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# The Healthy Supermarket Coach: effects of a nutrition peer-education intervention in Dutch supermarkets on adolescents' food purchases

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## Abstract

**Background** Dutch adolescents predominantly purchase unhealthy snacks in supermarkets, which negatively influence their health. The aim of this study was to investigate the short- and longer-term effects of a nutrition peer-education intervention in supermarkets on food purchases and determinants of food purchase behaviour among adolescents of different education levels.

**Methods** We performed a quasi-experimental study in three supermarkets (two intervention and one comparison school) in Amsterdam, the Netherlands. The intervention schools received a 45-min peer-education workshop in the supermarket near their school, and the comparison school received no intervention. The workshops also included a 2-week 'healthy snacking challenge' and were led by two young supermarket employees. Measurements were performed 2 weeks before the intervention (T0) 2 weeks after (T1) and 3 months (T2) after the intervention. Cash receipts were used to examine food purchases ($n=458$) and questionnaires to examine determinants of food purchase behaviour ($n=463$).

**Results** The nutrition peer-education intervention did not improve food purchases but did improve several determinants of food purchase behaviour. Adolescents from the intervention schools reported improved nutritional knowledge ($\beta=0.38$, 95% CI: 0.04–0.72) at T1, more favourable attitudes ($\beta=0.21$, 95% CI: 0.00–0.42) and stronger social support ($\beta=0.27$, 95% CI: 0.02–0.53) for healthy food purchases at T2 compared to those from the comparison schools. Adolescents with a low level of education reported more short- and longer-term improvements of determinants of food purchase behaviour compared to those with a higher level of education.

**Conclusions** While nutrition peer education in supermarkets did not improve adolescents' food purchases in the supermarket, determinants of food purchase behaviour did improve. The intervention was especially effective among adolescents with a low level of education. Nevertheless, to promote healthy food purchases of adolescents in supermarkets, more efforts are needed.

**Keywords** Adolescents, Supermarkets, Purchases, Questionnaires, Schools, Snacks, Educational status, Social support, Attitude

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## Background

The high prevalence of overweight and obesity among adolescents is a major public health concern in high- and middle-income countries [1]. One of the most important drivers of overweight and obesity among adolescents is an unhealthy diet [2]. Several studies have shown that the majority of adolescents, especially those with a lower level of education, consume less than the recommended amount of fruit, vegetables and fibre and instead consume excessive amounts of energy-dense, nutrient-poor and ultra-processed food and drink [3, 4]. Since it is known that overweight and obesity during adolescence are associated with nutrition-related chronic diseases later in life, there is an urgent need to promote healthy dietary behaviours among adolescents [5].

The school food environment comprises foods and drinks that are accessible within schools (e.g. in canteens or vending machines) as well as food outlets near school (e.g. supermarkets or fast-food outlets), and is an important determinant of unhealthy food choices among adolescents [6–10]. Previous studies have found that supermarkets close to secondary schools are frequently visited by adolescents during school hours and that adolescents mainly purchase unhealthy snacks and sugar-sweetened beverages during these visits to the supermarket [11–13].

In addition to the physical school food environment, adolescents' food choices are also influenced by their social environment, including their peers [14, 15]. This social environment has been the subject of interventions to improve dietary behaviours. Systematic reviews have shown that nutrition education provided by peers can induce positive changes in the dietary behaviours of adolescents [16, 17]. This could be explained by the fact that adolescents often perceive peer educators as a more credible source of information than adult educators, which can enhance the effectiveness of interventions aimed at this age group. Studies have shown that nutrition peer-education interventions within schools resulted in improved nutritional knowledge, attitudes and self-efficacy with regard to healthy eating behaviours, in addition to improving their dietary intake (e.g. increased fruit and vegetable intake and decreased sugar-sweetened beverages intake) among adolescents [18, 19]. However, to the best of our knowledge no studies investigated the effect of peer education to improve knowledge and attitudes of adolescents with regard to selecting healthy food choices at supermarkets around schools. Based on the theory of peer education and empirical insights into the unhealthy influence of supermarkets around schools, we developed a nutrition peer education intervention in supermarkets in 2016 (the Healthy Supermarket Coach) [13]. We evaluated this intervention among adolescents with a lower level of education and the results showed that this intervention improved nutritional knowledge and more positive attitudes towards healthy eating, but we did not measure actual purchases of the adolescents in the supermarket. These results could be promising, since actual food purchase data are likely to be more reliable than the questionnaires that we used to measure determinants of food purchase behaviour earlier [20]. In addition, to achieve sustainable healthy food choices among adolescents, research on the longer-term effects of nutrition peer education is needed to determine whether the effect is sustained over time [16]. Moreover, it is important to investigate if the intervention effects differ between adolescents with a lower and higher education level, since we know that healthy eating habits differ between these groups.

Therefore, the aims of this study were as follows: (1) to investigate the short- and longer-term effects of a revised nutrition peer-education intervention in Dutch supermarkets in the vicinity of secondary schools in order to promote healthy food purchases and to influence the determinants of food purchase behaviour and (2) to investigate differences across education levels in the effects among adolescents with low and high education levels. We also assessed the appraisal of the intervention and investigated if there were educational differences in the appraisal.

## Methods

### Context and design

This study was conducted as part of a collaboration between the Amsterdam Healthy Weight Programme [21], the Amsterdam Health and Technology Institute (AHTI), Albert Heijn supermarket (the supermarket chain with the largest market share in the Netherlands) and the Vrije Universiteit Amsterdam in the Netherlands. The overall aim of this collaboration is to create a healthier food environment for children and their parents in neighbourhoods in Amsterdam where the prevalence of childhood overweight and obesity are the highest and to study the effects of these efforts.

We conducted a quasi-experimental study including adolescents from two intervention schools and one comparison school (located in close proximity to supermarkets), in which intervention group participants received an in-store nutrition peer education and comparison group participants did not. We included a baseline (T0, 2 weeks prior to intervention), a post-intervention (T1, 2 weeks after the intervention) and a follow-up measurement (T2, 3 months after the intervention). Data were collected from March 2018 through June 2018 using supermarket cash receipts and questionnaires. The timing of the data collection was the same for both the

control and intervention groups in order to mitigate seasonal effects.

