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Promoting sustainable food choices through the Ta'am Mustadam pilot intervention at UAE university canteen: study protocol

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The United Arab Emirates (UAE) face big challenges related to human health and environmental sustainability. Sustainable food choices aim to promote optimal health while minimizing environmental impact. Till this date, there is a lack of evidence on previous interventions aimed at encouraging such behaviors among young adults in the Middle East. The primary objectives of this study are to develop the Ta'am Mustadam intervention aimed at promoting sustainable food choices and to assess its impact on food choice motives (FCMs). The secondary objectives include evaluating its effect on knowledge, intentions, practices, and self-reported behaviors toward sustainable food choices. Additionally, the study seeks to assess the effectiveness of this pilot intervention in a real-world setting. The Ta'am Mustadam intervention will be designed using the behavior change wheel (BCW) framework and behavior change techniques (BCTs). The intervention will consist of sending brief educational messages, tips and video recipes through WhatsApp group, offering activities/challenges, and restructuring the canteen's environment. The intervention will be implemented over a period of 6 weeks among a group of university students from the College of Medicine and Health Science at the UAE University. Three food categories will be targeted: fruits and vegetables, red and processed meat, and plant-based foods (e.g., legumes & nuts). Participants will be evaluated using validated questionnaires at 3 time-points: pre-intervention, post-intervention, and 4-week follow-up. Measurements will include FCMs, knowledge, intentions, practices and self-reported behaviors toward sustainable diets, and dietary intake. Sociodemographic and self-reported anthropometric data will also be collected. The Reach, Effectiveness, Adoption, Implementation, and Maintenance (RE-AIM) model will guide the evaluation of this intervention. An evaluation questionnaire will be used to collect opinions from participants and the canteen's customers. Moreover, the canteen's manager will be interviewed post-intervention to assess implementation and maintenance of the intervention. Data collection will start in September 2025 and is expected to be completed by the end of the year 2025. To our knowledge, this is among the first documented interventions aimed

at promoting sustainable food choices among young adults in the Middle East. The study will assess the feasibility of the intervention and generate preliminary evidence to inform the design of future large-scale initiatives.

Trial registration: NCT07042412 registered June 27, 2025.

KEYWORDS

sustainable food choices, behavior change wheel, young adults, RE-AIM, canteen, sustainable diet

1 Introduction

Sub-optimal diets are a leading risk factor for non-communicable diseases (NCDs) and premature mortality in the United Arab Emirates (UAE). Reports indicate that NCDs—mainly diabetes mellitus, cancer, chronic respiratory disease, and cardiovascular disease—are responsible for 77% of all mortalities in the UAE and 17% of premature mortalities (30–70 years) (Fadhil et al., 2019). Furthermore, obesity rates between 1989 and 2017 have doubled in the UAE reaching 31.7% among adults (Nawar et al., 2021), highlighting the growing burden of nutrition-related chronic diseases in the country.

In parallel of these public health challenges, the UAE faces significant environmental pressures. Water scarcity, poor soil fertility, and harsh climatic conditions compromise food production, stability and availability (Al Qaydi, 2016). Additionally, the increased growth of the UAE population increases the demand for water and food, placing further stress on natural resources in the country (Ajaj et al., 2019). The UAE's high reliance on food imports further exacerbates these environmental challenges by contributing to imbalances in food security, dietary adequacy, and environmental sustainability (Manikas et al., 2022).

By focusing on these cumulative challenges, the UAE has committed to accomplish the Sustainable Development Goals (SDGs) by setting up actionable initiatives and programs aimed to address environmental as well as health problems in the country (FAO, 2021; Umar et al., 2020). For instance, the Ministry of Climate Change and Environment and the Ministry of Health and Prevention in collaboration with Emirates Nature- WWF, UN-FAO in 2021 has the National Food Security Strategy 2051. This initiative aims to encourage resilient agriculture that would benefit the community, preserve ecological system, support the local economy, and fight hunger (UAE Government Portal, 2024). Similarly, the UAE National Action Plan in Nutrition, published in 2017, aims to better the nutritional status of all residents in the UAE with a collective vision of a healthier and sustainable future, directed by international, regional and national policies and actions to improve health (Ministry of Health and Prevention, 2017).

One proposal for resolving diet-environment-health trilemma is the adoption of sustainable diets (Berardy and Sabaté, 2023), which maintains individuals' health and wellbeing, while mitigating the environmental impacts of food production and consumption (Drewnowski et al., 2020). Such diets must be economically, culturally, and socially sustainable for present and future generations (Biesbroek et al., 2023). The EAT-Lancet Commission in 2018 proposed a reference diet that fulfills the

scientific goals (i.e., a “win-win diet”) of sustainable diets (Willett et al., 2019). This diet, also known as the planetary health diet (PHD) or the EAT-Lancet diet, could meet the health needs of 10 billion people in 2050 without surpassing the planetary boundaries (Willett et al., 2019). The PHD is based mainly on plant-based sources, and to a lesser extent animal-based sources (Willett et al., 2019). At the global level, shifting to plant-based foods could minimize greenhouse gas emissions up to 70% (Aleksandrowicz et al., 2016). Besides that, reducing meat consumption is associated with the prevention of cardiometabolic diseases, reduced diet-related mortality risk, and improved cancer risk (Willett et al., 2019; Song et al., 2016).

At present, most of the interventions related to diet sustainability failed in changing dietary behaviors due to a lack of systematic theoretical guidance (Hedin et al., 2019). Using theoretical concepts to change behavior maximizes the effectiveness of an intervention (Michie et al., 2008). A recent review by Hedin et al. (2019) recommends that sustainability interventions should be grounded in the Behavior Change Wheel (BCW) framework, which emphasizes the importance of clearly identified target behavior. The BCW provides a systematic approach to select appropriate interventions, policies, and behavior change techniques (BCTs) that are likely to effectively influence the target behavior (Michie et al., 2015). Briefly, the wheel uses nineteen theories and consists of three rings. The capability, opportunity, motivation, and behavior (COM-B) model serves as its core. This model can help in identifying whether greater capability (physical and psychological), more opportunity (social and physical), stronger motivation (reflective and automatic), or a combination is required to change the behavior (Michie et al., 2015). The second ring on the BCW is composed of nine intervention functions (IFs) that are linked to a taxonomy of 93 BCTs [Behavior Change Technique Taxonomy version 1 [BCTTv1]] (Michie et al., 2015, 2013). Finally, the outermost ring is comprised of seven policy categories that can be used to deliver the selected intervention (Michie et al., 2015). Applying the BCW and COM-B model provides a structured and evidence-based approach for designing effective dietary interventions. However, to scale and sustain such interventions, it is essential to involve institutions that shape environments and influence individual behaviors.

