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Reducing Ultra-processed Food Consumption in 12–15 Year-olds Using Digital Boards: A School-based Intervention

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Abstract

Background

Organisations define ultra-processed foods as industrial formulations made up of several ingredients and additives, frequently made from materials that are not commonly used in home cooking. Ultra-processed foods are becoming more widely acknowledged as a significant factor in youth's poor dietary quality, rising obesity rates, and mental health decline. Teenagers are especially susceptible to the effects of highly processed, high-energy, low-nutrient products, which frequently predominate in school and community food environments.

Aim

Here we used interactive digital boards to deliver education programme on the effect of ultra-processed foods on physical and emotional wellbeing to Year 9 and 10 schoolchildren (12–15 years of age), in an urban area in South-East England.

Methods

We used a questionnaire to assess our participant's baseline for emotional, physical and psychological wellbeing, nutrition and lifestyle choices, a pre- and post-intervention questionnaire to measure any quantifiable behavioural changes and a Kahoot quiz to measure comprehension of module content. Questionnaire responses were converted to a Likert scale ordinal score for evaluation. Total scores were analysed using Wilcoxon signed-rank test. Changes between pre- and post-intervention scores and performance scores across each session were assessed using the Friedman test. Corrections for multiple comparisons were made using Benjamini-Hochberg ($p < 0.05$).

Results

Participants reported to having overall positive mental and psychological wellbeing; however, screen time was high and physical activity was low. Furthermore, participants reported to consuming high amounts of ultra-processed carbohydrates and proteins, but low amounts of minimally processed proteins. Despite showing an understanding of the education programme in the Kahoot quiz assessment, no evidence change in physical health or dietary patterns was observed.

Conclusion

Participants engaged in the intervention and demonstrated understanding of the educational content but did not exhibit any behavioural changes indicative of reduced consumption of ultra-processed foods or

increased activity levels. Future interventions require extended contact and follow-ups with participants to allow further assessment of possible behavioural changes and improvements in overall mental, physical and psychological wellbeing.

Background

Ultra-processed foods (UPFs) are defined as industrial formulations made up of several ingredients and additives. It's frequently made from materials that are not commonly used in home cooking (Monteiro et al., 2010). Based on their level of processing, foods are divided into four categories: (1) unprocessed or minimally processed foods (MPFs e.g. fresh fruits, vegetables, and meats), (2) processed culinary ingredients (e.g. oils, sugar, and salt), (3) processed foods (e.g. bread, cheese, and canned vegetables), and (4) ultra-processed foods (e.g. confectionery, soft drinks, and ready-to-eat snacks). Convenience and hyper-palatability are the main goals of UPFs. Most of them frequently contain large amounts of added sugars, unhealthy fats, and salt to boost energy, improve flavour, and extend shelf life (Jung et al., 2025, Monteiro et al., 2018). These traits may interfere with normal hunger and satiety processes, which in turn promoting overconsumption and possibly causing young people to engage in eating behaviours that resemble addiction (Mengi Celik et al., 2025).

UPFs are becoming more widely acknowledged as a significant factor in youth mental health decline (Mesas et al., 2022, Rodrigues et al., 2025) and rising obesity rates (De Amicis et al., 2022, Zahid et al., 2020). Teenagers are especially susceptible to the effects of highly processed, high-energy, low-nutrient products. These foods commonly predominate in school and community food environments (Tanne, 2026). As a result, there is an increasing demand for educational initiatives that enable young people to make better, more informed decisions by teaching them the difference between MPFs and highly processed substitutes (Jeans et al., 2023).

Indicators of diet quality including nutrient density (the ratio of beneficial nutrients to total caloric content), dietary balance and variation (diversity across food groups), and nutritional adequacy (adequate intake of important macronutrients and micronutrients) (Hermawati et al., 2025). Limiting the intake of UPFs whilst promoting the consumption of MPFs can help to increase the quality of an individual's diet (Lane et al., 2024).

Incorporating digital tools, like interactive digital boards, into school education provides a creative way to involve students through active engagement and visual learning. Digital learning environments offer standardised, scalable content delivery while improving understanding and retention of difficult health concepts (Coelho et al., 2024). However, the effectiveness of digital teaching methods in enhancing adolescents' food-related knowledge, attitudes, and well-being outcomes is still poorly supported, despite their increasing use (Talens et al., 2025, Monteiro et al., 2018). Here we used interactive digital boards to deliver education programme on the effect of UPFs on physical and emotional wellbeing.

Methods

Aim

The purpose of this pilot study was to evaluate changes in dietary behaviour, and in the mental and physical health and wellbeing of Year 9 and 10 students in an urban area in South-East England after the attendance of an education programme. The education programme, delivered using interactive digital boards, was designed through a collaboration between Collaboration for Kids (CFK) and X-PERT Health including educational modules exploring the physical and mental impacts of consuming UPFs (compared with MPFs) and how individuals can identify less processed options (e.g. by understanding the information on food labels).

Study design

This study was the initial pilot programme for the CFK project, delivered as part of the Collaborative Health Community (CHC) Foundation (UK registered charity number 1207031). The overarching goal of the CFK project is to inspire children and families to turn away from UPFs and choose MPFs instead, and in doing so, improve their health and wellbeing. This pilot study used a quasi-experimental design to investigate whether a programme providing education programme on MPFs, and healthy lifestyle choices improved children's health literacy and wellbeing. It was conducted between May and October 2024 onsite at The Regis School in Bognor Regis, West Sussex, England.

Participants

A purposive sampling technique was used. Students from Years 9 and 10 at The Regis School were recruited based on their interest in health and nutrition and participation in a student ambassador group. 15 students aged 12 to 15 years participated in the intervention, of whom three did not complete the post-intervention questionnaire. Analyses are therefore based on data obtained from the 12 participants who completed all questionnaires. A co-creation survey followed the final session to get participants feedback on the session and interventions. Additionally, three months later, a follow-up online Kahoot quiz was completed by only six participants due to absenteeism.

