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The height premium: A systematic review and meta-analysis

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ABSTRACT

The taller people are, the more money they tend to earn. This phenomenon is widely known as the height premium. However, it is not yet known whether the height premium is universal, or whether it varies by context. To that end, a systematic review of the literature was performed. Five databases were searched until August 2020. Ultimately, a list of 42 studies were included in a narrative synthesis, and 17 studies were included in a meta-analysis. Based on the meta-analysis, we found evidence that the height premium varied by context: the height premium was smaller in the U.S. and Australia, and larger in Latin America and Asia. Within geographies, there appeared to be a larger height premium for men than for women. Cultural factors, labor market structures and biology may play a role in determining the strength of the height premium.

1. Introduction

The taller people are, the more money they have been shown to earn. The so-called 'height premium' – the positive association of height and wages – also has been shown in various populations (Hübler, 2016). But is the height premium absolute or relative (Bittmann, 2020)? In other words, is the size and direction of height's relationship to wages the same or varied across different populations (e.g. gender, time period, or geography)?

A systematic review could help to answer this question. Although Hübler (2016) conducted a literature review of height's relationship to wages, a systematic search of the literature and a statistical synthesis of findings have yet to be conducted. With the present study, we attempted to fill this gap, by summarizing the balance of evidence on the height premium.

We first undertook a step-by-step title and abstract scan, and then a paper search, resulting in 42 included studies. All studies were analyzed narratively, with a data extraction tool and critical appraisal. Next, the relationship between height and wages was tested empirically with a meta-analysis using 17 studies that met our inclusion criteria for quantitative synthesis. We also performed gender and geography sub-group analyses.

Heterogeneity among studies was extremely high, and prevented an overall height premium from being determined. We also saw that the height premium's size varied by geography. Studies in Asia reported that every 10 centimeter (cm) increase in height was associated with a 9% ($\beta = 0.09$, 95% CI: 0.07–0.10) increase in wages. Similarly, the study from Latin America reported a 14% increase in wages ($\beta = 0.14$, 95% CI: 0.08–0.20) for every 10 cm increase in height. In contrast, in the U.S., a 4% increase in wages ($\beta = 0.04$, 95% CI: 0.02–0.05) was found for a 10 cm increase in height.

Moreover, gender appeared to be related to the size of the height premium. When stratifying Asian studies by gender, there was a stronger height premium among Asian men, where a 10 cm increase in height was associated with a 10% increase in wages ($\beta = 0.10$, 95% CI: 0.07–0.12), than among Asian women, where a 10 cm increase in height was associated with a 7% increase in wages ($\beta = 0.07$, 95% CI: 0.05–0.10). It therefore appeared that, while most studies reported a height premium, its strength varied by geography, and within geography, by gender.

The remainder of this paper is organized as follows: the theoretical framework outlines why there may be a relationship between height and wages. The methods section provides an overview of our search and analytic strategies. The results section includes a narrative synthesis of all 42 included studies, and a meta-analysis of 17 of the included studies. In the discussion, the implications of our findings were considered, and recommendations for future research were given.

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1.1. Theoretical framework

Height has been found to be related to a host of beneficial later-life outcomes, including marriage (Thompson et al., 2021), health (Wormser et al., 2012), longevity (Davey Smith et al., 2000), and, most relevantly, occupational success and income/wages (Hübler, 2016). However, with wages, as with all of these later-life outcomes, it is not clear precisely why this is the case.

Height may also be related to wages because of what it represents about an individual during development. Although a large share of adult height is genetically determined, height partially reflects various environmental inputs over the entirety of development, from conception through the end of puberty (Silventoinen et al., 2000). These inputs can be summarized as net nutrition, a concept that refers to actual nutritional quality and quantity, minus diverted energy. Factors that divert energy include, inter alia, basal metabolism, disease, physical labor, toxins and pollutants, and stress (Steckel, 1986). The taller adults are, the more beneficial their net nutrition in early-life tends to have been.

Indeed, there is evidence that taller people are generally healthier over their lifetimes. For instance, taller people may be less likely to die from non-communicable diseases, such as coronary heart and respiratory diseases, although very tall individuals may be at higher risk of cancer mortality (Davey Smith et al., 2000). It may be that tallness, because it is related to better health, is associated with higher wages. Improved health has been associated with greater lifetime earnings, due to fewer labor market disruptions (Stephens and Toohey, 2018).

Because taller height is partially reflective of improved early-life conditions, it may also be correlated with a number of other, otherwise unrelated beneficial characteristics in adulthood. These beneficial characteristics may include health, intelligence, social skills, self-esteem, strength, and dominance (Floud et al., 2011; Case and Paxson, 2008; Persico et al., 2004; Prieto and Robbins, 1975; Stulp, Barrett, 2016; Thomas and Strauss, 1997). Taking intelligence as an example, Case and Paxson (2008) found that height was related to labor market outcomes because it was associated with cognitive ability. That is, taller men had better labor market outcomes not because they were taller, but because they were smarter. It may be these factors, rather than height itself, that are rewarded on labor markets.

However, height may also be directly related to wages. Here, height would function as a signal of a characteristic, even if the person in question does not actually possess that characteristic (Kok et al., 2023). For instance, taller men may perform better on labor markets because, by virtue of their tallness, they are perceived as more dominant than their shorter peers (Stulp, Barrett, 2016). If height functions as a signal, some element of subjectivity is likely involved, with the value placed on height being determined in part by cultural preferences and values (Kok et al., 2023).

2. Methods

2.1. Search

This review's search was conducted in accordance with the Preferred Reporting Items for Systematic Reviews and Meta-Analysis (PRISMA) statement (Moher et al., 2009). A comprehensive search was performed in the following bibliographic databases, searching from inception until 7 August 2020: PubMed, Embase.com, Web of Science Core Collections, Scopus, and Historical Abstacts (via EBSCOHOST). The search was undertaken in collaboration with a medical librarian (LS), this study's third author. Search terms included controlled terms (MesH in PubMed, Emtree in Embase and thesaurus terms in Historical Abstracts), as well as free text terms. The following terms were used (including synonyms and closely related words) as index terms or free-words: 'stature' and 'socio-economic status' (SES), as initially we had intended to focus on a variety of measures of SES, and not solely wages. A search filter was used to limit our search to adult humans. The search was performed without date restrictions. An initial attempt was made to exclude duplicate articles. The full search strategies for all databases can be found in Appendix A.

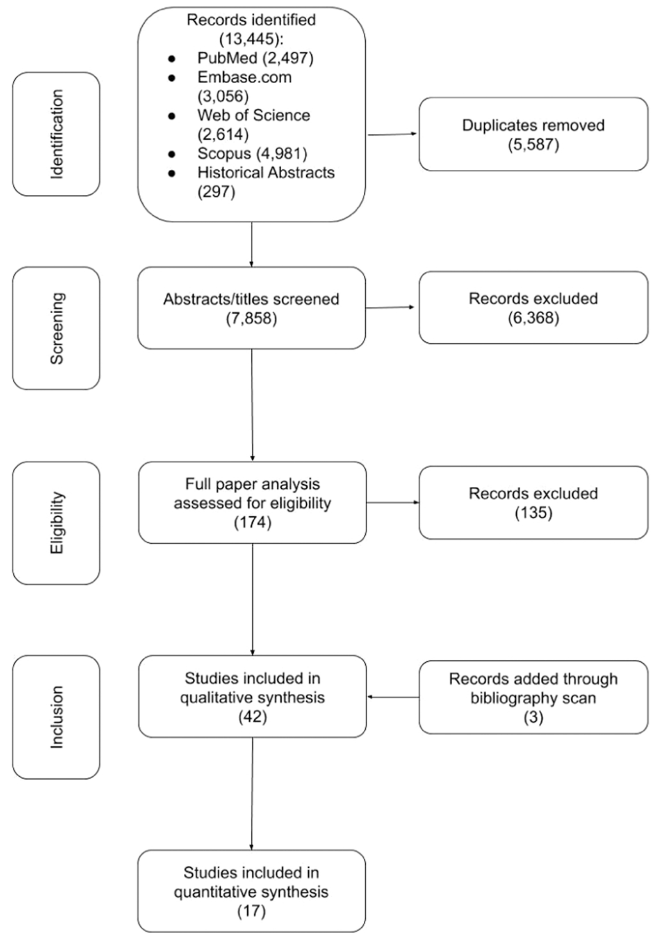

Fig. 1. Study inclusion steps.

2.2. Study selection and evaluation

Articles were stored and evaluated in Rayyan QCRI, a reference management program (Ouzzani et al., 2016). From there, the first and last authors undertook a step-by-step title and abstract scan of all papers. These authors separately assessed each title and abstract, and decided whether or not to include them. In cases of disagreement, we discussed the papers, and reached a consensus. At this stage, our inclusion criteria were as follows:

- The paper used quantitative data.
- The paper was written in English.
- The analysis allowed for the inclusion of control variables (e.g. regression, not solely t-tests).
- Individual-level height was the key predictor variable; individual-level SES was (one of) the outcome(s).
- The focus was on adults. We defined this as having a sample that is mostly (>50%) over the age of 25 in modern populations (post-World War II) and over the age of 18 in pre-modern populations (pre-World War II). We made this choice to be able to include historical papers: nearly all pre-modern anthropometric data is based on conscription records, which included examinations when boys were in their late teens or early twenties.

Based on these criteria, we generated a list of 174 papers to read in the full-paper scan. As we realized the heterogeneity in the measures of SES, we elected at this stage to focus solely on wages as our outcome. From there, we replicated our two-person procedure from the title-and-abstract scan with the full-paper scan. We excluded 133 papers. Reasons for exclusion throughout the study selection procedure included: wages not being included in measures of SES; height being the outcome, and wages being the predictor; studies not meeting our age requirements, not including statistical analyses; and not being written in English (two papers were written in German, and were not accessible in libraries in the Netherlands). We also found an additional three papers from a bibliographic scan of included papers. This resulted in a final list of 42 papers for the descriptive analysis.

We included 17 of these studies in a meta-analysis. We selected papers that were broadly similar to each other, and had the following key features: height was a continuous variable (and was possible to be converted to decimeters); wages were characterized as the log of individual-level annual wages (or were possible to convert to a log of annual wages); ordinary least squares regressions (OLS) were used; effect sizes were reported as beta coefficients (or were possible to convert to beta coefficients). The largest share of studies reported their results in this way. Studies that characterized height and wages in other ways, e.g. height as a deviation from the mean, or wages as a composite indicator with other elements included, were excluded from the meta-analysis. Fig. 1, based on the PRISMA diagram, showcases our process (Moher et al., 2009).

2.3. Data extraction

Data from all studies were extracted from each paper, based on the Cochrane Collaboration's data collection form for intervention reviews for RCTs and non-RCTs (Cochrane Collaboration, 2020). We selected this tool because it is validated and widely-used. However, given that we were not looking at interventions, we excluded a number of items from this form, and further specified several. In the former instance, we excluded, all elements related to patient recruitment, as the overwhelming majority of our included papers used routine data sources. In the latter instance, we replaced sample power with standard deviations, to better get a sense of the distribution and potential for synthesizing results. The data extraction form can be found in Appendix B.

2.4. Critical appraisal

To assess the quality of each included study, we conducted a critical appraisal. Doing so enabled us to assess the extent to which bias and/or confounding had influenced the results (Mueller et al., 2018). We selected the Joanna Briggs Institute's critical appraisal checklist for analytical cross-sectional study, because this is both a widely used and validated checklist, and relevant to our subject matter (Joanna Briggs Institute, 2021).

To score papers based on their risk of bias/quality, each paper was given one point per item (for a total score of nine points). Then we developed the following rating system:

- 7–9 points: High quality, low risk of bias.
- 5–6 points: Moderate quality, moderate risk of bias.
- < 5 points: Poor quality, high risk of bias.