Modifying dietary behaviors at the population level is essential to facilitate the transition toward more sustainable diets (Michie et al., 2011). Multi-component interventions, which target several components in the COM-B model, can be more successful at directing behavior toward a sustainable lifestyle. For instance, interventions that combine education with nudges techniques (i.e.,

environmental changes that subtly guide choices without restricting alternatives such as increasing the availability of healthy choices, repositioning healthier food options at the beginning of a buffet line, and labeling plant-based dishes with appealing icons) can produce long-term changes in dietary patterns (Thorsen et al., 2010; Hartmann-Boyce et al., 2018; Kwasny et al., 2021). Similarly, a recent systematic review highlights that interventions integrating education, persuasion, and environmental restructuring are the most effective in promoting environmentally sustainable diets (Wadi et al., 2024). Notably, studies employing more than one function reported greater reductions in meat consumption compared to interventions using one function (e.g., education alone) (Wadi et al., 2024).

Higher education institutions, in particular, are uniquely positioned to foster sustainable dietary practices not only through education and research but also by leveraging their food service units to promote and model sustainable food practices (Grech et al., 2020; Lee et al., 2021). This is particularly relevant in university settings where students often consume most of their meals in campus eating facilities. These environments offer a valuable and practical platform for implementing and reinforcing dietary behavior change, contributing significantly to public health and environmental sustainability goals.

Given the critical role of higher education institutions and on-campus food service units in shaping dietary behaviors, it is essential to rigorously evaluate interventions aimed at promoting sustainable food choices within these settings.

The present study employs the RE-AIM framework to comprehensively assess the intervention's impact and feasibility. The RE-AIM model evaluates five key dimensions: Reach, Effectiveness, Adoption, Implementation, and Maintenance (Wadi et al., 2024). This framework enables a systematic evaluation of both individual-level outcomes and organizational factors that influence the success and sustainability of interventions in real-world contexts. Reach assesses the proportion and representativeness of the population who engages with the intervention. Effectiveness measures the impact of the intervention on an intended outcome. Adoption examines the willingness of organizations and participants (e.g., students) to engage with and support the intervention, and adopt the proposed changes. Implementation evaluates the fidelity and quality of intervention delivery, including environmental modifications and the frequency and content of behavior change communications. Maintenance assesses the sustainability of behavior changes over time, both at individual and organizational levels, accounting challenges such as maintaining regular and high-quality supply of fresh food, managing food costs, and ensuring standardization of recipes to support long-term adherence to the proposed diet.

Compared to efficacy-oriented research evaluation, the RE-AIM model provides comprehensive information about to what extent, and how the intervention works in the real-world settings, which is crucial to researches aimed at changing health behaviors (Schwingel et al., 2017). Besides that, its focus on pragmatic evaluation aligns with growing calls for implementation science approaches to fill the gap between research and practice, ultimately strengthening the impact of public health interventions (Estabrooks et al., 2018).

2 Hypothesis and objectives

Hypothesis testing will take place at the pre-intervention (1-week before the start of intervention period), post-intervention (at intervention end), and follow-up (4-week after intervention end). Accordingly, we hypothesized that Ta'am Mustadam intervention—a multi-component intervention—can promote the adoption and maintenance of more sustainable dietary behaviors among a group of young adults from the College of Medicine and Health Science (CMHS) at the United Arab Emirates University (UAEU). Secondly, we assumed that this intervention can also change the baseline food choice motives (FCMs) across three time-points. We also hypothesized that it can positively change knowledge, intentions and practices toward sustainable diet consumption across three time-points. Additionally, we hypothesized that this intervention can modify the actual dietary intake across three time-points.

Based on the above, the primary objectives of the proposed protocol include:

- 1.1 To test whether this pilot intervention will successfully promote more sustainable food choices both at post-intervention and at follow-up

By sustainable food choices, we refer to a food choices with low environmental impact, that is, preference of plant-based foods (such as fruits and vegetables, legumes, nuts, and whole grains), organic foods; and local, seasonal and Fair-Trade products; while reducing the consumption of meat (especially red and processed meats) to reach SDGs set by the United Nations (UN) and reign in climate change (Willett et al., 2019).

And more specifically, we will evaluate the consumption of three food groups: (1) fruits & vegetables (F&V), (2) red and processed meat (RPM), and (3) plant-based foods (e.g., legumes & nuts).

- 1.2 To examine the extent of changes in FCMs at post-intervention and at follow-up

The secondary objectives are:

- 2.1 To test whether this pilot intervention will influence participants' knowledge, intentions, practices and behaviors toward healthy and sustainable food choices at post-intervention and at follow-up.
- 2.2 To test whether this pilot intervention will change baseline energy and nutrient intake at post-intervention and at follow-up
- 2.3 To evaluate the translational impact of Ta'am Mustadam intervention in a real-world setting using the RE-AIM model

3 Methods

3.1 Study design and setting

This 6-weeks pilot intervention will use a pre-post and 4-week follow-up quasi-experimental design without control group. A quasi-experimental design will be used due to difficulty in finding a

comparable control group, difficulty to randomly place participants into groups or locations, and limited sample size (Harris et al., 2006). This pilot intervention is planned to be implemented on the CMHS campus, with the canteen serving as the main hub for the intervention between September 2025 and October 2025 and will focus on three food behaviors. Each behavior will be addressed for 2 weeks, starting with F&V consumption, followed by RPM consumption, and ending with plant-based foods (e.g., legumes & nuts) consumption.