Data Collection Tools

The baseline questionnaire, comprised 49 self-reported questions that included 1) the *Stirling Children's Wellbeing Scale* (SCWS) (Liddle and Carter, 2015) which was used to assess psychological well-being through measures of positive emotional state, resilience, and social connection, 2) a food frequency questionnaire assessing consumption of MPFs and UPFs based on the NOVA classification, and 3) a lifestyle choices questionnaire assessing behaviours such as sleep quality, physical activity, hydration, and screen use.

The pre- and post-intervention questionnaire comprised 10 self-reported questions included questions on food preference and frequency, as well as lifestyle choices. These questionnaires were designed to capture short-term behavioural shifts and reflections on wellbeing, including energy levels, body image, and self-rated health, in response to the digital board sessions.

A co-creation survey comprised 11 self-reported questions, which was used to get the participants' feedback regarding the education programme contents and delivery.

A follow-up knowledge retention assessment comprised 25 questions. It was conducted in October 2024 using an online Kahoot quiz; this gamified online assessment tested participants' understanding of key educational learning outcomes such as the identification of UPFs versus MPFs, the role of nutrition in mood and energy, and the importance of balanced lifestyle habits.

Study Settings

a. Educator Training and Pedagogy

Prior to the start of the first session of the intervention, educators were trained by facilitators from X-PERT Health on how to use both the CFK educator manual and interactive digital boards. Educators were instructed in how to implement the pedagogical theories of *cognitive development* (Bruner, 1974), *facilitative learning* (Rogers, 1969) and *experiential learning* (Kolb, 2014). Participant engagement was a key aspect of the intervention, where educators were trained to use effective questioning to support students actively engage with the programme.

b. Intervention Design and Delivery

The intervention consisted of weekly 45-minute sessions delivered over 6 consecutive working term weeks. Each session focused on a different topic related to mental and physical health and wellbeing and making healthful lifestyle choices. The sessions followed a standardised structure: i) a 10-minute introductory activity, ii) a 25-minute interactive learning activity using interactive digital boards, and iii) a 10-minute recap and group discussion. Session topics and learning outcomes are summarised in the supplementary materials.

c. Interactive Digital Boards

To further facilitate participant engagement, the use of interactive digital boards was implemented. A projector and a whiteboard were used to display the boards. Chairs and tables were arranged so that each student had a clear view. The interactive digital boards (see Supplementary Figure 1) were used as a teaching aid, with educators guiding the general discussion and using the boards to help deliver the key learning outcomes for each session. Each board had multiple options and functions that enabled diverse learning, with interaction from participants guiding how the content of the board was used (e.g. the order labels were used in and the elements that were interacted with were based on questions and suggestions from participants, with educators helping to guide the direction of discussions by providing suitable responses and/or asking additional questions).

Data Collection and Statistical Analysis

Raw data were recorded in Microsoft Excel for initial data processing. Questionnaire responses were transformed into Likert ordinal scales and assigned rankings of either 1-5 or 1-3, depending on the number of response options. The most “positive” response was always assigned the highest value, and the most “negative” response was always assigned the lowest value (i.e. 1). Questions were thematically grouped into clusters.

Due to the small sample size, a non-parametric Wilcoxon signed-rank test was performed to evaluate behavioural eating habits and psychological and emotional well-being. The Friedman test was used to compare pre- and post-questionnaire data and for a comparison of performance across sessions in the Kahoot quiz. To account for multiple comparisons, p-values were adjusted using the Benjamini-Hochberg procedure The median and interquartile range (IQR), Wilcoxon W statistic (for the baseline questionnaire results and total score in the Kahoot quiz assessment), p-value, adjusted p-value and Chi-squared χ^2 statistic and Kenwall’s W (for the pre- and post-intervention questionnaire and score per session in the Kahoot quiz assessment) are all reported. “% High” in tables refers to when participants scored a Likert scale equivalent of ≥4 (in questionnaires with 5 possible choices and ≥2 in questions with 3 possible choices) on the corresponding questionnaires. All graphs and statistical analyses were performed in RStudio v4.5.1. Results were considered statistically significant at $p < 0.05$.

Ethical Consideration

The ethical oversight and approval for the intervention was granted by the Regis School Research and Safeguarding Committee, under the authority of the school’s governance structure and ratified through the formal agreement between The CHC and The Regis School. Research Ethics Committee approval was not required because this was a non-clinical, school-based educational programme delivered by a UK charity and did not involve NHS patients, staff, premises, or clinical procedures, in line with the UK Policy Framework for Health and Social Care Research (2017). The approval by the school principal and safeguarding lead is in compliance with the Education Act 1996 and the Children and Families Act 2014. All safeguarding requirements were met, including enhanced DBS checks for volunteers and adherence to The CHC Safeguarding Policy. Written informed consent was obtained from parents or legal guardians. Only anonymised or pseudonymised data were collected in accordance with the Data Protection Act 2018 (UK GDPR), and all procedures followed the principles of the Declaration of Helsinki.

Results

Baseline wellbeing, lifestyle choices and eating habits

The data in Table 1 highlights that participants’ (N = 30) psychological health was positive on average. The highest scores were found for “I think good things will happen in my life” (median = 4, IQR = 3–4.75, p = 0.006) and “I think people care about me” (median = 4, IQR = 3–5, p = 0.008). Statistical significance

was attained by both items ($p < 0.01$). Other items, such as “I can find lots of fun things to do”, “I feel that I am good at some things”, “I have been getting on well with people”, and “I have been cheerful about things”) achieved statistical significance. This was supported by qualitative answers to questions related to positive mental health and psychological wellness, with, for example, participants reporting “feeling good about themselves”, “being happy and confident”, and “feeling happy and ready to tackle the day”.