Two of this study's authors completed this procedure for all papers. We then compared our results, and discussed papers until consensus was reached. The complete results of the critical appraisal can be found in Appendix C.

2.5. Syntheses

First, a narrative synthesis was performed, including all 42 studies. We summarized the results from Appendix B, to understand how the relationship between height and wages has been studied, and where it has been studied, and what has been found. These results are presented in Tables 1–5.

Second, we conducted a meta-analysis, using the Meta package in Stata 16, and including 17 studies. We used the adjusted beta coefficients from all studies, as we anticipate that individual-level factors, such as age, ethnicity, educational attainment and marital status bias unadjusted estimates of the height premium.

Also, we treated the results from multiple datasets within the same paper as separate studies. For example, Case and Paxson (2010) presented the results of four separate datasets: the National Comorbidity Survey, the British Cohort Study, the Panel Study of Income Dynamics and the Health and Retirement Study. We included each of these results separately. Moreover, because most studies reported analyses of the height premium separately for men and women, we likewise stratified all results by gender, and include the stratified results as separate studies. As a result, although we only included 17 published studies in our meta-analysis, we included the results of 43 analyses separately, with 27 for men and 16 for women.

Next, we generated a funnel plot to check for reporting bias. We then ran an all-sample forest plot to obtain a combined effect size. In this instance, as in our later sub-group analyses, we assessed the between-

Table 1
Key findings.

Key finding	Study	Frequency
There is a height premium	Anderson (2018);Bargain and Zeidan (2017); Böckerman et al. (2010);Case and Paxson (2010); Case et al. (2009);Devaraj et al. (2018);Gao and Smyth (2010);Habibov et al. (2020);Hamermesh (2012);Harper (2000);Hersch (2008);Hübler (2009); Ibragimova and Salahodjaev (2019);Kim and Han (2017);Kortt and Leigh (2010);LaFave and Thomas (2017);Lång and Nystedt (2018);Lee (2017);Lindqvist (2012);Lundborg et al. (2014); Murasko (2019);Oreffice and Quintana-Domeque (2016);Patel and Devaraj (2018);Rashad (2008); Rietveld et al. (2015); Schick and Steckel (2015);Schultz (2003);Sohn (2015);Thomas and Strauss (1997);Tyrrell et al. (2016);Vogl (2014);Wang (2015);Yamamura et al. (2015)	33
There is not a height premium	Alter et al. (2004);Böckerman et al. (2017); Kropfhäußer (2016);Persico et al. (2004);Wang et al. (2020)	5
Mixed findings	Böckerman and Vainiomäki (2013);Heineck (2005);Heineck (2008);Mitra (2001)	4

Table 2
Gender of study subjects.

Gender included	Study	Frequency
Both genders	Böckerman et al. (2010);Böckerman et al. (2017); Böckerman and Vainiomäki (2013);Case and Paxson (2010);Case et al. (2009);Devaraj et al. (2018);Gao and Smyth (2010);Habibov et al. (2020);Harper (2000);Heineck (2005);Heineck (2008);Hersch (2008);Hübler (2009); Ibragimova and Salahodjaev (2019);Kim and Han (2017);Kortt and Leigh (2010); Kropfhäußer (2016);LaFave and Thomas (2017);Lång and Nystedt (2018);Lee (2017);Mitra (2001);Oreffice and Quintana-Domeque (2016);Patel and Devaraj (2018);Rashad (2008); Rietveld et al. (2015);Schick and Steckel (2015);Schultz (2003);Sohn (2015); Thomas and Strauss (1997);Tyrrell et al. (2016);Wang et al. (2020);Yamamura et al. (2015)	32
Men only	Alter et al. (2004);Anderson (2018);Bargain and Zeidan (2017);Hamermesh (2012);Lindqvist (2012); Lundborg et al. (2014);Persico et al. (2004);Vogl (2014);Wang (2015)	9
Women only	Murasko (2019)	1

Table 3
Study geography.

Continent	Geography	Study	Frequency
Europe	UK	Anderson (2018);Case and Paxson (2010);Case et al. (2009);Harper (2000);Heineck (2005);Hersch (2008);Schick and Steckel (2015);Tyrrell et al. (2016)	8
	Germany	Heineck (2008);Hübler (2009); Kropfhäußer (2016);Oreffice and Quintana-Domeque (2016); Rietveld et al. (2015)	5
	Sweden	Lång and Nystedt (2018); Lindqvist (2012);Lundborg et al. (2014)	3
	Finland	Böckerman et al. (2010); Böckerman et al. (2017); Böckerman and Vainiomäki (2013)	3
	Belgium	Alter et al. (2004)	1
	Netherlands	Hamermesh (2012)	1
	Russia	Ibragimova and Salahodjaev (2019)	1
	27 former Soviet bloc countries	Habibov et al. (2020);	1
Asia	China	Gao and Smyth (2010);Wang et al. (2020);Yamamura et al. (2015)	3
	Indonesia	Bargain and Zeidan (2017); LaFave and Thomas (2017); Sohn (2015)	3
	Korea	Kim and Han (2017)	1
North America	USA	Devaraj et al. (2018);Mitra (2001);Rashad (2008)	3
Oceania	Australia	Kortt and Leigh (2010);Lee (2017)	2
Latin America	Mexico	Vogl (2014)	1
	Brazil	Thomas and Strauss (1997)	1
Africa	Ivory Coast and Ghana	Schultz (2003)	1
Multiple	USA and UK	Persico et al. (2004);Wang (2015)	2
	Costa Rica, Argentina, Barbados, Brazil, Chile, Cuba, Mexico, Uruguay, Puerto Rico, China, India, Ghana, South Africa, Russia	Patel and Devaraj (2018)	1
	63 countries in Africa, South/ Southeast Asia, Latin America	Murasko (2019)	1

study heterogeneity and total variation due to heterogeneity by I^2 statistics, which describes the percentage of the variability in effect estimates that is due to heterogeneity rather than chance (Higgins, 2019). To interpret the I^2 statistics, the following thresholds were used (Higgins, 2019.):

- 0–40%: low heterogeneity
- 40–70%: moderate heterogeneity
- 70% or higher: substantial heterogeneity

The full-sample forest plot and the forest plot stratified by gender had I^2 statistics of over 99%, indicating near perfect heterogeneity. These forest plots should be interpreted with extreme caution, and are therefore reported in Appendix D.

However, I^2 statistics, particularly when based on relatively small sample sizes, have been found to be prone to bias (von Hippel, 2015). In this study, the smaller sample size may have impacted the validity of this measure.

Table 4
Study time period.

Time period	Study	Frequency
Modern	Bargain and Zeidan (2017);Böckerman et al. (2010); Böckerman et al. (2017);Böckerman and Vainiomäki (2013);Case and Paxson (2010);Case et al. (2009); Devaraj et al. (2018);Gao and Smyth (2010);Habibov et al. (2020);Hamermesh (2012);Harper (2000);Heineck (2005);Heineck (2008);Hersch (2008);Hübler (2009); Ibragimova and Salahodjaev (2019);Kim and Han (2017);Kortt and Leigh (2010);Kropfhäußer (2016); LaFave and Thomas (2017);Lång and Nystedt (2018);Lee (2017);Lindqvist (2012);Lundborg et al. (2014);Mitra (2001);Murasko (2019);Oreffice and Quintana-Domeque (2016);Patel and Devaraj (2018);Persico et al. (2004); Rashad (2008); Rietveld et al. (2015);Schick and Steckel (2015);Schultz (2003);Sohn (2015);Thomas and Strauss (1997);Tyrrell et al. (2016);Vogl (2014);Wang (2015); Wang et al. (2020); Yamamura et al. (2015)	40
Pre-modern	Alter et al. (2004);Anderson (2018)	2

Table 5
Critical appraisal results.

Risk of bias	Study	Frequency
Low risk	Alter et al. (2004);Bargain and Zeidan (2017); Böckerman et al. (2010);Böckerman and Vainiomäki (2013);Case and Paxson (2010);Harper (2000);LaFave and Thomas (2017);Lång and Nystedt (2018); Lundborg et al. (2014);Persico et al. (2004);Schick and Steckel (2015);Schultz (2003);Vogl (2014)	13
Moderate risk	Anderson (2018);Böckerman et al. (2017);Devaraj et al. (2018);Gao and Smyth (2010);Habibov et al. (2020);Heineck (2005);Hersch (2008);Hübler (2009); Kim and Han (2017);Kropfhäußer (2016);Lee (2017); Lindqvist (2012);Murasko (2019);Oreffice and Quintana-Domeque (2016);Rashad (2008); Rietveld et al. (2015);Sohn (2015);Thomas and Strauss (1997); Tyrrell et al. (2016);Wang (2015);Wang et al. (2020)	21
High risk	Case et al. (2009);Hamermesh (2012);Heineck (2008); Ibragimova and Salahodjaev (2019);Kortt and Leigh (2010);Mitra (2001);Patel and Devaraj (2018); Yamamura et al. (2015)	8

To investigate the source of heterogeneity in the full sample, and to empirically test whether the height premium differed by context, we ran sub-group analyses with forest plots, following the same methods. Our first subgroup analyses examined gender, stratifying by men and women. Our second subgroup analyses examined geography, stratifying by Asia, Australia, Latin America, the U.S., Europe and the U.K. While the U.K. is certainly geographically part of Europe, the other European studies largely center around northern continental Europe (Germany, Sweden, Finland, the Netherlands). Given that there was a comparatively large number of studies (five) conducted in the U.K., and the different cultural context of the U.K. relative to northern Europe, we included the U.K. as a separate geography.

We further stratified the geography forest plots by gender. Because only two studies were set prior to the twentieth century, and neither was suitable for inclusion in the meta-analysis, we did not perform sub-group analyses on time period. Given the high levels of heterogeneity found in the sub-group analyses, meta-regressions were not performed. The results of the forest plots are presented in Figs. 2–4.

Finally, several additional analyses were conducted. Three studies included in the meta-analysis were found to have a high risk of bias. The meta-analysis was performed with and without these studies. Given that these analyses yielded similar results, we elected to include these studies in the reported results. Different characterizations of geographies were