This research is performed in accordance with the guidelines in the Declaration of Helsinki. The study was approved by the Medical Ethical Committee of the Amsterdam UMC and registered in the Dutch Trial Register (6531). Passive written informed consent was obtained using an opt-out method, where caregivers were informed about the study via a letter and could express their objection by returning a signed form or by sending an email to the researchers. In addition, active oral informed consent (in relation to cash receipts) and written informed consent (in relation to the questionnaires) to participate were given by all adolescents.

#### Supermarket, school and participant recruitment

From the head office of the supermarket chain we received a list of supermarkets in Amsterdam that were willing to participate in our study. The researchers selected all secondary schools that were located within walking distance (≤500 m) of these supermarkets. The following criteria were used to select schools: (1) students were allowed to leave the school grounds during school hours, such that they were able to visit the supermarket; (2) they should be first-year and second-year secondary school students (12–14 years of age), because the eating habits of adolescents who have recently undergone the transition from primary to secondary school are more likely to be changing and becoming less healthy [22] and (3) students should be following either a pre-vocational track ('low education level') or pre-university track ('high education level'). To clarify, the secondary school system in the Netherlands offers three possible education tracks aimed at different levels of intellectual ability: pre-vocational, senior general and pre-university.

In total, seven schools met the criteria and were approached by the researcher via an email with an invitation to participate. Two schools agreed to participate; the other schools declined due to a lack of time. To recruit a comparison school, we selected a school that matched the intervention schools according to the inclusion criteria. We only included one comparison school due to resource constraints. We included a comparison school that was located in a different part of the city (and that was located within walking distance (≤500 m) of a supermarket from the participating chain) than the intervention schools, to prevent cross-contamination. After the comparison and intervention schools agreed to participate, the supermarkets in the vicinity of these schools were informed about their participation and the store managers of the supermarkets were visited by a head-office employee and the researcher. The selected supermarkets were comparable in size, pricing and product offerings.

#### Description of the intervention

The nutrition peer-education intervention, the 'Healthy Supermarket Coach' (HSC), was developed in 2016 (for detailed information, see [13]). The overall aim of the HSC was to improve adolescent purchasing behaviour and promote healthier food choices during school hours. The HSC consists of a 45-min workshop for a group of approximately 15 adolescents, led by two young supermarket employees who are trained in advance. The HSC intervention is based on principles from the social cognitive theory, the theory of planned behaviour [23, 24] and prior successful nutrition peer-education interventions [16]. Compared to our earlier study and the insights that we collected, we adjusted some elements of the workshop including (1) improvements to the interactive quiz and (2) removal of the exercise in which adolescents had to create an affordable, healthy lunch since it turned out that adolescents did not purchase lunch in the supermarkets but primarily purchased snacks. This was therefore replaced by a 2-week 'healthy snacking challenge'. In this new challenge, adolescents formulated action plans [25] about when and how they would replace the purchase of an unhealthy snack with a healthy snack during school breaks for a 2-week period (e.g. When I go to the supermarket during school time, I will purchase an apple instead of a chocolate bar.). To increase the likelihood that the adolescents completed the 'healthy snacking challenge', each group of participants signed a 'contract' and committed to the challenge [26]. The supermarkets' HSCs conducted 24 workshops across the two participating stores, each involving a new group of approximately 15 adolescents who participated during school hours. The workshops were conducted in the supermarkets.

#### Study procedure

Cash receipts were used to measure purchase behaviour of the adolescents and were collected at T0, T1 and T2. They were collected for 3 days (Monday, Wednesday, Friday) during the two main school breaks within a 1-week period. Adolescents were approached by one of the researchers at the checkout counters, after they had paid for their purchases and were asked which school and class they were attending to ensure that they were from the participating schools. If the adolescents were from the participating schools, they were asked to provide their cash receipt. The researcher recorded the name of their school, their class and sex on the cash receipts. During T1 and T2, adolescents from the intervention schools were also asked if they had received the HSC intervention (also recorded). Adolescents from the intervention schools who did not receive the HSC intervention were not included in this study ($n=22$). The main reason

adolescents did not provide cash receipts or answer questions was 'lack of time'. Because of the large number of adolescents at the checkouts during the measurements, we were unable to keep track of those unwilling to participate, although we aimed to keep this number as low as possible.

Determinants of food purchase behaviour and the appraisal of the HSC intervention were measured with questionnaires at T0, T1 and T2. Adolescents completed the questionnaires on paper in their classroom under the supervision of a teacher and accompanied by a researcher. Only the adolescents who had completed questionnaires at T0 and T1 were included in the analyses ($n=355$ adolescents from the intervention schools, $n=108$ adolescents from the comparison school) (Additional File A). Reasons for not filling out the questionnaire included absence due to illness or logistical reasons (e.g. unexpected changes in class schedules).

## Measures

### *Cash receipts*

All food and drink items on the cash receipts were scored for their degree of healthiness based on the Dutch dietary guidelines using the Wheel of Five criteria of the Netherlands Nutrition Centre [27]. The Wheel of Five contains products from the five core food groups (e.g. 'fruit and vegetables', 'bread, grain or cereal products and potatoes', 'dairy, nuts, fish, legumes, meat and eggs', 'drinks' and 'spreading and cooking fats') that either provide essential nutrients or have a beneficial effect on health [27]. Products were categorized as 'healthy food' (Wheel of Five) and 'unhealthy food' (Not Wheel of Five).

### *Questionnaires*

At the baseline measure (T0), we collected data on the following demographic characteristics: sex (boy, girl), level of education (low for pre-vocational track and high for pre-university track), school year (first, second), age (in years). The food purchase characteristics included frequency of supermarket visits during a regular school week (less than once a week to more than 5 days a week) and the average amount of money spent on food in the supermarket during school time per day (in euros, open-ended answers).

During T0, T1 and T2, we also collected data on determinants of food purchase behaviour (nutritional knowledge, intention, attitude, self-efficacy, social norm, social support for healthy/unhealthy food purchases). These were assessed with validated questions used in previous studies among adolescents [24, 28–30]. Nutritional knowledge was measured according to 11 multiple-choice items about various aspects that have been shown to influence the food choices of adolescents. The follow is one example: "On average, how many calories should girls consume per day?" (response categories: "1 = 2000," "2 = 2500," "3 = 3000"). All questions included 3 answer options and there was one correct answer to each of the questions, equivalent to one point. The scores on the 11 items were summed and averaged to create a total score (0–11), with higher scores indicating more nutritional knowledge. The following determinants were measured using a 5-point Likert scale (strongly disagree [−2] to strongly agree [+2]). Attitude towards healthy food purchases (T0 $\alpha=0.64$) and attitude towards unhealthy food purchases (T0 $\alpha=0.61$) were assessed with four questions each, and an average total score was calculated. Intention to make healthy food purchases was assessed with eight items, of which an average total score was calculated (T0 $\alpha=0.85$). Self-efficacy, social norms and social support regarding healthy and unhealthy food purchases were assessed with one question each. Higher scores indicated better attitude and greater intention, self-efficacy, social norms and social support for healthy/unhealthy food purchases. Additional File B includes all the questions on the determinants of food purchase behaviour as well as Cronbach's Alphas for the scales and the response options.