In contrast, elements that imply mood stability and mindfulness, like “I have been feeling calm” and “I have been feeling relaxed,” did not reach statistical significance and only had moderate median scores of 3. Likert scale median scores and % high responses for “I like everyone I have met”, “I think there are many things I can be proud of” and “I enjoy what each new day brings” were lower (median = 3 for all, % high ranged from 26.7 to 29.2%).

Table 1
Likert-Scale Ordinal Scoring for Stirling Children’s Wellbeing Scale among participants. (N = 30)

Question	Median	IQR	% (High)	W	p	p adjusted
I think good things will happen in my life	4	3–4.75	63.3	230.5	< 0.001*	0.006*
I have been able to make choices easily	3	2.25–4	33.3	102	0.460	0.460
I can find lots of fun things to do	4	3–4.75	56.7	194.5	0.005*	0.016*
I feel that I am good at some things	4	3–4	60	212	0.021*	0.045*
I think people care about me	4	3–5	63.3	222.5	0.001*	0.008*
I like everyone I have met	3	2–3.75	26.7	78.5	0.180	0.212
I think there are many things I can be proud of	3	3–5	29.2	63	0.057	0.093
I have been feeling calm	3	2.25–4	43.3	155	0.142	0.185
I have been in a good mood	3	3–4	48.1	142	0.047*	0.087
I enjoy what each new day brings	3	3–4	27.6	59.5	0.325	0.353
I have been getting on well with people	4	3–4	63.3	228	0.002*	0.008*
I have been cheerful about things	4	3–4	53.3	193	0.020*	0.045*
I have been feeling relaxed	3	3–4	48.3	152	0.067	0.097

W = Wilcoxon Signed Ranked test statistic; “% (High)” = percentage of participants with Likert scale equivalent of ≥ 4 on the questionnaire; * $p < 0.05$

The information in Table 2 demonstrates that sleep and emotional wellbeing had the highest wellbeing scores across all clusters. Alongside 82.1% of participants evaluating their sleep constructively, the sleep cluster had the highest fraction of participants reporting high scores (median = 4, IQR = 4–5, p < 0.001). The clusters for psychological wellbeing (median = 4, IQR = 3–4, 66.7% high, p < 0.001) and physical wellbeing highly (median = 4, IQR = 3–4, 59.7% high, p < 0.001) scored. Participants of the current study showed subordinate engagement in recreational or leisure activities, nevertheless this outcome was still statistically significant (median = 3, IQR = 3–4, *p* = 0.005). Conversely, engagement in physical activity did not reach statistical significance (median = 3, IQR = 2–4, *p* = 0.338). The cluster that showed the least engagement was “phone use” (median = 3, IQR = 2–4, p = 0.890), which is a portrayal of digital and screen-time interest. Several participants similarly mentioned the importance of appropriate or practical factors, such as “reading a book and eating healthily” or “having good education”.

Table 2
Likert-Scale Ordinal Scoring for Clustered lifestyle choices among Participants. (N = 30)

Cluster	**Median**	**IQR**	**% (High)**	**W**	**p**	**p adjusted**
Sleep	4	4–5	82.1	1192	< 0.001*	< 0.001*
Physical Activity	3	2–4	47.5	636	0.282	0.338
Recreational/Leisure Hobbies	3	3–4	46.7	592.5	0.003*	0.005*
Emotional Wellbeing	4	3–4	66.7	841	< 0.001*	< 0.001*
Physical Wellbeing	4	3–4	59.7	3380	< 0.001*	< 0.001*
Phone Use	3	2–4	36.2	420.5	0.890	0.890

W = Wilcoxon Signed Ranked test statistic; “% (High)” when participants scored a Likert scale equivalent of ≥ 4 on the questionnaire; * Significant at p < 0.05

The data shows certain occurrence of high UPF consumption throughout the participants (Table 3). The cluster with the highest frequency of intake was ultra-processed proteins (median = 4, IQR = 3–4, 61% high, p < 0.001), which was followed by ultra-processed carbohydrates (median = 3, IQR = 2.25–4, 46.3% high, p < 0.001). On the other hand, the real and natural protein sources cluster (median = 3, IQR = 2–3, 24.8% high, p = 0.027) and the real and natural carbohydrates cluster (median = 3, IQR = 2–4, 27.8% high, p = 0.370) demonstrated lesser median values and fewer high responses, with the latter being non-significant.

Table 3
Likert Scale for Clustered food frequency among participants.

Cluster	Median	IQR	% (High)	W	p	p adjusted
Ultra-Processed Carbohydrates	3	2.25–4	46.3	14866.5	< 0.001*	< 0.001*
Ultra-Processed Proteins	4	3–4	61	787	< 0.001*	< 0.001*
Real and Natural Carbohydrates	3	2–4	27.8	3080	0.370	0.370
Real and Natural Proteins	3	2–3	24.8	1120.5	0.020*	0.027*

W = Wilcoxon Signed Ranked test statistic; "% (High)" when participants scored a Likert scale equivalent of ≥ 4 on the questionnaire; * Significant at $p < 0.05$

Pre- and Post-Intervention Questionnaire assessing lifestyle and dietary habits

Data in Fig. 1 shows the median scores for overall physical health (pre: median = 3, IQR = 1, post: median = 3, IQR = 1, W = 16, d=-0.124 p = 0.792) and overall food intake (pre: median = 4, IQR = 1.75, post: median = 3.5, IQR = 1, W = 10, d = 0.43 p = 0.792) before and after the intervention. The small effect sizes suggest the absence of meaningful changes in physical health and dietary patterns (Fig. 1, Supplementary Table 3).

