यस अध्ययनले अन्ततः नेपाल र नेपालबाहिर पनि किशोरीहरुको पोषण र विकासलाई बढावा दिने एकीकृत प्रयासहरुमा योगदान पुऱ्याउनेछ ।

विधिहरू

यो अनुसन्धानमा अन्तरसंकाय मिश्रित-विधि अनुसन्धान ढाँचा अपनाइएको छ। मानव विकासको जिव-पारिस्थितिक सिद्धान्तभित्र संरचनावद्ध गरिएको भाग १ ले किशोरावस्थाको न्युनपोषणका विशिष्ट बहुतह उत्प्रेरकहरु (जस्तै, पुड्कोपन, ख्याउटेपन सूक्ष्म पोषकतत्वको कमि) र नेपाल तथा न्युन तथा मध्यम आय भएका मुलुकमा किशोरावस्थामा तिनका प्रभावहरुमा लक्षित छ । यो भागमा विधिवत साहित्य समीक्षा र नेपाल किशोरकिशोरी पोषण सर्वेक्षणको संख्यात्मक तथ्याङ्क विश्लेषण (अध्याय २ र ३) पनि समावेश छ । मानव पारिस्थितिकी र जीवन मार्ग सिद्धान्तबाट प्रेरित भाग २ मा हालसम्म कम अध्ययन भएका जीवनका मुख्य विषयक्षेत्रहरु जस्तै शिक्षा, व्यवसाय, विवाह, प्रजनन, स्वास्थ्य र पोषणसम्बन्धी नेपालका किशोरीहरुका आकाँक्षाहरु र तिनको पोषण र खानेकुराको विविधता सूचकसितको सम्बन्धबारे गहन विश्लेषण गरिएको छ (अध्याय ४ देखी ६ सम्म)। यो भाग २०१८ देखि २०१९ सम्म नेपालमा सञ्चालित मिश्रित विधि अनुसन्धानमा आधारित छ र सुआहारा दोस्रो बहुक्षेत्रीय पोषण कार्यक्रम (२०१७-२०२१) अन्तर्गत सम्पन्न गरिएको हो।

परिणामहरू

अध्याय २ मा न्युन तथा मध्यम आय भएका मुलुकमा सामाजिक-सांस्कृतिक र आर्थिक निर्धारकहरू र किशोरावस्थाको न्युनपोषण (पुडकोपन, ख्याउटेपन र सूक्ष्म पोषकतत्वको कमी) का परिणामहरुबारे व्यवस्थित साहित्य समिक्षा प्रस्तुत गरिएको छ । ९८ वटा आलेखहरुको समिक्षाबाट किशोरकिशोरीहरुका व्यक्तिगत, पारिवारिक, र बृहतस्तरमा न्यून पोषणको सामाजिक-सांस्कृतिक र आर्थिक निर्धारकहरूको विस्तृत सिंहावलोकन गरिएको छ । सामान्यतया, यी अध्ययनहरूले व्यक्तिगत र परिवार दुवैमा न्युनपोषणलाई प्रभाव पार्ने कारकहरू जस्तै उमेर, लिङ्ग, जन्म क्रम, धर्म, शैक्षिक अवस्था, काम र वैवाहिक स्थिति वा स्वच्छता अभ्यासहरू आदिबारे आंशिक प्रमाणहरूबाहेक अरू केही प्रदान गर्दैनन् । केही अध्ययनहरुले मौसमी वा भौगोलिकसहित सामाजिक या वातावरणीय स्तरमा कारकहरूको अनुसन्धान गरेका छन् । त्यसभन्दा पनि थोरै अध्ययनहरूले मात्र किशोरावस्थामा हुने न्युनपोषणको परिणामबारे अनुसन्धान गरेका छन् । अध्ययनहरु प्रायः शैक्षिक प्राप्ति वा संज्ञानात्मक सिपहरूमा सीमित थिए । यो समिक्षाले पोषण र आकांक्षाहरू बिचको सम्बन्ध अध्ययन गर्नका लागि सुरूवात बिन्दु प्रदान गऱ्यो।

अध्याय ३ ले नेपालका किशोर-किशोरीहरूबीच पुडकोपन, ख्याउटेपनको निर्धारण गर्ने व्यक्तिगत, पारिवारिक र सामुदायिक (बृहत तह) सामाजिक-सांस्कृतिक र आर्थिक निर्धारकहरूको विस्तृत अवलोकन गर्दछ। नेपाल किशोरकिशोरी पोषण सर्वेक्षण २०१४ (सं = ३७७३, १८८८ केटाहरू, १८८५ केटीहरू) बाट विश्लेषण गरिएको तथ्यांकले