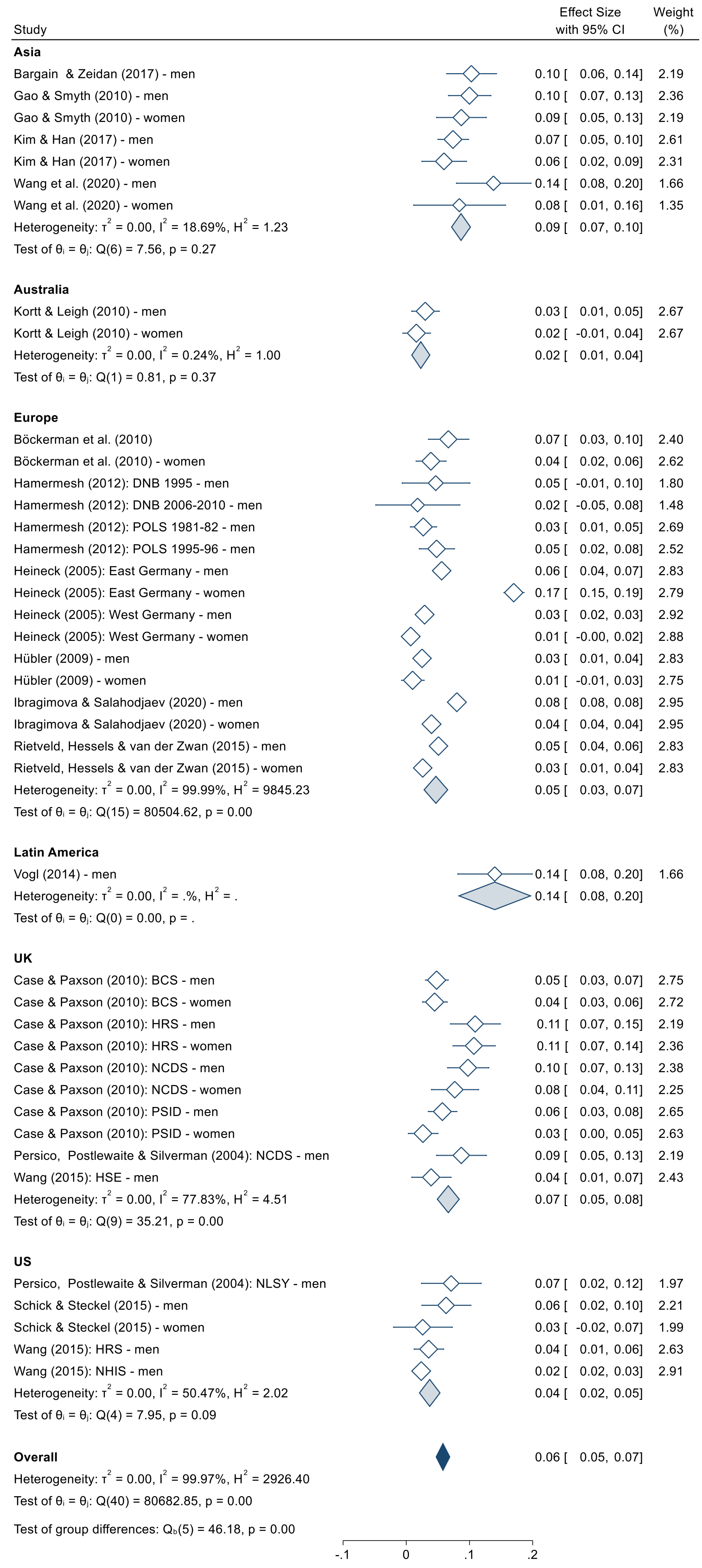

Fig. 2. Forest plot grouped by geography (excluding studies of multiple continents).

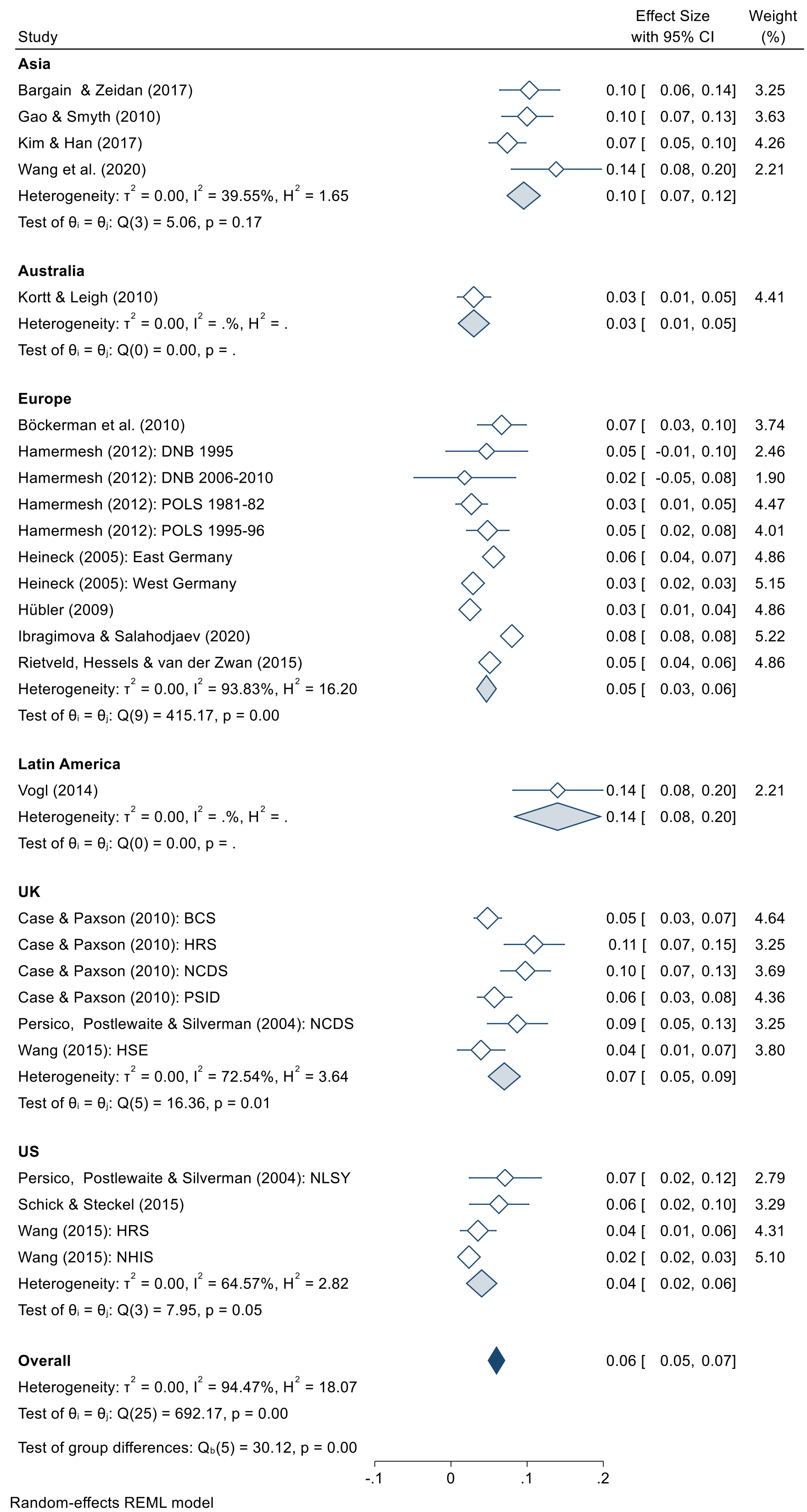

Fig. 3. Forest plot grouped by geography, men only.

also tested, including grouping studies only by country instead of broader regions/continents. These results were also similar to those in our main analyses.

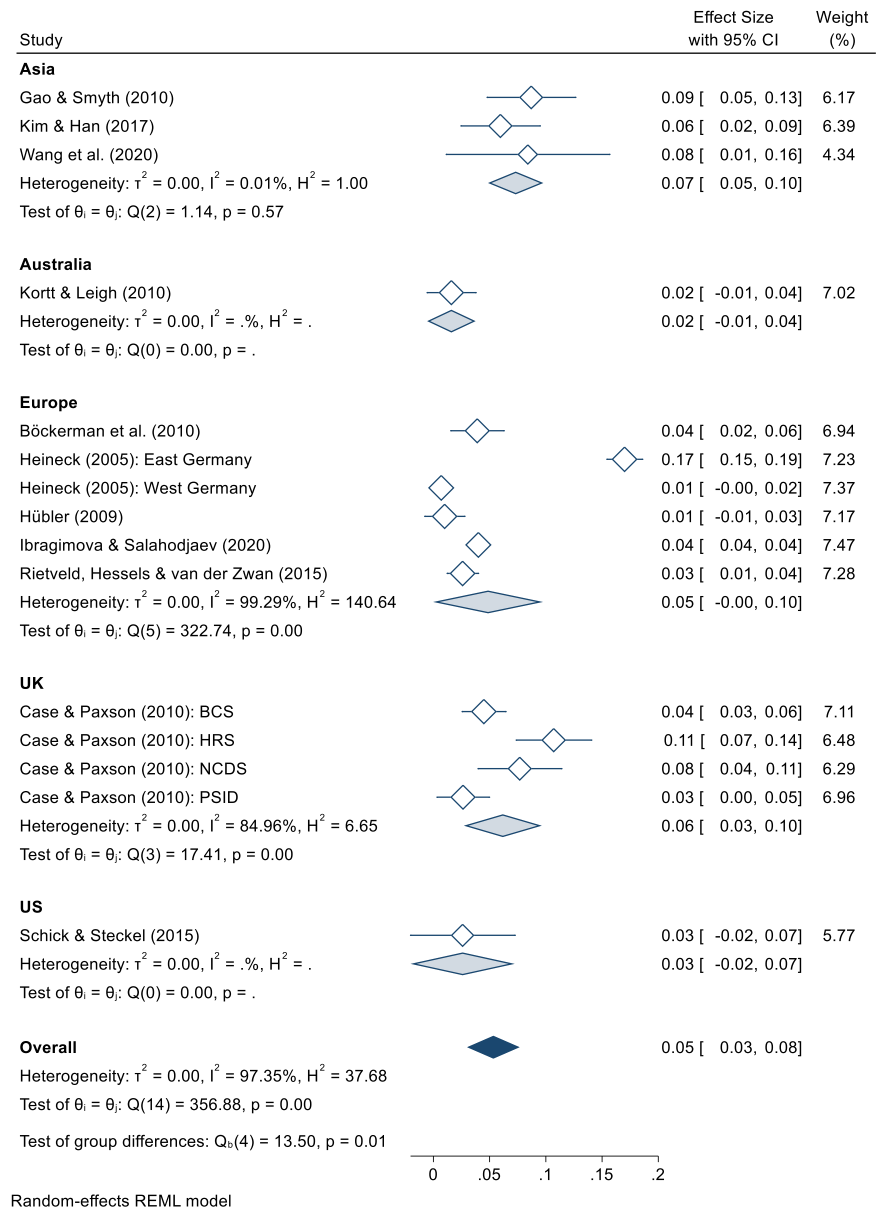

Fig. 4. Forest plot grouped by geography, women only.

3. Results

3.1. Narrative synthesis

In this section, the findings of the narrative synthesis are presented. For a full overview of the data underlying Tables 1–5, see Appendices B and C. Whether included studies found a height premium was explored in Table 1. The majority of studies (33 out of 42) found a height premium. A further five found no evidence of a height premium. Four studies reported results that varied by gender: two studies (Böckerman and Heineck et al., 2017, 2008) found a height premium for women, but not for men, while the other two (Heineck and Mitra, 2005, 2001), found a height premium for men, but not for women.

Next, we examined the gender of study subjects in Table 2. The vast majority of studies (32 of 42) included both men and women, followed by 9 studies that only included men, and 1 study that only included women.

Table 3 presents the geographies in which the height premium was studied. A majority of studies (23 of 42) were set in Europe, followed by Asia (7), North America (3), Oceania (2), Latin America (2), and Africa (1). Three studies examined two or more countries on different continents.

Table 4 presents the time period in which studies were set. Only two included studies (Alter et al., 2004; Anderson, 2018) used data with individuals born before the mid-twentieth century.

Table 5 presents the results of the critical appraisal. Thirteen of the 42 included studies had a low risk of bias, followed by 21 with a moderate risk of bias, and 8 with a high risk of bias.

3.2. Meta-analysis results

Seventeen studies were included in a meta-analysis. Fig. 2 presents a forest plot, stratified by geography. Studies conducted in Latin America and Asia had the largest height premiums. In Latin America, a 10 cm increase in height was associated with a 14% increase in wages (β = 0.14, 95% CI: 0.08–0.20). In Asia, a 10 cm increase in height was associated with a 9% increase in wages (β = 0.09, 95% CI: 0.07–0.10). This was followed by the U.K. (β = 0.07, 95% CI: 0.05–0.08), Europe (β = 0.05, 95% CI: 0.03–0.07), the U.S.A. (β = 0.04, 95% CI: 0.02–0.05), and Australia (β = 0.02, 95% CI: 0.01–0.04).

Much of the heterogeneity among studies appeared to be explained by geography. Heterogeneity among Asian studies was relatively low, with an I^2 statistic of 18.69%, indicating that we could interpret these findings with some confidence. Studies in the U.S.A. had an I^2 statistic of 50.47%, indicating moderate levels of heterogeneity. However, studies conducted in the U.K. and Europe had high levels of heterogeneity, with I^2 statistics of 77.83% and 99.99%, respectively, again indicating that these findings should be interpreted with extreme caution.