Assessment of Participant Comprehension of Intervention Content

Participants' comprehension of each module was assessed 4 months after the completion of the programme using an online Kahoot quiz (N = 6). Figure 2A shows the total median score (86.94%, IQR = 4.17) in the Kahoot quiz assessment. A one-sample Wilcoxon signed-rank test indicated that participant performance was significantly greater than what would be expected by chance (V = 666, p < .001). Figure 2B shows the median score across individual sessions. A Friedman test uncovered no significant difference in scores throughout sessions (rho = 3.56, p = 0.61). After multiple comparisons corrections, Spearman's rank correlations pointed no significant associations among overall test scores and individual session performance.

Participant Feedback on the Digital Education Programme

Participant feedback was collected using a co-creation survey at the end of the last session of the education programme. 55% of participants found the workshops "Interesting", whereas 36% said the workshops were "Moderately Interesting", when asked about how engaging the workshops were. 27% of participants found the information on UPFs to be "Extremely Clear", whereas 55% said it was "Clear". 36% of the participants found the quality of the group activities to be "Very Informative", whereas 55% of participants found the group activities to be "Informative". 27% of participants found the interactive

digital boards to be “Extremely Informative and Clear”, whereas 55% of participants said the digital boards were “Informative and Clear”. 72% of participants reported to have adopted “1–2 habit changes”.

Collaborative group discussions and open communication using the digital boards were reported as what participants liked most about the education programme, whereas too much delivery given by talking at participants was reported as the least liked part. Topics participants found the most interesting were food labels, the gut microbiome, physical activity and health, and the impact of diet on health and related diseases. The main recommendation for future education programmes was interactive activities to support the use of the digital boards. Examples that were given include: making videos and posters on the topics and activities that would get the participants moving around.

Discussion

The current pilot study aimed to evaluate dietary behaviour, in addition to the mental and physical health and wellbeing of a cohort of 12–15-year-old students in South-East England. The food habits of this group are consistent with well-established patterns documented in the literature on adolescent nutrition. Young people's diets are dominated by UPFs; for example, Petridi et al. (2025) estimated that adolescents in high- and middle-income countries get more than 80% of their calories from UPFs. Further, higher UPF consumption among adolescents is associated with poorer nutrient profiles, including lower fibre and protein quality, higher intake of free sugars, salt, and saturated fats (Petridi et al., 2026). These nutritional patterns contribute to the development of obesity, metabolic dysregulation, and mood fluctuations, highlighting the importance of programmes like this one.

The comparatively low consumption of MPFs found in this study also echoes data from Petridi et al. (2025), who reported that adolescents often show limited preference for whole grains, legumes, and unprocessed proteins, with behaviours driven by convenience, taste preferences, and marketing influences. The significance in natural protein intake ($p = 0.027$) seen in the current study may suggest some awareness of healthier food choices. Though the findings suggest this has not had a meaningful impact on participants’ behaviour. The prevalence of ultra-processed protein sources is in line with research by Fardet et al. (2021). They noted that industrial meat products and protein-enriched UPFs are replacing traditional dietary protein sources such as pulses, eggs, and fresh meats worldwide.

Overall participant feedback on the education programme was positive, in conjunction with high scoring on the Kahoot quiz assessment. However, despite scoring higher than would be expected through chance for each module in the Kahoot quiz assessment, food intake and physical health did not change over the course of the intervention. As only a subset of participants completed the Kahoot quiz ($N = 6$) it is possible that results may not be a true representation of the overall cohort. The findings of this small-scale pilot are however in line with earlier research showing that nutritional self-assessment and perceived physical health are slow-changing constructs that usually change over longer intervention periods. For instance, other studies in school-going adolescents found no change in diet despite increased nutritional knowledge (Raut et al., 2024), but it may be that a longer time is needed to observe

change. Horne et al. (2020) found that it frequently takes many months of repeated exposure and reinforcement to get quantifiable improvements in reported wellbeing after lifestyle modifications.

The results from this cohort are in line with earlier studies showing that teenagers frequently express high levels of optimism and social connectivity but inconsistent emotional stability. For instance, similar patterns were noted by Alimohamadi et al. (2025) in their validation of the Stirling Children's Wellbeing Scale: poorer consistency for calmness and emotional control, but high mean scores for questions representing social support and self-worth. Arslan and Coşkun (2022) found that social belonging and perceived care are among the strongest predictors of overall teenage wellbeing. This is consistent with the significant positive outcomes for questions like “I think good things will happen in my life” and “I think people care about me.” Orgiles et al. (2025) observed that, post-pandemic, adolescents in some parts of Europe experienced changes in emotional balance, with anxiety and tension moderating overall wellbeing scores. These findings are consistent with the moderate scores on serenity and relaxation seen in the current study, suggesting that although individuals maintain optimism and social support many still struggle with stress management and emotional relaxation.

Additionally, the tendency towards increased self-confidence (e.g., “I feel that I am good at some things”) is consistent with the Seligman (2019) positive psychology theory, which holds that resilience and flourishing are facilitated by self-efficacy and perceived competence (Mittelmark, 2022). This cohort appears to have a developmentally typical adolescent wellbeing profile, which it may be possible to improve using specific emotional literacy and mindfulness components like those included within our education programme.

The findings from this study also align with new research showing how adolescent sleep, emotional control, and wellness are interrelated. Adequate sleep length and quality are highly predictive of both academic performance and mental health stability (Castiglione-Fontanellaz et al., 2023, Liu et al., 2024, Xu et al., 2025), associations that are supported by the significant findings (and high median scores) for the sleep cluster in the current study.

Strong results for both physical and mental wellness are consistent with research by Shek (2025) who found that emotional health was a major factor in determining post-pandemic teenagers' quality of life. Like the current study, they discovered a strong correlation between emotional stability and self-perceived physical health, suggesting a reciprocal influence between mental and physical states.