The participants will be evaluated at three time-points: pre-intervention (1-week before the start of intervention period), post-intervention (at intervention end) and follow-up (4-week after intervention end) (refer to Figure 1 for an illustration). This study is named as a pilot study because the findings of this pilot study will be helpful for designing future larger scale interventions aimed at promoting sustainable food choices in public eating settings, such as canteens and restaurants, among young adults in the UAE. Besides that, it will provide insights about its' feasibility and acceptability among young adults in UAE.

3.2 Participants, sample size calculation, and recruitment

For the proposed intervention, we selected a sample size that would provide a high probability of observing at least one case of the outcome of interest during the pilot. Let π donate the event probability for a single participant and γ the desired probability of observing at least one event in the sample (Viechtbauer et al., 2015). The minimum sample size n that satisfies $P(\text{at least one event}) = 1 - (1 - \pi)^n \geq \gamma$ is

$$n = \frac{\ln(1-\gamma)}{\ln(1-\pi)}$$

Where \ln is the natural logarithm. Using $\gamma = 0.95$ (95% chance to observe at least one event) and $\pi = 0.05$ (event probability per subject = 5%), we obtain

$$n = \frac{\ln(0.05)}{\ln(0.95)} \cong 58.44$$

So, we round up to ($n = 59$). Considering a dropout rate of 25%, the participant target becomes

$$n_{\text{participant}} = \frac{59}{1 - 0.25} \cong 78.67$$

Therefore, minimum of 80 participants will be needed for this pilot intervention. In this study, at least 20% of the recruited sample size will be males to reflect the typical gender distribution of students at CMHS, where females constitute approximately by 72.3% of enrolled students (Hefny et al., 2024).

Participants will be included in the study if they meet the following criteria: students (both undergraduates and postgraduates) aged 18 years and older who regularly eat at the CMHS canteen (eat at least 1 meal/week). The exclusion criteria are students unwilling to provide an informed consent, reporting

a history of food allergies or any food intolerances (e.g., celiac disease, lactose intolerance, nut allergy, etc.), reporting any medical condition that might directly affect eating patterns (e.g., Type 1 or Type 2 diabetes, cardiovascular disease, Crohn's disease, Irritable bowel syndrome), use medications that may affect eating behaviors, being pregnant or breastfeeding, and following a vegan or vegetarian diet because these dietary patterns already align with food choices promoted in the intervention and may reduce the observable impact of the intervention.

Several methods will be used to recruit participants including promotional flyers at CMHS, emails to CMHS students, and official WhatsApp groups created by the faculty for student communication. Additionally, the research team will personally inform the regular users of the CMHS canteen about the study. Then, interested participants will be invited to scan a QR code linked to a screening questionnaire designed to identify potentially eligible participants. Initially, it is anticipated that at least 150 individuals will be screened, with the goal of enrolling a final sample of 80 participants. Eligible participants will be contacted by email or phone following the screening process. Supplementary file 1 contains the screening questionnaire used to verify the inclusion and exclusion criteria.

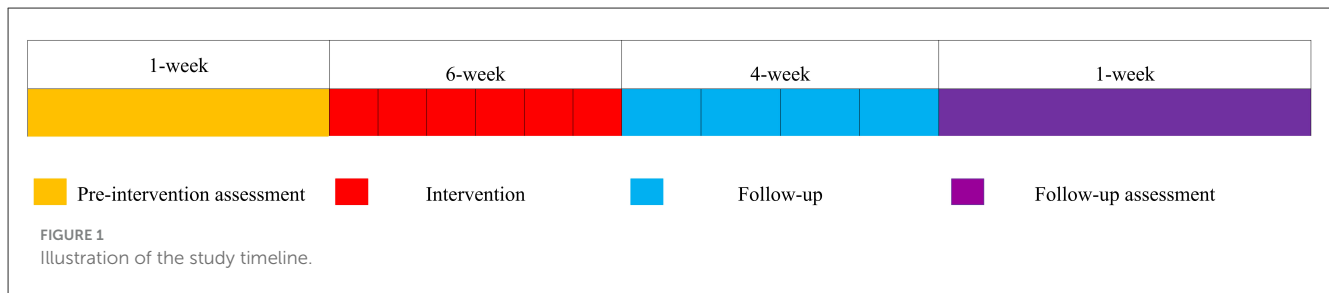
3.3 Ethical approval

Before implementing the intervention, we got permission from the office of associate provost for student's affairs, and from the manager of CMHS cafeteria. Moreover, this study was approved by the United Arab Emirates University Human Research Ethics Committee on 19 May, 2025 (approval code: ERSC_2025_6704). This protocol is registered at Clinical Trials.gov with the ID: NCT07042412 (<https://clinicaltrials.gov/study/NCT07042412>). This study will be conducted in accordance with the stated principles in the Declaration of Helsinki (World Medical, 2013). The research team will provide detailed information about the study's duration and activities, and the type of data that will be collected. They will also be clearly informed of their right to withdraw from the study at any point without the risk of penalty. Then, all participants will be asked to sign an informed consent at the pre-intervention.

To enable matching pre-, post-, follow-up questionnaires, participants will be asked to provide us with their university email address. All data collected as a part of the questionnaire will remain anonymous and won't be linked to any personal identification information. Participants will get discount vouchers from different shopping stores or gyms at the end of the intervention.

3.4 Designing Ta'am Mustadam intervention

A sustainability intervention will be designed to encourage sustainable food choices in young adults in CMHS. The intervention will be named "Ta'am Mustadam," which means in English, "Sustainable Food." The intervention will be designed using the BCW framework, which involves three stages: (1) understanding the behavior, (2) identifying intervention options,



and (3) identifying content and implementation options. These stages are further subdivided into 8 steps and are outlined in detail below and summarized in Table 1 (Michie et al., 2015). The intervention will be developed within half a year duration by a research team of a PhD candidate and two university faculty members.