The geography analyses were stratified further by gender. First examining the results for men (Fig. 3), there was evidence of a height premium in all geographies. For Asian and Latin American men, there were relatively strong height premiums. In Latin America, a 10 cm increase in men's height was associated with a 14% increase in wages (β = 0.14, 95% CI: 0.08–0.20). In Asia, a 10 cm increase in men's height was associated with a 10% increase in wages (β = 0.10, 95% CI: 0.07–0.12). This was followed by the U.K. (β = 0.07, 95% CI: 0.05–0.09), Europe (β = 0.05, 95% CI: 0.03–0.06), the U.S. (β = 0.04, 95% CI: 0.02–0.05), and Australia (β = 0.03, 0.01–0.05).

However, there again were high levels of heterogeneity in several geographies: 93.83% and 72.54% of the variation among European and U.K. studies were due to heterogeneity, respectively. Studies conducted in the U.S. and Asia had I^2s of 64.57% and 39.55%, respectively, indicating a moderate level of heterogeneity.

Next, examining women (Fig. 4), there was preliminary evidence that there is the largest female height premium in Asia, with a 10 centimeter increase in height associated with a 7% increase in wages (β = 0.07, 95% CI: 0.05–0.10). This was followed by the U.K. (β = 0.06, 95% CI: 0.03–0.10), Europe (β = 0.05, 95% CI: 0.00–0.10), the U.S.A. (β = 0.03, 95% CI: −0.02 to 0.07), and Australia (β = 0.02, 95% CI: −0.01 to 0.04). Among Asian studies, 0.01% of study variance was estimated to be due to heterogeneity. However, among European and U.K. studies, the I^2 statistics were 99.29% and 84.96%, indicating that we should interpret these results with extreme caution.

Ultimately, we found evidence of a relative height premium that is dependent particularly on geography. We found moderately strong evidence of height premiums in some geographies: for the Latin American and Asian studies, a 10 cm increase in height was associated with a 14% (β = 0.14, 95% CI: 0.08–0.20) and 9% (β = 0.09, 95% CI: 0.08–0.20) increase, respectively, in wages. For Australia and the U.S., we found that a 10 cm increase in height was associated with a 2% (β = 0.02, 95% CI: 0.01–0.04) and 4% (β = 0.04, 95% CI: 0.02–0.05) increase, respectively, in wages. While we were unable to determine whether the height premium differed for men and women overall due to high heterogeneity, the height premium appeared to vary by gender within geographies. For example, a 10 cm increase in height was associated with a 10% increase in wages for Asian men, but it is only associated with a 7% increase for Asian women.

4. Discussion

In this study, the height premium was explored with a systematic review and meta-analysis. This study is the first to attempt a meta-analysis of the height premium. Ultimately, this study aimed to better-specify what, how and where the height premium has been examined in the literature.

Although a quantitative determination of an overall height premium was not possible, a majority of included studies (33 out of 42) found evidence of a height premium, based on the findings of the narrative synthesis. With the exception of Wang et al. (2020), which was set in China, all studies that did not find evidence of a height premium, or found mixed evidence of a height premium, were from Europe or the United States (n = 8). Two of the nine studies that only included men (Alter et al., 2004; Persico et al., 2004) found no evidence of a height premium. In terms of historical studies (n = 2), Alter et al. (2004), set in nineteenth-century Belgium, found no evidence of a height premium, while Anderson (2018), set in nineteenth-century England, did find evidence of one. Further, studies that were considered 'high risk' of bias were from various geographies, and included various combinations of both genders: no clear pattern was present here. In all, there was not clear descriptive evidence that geography, gender, time period or risk of bias impacted the presence of a height premium.

The results of the meta-analysis painted a somewhat different picture. Based on these results, it appeared that the height premium's strength was in all likelihood not universal, and varied by geography, and within geographies, by gender. In the section that follows, each finding is examined in turn.

Height's relationship to environmental conditions may help to explain the geographic variation in the height premium that we found. In Silventoinen et al. (2000), the authors argued that in modern high-income countries, environmental conditions are generally beneficial, and, importantly, beneficial for most of the population. In these contexts, random genetic variation likely plays a larger role in population height variations. In contexts where environmental conditions are more variable, a larger share of height is likely determined by environmental conditions (*ibid.*). This may apply to some Asian and Latin American countries, with populations that are currently experiencing secular growth trends, indicating that environmental conditions are currently improving (Zong et al., 2015; Malina et al., 2004). Perhaps because of the more variable environmental conditions in Mexico, China and/or Korea, height may be a better barometer of well-being, and is therefore more related to labor market performance (Currie and Vogl, 2012).

Height may also be associated with, or signals, another characteristic that is more advantageous in Mexico, China, and/or Korea than in the other countries studied. This could also explain why the height premium appeared to be stronger for men than for women. As mentioned, height may be related to, or signal strength and dominance (Stulp et al., 2012). If women are less frequently employed in manual occupations due to gender norms, it follows that height – as well as these characteristics - would be less strongly valued on labor markets.

Gendered height preferences may also help to explain why the height premium is stronger for men than for women. The literature on height and mating preferences may be instructive here. Evidence suggests that in most contexts, women prefer taller male partners (Stulp et al., 2017). However, in countries Stulp et al. (2017) broadly define as 'Western' (North America, Europe, Australia and New Zealand), preferences for women of similar height to their male partners were stronger than in 'non-Western' countries (Latin America, Asia, Africa). 'Non-Western' countries tend to also have lower levels of gender equality, based on health, empowerment and labor market indicators (United Nations Development Programme, 2023). In countries with lower levels of gender equality, perhaps women's tallness is less valued than in countries with higher levels of gender equality in contexts outside of marriage and/or mating preferences. This would perhaps translate to a greater height premium for men, but not for women.

It also may be that what height signals about environmental exposures is different for men and women. For instance, men are more likely to be stunted after periods of poor net nutrition (Tanner, 1962). Height may be therefore a stronger signal of health for men than for women, and may therefore be more strongly rewarded on labor markets.

A lingering question is why there was more heterogeneity among the European and U.K. studies. Within Europe, this heterogeneity did not reduce (e.g. an I^2 below 60%) when comparing only among individual and neighboring countries, e.g. Germany and Sweden. A possible explanation is that European studies are more heterogeneous. For example, while a number of studies were conducted in Germany, none was rated as having a low risk of bias. We therefore have no clear idea whether there is a height premium in Europe or the U.K.

4.1. Limitations

Our study had several additional limitations. A central issue of our meta-analysis is that we only examined associations between height and wages. Several studies conducted instrumental variable analyses

(Böckerman et al., 2017; Böckerman and Vainiomäki, 2013; Heineck, 2005; Rietveld et al., 2015; Schultz, 2003; Tyrrell et al., 2016; Wang et al., 2020). A majority of these studies found that their instrumental variable estimates were smaller than their ordinary least squares estimates. This indicates that we may be overstating the size of the height premium. Because of the paucity of studies employing more causal analyses, as well as their diverse methods, we did not attempt to synthesize them. In future, synthesising findings from instrumental variable analyses could give much better insight into the causal pathways between height and wages.

The meta-analysis's characterization of wages may also be a source of bias. Studies included in the meta-analysis either reported annual wages, or reported them in a format that was convertible to annual wages (e.g. monthly or weekly earnings). In countries with a high percentage of full-time, non-seasonal employment, the difference between annual and weekly earnings should be relatively small (Rytina, 1983). However, in countries where seasonal employment is more common, this conversion may be more problematic. Still, using data from Germany, Hübler (2009) found evidence that the relationship between height and wages changed with the labor market cycle. This limitation is important to bear in mind when interpreting the findings of this study.

Another missing piece in our narrative is growth: adult height may be reached at different velocities (Thompson et al., 2020). Being a tall adult does not necessarily mean someone was a tall child, and vice versa. This is more frequently the case in contexts with greater variation in environmental conditions (*ibid.*). However, height during development may be an important determinant of wages in adulthood. Case and Paxson (2008) and Persico et al. (2004) both found that once adolescent height was introduced into their analyses, the relationship between adult height and wages was no longer significant. Future studies could benefit from taking into account height at varying points during development, as well as adult height.

Further, the present study did not exhaustively examine the height premium in all contexts. This is due to biases in the literature. Our study therefore reproduced biases regarding where, when and about whom the height premium has been studied. All included studies' research populations are from high- or middle-income countries (Serajuddin and Hamadeh, 2020). Understanding of the height premium could be more developed if studies are conducted in more diverse labor markets.

Also, time period was extremely limited among included studies. An initial intention of this study was to understand if the height premium varied over time. It was ultimately not possible to do so: only two studies (Alter, Neven and Oris, 2004 and Anderson, 2018) focused on a pre-modern period. Because of their wage measurements, they were not suitable for inclusion in this meta-analysis.

There may also be a gender bias in the included studies. While most studies (32) examined both men and women, far more studies (nine) examined men only than women only (one). Less is known about the height premium for women. This smaller sample size for women's studies may also have resulted in less precise estimates of the height premium in the meta-analysis.

Finally, this literature review did not study other physical characteristics that may impact the height premium. Race and ethnicity may be important factors to explore. A number of studies only included people of European descent, likely because race affects the relationship between height and wages (e.g. Oreffice and Quintana-Domeque, 2016; Persico et al., 2004). However, Devaraj et al. (2018) and Rashad (2008) explored the interactions of height, gender and skin tone, and found that the height premium varied significantly among sub-groups. Further, only a few studies (including Harper et al., 2008 Lee, 2017; Tyrrell et al., 2016) looked at the body in three dimensions, and considered the possibility that weight also impacts the relationship between height and wages. Taking into account these different confounders could help future studies better-understand how and why the height premium varies across contexts and for different groups.

5. Conclusions

This study provided the first systematic overview of height's relationship to wages. A majority of included studies found evidence of a height premium, but the size of the height premium appeared to vary by geography, and within geographies, by gender. Our study offered an initial view into where and why there are height premiums, but more work is required to more fully understand how, why and where it exists.

CRediT authorship contribution statement

Kristina Thompson: Conceptualization, Methodology, Formal analysis, Data curation, Writing – original draft. **France Portrait:** Formal analysis, Writing – review & editing, Supervision. **Linda Schoonmade:** Methodology, Formal analysis.

Data Availability

Data will be made available on request.

Appendix A. Search strategy

Final searches

PubMed History 7 August 2020.

Search	PubMed – 7 August 2020	Items found
#6	#5 NOT ((cardiovascular[ti] OR diabetes[ti] OR cancer[ti] OR obesity[ti] OR overweight[ti] OR body mass index[ti] OR BMI[ti]) NOT (stature[ti] OR height*[ti] OR anthropomet*[ti] OR tall*[ti]))	2230
#5	#4 NOT (animals[mh] NOT humans[mh])	2300
#4	#3 NOT (("Adolescent"[Mesh] OR "Child"[Mesh] OR "Infant"[Mesh] OR adolescen*[tiab] OR child*[tiab] OR schoolchild*[tiab] OR infant*[tiab] OR girl*[tiab] OR boy*[tiab] OR teen[tiab] OR teens[tiab] OR teenager*[tiab] OR youth*[tiab] OR pediatr*[tiab] OR paediatr*[tiab] OR puber*[tiab]) NOT ("Adult"[Mesh] OR adult*[tiab] OR man[tiab] OR men[tiab] OR woman[tiab] OR women[tiab]))	2305
#3	#1 AND #2	3688
#2	"Socioeconomic Factors"[Mesh] OR socio-economic status[tiab] OR socioeconomic status[tiab] OR SES[tiab] OR economic status[tiab] OR standard of living* [tiab] OR living standards* [tiab] OR wealth[tiab] OR income[tiab] OR employment[tiab] OR occupation* [tiab] OR educat* [tiab] OR career mobility[tiab] OR social mobility[tiab] OR social class[tiab] OR job[tiab] OR labor[tiab] OR inequalit* [tiab] OR social accumulation[tiab] OR wage* [tiab] OR cognitive abilit* [tiab] OR human capital[tiab] OR workplace[tiab] OR academ* [tiab] OR Labor market[tiab] OR labour market[tiab]	1333407
#1	"Body Height"[Majr] OR "Anthropometry"[Majr:NoExp] OR stature[ti] OR height* [ti] OR anthropomet* [ti] OR tall* [ti] OR stature[ot] OR height* [ot] OR anthropomet* [ot] OR tall* [ot] OR stature[ot] OR height* [ot] OR anthropomet* [ot] OR tall* [ot]	38126

Embase History 7 August 2020.