On the other hand, Guthold et al. (2020) showed that over 64% of adolescents worldwide did not achieve the WHO-recommended levels of daily physical activity (60 minutes of moderate to intense physical activity), which is consistent with the modest engagement in leisure hobbies and physical activity observed here. This indicates that although participants acknowledge the need of relaxation and well-being, active engagement in physical activity or organised leisure is still relatively low. This possibly related to the screen-based lifestyle choices or scholastic expectations. The weak finding for phone use (median = 3, $p = 0.890$) is consistent with research that links excessive screen time to poorer mental health and sleep quality (Kaewpradit et al., 2025). When taken as a whole, these results highlight the

potential importance of wellbeing programs incorporating balanced digital engagement tactics that can assist young people in controlling their technology use while upholding good physical and emotional routines.

The food habits of this group are consistent with well-established patterns documented in the literature on adolescent nutrition. Young people's diets are dominated by UPFs, which frequently account for more than half of their overall energy intake, according to numerous studies. For instance, Petridi et al. (2025) discovered that adolescents in high- and middle-income countries get more than 80% of their calories from UPFs. This finding is in line with the high consumption of ultra-processed proteins and carbs in the current study. Similarly, Petridi et al. (2026) observed that higher UPF consumption among adolescents was associated with poorer nutrient profiles, including lower fibre and protein quality, higher intake of free sugars, salt, and saturated fats. These nutritional patterns contribute to the development of obesity, metabolic dysregulation, and mood fluctuations issues directly relevant to the CFK project's focus on children's wellbeing and food addiction risk.

In contrast, the comparatively low consumption of MPFs found in this study echoes data from Petridi et al. (2025). They reported that adolescents often show limited preference for whole grains, legumes, and unprocessed proteins, driven by convenience, taste preferences, and marketing influences. The marginal significance in natural protein intake ($p = 0.027$) may suggest partial awareness of healthier food choices, but not yet strong behavioural adherence. Additionally, the prevalence of ultra-processed protein sources is in line with research by Fardet et al. (2021), who noted that industrial meat products and protein-enriched UPFs are replacing traditional dietary protein sources such as pulses, eggs, and fresh meats worldwide. These findings support mounting worries about the psychological and nutritional effects of regular UPF use, such as decreased satiety, emotional eating, and poorer diet quality in teenagers.

Despite scoring above chance for each module in the Kahoot quiz assessment, median food intake and physical health did not change over the course of the intervention, measured using the pre- and post-intervention questionnaire. However, due to only a subset of participants completing the Kahoot quiz ($N = 6$) due to absenteeism on the assessment day, and there being a disproportionate distribution of questions per module (module 1: 6 questions, module 2: 5 questions, module 3: 5 questions, module 4: 3 questions module 5: 4 questions, module 6 2 questions), these performance results may be significantly skewed and may not be a true perception of the overall cohort. However, the findings of this small-scale pilot are in line with earlier research showing that nutritional self-assessment and perceived physical health are slow-changing constructs that usually change over longer intervention periods. For instance, (Raut et al., 2024) discovered that while short-term nutrition education increased teenagers' nutritional knowledge, it had no effect on their food quality. In a similar manner, Horne et al. (2020) found that it frequently takes many months of repeated exposure and reinforcement to get quantifiable improvements in reported wellbeing after lifestyle modifications.

There are several limitations to this study that should be noted. The results' statistical power and generalisability are limited by the small sample size and incomplete participation in post-intervention and follow-up evaluations (both completed in separate sessions 4 months after completing the education programme). It is important to note that the purposive sampling strategy produced a group of exceptionally motivated kids, or “school ambassadors,” who had already shown a favourable attitude towards participating in extracurricular activities. Because participants may have overestimated or underestimated their habits or well-being, the use of self-reported data raises the possibility of response bias.

Furthermore, the results of information retention may have been distorted by absenteeism during data collection (N = 6 for assessment and N = 12 for questionnaire) and an uneven distribution of questions assigned to each module for the Kahoot quiz. Lastly, the lack of a control group restricts the interpretation of causality because observed changes may be the result of outside factors rather than the intervention. Notwithstanding these drawbacks, the pilot offers insightful initial data and a basis for improving upcoming comprehensive assessments of school-based digital wellbeing initiatives. The necessity of using a randomisation technique in subsequent interventions and incorporating an age-matched control group to bolster the study's validity and repeated and prolonged exposure to the education programme are the main conclusions of this pilot.

Conclusion

Diet quality and dietary patterns did not improve because of the digital education programme, despite increased knowledge. UPFs predominated in dietary patterns, while MPF intake was minimal. Participants displayed a wellbeing profile that is typical of this age group, with moderate emotional regulation and relaxation coupled with considerable optimism, social connectedness, and confidence. While screen time was high and physical activity was low, which also reflected broader trends in adolescents, sleep patterns were generally healthy. Small effect sizes indicate greater self-awareness and introspection, even though the intervention did not immediately result in significant improvements in self-rated health or food intake. This is consistent with research showing that brief digital nutrition programs typically increase knowledge and understanding prior to behavioural changes. Additionally, the CFK digital board intervention increased awareness and engagement, providing a basis for longer-term gains and demonstrating the potential of integrated digital education models that mix lifestyle and emotional support with nutrition literacy.

Abbreviations

UPFs Ultra-Processed Foods

MPFs Minimally-processed Foods

CFK Collaboration for Kids

CHC The Collaborative Health Community Foundation

Declarations

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Authors' contributions

FJMcE: Development and preparation of module content, data analysis, manuscript preparation and review. SW: Development of interactive digital boards, manuscript preparation. NG: Delivery of education programme. LMcG: Development and preparation of questionnaires; development and preparation of module template and content. JR: Development and preparation of module content. AL: Development and preparation of module content. KD: Preparation of questionnaires. JD: Delivery of education programme. JM: Delivery of education programme. SK: Data analysis. TB: Communication. ASM: Data analysis, manuscript preparation, DB: Communication. HG: Development of questionnaires and module content, manuscript preparation. HMM: Manuscript preparation and review. All authors read and approved the final version of the manuscript.