नेपालमा किशोरकिशोरीहरूका लागि औसत वृद्धि वातावरण देखायो जुन पुडकोपन (२९.२%) र ख्याउटेपन (१०.२%) सामान्यता दरले संकेत गर्दछ। पुडकोपन (उमेरअनुसार कम उचाइ) पुलिङ्ग, वृद्धावस्था, वैवाहिक स्थिति, धर्म, जातजाति, पोषणसम्बन्धी ज्ञान, बाबुआमाको पेशा र शिक्षा, पारिवारिक सम्पत्ति र भौगोलिक स्थानसँग सम्बन्धित थियो। ख्याउटेपन (उमेरअनुसार कम तौल/ बीएमआई) पुलिङ्ग, कलिलो उमेर, वैवाहिक स्थिति, धर्म, जातजाती, पारिवारिक सम्पत्ति, आमाको शिक्षा र बाबुको पेशासँग सम्बन्धित थियो। लिङ्ग र उमेर समूहका बिचको फरकले पोषणसम्बन्धी लक्ष्यहरू प्राप्त गर्नका लागि सबैलाई उपयुक्त हुने समाधान छैन भन्ने पुष्टि गर्दछ। यसका अतिरिक्त, बृहत बहु-स्तरीय कारकहरुको अध्ययन गर्दा किशोरकिशोरीहरूको हुर्काइको वातावरणलाई पनि आत्मसात गर्नुपर्ने कुरालाई जोड दिन्छ ।

अध्याय ४ ले शिक्षा, व्यवसाय, विवाह, प्रजनन, स्वास्थ्य र पोषणजस्ता विषयक्षेत्रमा किशोरीहरूका आकाँक्षाहरू र तिनका व्यक्तिगत, पारिवारिक र समुदायिक स्तरमा निर्धारकहरुबारे अनुसन्धान गर्दछ। सुआहारा दोस्रो कार्यक्रमको किशोरीसम्बन्धी अध्ययन दोस्रो चरण (२०१८) को तथ्याङ्कलाई उमेरको आधारमा छुट्याएर सानो उमेरका (१०-१४ बर्षको) र ठुलो उमेरका (१५-१९ बर्षको) बिच तुलना गरिएको थियो । विद्यालय जानेमध्ये आधा भन्दा बढि किशोरीहरुले कक्षा १२ भन्दा माथि पढ्न चाहन्छन् र सबैमध्ये तीन चौथाइभन्दा बढी किशोरीहरुले राम्रो सिप वा उच्च शिक्षा आवश्यक पर्ने जागिर खाने आकाँक्षा राख्दछन् र राष्ट्रियरुपमा सिफारिस गरिएको उमेर भन्दा पछि नै विवाह गर्ने र पहिलो बच्चा जन्माउने आकाँक्षा राख्दछन् । प्राय: सबै किशोरीहरूले स्वास्थ्य र पोषणलाई महत्त्वपूर्ण ठान्दछन् । विषयक्षेत्रसँग सम्बन्धितगत आकाँक्षाहरुमा भने भिन्नता देखिन्छ र साना र ठूला उमेरका किशोरीहरूबिच पनि निश्चित विषयक्षेत्रमा आकाँक्षाका निर्धारकहरुबिच भिन्नता पाइएको छ । आकांक्षा राख्ने क्षमता भने समानरुपले विद्यमान छैन । साना किशोरीहरूको शैक्षिक आकांक्षाबाहेक घरको आर्थिक स्थितिले किशोरीहरूको आकांक्षालाई निरन्तर निर्देशित गरेकोछ । आत्मबल - एक किशोरीले आफ्नो जीवनसम्बन्धी आफैं निर्णय लिने र नियन्त्रण गर्ने क्षमता - ले धेरै हदसम्म किशोरीहरुका आकाँक्षाहरु प्रभावित गरेको पाइयो । आकांक्षाका अन्य निर्धारकहरूमा उमेर, विद्यालय-स्थिति, र जाति /जातीयता तथा परिवारको आकार, घरमुलीले अध्ययन गरेको सबभन्दा उच्च तह र भौगोलिक क्षेत्र (नेपालको तराईमा बस्ने किशोरीहरुमा शिक्षामा बिताउने समयसम्बन्धी आकाँक्षा कम छ) पनि हुन् । यसबाट किशोरीहरुका आकांक्षाहरु उमेरअनुसार फरक छन् र उनीहरुका आकाँक्षाहरुलाई बढावा दिन विद्यालयमा टिकाइराख्नु र छिटो विवाह रोक्नु महत्वपूर्ण छन् भन्ने निष्कर्षमा पुग्न सकिन्छ ।