The post-intervention questionnaire for the intervention schools (T2) included also ten questions assessing the appraisal of the HSC intervention. Unless mentioned otherwise, adolescents were asked to use 5-point Likert scales (not at all [−2] to very much [+2]). First, they were asked to indicate whether they had enjoyed the workshop, and then whether the workshop was difficult, informative or childish. Subsequently, they were asked to grade the HSC intervention (on a scale from 1 to 10) and to explain their grade in an open question. They were then asked to indicate whether they perceived the HSC as a role model and whether they would like to appear similar to the HSC. Finally, they were asked to indicate whether they were interested in following the HSC's recommendations about healthy food purchases in the supermarket and whether they had learned how to make healthy food choices in the supermarket. Mean scores were calculated, with higher scores indicating more positive evaluations.

## Statistical analyses

For the cash receipt data, we calculated the number and percentage of unhealthy and healthy food purchases at T0, T1 and T2. Because we were not able to measure food purchases at an individual level, standard Fisher exact tests were used to examine differences in the percentage of food purchases between the intervention schools and the control school at T0, T1 and T2 and to investigate the difference in the change in food purchases between the

control school and the intervention schools at T1 and T2 (compared to T0).

A series of linear mixed model analyses, including a random intercept at the participant level, were conducted to investigate the effect of the HSC intervention on determinants of adolescent food purchase behaviour. In all mixed model analyses, the condition (intervention [yes = 1, no = 0]) was used as an independent variable and the scores on the determinants of food purchase behaviour at T1 and T2, adjusted separately for the score at baseline (T0), as the dependent variables. Both a crude model (adjusted for baseline score) and an adjusted model (additionally adjusted for age, gender and school year) were analysed. All analyses were stratified by level of education to investigate the effects of low and high education separately. In addition, we conducted independent sample *t*-tests to investigate differences in the appraisal of the HSC intervention between the two education groups. Statistical analyses were performed using IBM SPSS Statistics for Windows version 25.0. We used a two-tailed *p*-value of less than 0.05 statistical significance.

## Results

### Study sample—cash receipts

In total, 458 cash receipts were collected ($n = 326$ receipts from the intervention schools, $n = 132$ receipts from the comparison school) of which 181 (39.5%) were from boys (Table 1). Most cash receipts were from adolescents with a low level of education (55.9%) and from first-year secondary school students (77.3%). The median amount spent on food purchases per cash receipt was EUR 1.80 (IQR = 1.9) (~ USD 2.00), which was higher among those with a high level of education (median = 2.1, IQR = 2.2) compared to those with a low level of education (median = 1.5, IQR = 1.4).

### Study sample—adolescents

In total, 463 adolescents completed the questionnaires: 355 (76.7%) from the intervention schools and 108 (23.3%) from the comparison school (Table 1). The mean age of the adolescents was 12.8 years (SD: 0.9), with boys accounting for more than half of the group (56.6%). Most of the adolescents were first-year secondary school students (65.9%), with adolescents following a high level of education accounting for almost two thirds of the group (64.1%). Around half of the adolescents (48.1%) reported purchasing food in the supermarket one day a week or more, while more than half (51.9%) reported rarely or never purchasing food in the supermarket. Adolescents estimated they spent a median of EUR 2.00 (IQR: 2.0) (~ USD 2.20) per day on food and drink from the supermarket on an average school day. Adolescents with a low level of education more often reported that they purchased food in the supermarket one day a week or more than did those with a high level of education (77.7% vs 31.6%). In contrast, adolescents with a high level of education more often reported that they rarely or never purchased food in the supermarket than did adolescents with a low educational level (68.3% vs 22.3%).

### Food purchases

At T0, 97.5% of the food purchased by adolescents from the intervention schools consisted of unhealthy food and 2.5% of healthy food (Table 2). Adolescents from the comparison school purchased 100% unhealthy food. At T1 and T2, the majority of the food purchases remained predominantly unhealthy, and there were no significant differences in T0, T1 and T2 purchases between the groups, even after stratification for educational level. Nevertheless, compared to T0, adolescents from the intervention group purchased more healthy food (marginally statistically significant) at T2 than adolescents from the comparison school (7.5 vs 1.6 percentage points, $p = 0.046$, Additional File C); this difference was however very small.

### Determinants of food purchase behaviour

At T1, adolescents from the intervention schools reported higher nutritional knowledge scores ($\beta = 0.38$, 95% CI: 0.04 − 0.72), compared to those from the comparison school (Table 3). However, this difference disappeared at T2. Adolescents from the intervention schools also reported more positive attitudes to ($\beta = 0.21$, 95% CI: − 0.00 − 0.42) and greater social support for ($\beta = 0.27$, 95% CI: 0.02–0.53) healthy food purchases, compared to those from the comparison school at T2, but not at T1. We observed no other significant effects of the HSC intervention on determinants of food purchase behaviour.

Adolescents from the intervention schools with a high education level reported higher nutritional knowledge scores at T1 ($\beta = 0.87$, 95% CI: 0.40–1.35) and T2 ($\beta = 0.76$, 95% CI: 0.26–1.25), compared to the comparison school, while nutritional knowledge among adolescents from the intervention schools with a low level of education remained stable at T1 and declined at T2 ($\beta = -0.59$, 95% CI: − 1.12 to − 0.05) (Table 4). Adolescents from the intervention schools with a low level of education reported a higher social norm ($\beta = 0.63$, 95% CI: 0.21–1.04) at T1 and T2, compared to the comparison school, while adolescents in the intervention schools with a high level of education reported a lower social norm ($\beta = -0.33$, 95% CI: − 0.60 to − 0.01) at T1, compared to the comparison school.

