Does the Healthy Body Image program improve lifestyle habits among high school students? A randomized controlled trial with 12-month follow-up

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Abstract

Objectives: Positive embodiment and healthy lifestyle habits seem to be related; therefore, stimulating positive embodiment should promote healthy lifestyle habits. In the current study, we delivered the Healthy Body Image (HBI) intervention among Norwegian high school students and examined the effects on healthy lifestyle habits.

Methods: The HBI intervention comprises three interactive workshops, with three overarching themes related to body image, social media literacy, and lifestyle. A total of 2446 boys (43%) and girls in grade 12 (mean age 16.8 years) from 30 high schools participated in this cluster-randomized controlled study. Schools were randomized to the HBI intervention or control study arm. Data on physical activity, eating habits, and sleep were collected at baseline, post intervention, and 3- and 12-month follow-up and analyzed using linear mixed regression models.

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Results: The intervention had a minor negative effect on physical activity levels in boys at 12-month follow-up and short-term small-to-moderate positive effects on consumption of breakfast and fruit and vegetables, and sleep duration on school days.

Conclusions: In future, the lack of satisfactorily long-term effects might be better addressed using a combination of cognitive and behavioral approaches to more optimally integrate positive embodiment and lifestyle changes in the daily life of adolescents.

Trial registration: ClinicalTrials.gov ID: PRSNCT02901457. Approved by the Regional Committee for Medical and Health Research Ethics.

List of abbreviations

BMI: Body mass index
HBI: Healthy Body Image intervention
PA: Physical activity
TST: Total sleep time

Introduction

Promoting and optimizing good lifestyle habits among adolescents is described as essential for physical, mental, and social health from a life course perspective, and adolescents who adopt a healthy lifestyle during their school years are more likely to maintain such behaviors as adults.[1] Considering the numerous future health benefits of adopting healthier lifestyle habits during adolescence, health promotion initiatives are called for.[2,3]

Lifestyle behaviors are strongly connected with several aspects of mental health, such as body image.[4] One protective factor counteracting negative body image perception is positive embodiment. This concept emphasizes body appreciation as well as positive connection with and care for the body.[5] Adolescents who grasp the concept of positive embodiment seem to become more concerned with the functionality of their body than its appearance.[6] As a consequence, they become more aware of what their body needs to feel healthy and are more likely to engage in health-promoting behaviors.[7]

Successful promotion of positive embodiment has been reported to trigger the evolvement of more healthy lifestyle habits,[8] and such lifestyle habits might be viewed as a tool to care for the body, leading to feelings of emotional contentment and positive well-being.[6] Because favorable changes in positive embodiment predict changes in lifestyle habits like intuitive eating, less dieting, increased fruit and vegetable intake, and higher levels of physical activity,[9–11] we established these factors as outcome variables in the current study. In addition, we included sleep duration as an outcome because sleep influences lifestyle factors[12] and is generally critical for maintaining good cognitive abilities, mental well-being, and physical health in children and adolescents.[13]

To our knowledge, the only two studies that have successfully accomplished the aim of promoting both body image and lifestyle habits are the all-girl body image

intervention study "New Moves"[8] and the all-boy intervention entitled Physical Activity Leaders (PALs).[14] Unfortunately, these studies excluded perspectives related to a mixed-sex sample.

In the present cluster-randomized controlled study, we examined our hypothesis that the Healthy Body Image (HBI) intervention would bring about favorable changes in lifestyle habits such as physical activity, eating habits, and sleep habits among Norwegian high school students and that these changes could be sustained over time.

Methods

Design and randomization

A cluster-randomized controlled design was used. Clustering at the school level was necessary to minimize contamination biases within schools. A random allocation to the HBI intervention or the control arm in a 1:1 ratio was thought to minimize school differences in terms of socioeconomic and demographic variables, including ethnicity and urban/rural dimensions. Randomization was conducted by a professional not affiliated with the study. During the intervention period, students at the control schools followed their regular school curriculum. Students were informed about their allocation to the intervention or control group after the pre-test. Figure 1 presents a diagram of the recruited and included schools and students, respectively.

Procedures

The study was piloted in March and April 2016 (N = 120 high school students in grade 12), which resulted in minor improvements to the intervention and measurement methods.[15] The HBI intervention included high school students in all 12th grade classes following a general study program, excluding those following a vocational study program. No further exclusion criteria were set. During spring 2016, oral and written study information was provided to students and staff of all public and private high schools in Oslo and Akershus County, with the consent of the school principals. Adolescents gave their consent to participate by responding to an e-mail containing information about the study and an informed consent document. Students consented by responding "yes" to whether they consented to participate in the study, upon which they were redirected to the online questionnaire package SurveyXact 8.2 (Ramböll, Aarhus, Denmark). The Regional Committee for Medical and Health Research Ethics required that students complete the questionnaires outside of regular school hours.

Measures

As described in the study protocol,[15] participants completed standardized self-report questionnaires at baseline, post intervention, and at 3 and 12 months of follow-up, respectively. Post-intervention assessment was unavailable on the day of the last workshop but was completed within 1 week.