अध्याय ५ ले भावी जीवनका लागि किशोरीहरूको आकांक्षाबारे गहन बुझाइ प्रदान गर्दछ र नेपालमा कसले र कुन कुराले उनीहरूको आकांक्षालाई प्रभावित गरेका छन् भन्नेबारे पनि प्रष्ट्याउँछ । यो अध्ययन १७ वटा गुणात्मक गहन अन्तर्वार्तासँगै सिर्जनात्मक (क्रियटिभ एलिसिटेशन) विधि (समय रेखा र नक्सांकन अभ्यास) मा आधारित छ । यी किशोरीहरू सुआहारा दोस्रो कार्यक्रमको किशोरीसम्बन्धी अध्ययनमा पनि सहभागी भएका थिए र सम्भावनायुक्त नमुना विधिबाट मध्य नेपालको नवलपुर (पहाड) र परासी (तराइ) बाट छनोट गरिएको थियो । विषयगत विश्लेषणहरूले अविवाहित साना, अविवाहित ठुला र विवाहित किशोरीहरू (वा युवतीहरू) ले कुरा गर्ने तीन विशिष्ट कथानकहरुको खुलासा गऱ्यो । साना किशोरीहरू अधिकांशत: वर्तमान केन्द्रित र तिनलाई कसरी प्राप्त गर्ने भन्ने थाहा नभइ उच्च महत्वाकाँक्षी रहेको पाइयो । ठुला किशोरीहरु भने आफ्ना आकांक्षा, वास्तविकता, र सामाजिक अपेक्षाहरूबिच विभाजित भएको पाइयो । यसले गर्दा उनीहरु आकांक्षाहरुलाई सिमित गर्न तर्फ उन्मुख भए । विवाहित किशोरीहरूले भने निराश भएर आफ्ना विगतका आकांक्षाहरु त्यागेको र परिवारलाई (आर्थिक रुपमा) फाइदा गर्ने सामुहिक आकाँक्षामात्रै राखेको पाइयो । उनीहरूले आफ्ना आकाँक्षाहरुलाई बच्चाहरू वा भाइबहिनीहरूमा हस्तान्तरण गरेको र आफ्नै आकांक्षाहरूबारे मौन रहेका पाइए । ठूला किशोरीहरूले पनि संरचनात्मक कारकहरू जस्तै काम, शैक्षिक अवसरहरू वा वित्तीय अवरोधहरू आफ्ना आकांक्षामा बाधकको रूपमा रहेकोमा जोड दिए। निष्कर्षहरूले उजागर गर्दछन् कि कि आकांक्षाहरू कसरी समय र स्थान भित्र सम्मिलित हुन्छन् र कसरी अरु महत्वपुर्ण व्यक्तिहरु (उदाहरणका लागि आमाबाबु, साथीहरू, भाई-बहिनी)को प्रभावबाट निर्देशत हुन्छन् । यस अध्यायले नियन्त्रणमुखी लैंगिक सामाजिक साँस्कृतिक मुल्यमान्यतामार्फत कसरी किशोरीहरूको आत्मबल घटाइ उनीहरुका आकाँक्षा नियन्त्रित गरिन्छ भन्ने पनि देखाउँछ ।

अध्याय ६ ले पोषण-आकाँक्षा सम्बन्धमा जोड दिँदै किशोरीहरुको कुपोषण (ख्याउटेपन, रक्तअल्पता र न्यूनतम आहार विविधता [अर्थ: १० मध्ये ५ भन्दा कम खाद्यसमुहबाट खानु] ले जनाउने) र आकाँक्षाहरुबिचको सम्बन्ध खोतल्छ । सुपोषित किशोरीहरूले "उच्च" आकांक्षा राख्ने परिकल्पनाअन्तर्गत सुआहारा दोस्रोको किशोरीसम्बन्धी अध्ययनका दुई चरणहरु (२०१८ - २०१९) को तथ्याङ्क विश्लेषण गरिएको थियो। मुख्य निष्कर्षहरू यि थिए कि मोटाउनु, र रक्तअल्पताबाट मुक्त हुनु क्रमशः पहिलो बच्चा जन्माउने अभिलाषित उमेर र पढाइमा बिताउने उमेरको अभिलाषासित सम्बन्धित थियो। रजस्वला उमेरमा प्रवेश गरेका र नगरेका किशोरिहरुबिचको तथ्याङ्क छुट्याएर हेर्दा रक्तअल्पताबाट मुक्त हुनु र शैक्षिक आकाँक्षाबिचको सम्बन्ध रजस्वला उमेरमा प्रवेश गरेका किशोरीहरुको लागिमात्रै लागु भएको पाइयो । थप रूपमा, प्रारम्भिक क्रस सेक्शनल विश्लेषणले पत्ता लगाए कि उमेरअनुसार उचाइ पढाइका वर्षहरूसँग सकारात्मक रुपमा सम्बन्धित थियो; हेमोग्लोबिनको मात्रा कम सिप चाहिने जागिरको तुलनामा उच्च शिक्षा चाहिने राम्रो जागीरको चाहना र पहिलो बच्चा जन्माउने अभिलाषित उमेरसँग सकारात्मक रुपमा