Furthermore, comparing adolescents from the intervention schools and the comparison school with a low

**Table 1** Characteristics and purchase behaviour of adolescents ($n = 463$ questionnaires)

| | | Total study sample | | | Low level of education | | | High level of education | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | **Total** | **Comparison school** | **Intervention schools** | **Total** | **Comparison school** | **Intervention schools** | **Total** | **Comparison school** | **Intervention schools** |
| Total number of questionnaires | n | 463 | 108 | 355 | 166 | 63 | 103 | 297 | 45 | 252 |
| Sex | n (%) | | | | | | | | | |
| Girls | | 262 (56.6) | 60 (55.6) | 202 (56.9) | 74 (44.6) | 28 (44.4) | 46 (44.7) | 127 (42.8) | 20 (44.4) | 107 (42.5) |
| Boys | | 201 (43.4) | 48 (44.4) | 153 (43.1) | 92 (55.4) | 35 (55.6) | 57 (55.3) | 170 (57.2) | 25 55.6) | 145 (57.5) |
| Age (years) | m (SD) | 12.79 (0.94) | 12.57 (0.64) | 12.86 (1.00) | 13.10 (1.10) | 12.52 (0.56) | 13.45 (1.19) | 12.62 (0.79) | 12.64 (0.74) | 12.62 (0.80) |
| School year | n (%) | | | | | | | | | |
| First | | 305 (65.9) | 87 (80.6) | 222 (62.5) | 166 | 63 (100) | 103 (100) | 144 (48.5) | 25 (55.6) | 119 (47.2) |
| Second | | 158 (34.1) | 21 (19.4) | 133 (37.5) | - | - | - | 153 (51.5) | 20 (44.4) | 133 (52.8) |
| Frequency food and drink purchased in the supermarket near school | n (%) | | | | | | | | | |
| Rarely/never | | 240 (51.8) | 36 (33.3) | 204 (57.5) | 37 (22.3) | 14 (22.2) | 23 (22.3) | 203 (68.3) | 22 (48.9) | 181 (71.8) |
| 1-2 days per week | | 122 (26.3) | 42 (38.9) | 80 (22.5) | 55 (33.1) | 26 (41.3) | 29 (28.2) | 67 (22.5) | 16 ((35.5) | 51 (20.2) |
| 3-5 days per week | | 101 (21.8) | 30 (27.8) | 71 (20.0) | 74 (44.6) | 23 (36.5) | 51 (49.5) | 27 (9.1) | 7 (15.5) | 20 (8.0) |
| Money spent on food at supermarket on average per day | Median (IQR) | 2.0 (2.0) | 1.8 (1.0) | 2.0 (2.0) | 2.0 (2.0) | 2.0 (2.0) | 2.5 (1.0) | 2.0 (2.0) | 1.35 (1.0) | 2.0 (2.0) |

*n* number, *M* mean, *SD* standard deviation, *IQR* interquartile range

**Table 2** Number and percentage (%) of unhealthy and healthy food purchases in supermarkets ($n=1117$)

| | Comparison school | | Intervention schools | | |
|---|---|---|---|---|---|
| | Unhealthy *n* (%) | Healthy *n* (%) | Unhealthy *n* (%) | Healthy *n* (%) | *p*-value[1] |
| T0 | 69 (100.0) | 0 (0.0) | 306 (97.5) | 8 (2.5) | 0.21 |
| T1 | 129 (96.3) | 5 (3.7) | 230 (92.4) | 19 (7.6) | 0.18 |
| T2 | 62 (92.5) | 5 (7.5) | 324 (95.9) | 14 (4.1) | 0.22 |

*n* number, % percentage

[1] Difference in percentage of food purchases between the comparison and intervention schools, Fisher exact test

level of education, the former reported a higher self-efficacy ($\beta=0.59$, 95% CI: 0.16–1.03) and social support ($\beta=0.54$, 95% CI: 0.14–0.96) for healthy food purchases and a lower social norm for unhealthy food purchases ($\beta=-0.57$, 95% CI: −0.98 to −0.15) at T1 and at T2 (except for self-efficacy regarding healthy food purchases). Comparing adolescents from the intervention schools and the comparison school with a high level of education, these determinants remained stable at T1 and T2. Adolescents from the intervention schools with a low level of education reported a statistically significant higher intention ($\beta=0.33$, 95% CI: −0.00–0.66) and attitude ($\beta=0.54$, 95% CI: 0.24–0.84) towards healthy food purchases at T2, compared to adolescents with a low level of education from the comparison school, while the intentions and attitudes of adolescents in the intervention schools with a high level of education did not change.

### Appraisal of the HSC intervention

The adolescents evaluated the HSC intervention positively (Table 5). For example, they gave the workshop an average of 6.8 points (SD = 2.15, on a scale from 1 to 10) and reported having enjoyed the workshop (M = 0.44, SD = 1.34). They agreed (in part) that the workshop was informative (M = 0.34, SD = 1.32) and that the workshop had taught them how to make healthy food choices in the supermarket (M = 0.17, SD = 1.37). However, they did not perceive the HSC as a role model (M = −0.34, SD = 1.36) and would not like to appear similar to the HSC (−0.54, SD = 1.40). Adolescents in the intervention schools with a low level of education rated the HSC intervention higher ($p<0.001$) and reported having enjoyed the workshop ($p<0.001$) more than those with a high level of education (Table 5). Moreover, they perceived the HSC more as a role model ($p<0.001$) and reported that they would like to appear similar to the HSC ($p<0.001$) more than did those with a high level of education.

## Discussion

This study found that nutrition peer education in supermarkets did not improve actual food purchases among Dutch adolescents, with their food purchases remaining predominantly unhealthy. However, several determinants of food purchase behaviour improved as a result of the HSC intervention, including improved nutritional knowledge scores in the short term and more favourable attitudes towards and stronger social support for healthy food purchases in the longer term. The intervention seemed especially effective among adolescents with a low level of education, although in both education groups the HSC intervention was not effective in improving actual food purchases. We did observe differences in the determinants of food purchase behaviour, including more positive social norms, social support and self-efficacy regarding healthy food purchases in the short term, more positive intentions and attitudes towards healthy food purchases in the longer term and a more positive evaluation among those with a lower education level. However, while nutritional knowledge increased in adolescents with a high level of education in both the short and longer terms, it remained stable in the short term and decreased in the longer term in adolescents with a low level of education. Moreover, the HSC intervention was positively evaluated by the adolescents.