Demographic variables

Demographic variables were collected at all measurement points and included age, sex, body weight (kg), and height (cm). Body mass index (BMI) was calculated as body weight (kg) divided by height squared (m^2). Categorization of weight status was based on international age- and sex-adjusted cutoff scores.[16] Students rated their parents' total income by selecting one of five options: less than NOK 200,000; NOK 200,000 to 400,00; NOK 500,000 to 800,000; NOK 900,000 to 1 million; and more than NOK 1 million. Students also rated their parents' educational level as follows: primary school, high school,
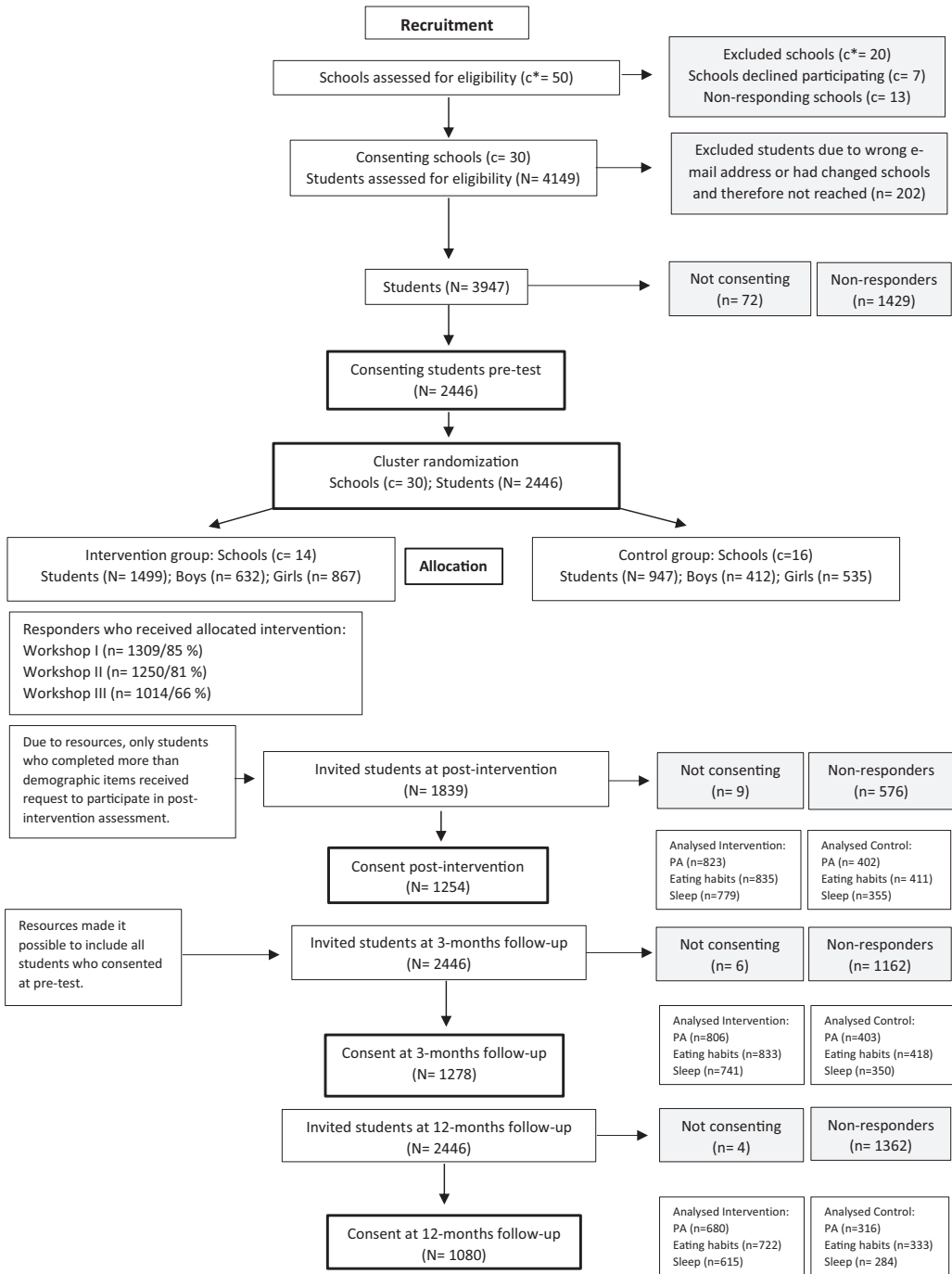
Figure 1. Schools (c*), students (n), and response rate of participating students.

college/university, or do not know. Immigration status was assessed via respondents' choices among the following statements: 1) I have immigrated. 2) Both my parents have immigrated. 3) Neither I nor my parents have immigrated.