Conflict of interest

The authors declare the following potential competing interests. The initial collaboration between The Regis School and The CHC was facilitated by Dr Lynne Kirkwood, Senior Partner at Westmeads Surgery, who initiated contact between the school and The CHC. Dr Sean Wheatley, affiliated with X-PERT Health, contributed to the educational development components of the intervention. Heidi Giaever serves as Chief Executive Officer (CEO) and Deepum Bhatia as Chief Operations Officer (COO) for both The CHC and CFK. These affiliations did not influence the study design, data collection, analysis, interpretation, or the decision to submit the work for publication.

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Data availability

Data will be available by the corresponding author/s based on request.

Ethics approval and consent to participate

The ethical oversight and approval for the intervention was granted by the Regis School Research and Safeguarding Committee, under the authority of the school's governance structure and ratified through the formal agreement between The CHC and The Regis School. Research Ethics Committee approval was not required because this was a non-clinical, school-based educational programme delivered by a UK charity and did not involve NHS patients, staff, premises, or clinical procedures, in line with the UK Policy Framework for Health and Social Care Research (2017). The approval by the school principal and safeguarding lead is in compliance with the Education Act 1996 and the Children and Families Act 2014. All safeguarding requirements were met, including enhanced DBS checks for volunteers and adherence to The CHC Safeguarding Policy. Written informed consent was obtained from parents or legal guardians. Only anonymised or pseudonymised data were collected in accordance with the Data Protection Act 2018 (UK GDPR), and all procedures followed the principles of the Declaration of Helsinki.

Consent for publication

Not applicable.

Supplementary Information

The online version contains supplementary material available at …

References

1. ALIMOHAMADI A, ABDOLMOHAMADI K, GHASEMZADEH M, RODRIGUEZ VJ. Emotional and psychological well-being in early adolescence: psychometric properties of the Stirling children's well-being scale in a sample of Iranian adolescents. BMC Public Health. 2025;25:1763.
2. ARSLAN G, COŞKUN M. School Belongingness in Academically At-Risk Adolescents: Addressing Psychosocial Functioning and Psychological Well-Being. J Happiness Health. 2022;3:1–13.
3. BRUNER JS. Toward a theory of instruction. Harvard University Press; 1974.
4. CASTIGLIONE-FONTANELLAZ CEG, SCHAUFLER S, WILD S, HAMANN C, KAESS M, TAROKH L. Sleep regularity in healthy adolescents: Associations with sleep duration, sleep quality, and mental health. J Sleep Res. 2023;32:e13865.
5. COELHO AS, PIRES R, MARTINS O. 2024. Digital Tools in Active Learning Activities: Motivating and Engaging Higher Education Students. *EDULEARN24 Proceedings.* Palma, Spain: EDULEARN24 Proceedings.
6. DE AMICIS R, PELLIZZARI MAMBRINISP, FOPPIANI M, BERTOLI A, BATTEZZATI S, A., LEONE A. Ultra-processed foods and obesity and adiposity parameters among children and adolescents: a systematic review. Eur J Nutr. 2022;61:2297–311.
7. FARDET A, THIVEL D, GERBAUD L, ROCK E. 2021. A Sustainable and Global Health Perspective of the Dietary Pattern of French Population during the 1998–2015 Period from INCA Surveys.

Sustainability, 13.

8. GUTHOLD R, RILEY STEVENSGA, L. M., BULL FC. Global trends in insufficient physical activity among adolescents: a pooled analysis of 298 population-based surveys with 1.6 million participants. Lancet Child Adolesc Health. 2020;4:23–35.
9. HERMAWATI L, IRAWATI, N. B. U., ZULFA, H. A., DIANA WA. The Role of Balanced Nutrition Knowledge in Influencing Nutritional Status and Health Risks: A Literature Review. Int J Med Public Health. 2025;2:1–14.
10. HORNE J, O'CONNOR GILLILANDJ, C., SEABROOK, J., MADILL J. Enhanced long-term dietary change and adherence in a nutrigenomics-guided lifestyle intervention compared to a population-based (GLB/DPP) lifestyle intervention for weight management: results from the NOW randomised controlled trial. BMJ Nutr Prev Health. 2020;3:49–59.
11. JEANS MR, LANDRY MJ, VANDYOUSEFI S, HUDSON EA, BURGERMASTER M, CHANDRA BRAYMS, J., DAVIS JN. Effects of a School-Based Gardening, Cooking, and Nutrition Cluster Randomized Controlled Trial on Unprocessed and Ultra-Processed Food Consumption. J Nutr. 2023;153:2073–84.
12. JUNG S, PARK KIMJY, LEE S, J. E., GROUP UPFW. Potential misclassification of ultra-processed foods across studies and the need for a unified classification system: a scoping review. Nutr Res Pract. 2025;19:331–44.
13. KAEWPRADIT K, NGAMCHALIEW P, BUATHONG N. Digital screen time usage, prevalence of excessive digital screen time, and its association with mental health, sleep quality, and academic performance among Southern University students. Front Psychiatry. 2025;16:1535631.
14. KOLB DA. Experiential learning: Experience as the source of learning and development. FT; 2014.
15. LANE MM, DU GAMAGEE, ASHTREE S, MCGUINNESS DN, BAKER AJGAUCIS, LAWRENCE P, O'NEIL MREBHOLZCMSROURBTOUVIERMJACKAFN, A., SEGASBY, T., MARX W. 2024. Ultra-processed food exposure and adverse health outcomes: umbrella review of epidemiological meta-analyses. *BMJ*, 384, e077310.
16. LIDDLE I, CARTER GFA. Emotional and psychological well-being in children: the development and validation of the Stirling Children's Well-being Scale. Educational Psychol Pract. 2015;31:174–85.
17. LIU J, JI X, PITT S, WANG G, ROVIT E, LIPMAN T, JIANG F. Childhood sleep: physical, cognitive, and behavioral consequences and implications. World J Pediatr. 2024;20:122–32.
18. MENGI CELIK O, GULER, U., EKICI EM. Factors Affecting Ultra-Processed Food Consumption: Hedonic Hunger, Food Addiction, and Mood. Food Sci Nutr. 2025;13:e70248.
19. MESAS AE, DE GONZALEZAD, ANDRADE SM, MARTINEZ-VIZCAINO V, LOPEZ-GIL JF, JIMENEZ-LOPEZ, E. &. 2022. Increased Consumption of Ultra-Processed Food Is Associated with Poor Mental Health in a Nationally Representative Sample of Adolescent Students in Brazil. Nutrients, 14.
20. MITTELMARK MB, BAUER GF, VAANDRAGER L, PELIKAN JM, SAGY S. ERIKSSON, M., LINDSTRÖM, B., & MAGISTRETTI, C. M. 2022. *The Handbook of Salutogenesis*.