The absence of an effect of the HSC intervention on actual food purchases of adolescents in the intervention schools in our study contrasts with a previous study in which a nutrition peer-education intervention in secondary schools resulted in higher sales of healthier food options in school cafeterias after adolescents participated in the programme [31]. However, the peer education in this previous study was combined with an increase in the availability of healthier food options in the school cafeterias during the intervention period, which might have been an additional stimulus to purchase healthier foods for the adolescents. Since there were no changes in the product assortment in the supermarkets during the HSC intervention, the adolescents in our study were not additionally encouraged to purchase healthier foods or discouraged to purchase less unhealthy food. Moreover, the amount of unhealthy, low-cost food in supermarkets is higher, compared to the relatively small product assortment in school cafeterias, which might have impeded the adolescents in our study from purchasing healthy food. The fact that we did found a small intervention effect on food purchases at follow-up, where the increase in

**Table 3** Means (SDs) of self-reported determinants of food purchase behaviour and results of linear mixed model analyses adjusted for baseline scores (T0) of adolescents in the comparison school and intervention schools ($n = 463$)

| | | | T0 (baseline) | T1 (post-intervention) | T2 (follow-up) | Crude model T1 $\beta$ (95 CI) | Crude model T2 $\beta$ (95 CI) | Adjusted T1[1] $\beta$ (95 CI) | Adjusted T2[1] $\beta$ (95 CI) |
|---|---|---|---|---|---|---|---|---|---|
| Nutritional knowledge (0–11) | | m (SD) | | | | | | | |
| | Intervention | | 6.92 (1.87) | 7.39 (1.93) | 7.29 (2.05) | 0.68* (0.34–1.03) | 0.51* (0.14–0.88) | 0.38* (0.04–0.72) | 0.23 (−0.13–0.58) |
| | Comparison | | 6.53 (1.64) | 6.47 (1.70) | 6.57 (1.83) | | | | |
| Intention to purchase healthy food (−2 to +2) | | m (SD) | | | | | | | |
| | Intervention | | −0.18 (1.06) | −0.09 (1.12) | −0.23 (1.10) | 0.12 (−0.09–0.34) | 0.04 (−0.18–0.26) | 0.17 (−0.05–0.39) | 0.08 (−0.15–0.31) |
| | Comparison | | −0.29 (0.98) | −0.27 (1.06) | −0.28 (1.09) | | | | |
| Attitude towards healthy food purchases (−2 to +2) | | m (SD) | | | | | | | |
| | Intervention | | −0.02 (1.01) | −0.05 (1.07) | −0.09 (1.05) | 0.08 (−0.11–0.28) | 0.20* (−0.00–0.41) | 0.09 (−0.11–0.29) | 0.21* (−0.00–0.42) |
| | Comparison | | 0.00 (0.82) | −0.12 (1.01) | −0.26 (0.97) | | | | |
| Attitude towards unhealthy food purchases (−2 to +2) | | m (SD) | | | | | | | |
| | Intervention | | −0.58 (0.91) | −0.62 (0.93) | −0.48 (0.96) | −0.02 (−0.21–0.17) | 0.11 (−0.10–0.31) | −0.00 (−0.20–0.19) | 0.13 (−0.10–0.33) |
| | Comparison | | −0.72 (0.88) | −0.65 (0.94) | −0.66 (0.94) | | | | |
| Self-efficacy regarding healthy food purchases (−2 to +2) | | m (SD) | | | | | | | |
| | Intervention | | −0.81 (1.32) | −0.72 (1.31) | −0.88 (1.28) | 0.23 (−0.04–0.49) | −0.03 (−0.32–0.27) | 0.27 (−0.01–0.55) | 0.02 (−0.27–0.31) |
| | Comparison | | −0.89 (1.19) | −0.96 (1.27) | −0.89 (1.29) | | | | |
| Self-efficacy regarding unhealthy food purchases (−2 to +2) | | m (SD) | | | | | | | |
| | Intervention | | −0.97 (1.14) | −0.98 (1.20) | −1.03 (1.17) | 0.07 (−0.19–0.32) | 0.08 (−0.19–0.34) | 0.09 (−0.17–0.35) | 0.10 (−0.17–0.37) |
| | Comparison | | −1.15 (1.13) | −1.07 (1.14) | −1.14 (1.12) | | | | |
| Social norm regarding healthy food purchases (−2 to +2) | | m (SD) | | | | | | | |
| | Intervention | | −0.99 (1.22) | −0.81 (1.30) | −0.85 (1.34) | 0.03 (−0.22–0.27) | 0.01 (−0.24–0.27) | 0.13 (−0.12–0.37) | 0.10 (−0.16–0.36) |
| | Comparison | | −0.98 (1.10) | −0.83 (1.12) | −0.87 (1.13) | | | | |
| Social norm regarding unhealthy food purchases (−2 to +2) | | m (SD) | | | | | | | |
| | Intervention | | 0.86 (1.26) | 0.91 (1.24) | 0.85 (1.22) | −0.00 (−0.25–0.24) | 0.04 (−0.23–0.30) | −0.12 (−0.38–0.13) | −0.08 (−0.34–0.19) |
| | Comparison | | 0.82 (1.15) | 0.92 (1.04) | 0.82 (1.25) | | | | |

**Table 3** (continued)

| | | | T0 (baseline) | T1 (post-intervention) | T2 (follow-up) | Crude model T1 *β* (95 CI) | Crude model T2 *β* (95 CI) | Adjusted T1[1] *β* (95 CI) | Adjusted T2[1] *β* (95 CI) |
|---|---|---|---|---|---|---|---|---|---|
| Social support for healthy food purchases (−2 to +2) | | m (SD) | | | | | | | |
| | Intervention | | −1.25 (1.15) | −1.05 (1.25) | −0.96 (1.30) | 0.14 (−0.11–0.370 | 0.17 (−0.08–0.42) | 0.24 (−0.01–0.48) | 0.27* (0.02–0.53) |
| | Comparison | | −1.53 (0.87) | −1.34 (1.10) | −1.32 (1.03) | | | | |
| Social support for unhealthy food purchases (−2 to +2) | | m (SD) | | | | | | | |
| | Intervention | | −0.95 (1.21) | −0.88 (1.33) | −0.68 (1.35) | 0.10 (−0.17–0.37) | 0.09 (−0.19–0.37) | 0.04 (−0.24–0.32) | 0.03 (−0.26–0.32) |
| | Comparison | | −1.04 (1.19) | −1.06 (1.21) | −0.82 (1.32) | | | | |

*n* number, *M* mean, *SD* standard deviation

* $p < 0.05$

[1] Model 2: crude model adjusted for sex, age, school year and level of education

healthy food purchased was higher among adolescents from the comparison school compared to those from the intervention schools, should be interpreted with caution since we believe that this finding can be explained by the fact that adolescents from the comparison school purchased no healthy food at T0 and, therefore, it was more likely that we would detect some effect in the comparison school at a later time. Furthermore, the increase from no healthy products to five healthy products is negligible from a public health view.