Outcome measures

The measures of lifestyle habits used in this study, namely, physical activity, meal frequency, frequency of eating breakfast, and amount of fruit and vegetables consumed, were chosen because these are positively associated with and predicted by body image.[10,11,17]

Physical activity

Students rated in hours and minutes how physically active they had been during the previous week. Physical activity was defined on the questionnaire as "all bodily movement that led to an increase in body temperature and light to heavy shortness of breath". Examples of activities were provided, such as walking, cycling (including back and forth to school), skating, dancing, resistance training, hiking, and engaging in sports activities such as physical education, organized or unorganized leisure-time activities, and family activities.[18] Students who reported being physically active 7 hours or more per week were defined as meeting the current physical activity recommendations for adolescents.[19] Self-reporting was chosen owing to the available resources. In addition, self-reporting is an accepted method that balances validity with time and cost-effectiveness, which can be problematic in studies with large samples.[20]

Eating habits

Using a food frequency questionnaire, students reported how many days per week they consumed each meal (breakfast, lunch, dinner, evening meal, and snack).

Students responded using a 5-point Likert scale, with 1 = never and 5 = every day. Eating all meals every day was defined as optimal meal frequency.[21] In addition, breakfast was analyzed as an individual variable because regular breakfast consumption is positively associated with positive body image.[17] For effect analyses, categorical data (Never, 1–2, 3–4, 5–6, and 7 times per week) were restructured as ordinal data (e.g., 0, 1.5, 3.5, 5.5, 7). The survey also queried the servings of fruit, berries, vegetables, and salads consumed (hereafter, fruit and vegetables), with response categories ranging from less than one per day to more than five per day, resulting in the total daily servings of fruit and vegetables combined. Values for physical activity, meal frequency, eating breakfast, and intake of fruit and vegetables were also dichotomized into meeting recommendations (1) or not meeting recommendations (0), to yield the percentage of students who met current recommendations at baseline.[22]

Sleep

Students rated their total sleep time (TST) by indicating the nightly hours of sleep on school and weekend days, separately. Participants were instructed to avoid including awake time in bed. The categorical response options were as follows: < 4, 4 to 5, 6 to 7, 8 to 9, 10 to 11, 12, and > 12 hours of sleep; these were recoded as 3.5, 4.5, 6.5, 8.5, 10.5, 12.0, and 12.5 hours of sleep. The accumulation of sleep debt on school days was calculated by subtracting the average TST on school days from TST on weekend days, with larger positive discrepancies indicating greater sleep debt accumulation.[23]

The intervention

The HBI intervention comprised three overarching themes related to body image,

social media literacy, and lifestyle. These themes have been found to improve physical self-perception, body satisfaction and appreciation, physical competence, and body esteem.[24] A sociocultural perspective[25] was considered, given the objective to change attitudes, beliefs, and knowledge about idealized lifestyles related to, for instance, extreme exercise and diet regimes as well as idealized bodies. Also embedded in the HBI intervention were an etiological model of risk and protective factors[26] as well as the developmental theory of embodiment,[27] within the realm of positive psychology.[28] An outline of the HBI intervention is provided below, and details are provided in the study protocol.[15]

Lifestyle-related workshop content

The body image workshop aimed to improve students' awareness of embodiment-enhancing influences (e.g., people, activities, social environments) that already existed in each student's life, to increase their time and resources spent on such positive influences. The media literacy workshop was intended to make students more critical consumers and users of social media, so that they can benefit from social media consumption rather than experience negative consequences of unhealthy exposure.

In the lifestyle workshop, students discussed how physical activity as well as regular sleep and eating habits might promote the experience of a better functioning body and mind. To reduce the risk of internalizing unhealthy ideals, attitudes, goals, or advice, lifestyle literacy was discussed to debunk myths and "truths" communicated via social media (e.g., skipping meals, not eating breakfast, what is a healthy body fat percentage, the need for supplementation) that are clearly in conflict with current safe guidelines and evidence-based recommendations.[22,29]

The intervention followed an interactive educational approach, which fit well within the school setting.[30] The intervention content was adapted to the cognitive developmental level of adolescents with respect to abstract reasoning. According to the elaboration likelihood model, several exposures are important to yield an effect, which are also supported in several studies.[24,31] Therefore, the intervention comprised three 90-minute interactive workshops to facilitate extensive student discussions. All workshops were arranged in classrooms during regular school hours. About 60 boys and girls (i.e., two school classes) participated per workshop. Student attendance was registered at each workshop, to assess program adherence. Intervals of 3 weeks between each workshop resulted in an intervention period of 3 months.

At the time of the intervention, the first and sixth author were PhD candidates and led the workshops. Both women hold a Master's degree in exercise science and are specialized in physical activity and health, sports nutrition, motivational interviewing, and promoting body image awareness among adolescents. Both facilitators had previous experience with intervention studies conducted in high schools, regularly presented talks to adolescents on relevant topics, and completed piloting of the intervention. The two facilitators took part in development of the questionnaire; the SurveyXact program was then used to distribute and collect the data. A detailed account of the content and targets of the intervention is provided in the study protocol.[15]

Sample size and power analyses

Statistical power estimation was based on two comparison groups ($\alpha = .05$ and $b = .20$) with an average within-cluster sample size of 70 students. The expected effect size was .28 according to a meta-analysis[32] that

included 35 studies examining the effects of intervention on body image variables. Moreover, we assumed that within-cluster dependency related to schools accounted for approximately 3% (intraclass correlation coefficient = .03). This is appropriate for variables related to psychological or mental health outcomes because selection factors such as socioeconomic status variables have less effect on these variables than, for example, academic performance. These considerations required a minimum of 10 clusters within each group and a total sample size of 10 schools $\times$ 2 groups $\times$ 70 students, or approximately 1400 students.