21. MONTEIRO CA, CANNON G, MOUBARAC, J. C., LEVY, R. B., LOUZADA, M. L. C., JAIME PC. The UN Decade of Nutrition, the NOVA food classification and the trouble with ultra-processing. Public Health Nutr. 2018;21:5–17.
22. MONTEIRO CA, LEVY, R. B., CLARO, R. M., CASTRO, I. R., CANNON G. A new classification of foods based on the extent and purpose of their processing. Cad Saude Publica. 2010;26:2039–49.
23. ORGILES M, AMOROS-RECHE V, FRANCISCO DELVECCHIOE, MAZZESCHI R, GODINHO C, PEDRO C, M., ESPADA, J. P., MORALES A. 2025. Anxiety and depressive symptoms among youth in Italy, Spain, and Portugal: A three-year post-pandemic study. Dev Psychopathol, 1–11.
24. PETRIDI E, MAGRIPLIS E, KARATZI K, CHARIDEMOU E, PHILIPPOU E, ZAMPELAS A. Ultra Processed Food Consumption in Children and Adolescents: Main Food Group Contributors and Associations With Weight Status. Nutr Bull. 2025;50:278–89.
25. PETRIDI E, MAGRIPLIS E, KOTOPOULOU S, MYRINTZOU N, PHILIPPOU CHARIDEMOUE, E., ZAMPELAS A. 2026. Associations Between Consumption of Ultra-Processed Foods and Diet Quality Among Children and Adolescents. Nutrients, 18.
26. RAUT S, KC D, SINGH DR, DHUNGANA RR, PRADHAN PMS, SUNUWAR DR. Effect of nutrition education intervention on nutrition knowledge, attitude, and diet quality among school-going adolescents: a quasi-experimental study. BMC Nutr. 2024;10:35.
27. RODRIGUES M, CARMO OLIVEIRAGAL, SILVA ASD, GONCALVES JPDNAKANOEY, V. S. S., TORAL N. Consumption patterns and eating behaviors of schoolchildren associated with mental health problems: a Brazilian nationwide study. PLoS ONE. 2025;20:e0320127.
28. ROGERS CR. Freedom to Learn. Columbus, Ohio, Charles E. Merri ll; 1969.
29. SELIGMAN MEP. Positive Psychology: A Personal History. Annu Rev Clin Psychol. 2019;15:1–23.
30. SHEK DTL. 2025. Quality of Life in Young People in the Pandemic and Post-Pandemic Eras: Empirical, Theoretical, Methodological, and Intervention Considerations. *Applied Research in Quality of Life*.
31. TALENS C, DA QUINTA N, ERKKOLA ADEBAYOFA, HEIKKILA M, BARGIEL-MATUSIEWICZ M, SANTA KZIOLKOWSKANRIOJAPLYSAE, CRUZ E, MEINILA J. Mobile- and Web-Based Interventions for Promoting Healthy Diets, Preventing Obesity, and Improving Health Behaviors in Children and Adolescents: Systematic Review of Randomized Controlled Trials. J Med Internet Res. 2025;27:e60602.
32. TANNE JH. RFK Jr unveils new US food pyramid recommending protein and full fat dairy, and removing alcohol limits. BMJ. 2026;392:s57.
33. XU Z, NIU M, DU W, DANG T. The effect of sleep quality on learning engagement of junior high school students: the moderating role of mental health. Front Psychol. 2025;16:1476840.
34. ZAHID N, VARIMEZOVA KHADKANGANGULYM, SPERO TTURTONB, L., SOKAL-GUTIERREZ K. 2020. Associations between Child Snack and Beverage Consumption, Severe Dental Caries, and Malnutrition in Nepal. Int J Environ Res Public Health, 17.