3.4.1 Stage 1: understanding the behavior

3.4.1.1 Step 1. Defining the problem in behavioral terms

Understanding a problem requires being specific about (i) the target individual, group or population involved in the behavior, (ii) the behavior that need to be changed to address the problem, and (iii) the place(s) in which the behavior occurs (Michie et al., 2015). In our case, this step will be based on the Global Nutrition Report of 2021 for UAE, which showed increased rates of obesity and NCDs. The report states that UAE's obesity prevalence exceeds the regional average, affecting 10.3% of women and 7.5% of men, while diabetes is estimated to affect 17.4% of adult women and 17.3% of adult men (GNR, 2021). In addition, the report indicated that the environmental costs of food system are also high on all levels (GNR, 2021). Hence, we defined the behavioral problem as unsustainable dietary practices among the adult population in UAE.

3.4.1.2 Step 2. Selecting the target behavior

Step 2 aims to state which behavior could address the problem. Step 2 involves consideration of all the specific behaviors to potentially target in the intervention design (Michie et al., 2015). Based on the literature, the target behavior is to make sustainable food choices in the UAE, which the intervention seeks to promote through targeted promotional activities (Cheikh Ismail et al., 2023). More specifically, we will focus on three food behaviors: (1) increase the consumption of F&V, (2) decrease the consumption of RPM, and (3) increase the consumption of legumes and nuts.

3.4.1.3 Step 3. Specify the target behavior

In specifying the context in which the target behavior will occur, the BCW guidebook recommends consideration of Who, What, When, Where, How often and with Whom (Michie et al., 2015). The target behavior is specified in Table 2.

3.4.1.4 Step 4. Identify what needs to change

The final step of stage 1 involves behavioral analysis using the COM-B model to determine which of the COM-B components need to change to achieve the desired behavior (Michie et al., 2015).

This step was built on the preliminary findings of Ta'am Mustadam study, which aimed to determine FCMs among young

adults in UAE (approval codes: ERSC_2024_4357), as well as focus group discussions conducted among students at CMHS between March and April 2025 (approval code: ERSC_2024_5471). The findings, which are currently under review, indicated that sensory appeal, price, convenience, and health were strong FCMs among young adults. Next, these FCMs were mapped into domains within the COM-B model. According to Table 3, our intervention will promote sustainable food choices by increasing participant capability (knowledge and skills in choosing and preparing sustainable foods), opportunity (availability of sustainable food choices) and motivation.

3.4.2 Stage 2: identifying intervention options

3.4.2.1 Steps 5 and 6: identifying intervention functions (IFs) and policy categories

Next, the IFs and policy categories that would be most likely to influence the behavior should be determined based on COM-B analysis. Following this, we linked IFs onto each of the theoretical domains identified in step 4. Specifically, a total of three IFs (education, incentivization, and environmental restructuring) will be used to promote sustainable food choices. These IFs will be evaluated according to the APEASE (Affordability, Practicability, Effectiveness and Cost-effectiveness, Acceptability, Side effects/Safety, and Equity) criteria (Michie et al., 2015). Once IFs are selected, policy categories—including communication/marketing, guidelines, fiscal measures, regulation, legislation, environmental/social planning, and service provision—would normally be determined to help in the delivery of the selected interventions. However, our intervention doesn't aim to change policies on diets; thus, policy categories will not be addressed.

3.4.3 Stage 3: identify content and implementation options

3.4.3.1 Step 7: identify behavior change techniques (BCTs)

Upon selecting appropriate IFs, we will use the Bcttv1 to link the most used BCTs to each IF (Michie et al., 2013). Additionally, we will identify a comprehensive list of appropriate BCTs depending on previous literature addressing BCTs within sustainable diets interventions (Lares-Michel et al., 2023; Fresán et al., 2023; Ghammachi et al., 2022). Consequently, the following BCTs will be used to develop our intervention content; information about health consequences [5.1], information about social and environmental consequences [5.3], how to perform a behavior [4.1], demonstration of the behavior [6.1], material reward

TABLE 1 Designing Ta'am Mustadam intervention according to the BCW framework.

Stage 1: Understanding the behavior	
Step 1. Defining the problem in behavioral terms	Unsustainable dietary practices among the adult population in UAE.
Step 2. Selecting the target behavior	To promote sustainable food choices in UAE. More specifically, we will focus on three food behaviors:- 1. Increase the consumption of F&V 2. Decrease the consumption of RPM 3. Increase the consumption of plant-based foods (e.g., legumes and nuts).
Step 3. Specify the target behavior	Who? Students (both undergraduates and postgraduates) who regularly eat at CMHS canteen What? Choosing, preparing, and eating sustainable food Where? Everywhere When? Whenever eating How often? Every time With whom? Individually or groups
Step 4. Identify what needs to change	To increase participant capability, opportunity and motivation.
Stage 2: Identifying intervention options	
Step 5: Identify IFs*	1. Education 2. Incentivization 3. Environmental restructuring
Step 6: Identify policy categories	Not addressed because this intervention doesn't aim to change policies related to diet
Stage 3: Identify content and implementation options	
Step 7: Identify (BCTs)*	1. Information about health consequences [5.1] 2. Information about social and environmental consequences [5.3] 3. How to perform a behavior [4.1] 4. Demonstration of the behavior [6.1] 5. Material reward [10.2] 6. Restructuring the physical environment [12.1] 7. Adding object to the environment [12.5] 8. Prompts/cues [7.1] 9. Goal setting (behavior) [1.1] 10. Credible source [9.1] 11. Social reward [10.4]
Step 8: Mode of delivery*	1. Face to face 2. Social platform (WhatsApp)

IFs, intervention functions; BCTs, behavior change techniques.

*These will be assessed using APEASE (Affordability, Practicability, Effectiveness and Cost effectiveness, Acceptability, Side effects/safety, Equity) criterion.

[10.2], restructuring the physical environment [12.1], adding object to the environment [12.5], prompts/cues [7.1], goal setting (behavior) [1.1], credible source [9.1], and social reward [10.4]. These BCTs will be checked in relation to APEASE criteria (Michie et al., 2015).