An increase in nutritional knowledge scores after the HSC intervention was also achieved in other nutrition peer-education interventions for adolescents, as several previous reviews have shown [16, 31–33]. This is promising insofar as nutritional knowledge is an important determinant of behavioural change [29]. In addition, the finding that the higher score in nutritional knowledge was not sustained three months after the HSC intervention is in line with previous studies that found the longer-term maintenance of improved nutritional knowledge to be a challenge at 2 years of follow-up [19, 31]. We should also acknowledge that the control condition experienced a decline in nutritional knowledge scores, which may have slightly inflated the intervention effect and should be considered when interpreting the outcomes.

Others also showed that improved scores on determinants of food purchase behaviour, such as nutritional knowledge, attitudes and social support, often do not lead to sustained healthier dietary choices among adolescents, as these factors are not always effectively translated into action [34]. While the HSC intervention significantly impacted these potential determinants, it also did not affect actual food purchases, likely due to the strong influence of peer norms favouring unhealthy eating, which can overshadow efforts to promote healthy choices [15, 34–36]. Despite the use of peer education to enhance social norms and support, the low levels of positive social support observed suggest that adolescents did not feel encouraged by their peers to make healthier purchases. Additionally, the effectiveness of peer education alone is questionable without addressing the supermarket environment, as in-store marketing strategies often promote unhealthy food choices, and low self-efficacy among adolescents further impedes their ability to make healthier food purchases [37, 38].

The HSC intervention appeared especially beneficial for adolescents with a low level of education. This might be explained by the fact that the supermarket is a more important point of purchase for those with a low level of education during school hours than those with a high level of education, with the former more often reporting that they purchased food and drinks in the supermarket during school hours than the latter. In fact, more than two thirds of adolescents with a high level of education reported rarely or never purchasing food in the supermarket. Another explanation may be that adolescents with a low level of education were better able to identify with the HSC, with the results of our study indicating that they perceived the HSC as a role mode to a greater degree than did those with a high level of education. Previous research has found that peer educators need to have high status, should be positive role models and should be a credible source to be effective in promoting health behaviours among adolescents [39]. We suggest

**Table 4** Means (SDs) of self-reported determinants of food purchase behaviour and results of linear mixed model analyses adjusted for baseline scores (T0) of adolescents with low and high levels of education in the comparison school and intervention schools ($n = 463$)

| | | | *Low level of education* | | | | | | | *High level of education* | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | **T0 (baseline)** | **T1 (post-intervention)** | **T2 (follow-up)** | **Crude model T1 β (95 CI)** | **Crude model T2 β (95 CI)** | **Adjusted Model T1[1] β (95 CI)** | **Adjusted model T2[1] β (95 CI)** | **T0 (baseline)** | **T1 (post-intervention)** | **T2 (follow-up)** | **Crude model T1 β (95 CI)** | **Crude model T2 β (95 CI)** | **Adjusted Model T1[1] β (95 CI)** | **Adjusted model T2[1] β (95 CI)** |
| Nutritional knowledge (0–11) | | m (SD) | | | | | | | | | | | | | | |
| | Intervention | | 5.27 (1.55) | 5.70 (1.55) | 5.22 (1.52) | −0.15 (−0.63–0.33) | −0.61* (−1.11–−0.10) | −0.12 (−0.64–0.40) | −0.59* (−1.12 to−0.05) | 7.60 (1.54) | 8.10 (1.63) | 8.18 (1.55) | 0.89* (0.42–1.36) | 0.77* (0.28–1.26) | 0.87* (0.40–1.35) | 0.76* (0.26–1.25) |
| | Comparison | | 6.06 (1.58) | 6.10 (1.59) | 6.00 (1.65) | | | | | 7.20 (1.49) | 7.00 (1.63) | 7.32 (1.79) | | | | |
| Intention to purchase healthy food (−2 to+2) | | m (SD) | | | | | | | | | | | | | | |
| | Intervention | | 0.23 (0.90) | 0.25 (0.93) | 0.22 (0.93) | 0.26 (−0.04−0.56) | 0.42* (0.10–0.73) | 0.17 (−0.15–0.49) | 0.33* (−0.00–0.66) | −0.35 (1.07) | −0.23 (1.16) | −0.43 (1.11) | 0.14 (−0.17–0.46) | −0.15 (−0.48–0.19) | 0.15 (−0.17–0.47) | −0.15 (−0.47 to−0.19 |
| | Comparison | | −0.26 (0.98) | −0.20 (1.08) | −0.31 (1.10) | | | | | −0.33 (0.99) | −0.36 (1.04) | −0.25 (1.08) | | | | |
| Attitude towards healthy food purchases (−2 to+2) | | m (SD) | | | | | | | | | | | | | | |
| | Intervention | | 0.43 (.0.98) | 0.30 (0.93) | 0.45 (0.90 | 0.29* (0.02–0.55) | 0.59* (0.30–0.87) | 0.24 (−0.05–0.52) | 0.54* (0.24–0.84) | −0.21 (0.96) | −0.19 (1.09) | −0.31 (1.04) | −0.04 (−0.33–0.25) | 0.02 (−0.28–0.32) | −0.05 (−0.34–0.24) | 0.00 (−0.30–0.30) |
| | Comparison | | −0.03 (0.87) | −0.20 (0.98) | −0.30 (1.01) | | | | | 0.04 (0.76) | −0.01 (1.05) | −0.20 (0.92) | | | | |
| Attitude towards unhealthy food purchases (−2 to+2) | | m (SD) | | | | | | | | | | | | | | |
| | Intervention | | −0.33 (1.04) | −0.44 (0.94) | −0.23 (1.03) | 0.18 (−0.11–0.46) | 0.18 (−0.13–0.48) | 0.13 (−0.18–0.43) | 0.14 (−0.18–0.45) | −0.68 (0.83) | −0.69 (0.91) | −0.59 (0.91) | −0.21 (−0.48–0.07) | 0.18 (−0.11–0.46) | −0.22 (−0.49–0.06) | 0.16 (−0.12–0.45) |
| | Comparison | | −0.79 (0.91) | −0.78 (0.88) | −0.57 (0.98) | | | | | −0.61 (0.85) | −0.46 (1.00) | −0.79 (0.87) | | | | |
| Self-efficacy regarding healthy food purchases (−2 to+2) | | m (SD) | | | | | | | | | | | | | | |
| | Intervention | | −0.40 (1.39) | −0.34 (1.17) | −0.42 (1.40) | 0.64* (0.24–1.05) | 0.34 (−0.10–0.77) | 0.59* (0.16–1.03) | 0.28 (−0.18–0.73) | −0.98 (1.25) | −0.87 (1.33) | −1.08 (1.18) | −0.05 (−0.43–0.33) | −0.14 (−0.54–0.25) | −0.06 (−0.44–0.32) | −0.15 (−0.55–0.25) |
| | Comparison | | −0.71 (1.28) | −1.03 (1.28) | −0.81 (1.38) | | | | | −1.13 (1.04) | −0.87 (1.25) | −1.00 (1.18) | | | | |