Statistical analysis

IBM SPSS 24 for Windows (IBM Corp., Armonk, NY, USA) was used to carry out the statistical analyses. The adequacy of the randomization procedure was examined by comparing group differences at baseline using independent *t*-tests or chi-squared tests (Table 1). A participant was recorded as a dropout if all post-intervention and follow-up data were missing. Owing to several layers of dependency in the outcome data, linear mixed regression models were fit, as suggested in comparable studies.[33] Students were nested within schools; hence, dependency within the school clusters was accounted for by adding school as a random factor. The dependency between the repeated measures was accounted for by fitting a compound symmetry matrix to the residual matrices (i.e., equal correlations between the repeated measures, as an autoregressive matrix did not improve fit). The baseline score was used as a covariate to adjust for imperfections in the randomization procedure and to increase the statistical power. The fixed factors were *group* (a coefficient for the difference between the intervention and the control group), *time* (a coefficient for each time point except the final one, to detect a nonlinear change), and *group* $\times$ *time* (to detect whether intervention effects were particularly pronounced at certain time points). To examine whether the level of participation in workshops influenced the outcomes, *workshop attendance* (*WA*; number of workshops attended) was added as a linear covariate, as well as interaction terms examining whether *WA* influenced the outcome, particularly at certain time points (*WA* $\times$ *time*) or additionally within just one of the groups (*WA* $\times$ *time* $\times$ *group*). Other moderators were similarly examined. The restricted maximum likelihood procedure and type III *F*-tests were used preferentially. The analyses were stratified by sex. Effects were deemed statistically significant if $p < .05$, including p-values for the planned comparison tests (least significant difference) examining group differences at each follow-up assessment. Results are expressed as absolute number (n) and percentage (%) for categorical data and as model-estimated mean including 95% confidence interval (CI) and standard deviation (SD) for continuous data. Effect sizes are presented using Hedges' *g* and the phi coefficient.

Ethics approval and consent to participate

The present study was conducted in accordance with the national Health Research Act and the internationally adopted Declaration of Helsinki. The study was approved by the Regional Committee for Medical and Health Research Ethics (P-REK 2016/142) and registered in the international database of controlled trials (www.ClinicalTrials.gov ID: PRSNCT02901457). Students could withdraw their consent at any time and without consequences. Because workshops were held during regular school hours, participation was mandatory, as for regular classes. However, students were informed that they could attend the HBI

Table 1. Estimated baseline differences in demographics and lifestyle factors between groups, mean (SD) and n (%).

	Boys (n = 1044)			Girls (n = 1400)		
	Intervention (n = 632)	Control (n = 412)	p-value (g/φ)	Intervention (n = 867)	Control (n = 535)	p-value (g/φ)
Age (years)	16.84 (0.57)	16.78 (0.64)	.126	16.80 (0.54)	16.78 (0.53)	.426
BMI (kg/m²)	21.85 (3.45)	21.78 (3.26)	.741	21.41 (2.82)	21.43 (3.65)	.946
Immigration status[a]	62 (9.8%)	71 (17.2%)	**.001** (0.11[d])	109 (12.5%)	87 (16.2%)	.050
Parents' income ≥1 million NOK[b]	319 (49.30%)	186 (44.6%)	.134	324 (36.5%)	143 (26.3%)	**<.001** (−.11[d])
Parents' educational level[c]	544 (86.5%)	314 (76.6%)	**<.001** (−.13[d])	745 (85.1%)	416 (77.5%)	**<.001** (−.10[d])
PA (h/week)	8.27 (5.88)	8.29 (5.27)	.961	6.89 (4.93)	6.44 (4.86)	.150
Meets PA recommendations	209 (50.7%)	118 (56.2%)	.197	270 (39.2%)	123 (34.1%)	.104
Eats breakfast	272 (64.3%)	129 (60.3%)	.340	488 (66.0%)	195 (53.3%)	**<.001** (16.38[d])
Regular meal intake	80 (18.9%)	42 (19.6%)	.832	84 (12.1%)	34 (9.3%)	.182
Consumption of fruit and vegetables	138 (32.7%)	67 (31.3%)	.788	292 (42.1%)	130 (35.5%)	**.041** (4.30[d])
Sleep (h/school day)	7.10 (1.33)	6.92 (1.32)	.094	6.96 (1.21)	6.85 (1.36)	.176
Sleep (h/weekend day)	9.27 (1.61)	9.07 (1.93)	.174	9.09 (1.56)	9.09 (1.73)	.968

BMI, body mass index; PA, physical activity.
[a]Both parents are immigrants. [b]Parents' total income. [c]One or both parents with college or university education levels. [d]Hedges' g and phi-coefficient (φ) presented for significant differences.

workshops without completing the question-naires if they preferred. Control schools were offered one condensed lecture that included highlights of the HBI intervention, after they completed the 12-month follow-up.