3.4.3.1.1 Step 8: mode of delivery.

The last step of BCW involves choosing the most appropriate mode to deliver the intervention. And accordingly, our intervention will be delivered via social platform (WhatsApp). Face-to-face will also be considered a second mode of delivery because we are planning to restructure the environment of CMHS canteen. Additionally, the selected delivery modes (social platform, face to face) will be evaluated according to the APEASE criteria.

Based on the above description, Ta'am Mustadam intervention will consist of three components; education; behavioral practice; and environmental restructuring at CMHS canteen.

A WhatsApp group will be created to enable the formation of a digital community where the research team can share educational messages and recipes, and participants could post pictures of meals they cooked. Participants will also receive weekly emails reminders of upcoming activities.

TABLE 2 Specification of the target behavior.

BCW question	Target behavior
Who needs to perform the behavior?	Students (both undergraduates and postgraduates) who regularly eat at CMHS canteen
What do they need to do differently?	Choosing, preparing, and eating sustainable food choices
Where will they do it?	At home, at CMHS canteen, or away from home
When will they do it?	Whenever choosing, preparing, eating foods
How often will they do it?	Everyday
With whom will they do it?	Alone or with family or friends

3.4.4 Education (E)

This component involves sharing educational messages and video recipes aimed at building participant knowledge, and skills.

3.4.4.1 Educational messages

The content of the educational messages will be adapted from several evidence-based sources (Fresán et al., 2023; Lim et al., 2021;

TABLE 3 Behavioral analysis and application of COM-B^a in diagnosis.

COM-B components	FCMs	What needs to happen for the target behavior to occur?	Is there a need for change
Capability (physical)	Price	Have the physical skills to prepare affordable sustainable recipes	Yes
Capability (psychological)	Health	Know the health benefits of sustainable foods	Yes
	Health	Provide information on what to eat	Yes
Opportunity (physical)	Price	Offering affordable prices of sustainable foods in CMHS canteen	No, because CMHS canteen provides free meals to students
	Convenience (convenience in cooking/ preparation)	Have the physical skills to prepare easy and simple recipes	Yes
	Convenience (availability)	Have sustainable food choices available at CMHS canteen	Yes
Motivation (automatic)	Sensory appeal	Sharing tasty recipes	Yes

^aCOM-B, capability, opportunity, motivation for behavior; FCMs, food choice motives.

Carfora et al., 2019; de Bruijn et al., 2015), and will be formulated using two framing styles: pre-factual statements “If... then”, which presents a hypothetical future scenario as the consequence of hypothetical current behavior, or factual statements which describe actual outcome. Previous studies have shown that both styles can be effective in influencing the behavior (Carfora et al., 2019; Bertolotti et al., 2020).

Each message will also be followed by a goal reminder aligned with the dietary recommendations proposed by Willett et al. (2019) in the EAT-Lancet report: “Remember to try and eat at least five servings of F & V this day”, “Remember to try and eat no more than two servings of RPM this week”, “Remember to try and eat at least one serving of legumes this day”, and “Remember to try and eat a handful of nuts or seeds this day”. Additionally, a weekly poll will be created on WhatsApp group asking participants “How likely are you going to increase F&V consumption,” “How likely are you going to decrease RPM consumption,” and “How likely are you going to increase plant-based food (e.g., legumes & nuts) consumption?” with response options (not at all, maybe, likely).

The educational messages -including posters, infographics, short videos, podcasts- will be distributed on 2 non-consecutive days per week for six consecutive weeks, that is, Fridays (before the weekend) and Tuesdays (a weekday), via social media (WhatsApp). In addition, we will share tips on Wednesdays to help participants to make changes in their dietary habits. The messages will be shared before the main meal time as indicated in the screening questionnaire, as former studies found that behavior change messages are most useful for behavior change when received at high-risk situations (Brown et al., 2014).

3.4.4.2 Recipes

We will share video recipes on Saturdays for six consecutive weeks via WhatsApp. These recipes aim to instruct participants on how to prepare tasty, simple affordable dishes high in fruits, vegetables, legumes, and nuts while low in meat and processed meat. The videos will summarize the recipe cooking and preparation time, number of servings, cost per serving, calories per serving, and difficulty level (easy, moderate, or advanced). Easy recipes involved minimal skill and simple preparation such as a salad, moderate recipes required some ingredient modification such as stir frying, while advanced recipes involved multiple cooking techniques such as moussaka (Nour et al., 2018). Video length will range from 20 s to 60 s.

3.4.5 Clarity of educational content

The educational content will be pretested for clarity. Around three individuals not implicated in the development of this intervention will be involved in testing and modifying the content of educational messages and recipe videos. Individuals will rate how clear each educational message and recipe video are on a scale of 0 (not clear) to 3 (very clear). They also will have the opportunity to provide feedback about the intervention content. According to their suggestions, the content will be rephrased, modified, or even removed. Supplementary file 2 shows text messages content along with their corresponding BCTs.

3.4.6 Behavioral practice (BP)

This component involves conducting several activities to give participants the opportunity to implement the desired behavior.

3.4.6.1 Cooking competition

A cooking competition will be conducted through posting quick and easy cooking recipes every 2 weeks. Participants will be encouraged to try the recipes and share pictures and feedback in the WhatsApp group. Participants who try the recipes will enter a prize draw to win a basket of organic vegetables.

3.4.6.2 Preparing sustainable meals

Participants will be asked to prepare a simple sustainable dish (salad, snack). In this activity, several food items (e.g., vegetables, fruits, cooked legumes, nuts, whole grain bread, tuna, etc.) will be placed on dining tables. This activity is fireless and requires only simple equipment (spoons, forks, cups).