**Table 4** (continued)

| | | | *Low level of education* | | | | | | | *High level of education* | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | **T0 (baseline)** | **T1 (post-intervention)** | **T2 (follow-up)** | **Crude model T1 β (95 CI)** | **Crude model T2 β (95 CI)** | **Adjusted Model T1[1] β (95 CI)** | **Adjusted model T2[1] β (95 CI)** | **T0 (baseline)** | **T1 (post-intervention)** | **T2 (follow-up)** | **Crude model T1 β (95 CI)** | **Crude model T2 β (95 CI)** | **Adjusted Model T1[1] β (95 CI)** | **Adjusted model T2[1] β (95 CI)** |
| Self-efficacy regarding unhealthy food purchases (−2 to + 2) | | m (SD) | | | | | | | | | | | | | | |
| | Intervention | | −0.52 (1.24) | −0.69 (1.31) | −0.71 (1.23) | 0.41* (0.02–0.81) | 0.26 (−0.16–0.67) | 0.22 (−0.19–0.63) | 0.05 (−0.38–0.48) | −1.15 (1.04) | −1.10 (1.14) | −1.16 (1.12) | −0.07 (−0.41–0.29) | 0.20 (−0.17–0.56) | −0.08 (−0.43–0.27) | 0.18 (−0.18–0.55) |
| | Comparison | | −1.17 (1.16) | −1.11 (1.12) | −0.96 (1.17) | | | | | −1.11 (1.11) | −1.02 (1.18) | −1.37 (0.99) | | | | |
| Social norm regarding healthy food purchases (−2 to + 2) | | m (SD) | | | | | | | | | | | | | | |
| | Intervention | | −0.07 (1.43) | 0.10 (1.41) | 0.08 (1.39) | 0.73* (0.34–1.12) | 0.67* (0.26–1.08) | 0.63* (0.21–1.04) | 0.55* (0.12–0.98) | −1.37 (0.90) | −1.18 (1.04) | −1.25 (1.10) | −0.32* (−0.65 to −0.00) | −0.23 (−0.57–0.11) | −0.33* (−0.6 to −0.01) | −0.24 (−0.58–0.10) |
| | Comparison | | −0.89 (1.18) | −0.89 (1.02) | −0.81 (1.13) | | | | | −1.11 (0.91) | −0.76 (1.26) | −0.95 (1.14) | | | | |
| Social norm regarding unhealthy food purchases (−2 to + 2) | | m (SD) | | | | | | | | | | | | | | |
| | Intervention | | 0.15 (1.37) | 0.17 (1.29) | 0.18 (1.27) | −0.61* (−0.99 to −0.22) | −0.47* (−0.88 to −0.06) | −0.57* (−0.98 to −0.15) | −0.43* (−0.86–0.00) | 1.14 (1.10) | 1.22 (1.10) | 1.13 (1.10) | 0.27 (−0.06–0.60) | 0.24 (−0.11–0.59) | 0.27 (−0.07–0.60) | 0.24 (−0.11–0.59) |
| | Comparison | | 0.63 (1.30) | 0.90 (1.10) | 0.78 (1.30) | | | | | 1.10 (0.85) | 0.93 (0.99) | 0.88 (1.19) | | | | |
| Social support for healthy food purchases (−2 to + 2) | | m (SD) | | | | | | | | | | | | | | |
| | Intervention | | −0.48 (1.39) | −0.15 (1.47) | −0.13 (1.46) | 0.59* (0.19–0.99) | 0.73* (0.33–1.14) | 0.54* (0.14–0.96) | 0.69* (0.28–1.11) | −1.55 (0.85) | −1.42 (0.94) | −1.32 (1.05) | −0.00 (−0.31–0.31) | −0.17 (−0.49–0.15) | −0.01 (−0.32–0.29) | −0.18 (−0.50–0.14) |
| | Comparison | | −1.50 (0.97) | 1.29 (1.11) | −1.43 (1.02) | | | | | −1.57 (0.73) | −1.40 (1.05) | −1.17 (1.05) | | | | |
| Social support for unhealthy food purchases (−2 to + 2) | | m (SD) | | | | | | | | | | | | | | |
| | Intervention | | −0.81 (1.25) | −0.82 (1.27) | −0.63 (1.26) | 0.20 (−0.19–0.59) | 0.12 (−0.29–0.53) | 0.05 (−0.36–0.46) | −0.02 (−0.45–0.41) | −1.00 (1.20) | −0.90 (1.36) | −0.70 (1.38) | −0.07 (−0.47–0.33) | 0.00 (−0.40–0.41) | −0.10 (−0.50–0.29) | −0.02 (−0.42–0.38) |
| | Comparison | | −0.88 (1.30) | −1.08 (1.18) | −0.76 (1.36) | | | | | −1.25 (0.99) | −1.02 (1.28) | −0.90 (1.28) | | | | |