Search	Embase - 7 August 2020	Items found
#6	#5 NOT ((cardiovascular:ti OR diabetes:ti OR cancer:ti OR obesity:ti OR overweight:ti OR 'body mass index':ti OR bmi:ti) NOT (stature:ti OR height*:ti OR anthropomet*:ti OR tall*:ti))	2751
#5	#4 NOT ([animals]/lim NOT [humans]/lim)	2888
#4	#3 NOT (('adolescent'/exp OR 'child'/exp OR adolescent*:ti,ab OR child*:ti,ab OR schoolchild*:ti,ab OR infant*:ti,ab OR girl*:ti,ab OR boy*:ti,ab OR teen:ti,ab OR teens:ti,ab OR teenager*:ti,ab OR youth*:ti,ab OR pediatr*:ti,ab OR paediatr*:ti,ab OR puber*:ti,ab) NOT ('adult'/exp OR 'aged'/exp OR 'middle aged'/exp OR adult*:ti,ab OR man:ti,ab OR men:ti,ab OR woman:ti,ab OR women:ti,ab))	2915
#3	#1 AND #2	4625
#2	'socioeconomics'/exp OR 'socio-economic status':ab,ti,kw OR 'socioeconomic status':ab,ti,kw OR SES:ab,ti,kw OR 'economic status':ab,ti,kw OR 'standard of living* ':ab,ti,kw OR 'living standards* ':ab,ti,kw OR wealth:ab,ti,kw OR income:ab,ti,kw OR employment:ab,ti,kw OR occupation* :ab,ti,kw OR educat* :ab,ti,kw OR 'career mobility':ab,ti,kw OR 'social mobility':ab,ti,kw OR 'social class':ab,ti,kw OR job:ab,ti,kw OR labor:ab,ti,kw OR inequalit* :ab,ti,kw OR 'social accumulation':ab,ti,kw OR wage* :ab,ti,kw OR 'cognitive abilit* ':ab,ti,kw OR 'human capital':ab,ti,kw OR workplace:ab,ti,kw OR academ* :ab,ti,kw OR 'labor market':ab,ti,kw OR 'labour market':ab,ti,kw	1715421
#1	'body height'/mj OR 'anthropometry'/mj OR stature:ti,kw OR height* :ti,kw OR anthropomet* :ti,kw OR tall* :ti,kw	47439

Web of Science Core Collection History 7 August 2020.

Search	Web of Science Core Collection – 7 August 2020	Items found
#5	#4 NOT (TS=(cardiovascular OR diabetes OR cancer OR obesity OR overweight OR "body mass index" OR bmi) NOT TS= (stature OR height* OR anthropomet* OR tall*))	2273
#4	#3 NOT (TS=(adolescent OR child OR schoolchild* OR infant* OR girl* OR boy* OR teen OR teens OR teenager* OR youth* OR pediatr* OR paediatr* OR puber*) NOT TS= (adult* OR aged OR man OR men OR woman OR women))	2273
#3	#1 AND #2	2464
#2	TS= ("socio-economic status" OR "socioeconomic status" OR "SES" OR "economic status" OR "standard of living*" OR "living standards*" OR "wealth" OR "income" OR "employment" OR occupation* OR educat* OR "career mobility" OR "social mobility" OR "social class" OR "job" OR "labor" OR inequalit* OR "social accumulation" OR wage* OR "cognitive abilit*" OR "human capital" OR workplace OR academ* OR "labor market" OR "labour market")	2203714
#1	TI= (stature OR height* OR anthropomet* OR tall*)	59679

Scopus History 7 August 2020.

Search	Scopus - 7 August 2020	Items found
#5	(((TITLE (stature OR height* OR anthropomet* OR tall*)) AND (TITLE-ABS-KEY ("socio-economic status" OR "socioeconomic status" OR ses OR "economic status" OR "standard of living*" OR "living standards*" OR "wealth" OR "income" OR "employment" OR occupation* OR educat* OR "career mobility" OR "social mobility" OR "social class" OR "job" OR "labor" OR inequalit* OR "social accumulation" OR wage* OR "cognitive abilit*" OR "human capital" OR workplace OR academ* OR "labor market" OR "labour market"))) AND NOT (TITLE-ABS-KEY (adolescent* OR child* OR schoolchild* OR infant* OR girl* OR boy* OR teen OR teens OR teenager* OR youth* OR pediatr* OR paediatr* OR puber*) AND NOT TITLE-ABS-KEY (adult* OR aged OR man OR men OR woman OR women))) AND NOT ((TITLE (cardiovascular OR diabetes OR cancer OR obesity OR overweight OR "body mass index" OR bmi) AND NOT TITLE (stature OR height* OR anthropomet* OR tall*)))	4129
#4	((TITLE (stature OR height* OR anthropomet* OR tall*)) AND (TITLE-ABS-KEY ("socio-economic status" OR "socioeconomic status" OR ses OR "economic status" OR "standard of living*" OR "living standards*" OR "wealth" OR "income" OR "employment" OR occupation* OR educat* OR "career mobility" OR "social mobility" OR "social class" OR "job" OR "labor" OR inequalit* OR "social accumulation" OR wage* OR "cognitive abilit*" OR "human capital" OR workplace OR academ* OR "labor market" OR "labour market"))) AND NOT (TITLE-ABS-KEY (adolescent* OR child* OR schoolchild* OR infant* OR girl* OR boy* OR teen OR teens OR teenager* OR youth* OR pediatr* OR paediatr* OR puber*) AND NOT TITLE-ABS-KEY (adult* OR aged OR man OR men OR woman OR women))	4129
#3	#1 AND #2	4891
#2	TITLE-ABS-KEY("socio-economic status" OR "socioeconomic status" OR SES OR "economic status" OR "standard of living*" OR "living standards*" OR "wealth" OR "income" OR "employment" OR occupation* OR educat* OR "career mobility" OR "social mobility" OR "social class" OR "job" OR "labor" OR inequalit* OR "social accumulation" OR wage* OR "cognitive abilit*" OR "human capital" OR workplace OR academ* OR "labor market" OR "labour market")	4842285

JSTOR History 7 August 2020.

Search	Scopus - 7 August 2020	Items found
#7	#1 AND #6	1995
#6	(("social accumulation" OR wage* OR "cognitive abilit*" OR "human capital" OR workplace OR academ* OR "labor market" OR "labour market"))	3292295
#5	#1 AND #4	2842
#4	("income" OR "employment" OR occupation* OR educat* OR "career mobility" OR "social mobility" OR "social class" OR "job" OR "labor" OR inequalit*)	1567222
#3	#1 AND #2	1230
#2	("socio-economic status" OR "socioeconomic status" OR SES OR "economic status" OR "standard of living*" OR "living standards*" OR "wealth")	474295
#1	(ti:((stature OR height* OR anthropomet* OR tall*)))	8249

Appendix B. Data extraction form

Study title	Dataset	Study aim	Study design	Time period	Sample characteristics	Sample size	Subgroups reported	Height units	Wages units	Methods	Key effect size	Standard error	Findings
Alter et al. (2004)	Mixed: population registers; tax registers; conscription registers; succession information; land ownership	What are the effects of height on old age mortality, and is this relationship mediated by experiences in mid-life (wealth and marital status)?	Longitudinal	1818–1900	Belgium - Conscripts from Sart-lez-Spa.	unclear.	N	cm	Inherited successions; land taxes; landholdings	SES: regression; marriage: Cox proportional hazard models	0.000	None reported	Taller adults more likely to marry; married couples more likely to accumulate wealth; taller, married people more likely to live to old age.
Anderson (2018)	company log-books	Did the height premium exist in physical and non-physical jobs in a pre-modern labor market?	Cross-sectional	1861–1926	UK - railwaymen	2206	Occupational grade at railway	inches	Log of weekly wages (shillings)	OLS; probit	0.005	0.001	The height premium only applied to taller men working in skilled grades that required a higher cognitive skill-based ability than strength
Bargain and Zeidan (2017)	IFLS	What is the effect of height on wages; and to what extent does height capture the effects of endowments before entering the labor market?	Longitudinal - 4 waves	1993 – 2007	Indonesia - representative sample of employed individuals	7878	Occupation sector (whole sample; entrepreneurs; public sector; private sector; informal workers); women and men	cm	Log of annual earnings (euros)	OLS	0.0103	0.00281	Human capital, not physical and cognitive skills, explains the height premium. Taller workers tend to have more education, and more educated workers have higher occupations.
Böckerman et al. (2010)	Health Finland 2000 and Finnish Longitudinal Employer/ Employee Data	What is the role that physical strength plays in determining the height premium?	Cross-sectional	2000 – 2001	Finland - representative sample of salaried workers working at least 29 h per week.	2506 (1259 women; 1247 men)	Women and men	cm	Log of annual earnings (euros)	OLS	0.0026 (women); men (0.00707)	0.00179 (women); 0.00232 (men)	There are no differences in the height premium between four different work strain categories.
Böckerman et al. (2017)	Young Finns study and Finnish Longitudinal Employer/ Employee Data	Is there a causal link between height and earnings over the life course?	Longitudinal	1980 – 2011/ 12	Finland - representative sample of 6 age cohorts in 1980 in five Finnish regions	3596	Height above gender-specific mean; height below gender specific mean	cm	Log of annual income (euros)	OLS and IV (IV using genetic marker)	0.014	Confidence intervals: 0.005; 0.020	When instrumenting genetic markers, the height premium is no longer significant. This means that there is probably an overestimation of the influence

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Study title	Dataset	Study aim	Study design	Time period	Sample characteristics	Sample size	Subgroups reported	Height units	Wages units	Methods	Key effect size	Standard error	Findings
													of height on wages.
Böckerman and Vainiomäki (2013)	Older Finnish Twin Cohort Study and Finnish Longitudinal Employer/ Employee Data	To what extent is height associated with wages, controlling for unobservable family characteristics?	Longitudinal	1974, 1981, 1990 (height); 1990–2004 (wages)	Finland - nearly all twin pairs born before 1958 and alive in 1974 (wave 1)	5060 women; 4680 men	Women and men, monozygotic and dizygotic	cm	Average of log-transformed annual earnings, 1990–2004 (euros)	OLS and IV	Individual-level models (not twin difference models), DZ and MZ: 0.0175 (women); 0.0182 (men)	0.0067 (men); 0.0070 (women)	There is a height premium for women, but not for men (when using IV estimation). Also, using capital income as the outcome point to discrimination against short persons for women.
Case and Paxson (2010)	NCDS; BCS: PSID; Whitehall II	What are the consequences of childhood health for economic and health outcomes in adults, using height as a marker for health in childhood?	Longitudinal	various	UK - representative	NCDS: 5833 men; 5815 women; BCS: 5424 men'; 5757 women; PSID: 31,996 men; 31999 women; HRS: 27606 men; 35927 women	Women and men	inches	Years of schooling; binary employment status; log average hourly earnings, if employed (GBP)	OLS	NCDS: 0.0195 (women), 0.0248 (men); BCS: 0.0114 (women), 0.0122 (men); PSID: 0.0067 (women), 0.0145 (men); HRS: 0.0272 (women); 0.0277 (men)	NCDS: 0.0048 (women), 0.0042 (men); BCS: 0.0025 (women), 0.0023 (men); PSID: 0.0030 (women), 0.0029 (men); HRS: 0.0044 (women), 0.0051 (men)	Childhood health influences health and economic status throughout the life course
Case et al. (2009)	British Household Panel Survey	Why does the height premium exist?	Longitudinal	1997 – 2005	UK - representative	2618 women; 2360 men	Women and men; age 21–50 and age 21–60; with and without controls for age, race, education, occupation	inches	Difference for the mean of gross hourly pay (GBP); occupational skill level; educational level.	OLS	0.003 (women); 0.004 (men)	0.002 (women); 0.002 (men)	Every inch of height increases wages by approx. 1.5%, and much of this premium can be explained by taller workers obtaining more education and sorting into higher-status occupations.
Devaraj et al. (2018)	National Longitudinal Study of Youth	To what extent do observable physical characteristics (including height) impact earnings?	Longitudinal	1997 – 2011	USA - representative	4340	Race	deviation from average in inches	Log of total real annual income (USD)	pooled OLS regressions	0.0200	0.000	Skin tone, height and gender interact so that all of them determine earnings
Gao and Smyth (2010)	China Urban Labor Survey	To what extent does height influence earnings, while holding early-life human capital constant?	Cross-sectional	2005 – 2005	China - a representative sample of school leavers from five provincial capital cities	8919	Women and men	cm	Log of total real income (RMB)	OLS and two-stage least squares/IV	0.0087 (women); 0.0100 (men)	0.0020 (women); 0.0017 (men)	The TSLS estimates of are larger than the OLS estimates, indicating that genetics play a large role in determining both