Figures

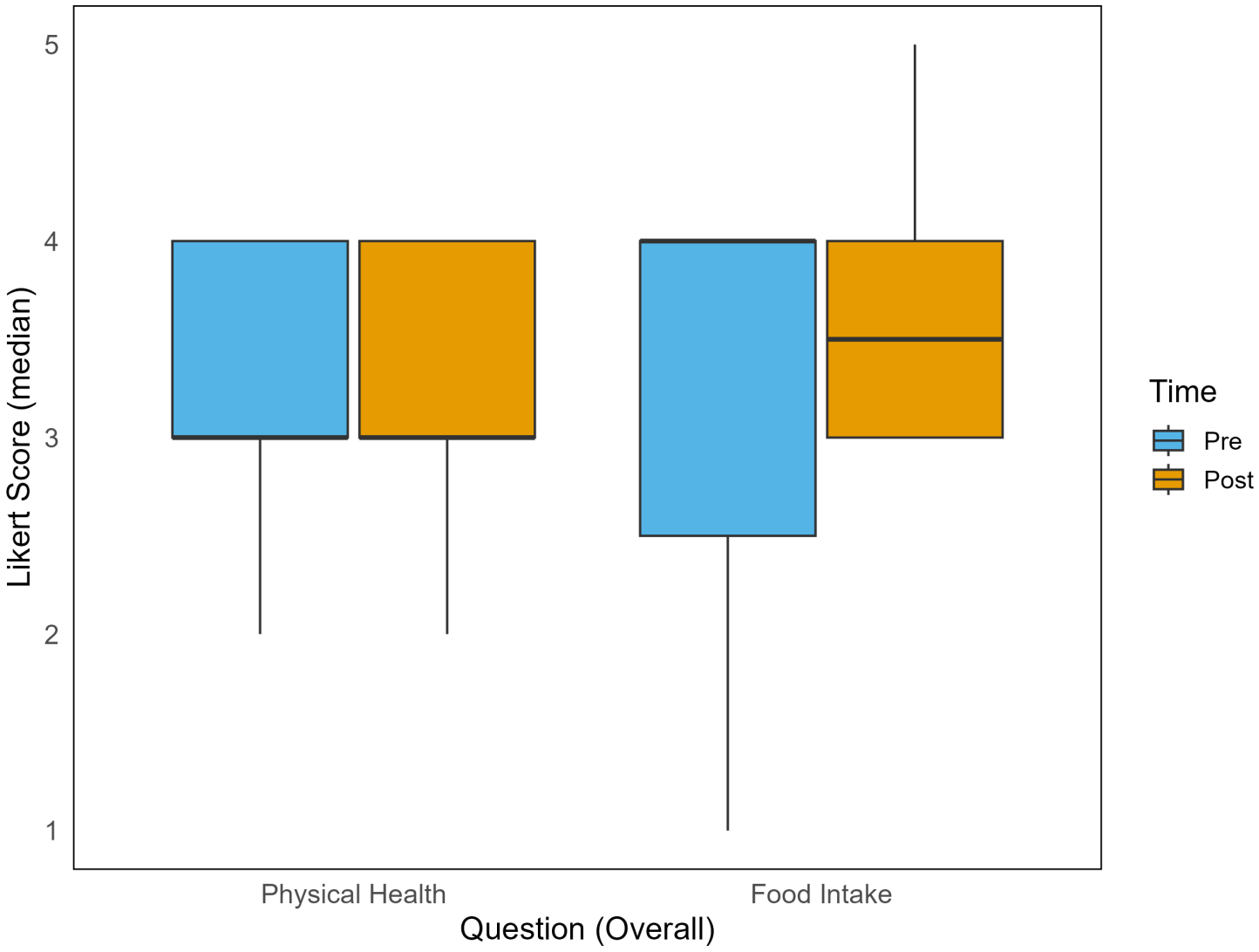


Figure 1

Likert-Scale Ordinal Scoring of Pre- and Post-Intervention Physical Health and Food Intake.

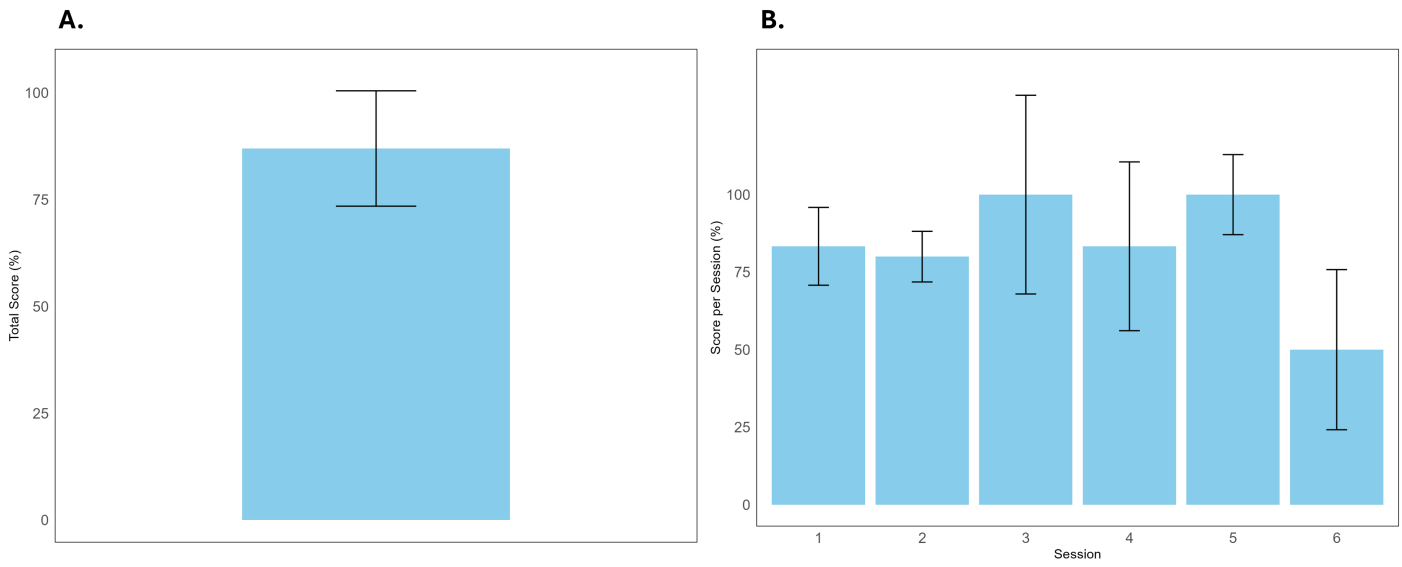


Figure 2

Kahoot Quiz Assessment Results among Participants. A. Total Score. B. Total Score per Session.

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