सम्बन्धित थियो । समग्रमा तथ्यहरुले देखाउँछन् कि राम्रो पोषणले किशोरीहरूको आकांक्षालाई बढावा दिन सक्ने परिकल्पनाको लागि प्रारम्भिक आधार प्रदान गर्दछन् ।

अध्याय ७ मा सबै अध्ययनका निष्कर्षहरू एकत्रित गरिएका छन् र चारवटा बृहत निष्कर्ष निकाल्न सकिन्छ:

१. पोषण वा आकांक्षा कुनैपनि एकान्तमा विकास हुँदैनन् । किशोरकिशोरी पोषण, आकांक्षा वा पोषण-आकांक्षा सम्बन्धलाई बुझ्न र सो क्षेत्रमा काम गर्नको लागि किशोरकिशोरीहरूको दैनिक जीवन वातावरण र त्योभन्दा पर पनि हेरेर समग्र कारकहरूबारे विचार गर्नु आवश्यक छ । यसमा सूक्ष्म-तहका कारकहरू (जस्तै, उमेर, जीवन चरण, आत्मबल) देखि बृहत् तह (उदाहरणका लागि: गरीबी र अवसरहरूको उपलब्धता) तथा ती तहबिचको सम्बन्ध पनि समावेश छन् । यो निष्कर्षलाई आधार प्रदान गर्न, किशोरकिशोरी विकासको एक भित्रबाट-बाहिर (इनसाइड आउट) ढाँचा प्रस्तावित छ। यो मोडेलले परम्परागत जैविक पारिस्थितिक दृश्टिकोणभन्दा भिन्न जैविक पारिस्थितिक ढाँचाको बाहिरी तह र बृहत तह ढाँचा भित्री भागमा रहन्छ ।

२. किशोरावस्था भनेको जीवनको एक चरण मात्र होइन। त्यहाँ उमेरसमुह (ठुलो र सानो) बिच, जीवनका महत्वपुर्ण बिन्दुहरु वा क्षणहरू (जस्तै विवाह वा स्कूल छोड्ने आदि), वा पहिलो महिनावारीजस्तो जैविक घटना अनुसार पोषण स्थिति, आकांक्षा र पोषण र आकांक्षाबिचको सम्बन्धबिच भिन्नताहरू छन्।

३ किशोरकिशोरी पोषण र आकांक्षाहरू सँधै अन्य महत्त्वपूर्ण (व्यक्ति वा घटना) सँगको अन्तर्क्रियामा र सामाजिक प्रभावमा साकार हुन्छन् । संख्यात्मक अध्ययनले आकाँक्षाहरुको विकासमा सामाजिक प्रभावको भुमिकालाई संकेत गर्दछ भने, गुणात्मक अध्ययनले महत्त्वपूर्ण व्यक्तिको प्रभावमा आकांक्षाहरू कसरी आकार लिन्छन् भनेर अन्वेषण गरेको छ।

४ यो शोधले राम्रो पोषणले किशोरीहरूको आकांक्षालाई मलजल गर्ने सम्भावना रहेको छ भन्ने परिकल्पनाको लागि शुरुवाती आधार प्रदान गरेको छ । यस अध्ययनले ख्याउटेपन र रक्तअल्पतामा परिवर्तनहरु पढाइमा बिताउने समय र पहिलो बच्चा जन्माउने उमेरसँग सम्बन्धित रहेको देखाएपनि यी आकाँक्षाहरुलाई किशोरीहरुको दैनिक जीवनको सन्दर्भबाट विचार गर्नका लागि वकालत गर्दछ। राम्रो पोषण वा स्वस्थ आहारले किशोरीहरुका आकांक्षालाई असर गर्न सक्दैन जब सम्म तिनलाई गरीबी उन्मूलन, सामाजिक सहयोग अभिवृद्धि, र सामाजिक असमानताहरूको चुनौती सामनासित जोडिँदैन ।