3.4.7 Environmental restructuring (ER)

Multiple nudging strategies, informed by suggestions obtained from previous focus group discussions (approval code: ERSC_2024_5471), will be applied in CMHS canteen to encourage the selection of sustainable food choices. They are listed below according to the Ensaff classification (2021) (Ensaff, 2021):-

1. Availability: The availability of plant-based dishes will be increased twice per week both at breakfast and lunch with the support of the canteen's manager. Efforts will also be made to expand the variety of seasonal and locally produced F&V, which will be offered in various forms (e.g., fresh, chopped, or juices)

to enhance accessibility and appeal. As a further healthy snack option, the canteen manager may offer nut boxes or small boxes of dates filled with nuts.

2. Position: fruit basket will be repositioned at eye level with.
3. Semiotic: Symbols (e.g., smile and sad faces) will be placed on all target foods to make the sustainable choice more salient. Additionally, facial expressions will be used to indicate sustainability rate of dishes via QR codes on the menu, providing canteen users with immediate visual feedback to guide their choices.
4. Descriptive: Displaying nutritional information—including calories, fat, protein, carbohydrates for dishes via QR codes on the menu to promote sustainable food choices.
5. Prompt: The PHD plate will be printed on tray mats and a banner, visual tools specifically designed for Ta'am Mustadam intervention to promote sustainable food choices. The plate will depict some of the target food categories: F&V, RPM, and plant-based foods (e.g., legumes & nuts). To encourage F&V consumption, a sign stating "*Consuming five fruits and vegetables per day prevents many illnesses—World Health Organization*" will be placed next to the F&V basket. Besides that, all educational messages described earlier will also be shared with the CMHS canteen users through QR codes or display stands. To further enhance participants' knowledge of the environmental impact of food choices, a curated selection of short videos sourced from YouTube ([Video 1](#), [Video 2](#), [Video 3](#), [Video 4](#), [Video 5](#)) will be played in the canteen.

3.5 Data collection

As mentioned above, the participants will complete an identical questionnaire at three- time points; pre-intervention (1-week before the start of intervention period), post-intervention (at the end of the 6-week intervention period), and follow-up (4-week after intervention end) (see [Supplementary file 3](#)). The questionnaires will be administrated online via Qualtrics and will be available for 1 week at each time point. We will send reminders via E-mail/WhatsApp to remind participants to complete the questionnaires.

At post-intervention, all canteen users, including non-participants will be asked to fill out evaluation questionnaires. One member of the research team will be in the canteen during lunchtime encouraging canteen users to complete the questionnaire.

Additionally, the canteen's manager will be invited to participate in a face-to-face interview following the implementation of the Ta'am Mustadam intervention. The purpose of the interview will be clearly explained to the manager, and informed consent will be obtained before the interview. The interview will then be audio-recorded and transcribed verbatim.

3.5.1 Reliability of data collection

Multiple strategies will be used to improve the quality of the collected data. The questionnaires used in this intervention were reviewed by experts in the field to ensure comprehensive

item coverage. Additionally, the Food Choice Questionnaire (FCQ) and the Food Frequency Questionnaire (FFQ) have already been validated in the UAE population ([El Mesmoudi et al., 2022](#)). Questionnaires used to assess knowledge, intentions, practices, and self-reported behaviors toward sustainable diets will be piloted among 30 participants, and internal consistency will be measured using Cronbach's alpha ([Tavakol and Dennick, 2011](#)). Finally, forced-response settings will be applied in the web-based questionnaire to avoid missing values by requiring participants to complete each question before proceeding.

3.6 Measurements

3.6.1 General information

At the beginning of the questionnaire, participants will be asked to provide basic sociodemographic information (e.g., gender, age, marital status, nationality, family size, employment status, educational level, and household monthly income). Additionally, they will be asked to self-report their height and weight for body mass index (BMI) calculation. Participants will also be asked if they have consulted a nutritionist/dietician, had formal nutrition education, and about their nutrition knowledge level. Moreover, they will be asked how frequently they choose locally sourced food products.

3.6.2 Food choice motives

Participants' food choice motives will be assessed using the English version of Food Choice Questionnaire (FCQ) tailored for Arabic-speaking countries. The FCQ was recently validated among young adults in a university setting, and it consists of 37 items covering nine domains, including sensory appeal, convenience, mood, health, natural content, familiarity, weight control, eco-ethics and price. Participants will be asked to rate the importance of each item on a four-point Likert scale in which: 1 = "Not at all important," 2 = "A little important," 3 = "Moderately important," 4 = "Very important."

3.6.3 Knowledge, intentions, practices, and self-reported behaviors toward sustainable diets

Knowledge will be assessed by participants' agreement with five statements related to sustainable diets. These statements are adapted from a previously validated tool ([Faber et al., 2020](#); [Teng and Chih, 2022](#)). The responses will be measured using 5-point Likert scale ranging from "completely disagree" to "completely agree." A score of 0 will be assigned to answers that "completely disagree," "disagree" or "neither disagree nor agree." Answers that "agree" with correct definition of sustainable diets will be recorded as 1, and those "completely agree" with the correct definition will be recorded as 2. The total knowledge score will range from 0, indicating very little knowledge, to 10, indicating excellent knowledge ([Faber et al., 2020](#)).

Intentions will be assessed using three statements that measure participants' intention to adopt sustainable food choices. The statements are adapted from a previously validated questionnaires ([Lim et al., 2021](#); [Trewern et al., 2022](#)). The responses will be coded

on a 4-point Likert scale ranging from 0 “Very unlikely” to 3 “Very likely.” The total score ranges from 0 to 9, with higher scores indicating a greater intention to follow a sustainable diet.

Practices will be assessed using three statements that capture the extent to which participants engage in sustainable behaviors. The statements are adapted from previously validated questionnaire developed specifically for UAE population (Hilary et al., 2024). The responses will be coded on 5-point-Likert scale ranging from 0 “I’m not interested in doing this at the moment” to 4 “I’m doing this confidently most of the time” (Hilary et al., 2024). The total score ranges from 0 to 12, with higher scores indicating a greater adherence to sustainable dietary practices.