Results

Sample characteristics and participant demographics

Baseline data are presented in Table 1. Thirty schools were randomized and 2446 students consented to participate at pre-test. Dropout led to 1254, 1278, and 1080 students participating at post intervention and at 3- and 12-month follow-up, respectively (Figure 1). The included participants were age 16.8 (SD 0.76) years at baseline. Students had a mean BMI within the normal weight range for the current age group, and 11% and 1% were categorized as overweight and obese, respectively. A total 13% were categorized as immigrants, 39% had parents with a total income of ≥ 1 million NOK (approximately 100.000 €), and 82% reported that one or both parents had a higher education level. The adolescents showed low adherence to recommendations for physical activity, diet, and sleep (Table 1). Among girls, the inter-vention and control groups differed signifi-cantly with regard to socioeconomic classification and eating habits, whereas differences between groups were found for immigration status and parental income among boys. Dropout differences were also adjusted for in the analyses, but this was only related to meal irregularities in boys ($p < .02$–0.01) and in girls ($p < .03$–.001).

Effect of intervention on lifestyle habits

For physical activity in boys, the main effects of *group* and *time* were not signifi-cant whereas the effect of the interaction *group* × *time* was significant ($F_{2.334} = 3.25$,

$p = .040$). Between-group planned compari-son analyses showed a small reduction in physical activity level at post intervention compared with controls at 12-month follow-up in boys. No significant effects were evident in girls (Table 2).

The intervention had no effect on break-fast consumption among boys. However, in girls, the main effects of *group* ($F_{1.772} = 4.35$, $p = .037$) and *time* ($F_{2.905} = 3.59$, $p = .023$) were significant, whereas the interaction *group* × *time* was not significant. The between-group planned comparison analy-ses showed that girls in the intervention group reported a small increase in breakfast consumption compared with girls in the control group post intervention; this increase had disappeared at follow-up assessment (Table 3). With regard to meal frequency, no significant effects were seen among boys or girls (Table 3).

Regarding total intake of fruit and vege-tables, a main effect of *group* ($F_{1.370} = 7.72$, $p = .006$ (boys) and $F_{1.816} = 12.88$, $p < .001$ (girls)) and *time* ($F_{2.368} = 5.78$, $p = .003$ (boys), and $F_{2.955} = 6.29$, $p = .001$ (girls)) was observed. No interaction effect of *group* × *time* was found in either boys or girls). In the intervention group, we observed a slight increase in intake of fruit and vegetables among boys and girls at both post interven-tion and 3-month follow-up, as compared with the control group (Table 3).

With respect to sleep duration on school days among boys and girls, the intervention showed a main effect of *group* ($F_{1.360} = 7.81$, $p = .005$, and $F_{1.755} = 7.30$, $p = .007$, respec-tively) and *time* ($F_{2.352} = 3.67$, $p = .026$, and $F_{2.878} = 5.96$, $p = .003$, respectively) whereas the interaction effect *group* × *time* was not significant in either sex. Furthermore, there was a small increase in sleep duration on school days among girls in the intervention group as compared with control girls at post intervention, and a moderate increase among boys who completed the

Table 2. Estimated mean scores for the effects of intervention on physical activity.

	Intervention group		Control group			
	n	PA h/week [95% CI]	*n*	PA h/week [95% CI]	Mean difference [95% CI]	*p*-value (*g*)
Boys						
Baseline*	412	8.27 [7.71, 8.85]	210	8.29 [7.57, 9.01]	−0.02 [−0.97, 0.92]	.961
Post intervention	280	8.10 [7.65, 8.54]	136	7.92 [7.30, 8.55]	0.18 [−0.59, 0.95]	.646
Follow-up at 3 months	257	7.84 [7.30, 8.37]	136	8.21 [7.42, 8.99]	−0.37 [−1.32, 0.57]	.438
Follow-up at 12 months	201	7.50 [6.80, 8.21]	99	8.99 [7.94, 10.05]	−1.49 [−2.76, −0.23]	**.021** (0.22)
Girls						
Baseline*	689	6.89 [6.53, 7.27]	361	6.44 [5.94, 6.94]	0.46 [−0.17, 1.08]	.150
Post intervention	543	6.59 [6.26, 6.91]	266	6.13 [5.67, 6.60]	0.45 [−0.11, 1.01]	.116
Follow-up at 3 months	549	6.65 [6.33, 6.98]	267	6.56 [6.09, 7.04]	0.09 [−0.49, 0.66]	.762
Follow-up at 12 months	479	6.55 [6.14, 6.95]	217	6.52 [5.91, 7.14]	0.02 [−0.72, 0.76]	.953

PA, physical activity; CI, confidence interval.

All estimations were adjusted for school as a random factor, immigration status, parents' income, and parents' education as fixed covariates. When these variables were non-significant, they were excluded from the final model; only immigration remained a significant covariate for boys.

*Baseline scores are reported as unadjusted observed scores. Baseline PA h/week was included as a covariate. Hedges' *g* presented for significant differences.

intervention compared with control boys at 12 months of follow-up (Table 4).

No significant group differences in sleep duration on weekend days were evident. Accumulation of sleep debt was not observed in boys. Among girls, the main effect of *group* ($F_{1,744} = 7.53, p = .006$) was significant whereas *time* and *group × time* were not. At post intervention and at 12-month follow-up, girls in the intervention group showed a small reduction in sleep debt accumulation in comparison with girls in the control group (Table 4).