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Study title	Dataset	Study aim	Study design	Time period	Sample characteristics	Sample size	Subgroups reported	Height units	Wages units	Methods	Key effect size	Standard error	Findings
													height and wages.
Habibov et al. (2020)	Life-in-Transition Survey	How does height influence the likelihood of employment, occupational sorting, and earnings?	Cross-sectional	2016	Various – 27 post-Communist countries	5555 women; 5243 men	Women and men; rural and urban	cm; deviation from average	Log of monthly currencies (various currencies)	OLS	0.012 (women); 0.005 (men); 0.010 (rural); 0.008 (urban)	Confidence intervals: 0.01, 0.02 (women); 0.00,0.01 (men); 0.01,0.01 (rural); 0.00,0.01 (urban)	Taller people have better outcomes in terms of employment, occupational sorting, and earnings.
Hamermesh (2012)	Permanent Onderzoek Leefsituatie and DNB Household Survey	What is the height premium in the Netherlands, which experienced a dramatic change in average heights?	Longitudinal	1981–2010	Netherlands representative sample of men	POLS 1981–82: 2017; POLS 1995–96: 1926; DNB 1995: 1339; DNB 2006–10: 872	Men	cm	Log of wages (gelders and EUR)	OLS and kernel estimations	POLS 1981–82: 0.0027; POLS 1995–96: 0.0048; DNB 1995: 0.0047; DNB 2006–10: 0.0018	POLS 1981–82: 0.0011; POLS 1995–96: 0.0014; DNB 1995: 0.0027; DNB 2006–10: 0.0034	The height premium is stronger for older workers (whose heights were probably closer to their employers). The height premium decreases for younger cohorts.
Harper (2000)	National Child Development Study	What is the effect of physical appearance on financial well-being?	Longitudinal	1958–1991	UK -individuals who were born in the week 3 ± 9 March 1958 and are currently employed	3541 women and 4160 men	Women and men; short and tall	Percentiles	Log of hourly wages (GBP); occupational categories	OLS	short 0–9%: − 0.051 (women), − 0.043 (men); short 10–19%: 0.051 (women), − 0.038 (men); tall 80–89%: 0.012 (women), 0.059 (men); tall 90–100%: − 0.035 (women), 0.017 (men)	T statistics - short 0–9%: − 1.72 (women), − 1.17 (men); short 10–19%: 1.79 (women), − 1.41 (men); tall 80–89%: 0.44 (women), 2.08 (men); tall 90–100%: − 1.20 (women), 0.60 (men)	Physical appearance is as important for men as it is for women. Also, the penalty for plainness, which is around 15% for men and 11% for women, exceeds the premium for being attractive.
Heineck (2005)	German Socio-Economic Panel (GSOEP)	Do taller workers earn more than their shorter counterparts?	Longitudinal	1991 – 2002	Germany - West and (later) east German panel data	4668 women and 4980 men	Women and men; east and west Germany	cm	Log of gross monthly earnings (EUR)	OLS and Hausman–Taylor IV estimator	0.0017 (women, east); 0.0007 (women, west); east (men, east): 0.0056; 0.0029 (men, west)	0.0008 (women, east); 0.0005 (women, west); 0.0007 (men, east); 0.0003 (men, west)	For men in West Germany within 'normal' height ranges, a one standard deviation in height is associated with a height premium of 4%. This does not hold for women.
Heineck (2008)	BHPS	To what extent does height impact wages,	Cross-sectional analysis of	2004 – 2004	UK	4650	Women and men;	inches, also deviation	Log of gross hourly wages (GBP)	OLS	OLS: 0.0052 (women);	0.0028 (women); 0.003 (men)	OLS estimates point towards a positive

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Study title	Dataset	Study aim	Study design	Time period	Sample characteristics	Sample size	Subgroups reported	Height units	Wages units	Methods	Key effect size	Standard error	Findings
		and is this relationship linear?	longitudinal dataset				occupation type	from average height			− 0.0012 (men)		association for women but not for men. This relationship decreases when controlling for socio-economic factors.
Hersch (2008)	New Immigrant Survey	To what extent do skin color and height affect earnings of new immigrants to the U.S.A.?	Cross-sectional	1993 – 1993	US - recent immigrants who are currently working and earn between $1.50 and $100 per hour	1536	N	inches below or above average height	Log of gross hourly wages (USD)	OLS	OLS: Inches below average height: − 0.005; inches above average height: 0.017	Inches below US gender average height SE: 0.005; inches above US gender average height: 0.009	Taller immigrants have higher wages, although weight does not affect wages. Also, lighter-skinned workers have higher wages.
Hübler (2009)	German Socio-Economic Panel (GSOEP)	What is the curvilinear effect of height on wages?	Longitudinal	1985–2004	Germany - West and (later) east Germany, ages 25–55	13918 women; 22836 men	Women and men; occupational sector	cm	Log of wages per hour (deutschmarks and EUR)	OLS	0.0025 (women); 0.0010 (men)	0.0009 (women); 0.007 (men)	Height's influence on wages is curvilinear, and more so for men than for women. Women who are shorter than average and men who are taller than average have the largest height premiums.
Ibragimova and Salahodjaev (2019)	Russian Longitudinal Monitoring Survey	To what extent does height influence earnings in Russia?	Cross-sectional	2015	Russia	2623	Women and men	cm	Log of monthly wages (RUB)	OLS	0.003 (women); 0.005 (men)	0.00 (women) 0.00 (men)	Height for both men and women is significantly associated with increased wages for both men and women.
Kim and Han (2017)	Korean Labor and Income Panel Study	What is the effect of height on wages?	Longitudinal	1998 (first wave); 2012 (second wave)	Korea - representative sample of households	20233 women; 34015 men	Women and men	cm	Log of monthly wages (1 million KRW)	mixed-effects linear model	0.00596 (women); 0.00739 (men)	0.00179 (women); 0.00122 (men)	There is a non-linear relationship between height and wages. This was larger for men overall in the 90th quintile of wages; and also true for self-employed women and salaried men.
Kortt and Leigh (2010)	Household, Income and Labor	What is the effect of height on wages, and of overweight	Longitudinal	2006 (first wave used); 2007 (second wave used)	Australia - sample of working-age individuals,	3357 women; 3465 men	Women and men	dm	Log of hourly wages (2006 and 2007 AUD)	OLS	0.023 (overall); 0.016	0.008 (overall); 0.011 (women); 0.011 (men)	The height premium appears to be smaller

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Study title	Dataset	Study aim	Study design	Time period	Sample characteristics	Sample size	Subgroups reported	Height units	Wages units	Methods	Key effect size	Standard error	Findings
	Dynamics survey	on wages in Australia?			employed or self-employed						(women); 0.030 (men)		than in other countries.
Kropfhäußer (2016)	German Socio-Economic Panel (GSOEP)	To what extent does height impact wages in young german workers?	Longitudinal	2001–2014	Germany - representative sample of workers	11374 women; 10178 men;	General sample and subset of siblings	cm	Log of real hourly wage (EUR); real monthly earnings (EUR)	OLS	0.0092	0.0007	The wage/height premium is explained by unobserved heterogeneity at the sibling level.
LaFave and Thomas (2017)	The Work and Iron Status Evaluation	To what extent is the height premium driven by employer choice, or by occupational sorting?	Longitudinal	2001–2009	Indonesia - Representative sample of earning men	5304	Wage sector only & self-employed (in some models)	log of cm	Log of real wages: hourly earnings (10,000 INR)	OLS and odds ratios	1.763 (male waged workers)	0286	Taller men are more productive as measured by wages and self-employed sector - and this is stronger for those who self-select into the self-employed sector.
Lång and Nystedt (2018)	The Swedish Twin Registry	To what extent is the height premium persistent in monozygotic twins (for whom variations in height will be entirely due to environmental influences)	Longitudinal	1963 (when height first reported) - 2007 (when income last reported)	Sweden - monozygotic and dizygotic twins	17,934 DZ and 11,642 MZ twins (women and men)	Women and men; MZ & DZ; twin pairs concordant and discordant in height	cm	Percentiles of income	OLS & WTPD	Impact of height on earnings at age 35–39, controlling for birth weights: 0.085 (women); 0.031 (men)	0.041 (women); 0.015 (men)	The WTPD and the OLS estimates are similar for MZ and DZ twins, implying that environmentally and genetically induced differences in height have a similar influence on earnings.
Lee (2017)	Household, Labor and Income Dynamics Survey	To what extent does height and weight impact wages?	Longitudinal	2006–2012	Australia - Representative sample of the working age population, working at least 20 h per week.	3813 women; 4036 men	Women and men	meters	Log of hourly wages, averaged over time (2011 AUD)	OLS; correlated random effects (OLS results reported)	Impact of height on wages, controlling for weight: 0.220 (women); 0.324 (men)	3.51 (women); 4.07 (men)	The benefits of height change with age, sex and weight. Women with lower weights and shorter heights have a larger height premium. For relatively tall men, there is a height premium for being overweight.
Lindqvist (2012)	LINDA and Swedish conscription records	To what extent can the association between height and leadership can be explained by a correlation	Longitudinal	1983 (first conscription year) - 2006 (last employment year)	Sweden -Representative sample of men	13450 men	N	meters	Log of wages (2006 SEK) and the likelihood (0/1) of holding a managerial position	OLS; probit	0269	0.037	There is a height premium, but it is largely explained by cognitive and noncognitive ability, as well as taller people selecting into