निष्कर्ष र प्रभावहरू

यस अध्ययनले किशोरावस्थाको पोषण, किशोरीहरूको आकांक्षा र पोषण-आकांक्षा सम्बन्धबारे अनुसन्धानमा भएका कमीहरुलाई सम्बोधन गर्न योगदान गर्दछ। किशोरकिशोरीहरूको भलाइ र भविष्यको विकास सम्भावनालाई बढावा दिने अनुसन्धान र कार्यक्रमहरूको लागि महत्वपूर्ण मार्गनिर्देशन यो अध्ययनका निश्कर्षहरुले दिन्छन् । सर्वप्रथम, समग्र रूपमा र जीवन-मार्ग दृश्टिकोणबाट बनाइने कार्यक्रमहरुलाई किशोर-किशोरीहरूसँगै काम गर्ने गरि बनाउन सिफारिस गरिन्छ । यसमा, गरीबी र सामाजिक असमानता जस्ता संरचनात्मक कारकहरूलाई सम्बोधन गर्नु आवश्यक छ। दोस्रो, किशोर-किशोरीहरू र उनीहरुका महत्त्वपूर्ण अन्यको पनि अर्थपूर्ण सहभागिता लाई प्रवर्द्धन गर्ने कार्यक्रमहरूलाई प्रोत्साहित गरिन्छ। किशोरकिशोरीहरूको आवश्यकता, आशा र कथाहरू बुझ्ने र प्राथमिकता दिन आवश्यक छ र उनीहरूलाई र समुदायहरूलाई कार्यक्रमको बनोट, कार्यान्वयन र मुल्याङ्कनमा संलग्न गराउन आवश्यक छ। तेस्रो, साना किशोरीहरुसित उनीहरुका आकाँक्षाबारे कुरा गर्दा समुदाय र सामाजिक सांस्कृतिक मान्यताहरूको महत्त्वपूर्ण भूमिकालाई मान्यता दिई कुराकानी थाल्दा उनीहरुका आकाँक्षा प्रवर्द्धन गर्न सकिन्छ भने आशालाई वास्तविकतासित सन्तुलन गर्न खोज्ने ठुला किशोरीहरुसित कुरा गर्दा उनीहरुलाई समर्थन गर्दै आफ्नो आवाजलाई आफैं नियन्त्रण गर्न खोज्ने प्रवृत्तिलाई पनि सम्बोधन गर्नुपर्छ। चौथो, सकारात्मक परिवर्तनका कथाहरू, सफल अपवाद वा प्रेरणाको स्रोतहरूबाट सिक्दै किशोरकिशोरी पोषणमा सुधार ल्याउने वा पुँजी र क्षमतामा जोड दिंदै आकाँक्षाहरुलाई बढावा दिने पहलकदमीहरु निर्माण गर्न सघाउ पुग्नसक्छ । अन्तमा, एलएमआईसीहरू र विशेष गरी नेपालमा वयस्क हुँदैगर्दा आउन सक्ने जटिलतालाई स्वीकार गर्दै किशोरकिशोरी पोषण, कल्याण र विकासको मुद्दालाई अगाडि बढाउनु र त्यसमा लगानी वृद्धि गर्नुको ठूलो महत्त्व छ। अधिकतम वृद्धिविकासको वातावरणसित जोडेर राम्रो पोषणको प्रवर्द्धनले आशा सञ्चार गर्ने र अन्ततः किशोरकिशोरीहरूको भविष्यको क्षमता उजागर गर्ने सम्भावना बढाउँछ ।

Acknowledgments

'As you start to walk on the way, the road appears' ~ Rumi

The past years have been a tremendous learning- and growth trajectory in many ways: working towards aspirations, changing directions, and celebrating milestones. I practiced gratitude, determination, and flexibility. Above all, I practiced imperfection. I learned to let go of fears by going to places that scared me. There were *namastes* and goodbyes, adventures, tears, monsoon rain and heat, elephants, cats, and so on. Just like growing up, this PhD trajectory has been a dynamic and non-linear process. At times, it challenged me to my limits (and beyond), but it also taught me to navigate between a multitude of people, countries, cultures, disciplines, theories, and workplaces. I am incredibly thankful that I was given the opportunity to work on a project that is very near to my heart and that I am inordinately proud of. I hope this thesis is a humble contribution to keeping up the momentum on global nutrition and youth participation in global health.

I feel fortunate that I was able to meet and collaborate with many wonderful people during the course of this project. I owe a debt of gratitude to all those who have been part of, or supported this project in one way or another. To all colleagues, family, and friends around the world: I wish to express a heartfelt thank you, "dherai dherai dhanyabad", "merci", and "dank je wel". I could not have accomplished this without your positive support, sympathetic ears, coffees, hospitality, and understanding for me missing out on many special occasions.