Self-reported behaviors will be assessed by participants’ weekly consumption of 6 food groups (e.g., “How often do you consumed fruits in a typical week”) using five intake frequencies (“0 times,” “1–2 times,” “3–4 times,” “5–6 times,” “seven or more times”). The responses are coded from 0 to 4 for all food groups except for red meat, and processed meat, which are reverse-coded (Hilary et al., 2024). This measure is adapted from previously validated questionnaire developed specifically for UAE population (Hilary et al., 2024).

3.6.4 Dietary intake

Participants’ dietary intake will be assessed through a validated English version of Food Frequency Questionnaire (FFQ) tailored for the UAE population (El Mesmoudi et al., 2022). The FFQ contains 130 culture-specific food items, divided into 12 groups; (1) dairy foods; (2) composite dishes; (3) proteins, including vegetarian and animal sources; (4) vegetables; (5) cereals (including pasta and other cereals), rice, and starches; (6) sandwiches and baked snacks; (7) breads and savory biscuits; (8) spreads on breads, vegetables, or salads, excluding use in cooking; (9) soups; (10) fruits and dried fruits; (11) beverages; and (12) sweets and other snacks (El Mesmoudi et al., 2022).

For each food item, participants could select from 9 frequency categories, which will be converted later to average daily frequency using the method described by Salvini et al. (1989), whereby food frequencies will be multiplied by a specific factor as the following: Never or less than once/month = 0; 1–3 times/month = 0.07; 1 time/week = 0.21; 2–4 times/week = 0.43; 5–6 times/week = 0.79; 1 time/day = 1.0; 2–3 times/day = 2.50; 4–5/day = 4.50; ≥ 6 times/day = 6.

Since the UAE lacks food composition tables and only a limited number of traditional dishes have been chemically analyzed (Bawajeel et al., 2021), we will obtain reference values of food list in the FFQ from several high-quality international food composition databases (Al-Amiri et al., 2009; Ahuja et al., 2013; Government of Canada, 2024). Then, nutrient intake and energy intake for each participant will be calculated using the following formula:

Daily nutrient intake (g) = \sum [(daily consumption frequency of a food) \times (portion size consumed of a food (g) \times component value/100g)] (El Mesmoudi et al., 2021).

3.6.5 Intervention evaluation

Ta’am Mustadam intervention will be evaluated using an evaluation questionnaire to get better idea about the perceived

effectiveness of all intervention components (i.e., changes in their eating behaviors, and changes in their knowledge toward sustainable diets), acceptability of communicating with participants via WhatsApp group, and to identify potential improvements to the intervention’s implementation. This questionnaire contains yes/no questions, Likert-scale questions, and an open-ended question to collect detailed feedback from participants and all canteen users. The evaluation questionnaire is shown in [Supplementary file 4](#).

3.6.6 Manager interview

A face-to-face interview will be conducted in Arabic with the canteen’s manager at three- time points; pre-intervention (1-week before the start of intervention period), post-intervention (at the end of the 6 week intervention period), and follow-up (4-week after intervention end). Each interview will be moderated by SZ, a PhD candidate who has received appropriate training in qualitative research methods, and is expected to last between 15 and 30 min. The pre-intervention interview will explore anticipated challenges, potential difficulties in implementing the intervention, and baseline attitudes toward promoting sustainable food choices. The post-intervention interview will evaluate the implementation and potential maintenance of the intervention, fidelity to the intervention implementation, additional costs or resources required, and any adaptations made in CMHS canteen to support its delivery. The follow-up interview will assess long-term maintenance plans, and facilitators and barriers to continuing the Ta’am Mustadam intervention. The interview guide is included in [Supplementary file 5](#).

3.6.7 RE-AIM model

According to RE-AIM model, the impact of public health interventions is evaluated based on five dimensions. The Reach dimension indicates the number and characteristics of potentially eligible participants for the intervention. The Effectiveness dimension refers to intervention outcomes. Adoption focuses the readiness of settings to initiate the intervention. Implementation dimension measures the extent that the intervention is delivered as intended, adaptations made and costs of implementation. Lastly, Maintenance dimension assesses participants’ long-term outcomes, as well as the extent to which an intervention becomes part of the routine practices in the setting. Adoption dimension focuses on the readiness and willingness of several settings to initiate the intervention (Glasgow et al., 2019); however, in this study, Adoption will not be assessed because the canteen is conducted in a single canteen setting.

Given this, Reach will be assessed by determining exclusion rates, reasons for exclusion, participation rates, participants characteristics, and drop-out rates. Effectiveness will evaluate the impact of the intervention on FCMs, dietary intake, knowledge, intentions, practices and behaviors toward sustainable diets, and energy and nutrient intakes. Implementation will assess the needed costs and adaptations made to implement the intervention, as well as if the intervention was implemented as intended. Maintenance will evaluate continuation of Ta’am Mustadam

intervention effects over time at both participant and setting level. Table 4 summarizes the measures and data sources for each dimension of RE-AIM model that will be used in evaluating Ta'am Mustadam intervention.

3.7 Data analysis

The data collected will be checked for accuracy and completeness and will be analyzed using the latest version of SPSS. To minimize bias from misreporting, we will exclude participants whose reported energy intake falls outside the plausible range of 800–3,500 kcal for women or 1,000–4,000 kcal for men (Willett, 2012; Banna et al., 2017). According to Willett, energy intakes above 4,000 kcal/day are considered illogic even among highly active individuals (Willett, 2012). This method is preferred over the Goldberg approach, which relies on body weight to estimate energy requirements, as it helps to reduce selection bias associated with the tendency of individuals with higher BMI to underreport their energy consumption (Rhee et al., 2015).

The analysis will follow the intention to treat principles. Descriptive statistics will be used to describe the data. Categorical data in the study will be presented in frequencies and percentages, while continuous data will be reported as a mean and standard deviation (for normally distributed variables), and median (for skewed variables). The normality of continuous variables will be assessed using Shapiro Wilk test and graphically through histograms to determine appropriate test techniques for data analysis.