*n* number, *M* mean, *SD* standard deviation, *IQR* interquartile range

* $p < 0.05$

[1] Model 2: crude model adjusted for sex, age and school year

**Table 5** Appraisal of the HSC by adolescents with low level of education and high level of education in the intervention schools ($n = 355$)

| | Total Mean (SD) | Adolescents with a low level of education ($n = 103$) Mean (SD) | Adolescents with a high level of level ($n = 252$) Mean (SD) |
|---|---|---|---|
| I enjoyed the HSC workshop (− 2 to + 2) | 0.44 (1.34 | 1.05 (1.10)* | 0.18 (1.37) |
| The HSC workshop was difficult (− 2 to + 2) | − 1.08 (1.19 | − 0.54 (1.36)* | − 1.30 (1.03) |
| The HSC workshop was informative (− 2 to + 2) | 0.34 (1.32 | 0.69 (1.23)* | 0.19 (1.33) |
| The workshop was childish (− 2 to + 2) | − 0.19 (1.42) | − 0.40 (1.40) | − 0.11 (1.42) |
| Workshop grade (1 to 10) | 6.8 (2.15) | 8.0 (1.55)* | 6.2 (2.15) |
| I perceive the HSC as a role model (− 2 to + 2) | − 0.34 (1.36) | 0.51 (1.29)* | − 0.69 (1.23) |
| I would like to appear similar to the HSC (− 2 to + 2) | − 0.54 (1.40) | 0.36 (1.38)* | − 0.90 (1.24) |
| I am interested in following the HSC's recommendations about healthy food purchases in the supermarket (− 2 to + 2) | 0.04 (1.21) | 0.50 (1.13)* | − 0.15 (1.20) |
| I learned how to make healthy food choices in the supermarket (− 2 to + 2) | 0.17 (1.37) | 01.86 (1.09)* | − 0.11 (1.38) |

*N* number, *%* percentage, *M* mean, *SD* standard deviation

* $p \leq 0.05$, represents the significance of differences in scores between low and high education levels

that future interventions carefully consider the selection of peer educators to enhance identification with participants.

Our finding of short- and longer-term improvements in nutritional knowledge among adolescents with a high level of education, but not among those with a low level of education, may partly be explained by differences in cognitive abilities and learning capacities typically associated with educational levels [40]. However, it is important to consider that this learning effect could also be influenced by other background characteristics, such as household income, parental support for healthy eating or the types of foods available to adolescents at home and in school. While the results of the appraisal did not indicate that the workshop was too difficult for those with a lower level of education, future studies should explore whether the workshop content needs to be tailored to the diverse educational backgrounds and contextual factors of adolescents.

The results of this study should be considered in the context of its strengths and limitations. One major strength of this study is that, to our knowledge, it is the first to use cash receipt data of adolescents to investigate the effect of nutrition peer education in supermarkets on food purchased. This resulted in objective data that have been shown to provide a reasonable and accurate measure of overall dietary quality [20, 41]. Another strength of this study was that we conducted the peer education in the supermarkets. In doing so, we intervened at a key point of unhealthy food purchases by adolescents, where their food choices could be directly influenced, potentially having a greater impact on food purchases than peer education outside the purchase environment. The final strength is that we used longer term follow-up measures to assess the maintenance of improvements attributed to peer education.

There were also some limitations to our study, which should also be noted. First, the study was conducted among first-year and second-year students from secondary schools in urban areas, so the results cannot be generalized to older adolescents or rural areas. Moreover, due to practical resource constraints we only included three supermarkets and three schools in one city, so the results cannot be generalized to other cities in the Netherlands. Another limitation is that we did not have access to individual-level purchase data, so we were not able to investigate the effect of the HSC intervention at the individual level. Moreover, it is likely that we collected cash receipts of adolescents who participated more than once in our study. Therefore, we cannot exclude the possibility that this might have led to an under- or overestimation of the effect of the HSC intervention on food purchases.

In order to overcome these limitations, future studies who are using cash receipts or cash data to investigate food purchases of adolescents should use a tracking system, such as a personal card that could be scanned at the checkout, to link the adolescents to their purchases. Future studies should also include the medium educational level to fully evaluate the intervention's applicability across all educational groups. Moreover, more insight is needed into the underlying mechanisms of the discrepancy between improved scores on the potential determinants of food purchase behaviour and their failure to translate into improved food purchases in the supermarket.

In order to develop more effective interventions that promote healthy food choices in the supermarket by adolescents, peer education in supermarkets must be complemented by other efforts at the point of purchase. Since the majority of food products available in supermarkets are unhealthy and the majority of the food purchased in our study was unhealthy, future interventions should also focus on discouraging the purchase of unhealthy food by adolescents. In addition to supermarkets, studies should identify supplementary strategies and interventions that create a supportive food environment around secondary schools more broadly, especially since these environments do not currently stimulate healthy food choices.

## Conclusion

This study showed that nutrition peer education in supermarkets did not improve actual food purchases, although scores on several potential determinants of healthy food purchase behaviour did improve. Furthermore, the HSC intervention seemed especially effective in improving scores on the determinants of food purchase behaviour among adolescents with a low level of education compared to those with a higher education. However, additional efforts are needed to promote sustainable healthy food choices by adolescents in supermarkets. Future studies of interventions should be complemented by a consistent set of changes targeting the entire school food environment.

### Abbreviation

HSC Healthy Supermarket Coach

## Supplementary Information

The online version contains supplementary material available at https://doi.org/10.1186/s12916-024-03828-8.

Additional file 1. A: Figure flowchart.

Additional file 2. B: Overview of the measures of the behavioural determinants and appraisal.

Additional file 3. C: Difference in unhealthy and healthy purchases in supermarkets for adolescents from the comparison and intervention schools.

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### Authors' contributions

M.H. contributed to the design of the study, collected the data, carried out the data analysis and wrote the manuscript. J.T. helped with the data analysis. S.C.D, M.P. P. and J.C.S. developed the design of the study, interpreted the results and reviewed and critiqued the manuscript. All authors have read and agreed to the published version of the manuscript.

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### Data availability

The data underlying this article will be shared on reasonable request to the corresponding author.

## Declarations

### Ethics approval and consent to participate

This research is performed in accordance with the guidelines in the Declaration of Helsinki. The study was approved by the Medical Ethical Committee of the Amsterdam UMC and registered in the Dutch Trial Register (6531). Passive written informed consent for participation was obtained from the caregivers of all of the adolescents. In addition, active oral informed consent (in relation to cash receipts) and written informed consent (in relation to the questionnaires) to participate were given by all adolescents.

### Consent for publication

Not applicable.

### Competing interests

The authors declare no competing interests.

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