Workshop attendance

Among all students in the intervention group who were requested to take part in the workshops, 85%, 81%, and 66% were registered in workshops I, II, and III, respectively. Attendance did not moderate the intervention effect on any of the investigated lifestyle habits.

Discussion

Our hypothesis was partly supported because short-term positive changes in

eating habits and sleep duration among both boys and girls were observed after the HBI intervention; however, long-term positive effects of the intervention were lacking.

Our findings regarding a lack of effects owing to the HBI intervention on physical activity are similar to those of the body image study New Moves[8] and PALs.[14] Girls attending the New Moves intervention positively changed their physical activity stages of change, but not their actual activity levels. No changes in mean steps per day were found for boys who participated in PALs. Findings from other studies show that time spent engaged in physical activity normally decreases during adolescence in both sexes.[34] Thus, maintaining rather than improving physical activity level might be a more realistic outcome to target during this period of life.

The PALs study findings showed a small reduction in the consumption of sugar-containing beverages, but no change in fruit and vegetable consumption.[14] In the New Moves study, girls had improved

Table 3. Estimated mean scores for the effects of intervention on breakfast, meal frequency, and fruit and vegetables intake.

	Boys						Girls					
	Intervention		Control		Mean difference [95% CI]	p-value (g)	Intervention		Control		Mean difference [95% CI]	p-value (g)
	n	Mean [95% CI]	n	Mean [95% CI]			n	Mean [95% CI]	n	Mean [95% CI]		
Breakfast												
Baseline*	423	5.75 (5.39, 6.11)	214	5.44 (4.78, 6.10)	0.04 (−0.04, 0.12)	.322	694	5.70 (5.54, 5.86)	366	5.03 (4.78, 5.29)	0.12 (0.06, 0.18)	**<.001** (0.30)
Post intervention	285	5.67 (5.50, 5.84)	138	5.45 (5.20, 5.70)	0.22 (−0.09, 5.22)	.159	550	5.61 (5.49, 5.73)	273	5.33 (5.15, 5.50)	0.29 (0.08, 0.50)	**.008** (0.33)
Follow-up at 3 months	268	5.56 (5.37, 5.75)	144	5.56 (5.28, 5.84)	0.00 (−0.34, 0.34)	.997	565	5.67 (5.54, 5.79)	274	5.50 (5.32, 5.70)	0.16 (−0.06, 0.38)	.161
Follow-up at 12 months	213	5.50 (5.20, 5.70)	102	5.48 (5.18, 5.79)	0.02 (−0.35, 0.38)	.936	509	5.48 (5.33, 5.63)	231	5.34 (5.11, 5.57)	0.14 (−0.14, 0.41)	.327
Meal frequency												
Baseline*	423	5.36 (5.17, 5.55)	214	5.18 (4.75, 5.60)	0.04 (−0.18, 0.26)	.718	694	5.30 (5.19, 5.42)	366	4.76 (4.61, 4.91)	0.42 (0.26, 0.59)	**<.001** (0.30)
Post intervention	285	5.41 (5.31, 5.52)	138	5.32 (5.17, 5.46)	0.10 (−0.08, 0.28)	.282	550	5.15 (5.08, 5.22)	273	5.02 (4.92, 5.13)	0.13 (−2.32, 0.25)	.050
Follow-up at 3 months	268	5.34 (5.22, 5.45)	144	5.35 (5.19, 5.52)	−0.02 (−0.22, 0.19)	.860	565	5.20 (5.13, 5.27)	274	5.10 (4.99, 5.21)	0.10 (−0.02, 0.23)	.129
Follow-up at 12 months	213	5.55 (5.10, 5.35)	102	5.24 (5.05, 5.43)	−0.01 (−0.24, 0.21)	.906	509	5.02 (4.94, 5.09)	231	4.98 (4.86, 5.10)	0.04 (−0.10, 0.18)	.586
Fruit & vegetables												
Baseline*	422	3.67 (3.22, 4.11)	214	2.67 (2.08, 3.25)	0.02 (−0.43, 0.48)	.915	694	4.37 (4.18, 4.57)	366	3.98 (3.72, 4.24)	0.39 (0.06, 0.72)	.323
Post intervention	281	3.69 (3.47, 3.92)	136	3.14 (2.82, 3.47)	0.55 (0.15, 0.95)	**.007** (0.30)	548	4.31 (4.16, 4.46)	268	3.78 (3.57, 4.00)	0.53 (0.26, 0.79)	**<.001** (0.35)
Follow-up at 3 months	263	3.55 (3.32, 3.78)	139	3.11 (2.78, 3.45)	0.44 (0.03, 0.85)	**.036** (0.26)	562	4.42 (4.24, 4.59)	272	3.97 (3.72, 4.22)	0.45 (0.15, 0.75)	**.004** (0.28)
Follow-up at 12 months	208	3.16 (2.90, 3.43)	102	2.80 (2.40, 3.20)	0.37 (0.15, 0.85)	.140	498	4.03 (3.85, 4.21)	227	3.72 (3.44, 4.00)	0.31 (−0.2, 0.64)	.065

CI, confidence interval.