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Life unfolds over time, and so does a PhD project. A major turning point in the life course of this project dates around spring 2019, when the project and I moved to the Health and Society group. I continued the project under the supervision and guidance of another amazing team of (co)promotors. Dr. Lenneke Vaandrager, prof. dr. Maria Koelen, and dr. Elise Talsma: I feel lucky that you were there to dive right in and help me carry on this project. You boosted my confidence, encouraged and supported me to set boundaries, and empowered me to finalize the project. The project became manageable, understandable, and meaningful. You succeeded in making me realize that less is more - although this does not apply to writing acknowledgements - and that there exists no such thing as a perfect thesis. Lenneke, you are an inspiring mentor in science and beyond. Your focus on wellbeing and staying healthy, and your genuine interest in how I was doing made this last stretch manageable. Thank you for your positive and encouraging words, advice, and the constructive discussions. Maria, I greatly appreciate your interest in and enthusiasm for the project you showed from the very start. You raised the right questions that helped me to theorize and unpack this study's findings. Your encouragement got me out of the sometimes vicious thinking cycles so I could start writing. Thank you for being a great mentor and for your support with helping to balance the bigger picture with tiny details. Elise, I admire your never-ending enthusiasm and positivity! Your honest and critical take on this project, your expertise and input from a nutrition perspective helped me to get this done, and connect the complex dynamic dots between nutrition and aspirations. I learn(ed) a lot from you and I am happy that we can continue working together within the push-pull project.

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was you who brought me to Vino Bistro after an intense period of fieldwork in the plains to enjoy some of the best cheese I have ever had. It means the world to me that you were willing to spend the little time you had, on reviewing and proofreading the introduction and discussion of this thesis. Thank you!

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During my PhD trajectory, I moved between several chair groups. It would be almost impossible to mention everyone here, but I wish to take this opportunity to thank all former SCH, RHI, and HSO colleagues. I particularly thank my fellow PhDs at the 2nd, 3rd, and 4th floors with whom I have shared offices. I am appreciative of the support from (former) SCH colleagues, in particular Hedy Munro and Margaret van Wissen, and for the fruitful discussions with dr. Chizu Sato and dr. Marloes de Lange in the early stages. Thank you, Yohanes Kunto, for the nice chats and your advice on statistical analyses! In 2018-2019 I became part of the Rural and Environmental History Group, a great group of people who should win the price for best group outings, and I would like to thank you for involving me in interesting discussions that broadened my horizon and gave me a different perspective on my project. I would especially like to thank prof. dr. Ewout Frankema for the support and making me feel welcome at RHI. Many thanks to Sandra Vermeulen: you were there from my start at SCH until I moved to HSO. I enjoyed our chats and you have been a great support in many ways.

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As a PhD student, it was great to be part of the "Ten2Twenty" adolescent nutrition team and the Edema-Steernberg PhD cohort. I am looking forward to all your dissertations! To the Ten2twenty PhDs Arli Zarate Ortiz, Lowela Padilla, Ursula Trübswasser, Mahsina Akhter, and Muhammad Asrullah: I love sharing with you the passion for adolescent nutrition and I hope we get the opportunity to integrate our studies at some point. To the

ESF PhD cohort Rachelle de Vries, Kristel Polhuis, Yvette Beulen, and Amy van der Heijden: it was great to all work on an important area of research, I enjoyed our discussions and progress meetings. A special thanks to Ten2Twenty and ESF twin-PhD Fusta Azupogo: we aspired to conduct similar studies in Ghana and Nepal. Although our trajectories diverted, I enjoyed kick-starting our projects with the review and our catch-up chats over the years.

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I deeply thank my parents Gholam Madjdian and Lei Braam, who taught me perseverance as well as embracing flexibility. Faar Madjdian, thank you for being a great sister and friend, teaching me that there are other things in life besides a PhD, and allowing me to sit on the 'praatstoel' from time to time. The three of you saw the highs and lows and your unconditional encouragement kept me going. Thank you for the airport drop-offs and pick-ups, the relativizing pep-talks, and for cat-sitting Catmandu en Cato when abroad.

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Finally, this study would not have existed without the participation of all adolescents. I am immense grateful for their willingness and time to create timelines and network maps and for sharing their stories and dreams with us. I dedicate this thesis to Nepal's youth and to those who have moved me with their stories of hope and resilience in a way I cannot even describe.