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Study title	Dataset	Study aim	Study design	Time period	Sample characteristics	Sample size	Subgroups reported	Height units	Wages units	Methods	Key effect size	Standard error	Findings
		between height and ability?											managerial positions.
Lundborg et al. (2014)	registers from Statistics Sweden and the Swedish National Service Administration	Why do tall people earn more?	Longitudinal	1984 (first conscription year) - 2003 (last SES measure)	Sweden -Representative sample of men	448702 (including 145210 siblings)	N	decimeters	Log of wages (2003 SEK)	OLS; family fixed effects	0.052	0.002	Cognitive and noncognitive skills, family background and muscular strength are important for the height premium.
Mitra (2001)	1993 wave of National Longitudinal Survey of Youth	What effects do physical attributes have on wages?; Are these influences equal among women and men?; Do physical attributes exert significant effects on the wages of workers with high mathematical scores?	Cross-sectional	1993	USA - National probability sample of women and men who were aged 14–21 in 1979 and were full-time workers.	12686	Professionals and managers; above and below-average mathematical skills; women and men	inches	Log of hourly wages (USD)	OLS	0.0251 (professionals and managers, women), 0.0061 (professionals and managers, men); 0.0030 (blue collar workers, women); 0.0017 (blue collar workers, men)	T-statistics - 2.956 (professionals and managers, women), 0.616 (professionals and managers, men); 0.334 (blue collar workers, women), 0.345 (blue collar workers, men)	Only taller women experience a height premium. Overall, physical attributes significantly impact the wages of women, but have no effect for men.
Murasko (2019)	Demographic and Health Surveys (USAID)	What are the associations among beight, education and economic outcomes among women in less-developed countris?	Repeated cross-sectional	1991 – 2006	Various - Women from 63 low(er) income countries	1.9 million	Amount of schooling: any vs years > 0; manual work vs high wealth	cm	Derived from a PCA of wealth indicators, e.g. Physical assets and the built environment; household wealth; occupation	OLS	Height's association with manual work: − 0.155; Heights association with high wealth: 0.366	Height's influence on manual work: 0.043; height's influence on high wealth: 0.076	Height is shown to have a generalized association to school participation, years of schooling, type of occupation and relative household wealth.
Oreffice and Quintana-Domeque (2016)	German General Social Survey	What components influence attractiveness, and how does attractiveness influence wages?	Repeated cross-sectional	1980 – 2012	Germany - representative sample of Germany-born citizens	1075 (descriptives given for 2008 and 2012 combined waves only)	Women and men	cm	Log of hourly wages (EUR)	OLS	0.011 (women); 0.008 (men)	0.005 (women);0.004 (men)	Height plays a significant role in determining wages, in addition to other characteristics of physical attractiveness - meaning height is not just about physical attractiveness.
Patel and Devaraj (2018)	Research on Early Life and Ageing Trends and Effects	Do taller individuals in developing countries	Cross-sectional	1996 (first countries data collected) - 2008 (last	Various - women and men from 14 lower and middle	45018	None reported	cm	Income, and when unavailable, series of	OLS and 2SLS; Oaxaca-Blinder decomposition	OLS: median adjusted height (cm) impact on	0.00154	For a 1 cm increase in height above the median country-

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Study title	Dataset	Study aim	Study design	Time period	Sample characteristics	Sample size	Subgroups reported	Height units	Wages units	Methods	Key effect size	Standard error	Findings
	(RELATE) + other datasets harmonized with RELATE	receive higher income due to greater endowments or due to discirimination against shorter individuals?		country's data collected	income countries				questions was used to estimate individual-level income.		income: 0.0145		sex adjusted height, income increases by 1.37%
Persico et al. (2004)	National Child Development Study UK) and the National Longitudinal Survey of Youth (US)	How does height at different ages affect height premiums?	Longitudinal	NLSY: 1979–1991; NCDS: 1958 – 1994	USA and UK - white non-Latinx men	NLSY: 2063; NCDS: 1772	Two samples (one from the U.S.A., one from Britain).	inches	Log of income, ages 31–38 (NLSY); age 33 (NCDS)	OLS	0.006 (NCDS); – 0.006 (NLSY)	0.0077 (NCDS); 0.0091 (NLSY)	The effect of adult height on wages is eliminated after controlling for teen height. The teen height premium is itself mediated in part through social capital.
Rashad (2008)	Behavioral RIsk Factor Surveillance System	What are the relationships between height, physical health and labor market outcomes in the U.S.A., 1984–2005?	Cross-sectional	1984–2005	USA - Adults who are 45 in 1984 through adults who are 21 in 2005	920932	Women and men; white black, Latinx, other race.	cm	Log of real annual family income (1982–1984 USD)	OLS	0.54 (white men); 0.77 (black men); 1.04 (Latinx men); 0.55 (other men); 0.54 (white women); 0.42 (black women); 1.07 (Latinx women); 0.49 (other women)	none reported	Results indicate that being 10 cm taller yields a $1874-$2306 increase in earnings for men, and a $891-$2243 earnings premium for women.
Rietveld et al. (2015)	German Socio-economic Panel	To what extent does height explain the likelihood of being self-employed? Among those who are self-employed, does height increase the likelihood of having employees and of earning more?	Longitudinal	2002–2012	Germany – nationally representative sample.	111231	Women and men	cm	Log of hourly earnings (EUR)	OLS and logit; Hausman-Taylor IV estimation	0.0026 (women); 0.0051 (men)	0.0007 (women); 0.0007 (men)	There is a height premium for self-employed and employed individuals. But about a third of the height premium is explained by educational attainment.
Schick and Steckel (2015)	National Childhood Development Study	Do cognitve or noncognitive skills explain the height premium?	Longitudinal	1958 – 2000 (although most information taken from 1992)	UK - 1958 cohort (all children during the week of 3 March 1958).	1167 women; 1383 men	Women and men	inches	The log of hourly wages (GBP)	OLS	OLS: 0.000 (women); 0.005 (men).	0.006 (women); 0.005 (men)	Taller children have higher cognitive and non-cognitive test scores - each accounts for a substantial and

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Study title	Dataset	Study aim	Study design	Time period	Sample characteristics	Sample size	Subgroups reported	Height units	Wages units	Methods	Key effect size	Standard error	Findings
													roughly equal portion of the stature-earnings premium.
Schultz (2003)	Living Standards Measurement Survey	What impacts do different human capital imputs have on the wage function in the Ivory Coast and Ghana?	Repeated cross-sectional	1985–1989	Ivory Coast and Ghana	Ivory Coast: 1692 men; 1180 women. Ghana sample: 3414 men; 3400 women	Women and men, from Ghana and Cote d'Ivoire	cm	Log of hourly wages (GHS and CFA)	OLS and IV	0.416 (Ivory Coast, women); 0.862 (Ivory Coast, men); 1.29 (Ghana, women); 1.48 (Ghana, men)	absolute value of the t ratio: 0.62 (Ivory Coast, women); 2.00 (Ivory Coast, men); 3.63 (Ghana, women); 5.02 (Ghana, men)	The wage effects of child nutrition proxied by height are greater in poorer, more malnourished Ghana.
(Sohn, 2015)	Indonesian Family Life Study	What is the size of the height premium in Indonesia, and what are its mechanisms?	Cross-sectional (only uses one wave of a longitudinal study)	2007 – 2007	Indonesia - representative sample of 83% of provinces	4811 women; 8432 men	Women and men; self-employed; private sector employee; public sector employee	dm	Natural log of annual earnings (IDR)	OLS	0.180 (women, self-employed); 0.123 (men, self-employed);: 0.065 (women, public sector); 0.039 (men, public sector); 0.111 (women, private sector); 0.001 (men, private sector)	0.069 (women, self-employed); 0.048 (men, self-employed); 0.1116 (women, public sector); 0.068 (men, public sector); 0.054 (women, private sector); 0.033 (men, private sector)	When the height premium is estimated by sector, discrimination based on customers' preference for taller workers.
Thomas and Strauss (1997)	Estudo Nacional da Despesa Familiar	To what extent do four dimensions of health (of which height is one) impact labor market outcomes in Brazil?	Cross-sectional	1974–1975	Brazil	17925 women; 16169 men	Women and men; self-employed and market sector	log of cm	Log of annual earnings (BLR)	OLS and IV	2.458 (women, market sector); 3.921 (men, market sector); − 1.002 (women, self-employed); 3.580 (men, self-employed).	0.67 (women, market sector); 0.98 (men, market sector); 3.40 (women, self-employed); 1.50 (men, self-employed)	Taller women and men earn more (except for self-employed women!). The effect size varies by sex and sector of employment.
Tyrrell et al. (2016)	UK Biobank	Do height and BMI have a causal role in five measures of SES (exploiting Mendellian genetics)?	Cross-sectional	2006–2010	UK - British people of British ancestry	119669	Women and men	standard deviation above or below mean (based on cms)	Education level; age completed full-time education; annual household income; occupation	OLS and IV	0.02 (women); 0.07 (men); 0.05 (overall)	SDs: 0.00–0.05 (women); 0.05–0.10 (men); 1.07–1.18 (overall)	Shorter stature and higher BMI were observationally associated with several measures of lower SES, and using IV with a genetic marker shoes these relationships are causal.

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Study title	Dataset	Study aim	Study design	Time period	Sample characteristics	Sample size	Subgroups reported	Height units	Wages units	Methods	Key effect size	Standard error	Findings
Vogl (2014)	Mexican Family Life Survey	What roles do intelligence and strength play in explaining the labor market height premium (both wages and occupational sorting) in Mexico?	Longitudinal (two waves)	2002, 2005	Mexico - Nationally representative sample of men, aged 25 through 65.	3860 in earnings analysis; 4715 in occupational choice analysis	Indigenous & non-indigenous; non-urban birthplace & urban birthplace (in some analyses, although not all)	cm	Log of hourly earnings (tax information, number of weeks/hours worked per year, monthly income, annual income, occupation)	OLS and nonparametric regressions	0.014 (overall); 0.023 (indigenous); 0.013 (non-indigenous); 0.016 (non-urban birthplace); 0.012 (urban birthplace)	0.003 (overall); 0.007 (indigenous); 0.004 (non-indigenous); 0.004 (non-urban birthplace); 0.005 (urban birthplace)	While cognitive tests account for a small share of the height premium, half of the premium can be explained by the educational and occupational choices of taller workers.
Wang (2015)	National Health Interview Survey; the Health Survey of England; Health and Retirement Survey; New Immigrant Survey	What are the wage returns of height, when comparing immigrants with native-born workers?	Cross-sectional (some are repeated cross-sectional with multiple waves used, and some are cohort studies but only one wave is used)	NHIS: 2000–2007; HSE: 1999–2004; HRS: 1992–1992; NIS: 2003–2003	UK and US – men only	NHIS: 51,189; HSE: 5162; HRS: 10,104; NIS: 2958	Immigrants (those born in another country) and native-born individuals	inches	Log of real hourly wages (USD, GBP)	OLS + nonlinear robustness check	0.006 (NHIS, native); 0.013 (NHIS, immigrant); 0.010 (HSE, native); 0.023 (HSE, immigrant); 0.009 (HRS, native); 0.015 (HRS, immigrant); 0.009 (NIS, immigrant only).	0.001 (NHIS, native); 0.002 (NHIS, immigrant); 0.004 (HSE, native); 0.008 (HSE, immigrant); 0.003 (HRS, native); 0.008 (HRS, native); 0.003 (NIS, immigrant only)	The height premium is almost twice as large for immigrants as for native-born individuals. This may be due to the productivity gap between tall and short immigrant workers is greater.
Wang et al. (2020)	Proprietary data	To what extent does height impact wages, correcting for genetics?	Cross-sectional	2018–2019	China	3427	Women and men	cm	Log of annual wages (CNY)	OLS + IV	OLS: 0.0084 (women); 0.0138 (men)	0.0037 (women); 0.0030 (men)	While OLS estimates are significant, IV estimates are not. This indicates that once genetics are taken into account, no height premium is present.
Yamamura et al. (2015)	Chinese General Social Survey	Through what mechanisms does height influence income in China?	Cross-sectional	2008–2008	Nationally representative survey collected in 27 provinces. But in this study, only those from the urban sample.	4596	Member of communist party and non-member; wage earners and those less than 60 years old	cm	Annual income divided by hours worked; log of result.	probit; Heckman-tobit estimates	0.009 (women, earners); 0.011 (men, earners)	1.45 (women, earners); 2.71 (men, earners)	Controlling for communist party membership results in a larger height premium. This suggests that the height premium through the market channel is larger than through the political one.