All estimations were adjusted for school as a random factor; immigration status, parents' income, and parents' education as fixed covariates. When these variables were non-significant, they were excluded from the final model.

*Baseline scores are reported as unadjusted observed scores. Baseline dietary scores were included as a covariate. Hedges' g is presented for significant differences.

Table 4. Estimated mean scores for the effects of intervention on total sleep time (TST) and sleep debt during school days and weekend days.[a]

	Intervention		Control			
	n	Hours [95% CI]	n	Hours [95% CI]	Mean difference [95% CI]	p-value (g)
Boys TST, school days						
Baseline*	448	7.08 [6.96, 7.21]	228	6.93 [6.75, 7.11]	0.18 [−0.03, 0.39]	.094
Post intervention	258	6.87 [6.74, 7.01]	122	6.72 [6.52, 6.91]	0.16 [−0.08, 0.39]	.195
Follow-up at 3 months	235	6.95 [6.81, 7.09]	116	6.74 [6.53, 6.95]	0.22 [−0.04, 0.47]	.096
Follow-up at 12 months	182	6.85 [6.68, 7.02]	87	6.40 [6.14, 6.65]	0.46 [0.15, 0.76]	**.003** (0.45)
Boys TST, weekend days						
Baseline*	448	9.28 [9.12, 9.43]	228	9.07 [8.80, 9.33]	0.20 [−0.07, 0.48]	.174
Post intervention	258	9.28 [9.12, 9.44]	122	9.28 [9.04, 9.51]	0.00 [−0.28, 0.29]	.976
Follow-up at 3 months	235	9.18 [8.98, 9.39]	116	9.19 [8.88, 9.50]	−0.01 [−0.38, 0.36]	.959
Follow-up at 12 months	182	9.28 [9.08, 9.47]	87	9.08 [8.79, 9.37]	0.20 [−0.15, 0.54]	.264
Boys, sleep debt						
Baseline*	448	2.17 [1.98, 2.36]	228	2.15 [1.85, 2.45]	0.02 [−0.32, 0.36]	.906
Post intervention	258	2.36 [2.16, 2.57]	122	2.60 [2.30, 2.90]	−0.24 [−0.60, 0.13]	.201
Follow-up at 3 months	235	2.30 [2.09, 2.58]	116	2.54 [2.21, 2.86]	−0.23 [−0.62, 0.16]	.239
Follow-up at 12 months	182	2.38 [2.12, 2.65]	87	2.61 [2.21, 3.02]	−0.23 [−0.72, 0.25]	.349
Girls TST, school days						
Baseline*	711	6.96 [6.87, 7.05]	387	6.85 [6.71, 6.99]	0.11 [−0.05, 0.27]	.176
Post intervention	521	6.99 [6.90, 7.08]	233	6.76 [6.63, 6.89]	0.23 [0.07, 0.39]	**.004** (0.25)
Follow-up at 3 months	506	6.91 [6.81, 7.00]	234	6.75 [6.61, 6.89]	0.16 [−0.01, 0.33]	.070
Follow-up at 12 months	433	6.78 [6.68, 6.88]	197	6.63 [6.47, 6.79]	0.15 [−0.04, 0.34]	.111
Girls TST, weekend days						
Baseline*	711	9.11 [8.99, 9.23]	387	9.08 [8.90, 9.26]	−0.00 [−0.21, 0.19]	.968
Post intervention	521	9.04 [8.93, 9.15]	233	9.09 [8.92, 9.26]	−0.05 [−0.24, 0.15]	.629
Follow-up at 3 months	506	8.95 [8.83, 9.07]	234	8.97 [8.79, 9.16]	−0.02 [−0.24, 0.20]	.833
Follow-up at 12 months	433	8.92 [8.79, 9.05]	197	8.99 [8.78, 9.19]	−0.06 [−0.30, 0.18]	.619
Girls, sleep debt						
Baseline*	711	2.13 [2.00, 2.26]	387	2.24 [2.05, 2.44]	−0.11 [−0.35, 0.12]	.350
Post intervention	521	2.05 [1.93, 2.17]	233	2.32 [2.14, 2.51]	−0.28 [−0.50, −0.06]	**.013** (0.15)
Follow-up at 3 months	506	2.11 [1.97, 2.25]	234	2.19 [1.98, 2.40]	−0.08 [−0.33, 0.17]	.537
Follow-up at 12 months	433	2.05 [1.89, 2.21]	197	2.47 [2.23, 2.71]	−0.42 [−0.70, −0.13]	**.004** (0.12)

CI, confidence interval.
All estimations were adjusted for school as a random factor, immigration status, parents' income, and parents' education as fixed covariates in the first model. When these variables were non-significant, they were excluded from the final model.
*Baseline scores are reported as unadjusted observed scores. Baseline TST and sleep debt score were included as covariates.
[a]TST scores ranged from 3.5–12.5.
Hedges' g presented for significant differences.

their stages of change for consumption of fruit and vegetables at short-term follow-up.[8] The present study results support these findings as we collected self-reported consumption information from both boys and girls; the non-significant differences at 12 months of follow-up showed that the HBI intervention effects were transient. Generally, there is a change in levels of fruit and vegetable intake as adolescents grow older and have increased freedom of food choices.[35] The HBI intervention might have increased support for consuming fruit and vegetables during the intervention. When the intervention ended, the experience of support might have faded, making it difficult to maintain improved consumption levels over time. Regular, sustained support and encouragement could be important to implement post intervention, to maintain the effects of intervention over time.