~ Maya Namarnus

About the author

Curriculum Vitae
List of Publications

Curriculum Vitae

Dónya Sarah Madjdian was born on 26 January 1990 in Amsterdam, the Netherlands. She received her secondary school diploma from Vrije School de Berkel Zutphen, in 2008. In 2012, she obtained her Bachelor Health and Society at Wageningen University & Research in Wageningen. During her Master Applied Communication Science, specialization Health and Society, at Wageningen University & Research, she developed a specific interest for the connections between food and nutrition security and global health. In her research internship at the Nepal Trust in 2014, she studied intrahousehold food allocation practices and maternal health in Humla district, in Nepal's hidden Himalayas. For this research project she received a grant from the Neys-van Hoogstraten Foundation. After obtaining her MSc degree in 2015, Dónya worked as a research and education assistant at Wageningen University, whilst seeking funding for her aspired PhD research project on the interrelations between adolescent girls' nutritional, social, and economic life trajectories in Nepal. In 2017, she was provided the opportunity to start her PhD trajectory at the Sociology of Consumption and Households Group and later the Health and Society Group, and the Division of Human Nutrition and Health, Global Nutrition, at Wageningen University, which resulted in this thesis. The project was funded by the Edema-Steernberg Foundation and carried out under the umbrella of the Suaahara II program in Nepal, implemented by Helen Keller International. Early 2021, she started as a postdoctoral researcher at the Consumption and Healthy Lifestyles Group at Wageningen University, where she presently collaborates on evaluating the impact of a project that aims to incentivizing food safety in urban informal markets in Burkina Faso and Ethiopia, using a pull-push approach. Dónya is passionate about contributing to food and nutrition security, global health, and gender equality & youth development, through creative and innovative thinking and collaboration.

List of Publications

(Published and forthcoming)

- **Madjdian, D.S.,** Talsma, E.F., Vaandrager, L., Sen Gupta, A., van de Geest, J.M.J., Koelen, M., & Cunningham, K. *(under review).* Nourishing Hope. Changes in malnutrition and changes in girls' aspirations - evidence from the *Suaahara II* Adolescent Girls Panel in Nepal.
- **Madjdian, D.S**., Talsma, E.F., Shrestha, N., Cunningham, K., Koelen, M., & Vaandrager, L. (*under review)*. "Like a frog in a well". A qualitative study of adolescent girls' life aspirations in Western Nepal.
- **Madjdian, D.S**., Cunningham, K., Bras, H., Koelen, M., Vaandrager, L., Adhikari, R.P., Talsma, E.F. *(under review*). Unravelling aspirations: individual, household and community level determinants of adolescent girls' aspirations in Nepal.
- Van Tuijl, C., **Madjdian, D.S.,** Bras, H., & Chalise, B. (2021). Sociocultural and economic determinants of stunting and thinness among adolescent boys and girls in Nepal. *Journal of Biosocial Science*, 53(4), 531-556. https://doi.org/10.1017/s0021932020000358.
- Marcus-Varwijk A.E., **Madjdian D.S.**, de Vet, E., Mensen, M.W.M., Visscher, T.L.S., Ranchor, A.V., Slaets, J.P.J., & Smits, C.H.M. (2019) Experiences and views of older people on their participation in a nurse-led health promotion intervention: "Community Health Consultation Offices for Seniors". *PLOS ONE,* 14(5), https://doi.org/10.1371/journal.pone.0216494.
- Chalise, B., Aryal, K.K., Mehta, R.K., Dhimal, M., Sapkota, F., Mehata, S., Karki, K.B., **Madjdian, D.S**., Patton, G., & Sawyer, S. (2018). Prevalence and correlates of anemia among adolescents in Nepal: findings from a nationally representative cross-sectional survey. *PLOS ONE*, 13(12), https://doi.org/10.1371/journal.pone.0208878.
- **Madjdian, D.S.**, Azupogo, F., Osendarp, S.J., Bras, H. and Brouwer, I.D. (2018), Socio-cultural and economic determinants and consequences of adolescent undernutrition and micronutrient deficiencies in LLMICs: a systematic narrative review. *Annals of the New York Academy of Sciences*, 1416, 117-139, https://doi.org/10.1111/nyas.13670.
- **Madjdian, D. S.** (2018). Gender, intra-household food allocation and social change in two Himalayan communities in Nepal. In A. Niehof et al. (*eds*.) *Diversity and change in food wellbeing - Cases from Southeast Asia and Nepal* (pp. 153-175).

Wageningen: Wageningen Academic Publishers, https://doi.org/10.3920/978-90-8686-864-3_8.

- **Madjdian, D.S.** & Bras, H. (2016). Family, Gender, and Women's Nutritional Status. A comparison between two Himalayan Communities in Nepal. *Economic History of Developing Regions*, 31(1), 198-223, https://doi.org/10.1080/20780389.2015.1114416.