Appendix C. Critical appraisal tool

Study	Theory specified?	Sample described?	Height measured?	SES measured?	Longitudinal design?	Sub-groups reported?	Causal analyses explored?	Confounding factors identified?	Discussion?	Total score	Risk of bias
Alter et al. (2004)	1	1	1	1	1	0	0	1	1	7	Low risk
Anderson (2018)	1	0	1	1	0	1	0	1	1	6	Moderate risk
Bargain and Zeidan (2017)	1	1	1	0	1	1	1	1	1	8	Low risk
Böckerman et al. (2010)	1	1	1	1	0	1	0	1	1	7	Low risk
Böckerman and Vainiomäki (2013)	0	0	1	1	1	0	1	1	1	6	Moderate risk
Böckerman et al. (2017)	1	0	0	1	1	1	1	1	1	7	Low risk
Case and Paxson (2010)	1	0	1	0	1	1	1	1	1	7	Low risk
Case et al. (2009)	0	0	1	0	1	1	0	1	0	4	High risk
Devaraj et al. (2018)	1	1	0	0	1	0	0	1	1	5	Moderate risk
Gao and Smyth (2010)	1	1	0	0	0	1	1	1	1	6	Moderate risk
Habibov et al. (2020)	1	1	0	0	0	1	0	1	1	5	Moderate risk
Hamermesh (2012)	0	1	0	0	1	0	0	1	1	4	High risk
Harper (2000)	1	1	1	0	1	1	0	1	1	7	Low risk
Heineck (2005)	1	0	0	0	1	1	1	1	1	6	Moderate risk
Heineck (2008)	0	0	0	0	0	1	0	1	0	2	High risk
Hersch (2008)	1	1	0	0	0	1	0	1	1	5	Moderate risk
Hübler (2009)	1	0	0	0	1	1	0	1	1	5	Moderate risk
Ibragimova and Salahodjaev (2019)	1	0	0	0	0	1	0	1	1	4	High risk
Kim and Han (2017)	1	0	0	0	1	1	0	1	1	5	Moderate risk
Kortt and Leigh (2010)	0	0	0	0	1	1	0	1	1	4	High risk
Kropfhäußer (2016)	0	0	0	1	1	1	1	1	0	5	Moderate risk
LaFave and Thomas (2017)	1	1	1	0	1	1	0	1	1	7	Low risk
Lång and Nystedt (2018)	1	1	0	1	1	1	1	1	1	8	Low risk
Lee (2017)	0	1	0	0	1	1	0	1	1	5	Moderate risk
Lindqvist (2012)	0	0	1	1	1	0	1	1	0	5	Moderate risk
Lundborg et al. (2014)	1	1	1	1	1	0	1	1	1	8	Low risk
Mitra (2001)	1	0	0	0	0	1	0	1	1	4	High risk
Murasko (2019)	1	1	1	0	0	1	0	1	1	6	Moderate risk
Oreffice and Quintana-Domeque (2016)	1	1	0	0	0	1	0	1	1	5	Moderate risk
Patel and Devaraj (2018)	0	1	0	0	0	0	0	1	0	2	High risk
Persico et al. (2004)	1	1	1	0	1	1	1	1	1	8	Low risk
Rashad (2008)	1	1	0	0	0	1	0	1	1	5	Moderate risk
Rietveld, Hessels and van der Zwan (2015)	1	0	0	0	1	1	1	1	1	6	Moderate risk
Schick and Steckel (2015)	1	1	1	0	1	1	0	1	1	7	Low risk
Schultz (2003)	1	1	1	0	0	1	1	1	1	7	Low risk
Sohn (2015)	1	1	1	0	0	1	0	1	1	6	Moderate risk
Thomas and Strauss (1997)	1	1	1	0	0	1	0	1	1	6	Moderate risk
Tyrrell et al. (2016)	0	1	1	0	0	1	1	1	1	6	Moderate risk
Vogl (2014)	1	1	1	0	1	1	0	1	1	7	Low risk
Wang (2015)	1	0	1	0	0	1	0	1	1	5	Moderate risk
Wang et al. (2020)	1	1	0	0	0	1	1	1	1	6	Moderate risk
Yamamura et al. (2015)	1	1	0	0	0	1	0	0	1	4	High risk

Appendix D. Meta-analysis results

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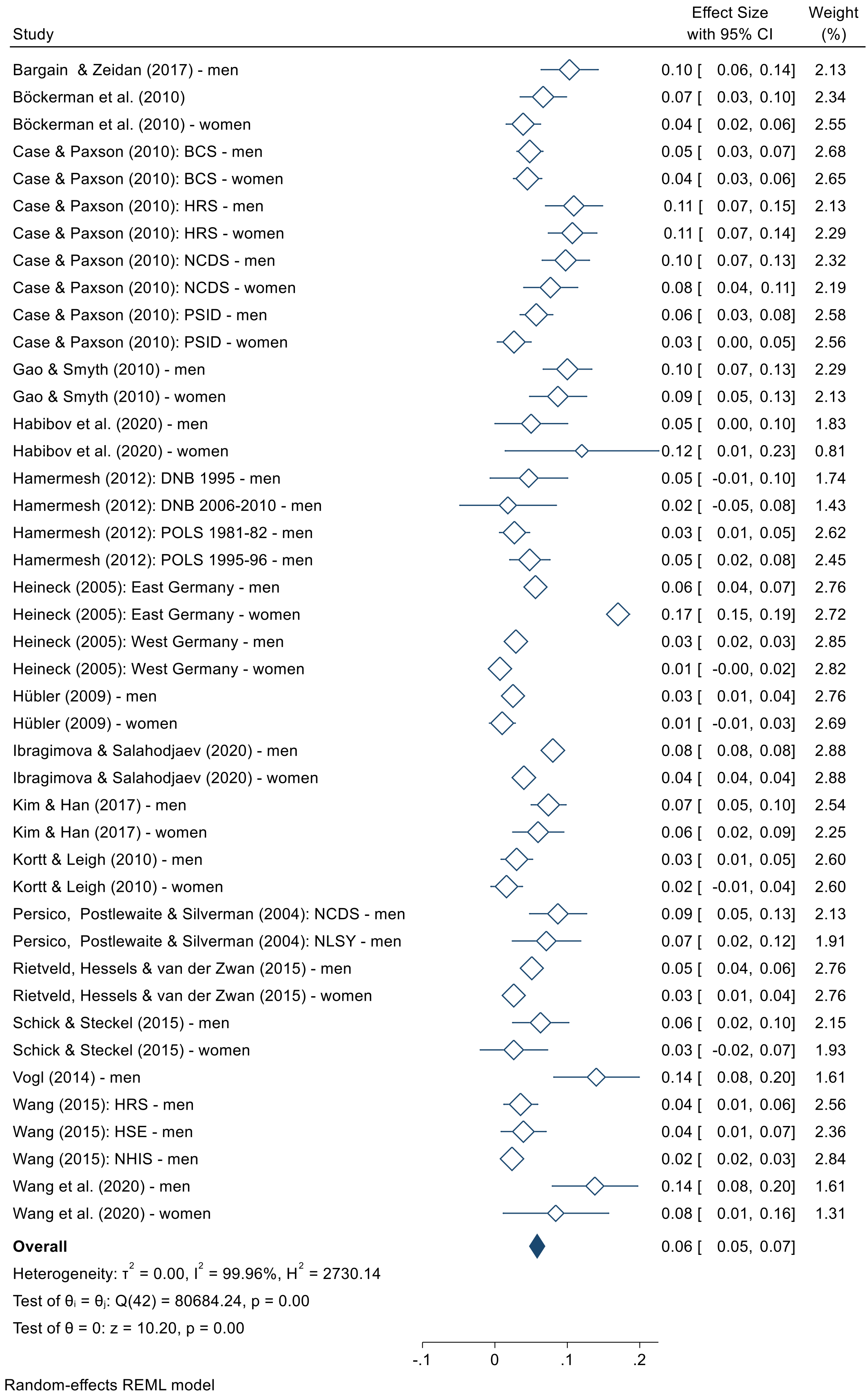

Fig. D.1. Full sample forest plot.

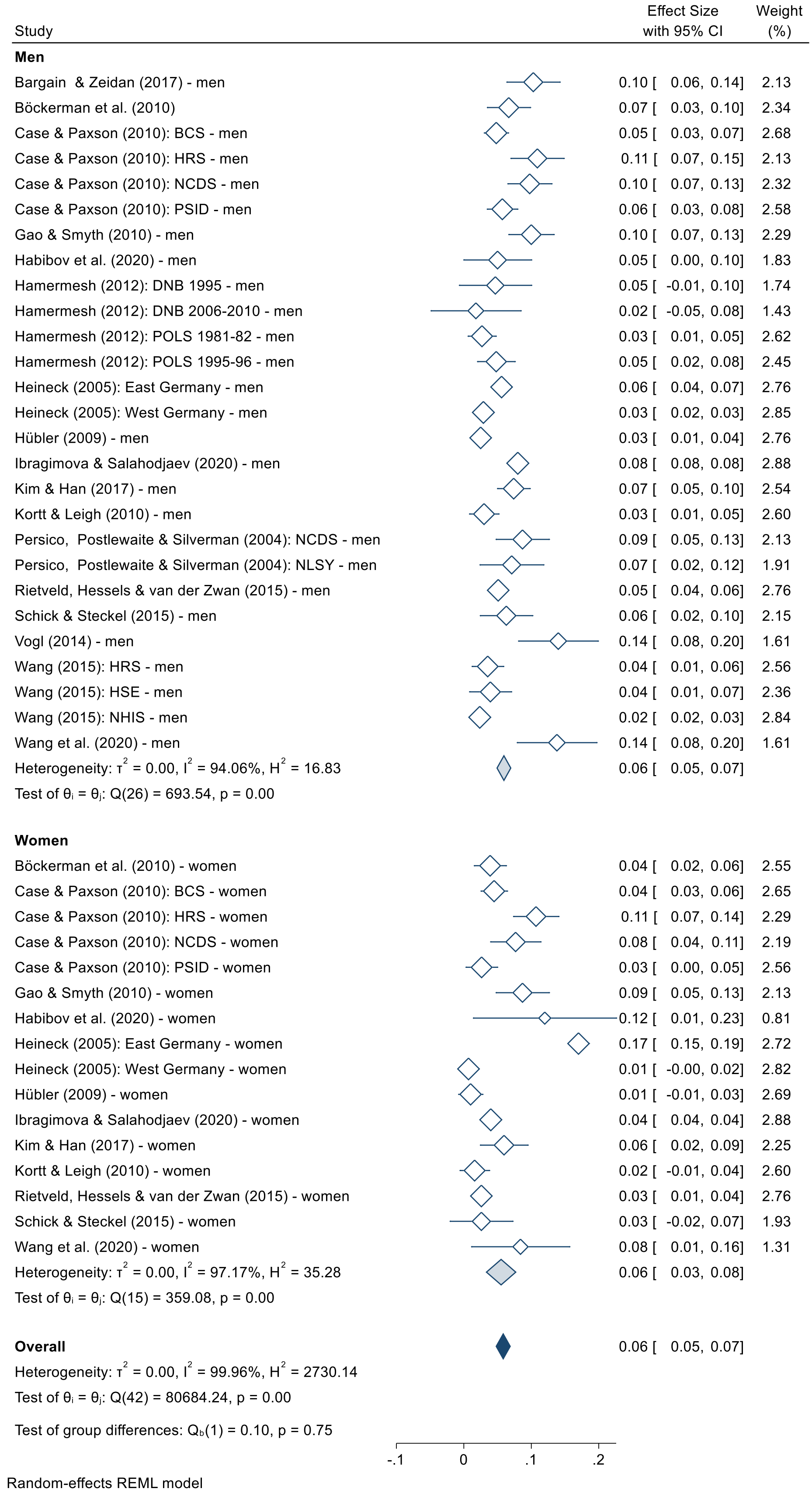

Fig. D.2. Forest plot stratified by gender.

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