At 12-month follow-up, boys in the intervention group slept longer during school days in comparison with boys in the control group; this was the result of a less reduction in sleep time over the long term in the intervention versus the control group for boys. The small reduction in sleep debt among girls at post intervention and at 12 months of follow-up reflects a healthier sleep pattern than that among controls, which has been suggested to be important for both physical and mental health as well as cognitive function.[36]

To promote healthy lifestyle habits through the HBI intervention, the workshops emphasized the benefits of adhering to evidence-based lifestyle recommendations while considering students' busy schedules. At the same time, we emphasized that being preoccupied with healthy living and engaging in extreme lifestyle regimes that are often promoted in social media can be harmful. Further, the importance of autonomy and individual preferences related to lifestyle choices were highlighted. One could speculate that our workshops promoted a relaxed attitude toward lifestyle habits and promoted positive embodiment but at the same time reduced students' interest in lifestyle changes.

In the HBI intervention, the lack of strong and sustained effects on lifestyle behaviors could be explained by the use of a solely cognitive approach in the workshops. A cognitive approach was chosen because this has been described as the most effective for change in body image outcomes, which was the main aim of the overall study.[24,37] However, self-monitoring of behaviors, intention formation, specific goal setting, providing feedback on performance, and review of behavior goals are described as effective techniques for changing lifestyle behaviors.[38] Regular booster sessions following the final workshop aimed at motivating, encouraging, and reminding adolescents of the information

taught and skills learned could potentially lead to a more sustained effect. Such methods have been found to be effective in successful body image interventions.[39] In future studies, the interventional approach might need to include both cognitive and behavioral change techniques, such as those in the present study, together with booster sessions aiming to change cognition related to positive embodiment as well as long-term changes in lifestyle habits.[24,37,38]

Strengths and limitations

To our knowledge, this is the first study to investigate lifestyle factors as an outcome in a positive embodiment intervention targeting both boys and girls. Our results contribute to the current literature on positive embodiment and lifestyle habits among adolescents and deepen knowledge and understanding of effective approaches to changing lifestyle habits among adolescents via a body image intervention.[9] The strengths of this study include its randomized controlled design and user involvement through the pilot study. Moreover, student attendance was recorded and long-term follow-up conducted, specific factors that have been highlighted in previous literature.[24]

In the current study, schools were randomized using a 1:1 ratio to minimize differences between intervention and control schools. Still, differences were found for immigration and parental education status in boys and parental income, parental education levels, and consumption of breakfast and fruits and vegetables in girls (Table 1). This reflects an imperfect randomization. Studies have shown that adolescents' eating habits are associated with parental socioeconomic status.[40–42] Because parental education and income were lower in the female control group, this might have influenced the additional differences in eating habits between groups. We believe that the

effects identified were caused by the intervention and not baseline differences because effect analyses were adjusted for baseline scores. In addition, all estimations were adjusted for immigration status, parental income, and parental education as fixed covariates. A main limitation in this study was the considerable number of dropouts, especially for boys and control students. Nevertheless, the dropout rate did not lower the statistical power to such a degree that group comparisons became invalid. There was also a discrepancy between the rate of participation in each workshop and the actual questionnaire response rate. Therefore, we were unable to capture the effects of intervention among all students who participated in all workshops, which could potentially influence the reported effect. Objective measures of physical activity levels would have been more appropriate; however, self-reporting remains an accepted method that balances validity with time and cost-effectiveness.[20] Finally, the limitation of recall bias is generic in all studies using self-reporting;[43] however, this bias is addressed by the present study design.

Conclusion

Overall, the HBI intervention resulted in only minor, short-term effects on certain lifestyle habits among our high school students. This conclusion might appear disappointing, yet it can be informative when evaluating positive findings of previous or future studies with a shorter follow-up and fewer measurement points than in the present study.

Submission declaration

This article is not under consideration for publication elsewhere. If accepted by the journal, the article will not be published elsewhere. Publication of this article has been approved by all authors.

Author's contributions

This study was a multidisciplinary cooperative effort between experts in exercise medicine from the Norwegian School of Sport Sciences, the University College of Southeast Norway, and the University of Agder, involving experts in psychology and health care sciences and methodology from UiT – The Arctic University of Norway. Drs JSB, JR, and CSB (doctoral candidate) developed the original research idea, in collaboration with Drs SBS, MKT, and GP. Drs JSB, JR, SBS, MKT, GP, OF, EK as well as CSB and KMEE (doctoral candidates) developed the questionnaire. CSB and KMEE managed the project together, including piloting, intervention, and data collection. OF was chiefly responsible for the data analyses. CSB, OF, and SBS wrote the main manuscript, with important contributions from all co-authors. All authors have approved the final manuscript.

Declaration of conflicting interest

The authors declare that there is no conflict of interest.

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