International Conferences

- International Symposium Countries in Socioeconomic Transition: Evidence from Auxology and allied Disciplines. 21-24 November, 2018, Indian Statistical Institute, Kolkata, India, Presentation: *"Nourishing hope: adolescents' life aspirations and nutrition in Nepal"*.
- 11th IAAH World Congress on Adolescent Health – The future is now. International Association for Adolescent Health, 27-29 October 2017, New Delhi, India. Presentation IAAH70319: *"Ten2Twenty: Nutritional, social and economic pathways of optimizing adolescent nutrition in LMICs: a systematic literature review"*
- Feed the Future Nutrition Innovation Lab 5th Annual Agriculture to Nutrition Scientific Symposium & the 2nd Annual Agriculture, Nutrition and Health Academy Week. 9-13 July, 2017, Kathmandu, Nepal. Presentation: *"Ten2Twenty: determinants and consequences of adolescent undernutrition in LMICs: a systematic narrative review"*.
- 4th International Workshop: "From Traditional Crops to Fast Food; Diversity and Change in Southeast Asian Food Production and Consumption". Neys - van Hoogstraten Foundation, 12-17 April 2015, Baguio, Philippines. Presentation: *"Family, Gender & Women's Nutritional Status. A comparison between two Himalayan communities in Nepal"*.

Dónya Sarah Madjdian
Wageningen School of Social Sciences (WASS)
Completed Training and Supervision Plan

Name of the learning activity	Department/Institute	Year	ECTS*
A) Project related competences			
Project and Time Management	WGS, WUR, The Netherlands	2017	1.5
Masterclass Practicing Feminist Political Ecology	WASS, WUR, The Netherlands	2017	0.5
Summer School Applied Multivariate Analysis	Utrecht University, The Netherlands	2017	3.0
WASS Introduction course	WASS, WUR, The Netherlands	2017	1.0
"Ten2Twenty: Nutritional, social, and economic pathways of optimizing adolescent nutrition for better health in low- and middle-income countries: a systematic literature review" & participation in skill-building workshop	11th World Congress on Adolescent Health, New Delhi, India	2017	1.2
"Determinants and consequences of adolescent undernutrition and micronutrient deficiencies in LMICs: a systematic narrative review"	5th Annual Agriculture to Nutrition Scientific Symposium, Kathmandu, Nepal	2017	1.0
"Nourishing Hope. Adolescents' life aspirations and nutrition in Nepal"	Countries in Socioeconomic Transition: Evidences from Auxology and Allied Disciplines, Kolkata, India	2018	1.0
Systematic Approaches to Reviewing Literature	WASS, WUR, The Netherlands	2017	4.0
Visual, creative, and participatory methods in social science research	University of Surrey, United Kingdom	2018	1.5
Nepali Language Course	Nepal Development Academy, Utrecht, The Netherlands	2017	3.0
Advanced Qualitative Research Data Collection Design	WASS, WUR, The Netherlands	2018	4.0
B) General research related competences			
Efficient Writing Strategies	WGS, WUR, The Netherlands	2020	1.3
Making an Impact! How to increase the societal relevance of your PhD research	WGS, WUR, The Netherlands	2020	1.0
Peer-reviewing three scientific papers	Maternal and Child Health, Annals of the New York Academy of Sciences, and Journal of Adolescent Health	2019-2020	3.0
PhD Workshop Carousel	WGS, WUR, The Netherlands	2017	0.3
Brain Training	WGS, WUR, The Netherlands	2019	0.3
Health & Sustainable Diets Masterclass	VLAG, WUR, The Netherlands	2017	0.8
Nutri-Science: Global Nutrition. From Nutrients to Whole Diets	VLAG, WUR, The Netherlands	2017	1.5
Supervising two MSc students	WUR, The Netherlands	2019-2021	2.0
Reviewing a Scientific Paper	WGS, WUR, The Netherlands	2019	0.1

Name of the learning activity	Department/Institute	Year	ECTS*
Edema-Steernberg PhD literature discussion group (LDG) "Why do we eat what we eat?"	WASS/VLAG, WUR, The Netherlands	2017-2020	1.0
C) Career related competences/personal development			
PhD Competence Assessment	WGS, WUR, The Netherlands	2017	0.3
Career Perspectives	WGS, WUR, The Netherlands	2020	1.6
Interpersonal Communication Skills	WGS, WUR, The Netherlands	2018	0.6
Total			**35.5**

*One credit according to ECTS is on average equivalent to 28 hours of study load

Colophon
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