Changes in the primary and secondary outcomes corresponding to continuous variables (i.e., food choice motives scores, knowledge, intention, practices, and behavior toward sustainable diets, energy (kcal/day), carbohydrate (g/day), protein (g/day), fat (g/day) will be evaluated at three-time points; pre-intervention, post-intervention, and 4-week follow-up. For normally distributed data, repeated measures ANOVA with a Bonferroni *post-hoc* test will be used. For non-normally distributed, the Friedman test followed by Bonferroni-adjusted pairwise comparisons will be applied. When significant differences are detected, the effect size (partial eta squared (η_p^2) for repeated measures analysis and Kendall's W for Friedman test) will be calculated to assess the magnitude of difference between the time points. Effect sizes will be interpreted small at 0.01, medium at 0.06 and large at 0.14 for partial eta squared tests (Al-Nawaiseh et al., 2021) and 0.1 for small, 0.3 for medium and 0.5 for large for Kendall's W (Tomczak and Tomczak, 2014). The 95% CIs will be also reported for each outcome measure. The significance level will be set at <0.05.

The evaluation form at post-intervention will be analyzed using descriptive statistics.

4 Results

Any amendments in the protocol will be transparently submitted to both the ethics committee and Clinical Trials.gov. This study will start in September 2025. The final results

are expected to be published in May 2026. The results of this study will be submitted to peer-reviewed journals for publication. The findings will also be presented at national and international conferences.

5 Discussion

The Ta'am Mustadam pilot study represents the first intervention aimed at promoting sustainable food choices within Middle East region. The intervention will employ an innovative, theory-informed approach with regard to the methodologies used. Its primary objectives are to promote sustainable food choices and to examine changes in FCMs. Secondary objectives include assessing changes in participants' knowledge, intentions, practices, and self-reported behaviors related to sustainable food choices, as well as evaluating its impact on dietary intake. This approach is grounded in Ajzen's Theory of Planned Behavior, which suggests that behavioral intention is the strongest predictor of actual behavior (Ajzen, 1991). Moreover, Clonan et al. (2010) underscore the importance of improving individuals' knowledge as a key strategy for fostering sustainable dietary behaviors (Clonan et al., 2010). By integrating these constructs, it is expected that this intervention will produce meaningful changes in both dietary behaviors and underlying cognitive drivers.

A key strength of the Ta'am Mustadam intervention is its systematic development using the BCW framework, which provides a theory-driven and evidence-based approach to intervention design. This framework facilitates a deeper understanding of the behavior change process and guides the selection of appropriate BCTs (Michie et al., 2008). Previous sustainability-focused interventions often lacked such theoretical foundations, limiting their long-term effectiveness (Michie et al., 2008). While multiple behavioral theories are available, many fall short in offering specific guidance for intervention design or for explaining the mechanisms of change (Michie et al., 2015).

An additional strength of this study is the incorporation of qualitative insights from focus group discussions, which enabled an in-depth exploration of the motives behind food choices among young adults. These findings were instrumental in tailoring the intervention strategies to the CMHS canteen, thus improving the intervention's relevance, acceptability, and contextual fit.

Finally, the use of the RE-AIM model represents a further strength, as it supports a comprehensive and multidimensional evaluation of the intervention beyond simple efficacy outcomes (Glasgow et al., 2019). The RE-AIM model will enable assessment across key dimensions, Reach, Effectiveness, Adoption, Implementation, and Maintenance, thereby capturing both individual- and setting-level outcomes. This will allow for the evaluation of how effectively the Ta'am Mustadam intervention engages the target population, achieves its intended outcomes, is implemented with fidelity, and is maintained over time (Glasgow et al., 2019). Furthermore, RE-AIM will facilitate the identification of barriers and facilitators across different contexts, thereby enhancing opportunities for future improvements and broader implementation.

Nonetheless, several limitations warrant consideration. First, the intervention will be conducted among students at CMHS,

TABLE 4 RE-AIM Evaluation of Ta'am Mustadam intervention.

Dimensions	Measures	Data sources
Reach	<i>Participant level</i> <ul style="list-style-type: none"> • Number and reasons for exclusions • Number of eligible participants • Characteristics of participants • Dropout rate 	<ul style="list-style-type: none"> • Participant questionnaire (screening questionnaire and pre-intervention questionnaire)
Effectiveness	<i>Participant level</i> <ul style="list-style-type: none"> • Impact on FCMs, and dietary intake. • Impact knowledge, intentions, practices and behaviors toward sustainable diets • Impact on energy and nutrient intakes 	<ul style="list-style-type: none"> • Participant questionnaire (post-intervention questionnaire)
Adoption	<i>Participant level</i> <ul style="list-style-type: none"> • Participants' willingness to adopt changes 	<ul style="list-style-type: none"> • Weekly poll created on WhatsApp group
Implementation	<i>Participant level</i> <i>Setting level</i> <ul style="list-style-type: none"> • Anticipated challenges or difficulties in implementing the intervention • Resources, staff, or logistical issues that might affect implementation. • Baseline attitudes toward promoting sustainable food choices. • Current practices regarding sustainable food choice in the canteen. • Extent to which the intervention was delivered as intended • Additional costs for implementing the intervention • Types of adaptations made to implement the intervention. • Challenges influencing ability to implement the intervention as intended 	<ul style="list-style-type: none"> • Evaluation questionnaire • Manager interview (pre-intervention, post-intervention and follow-up)
Maintenance	<i>Participant level</i> <ul style="list-style-type: none"> • Long-term impact of the intervention (4- week follow-up) <i>Setting level</i> <ul style="list-style-type: none"> • Intervention continuation • Enablers and challenges to Ta'am Mustadam intervention maintenance over long-term 	<ul style="list-style-type: none"> • Participants questionnaire (follow-up questionnaire) • Manager interview (post-intervention and follow-up)

who may have general nutrition knowledge, potentially introducing bias in interpreting results. To address this, participants' general nutrition knowledge will be assessed prior to the intervention, allowing for a more accurate interpretation of the results and minimizing potential bias. Second, the Adoption dimension of the RE-AIM models will not be assessed at the setting level due to the single-setting design, limiting insights into the readiness and willingness of other settings to adopt the intervention. Additionally, our intervention will not target policy-level changes within food service unit at UAEU, which may constrain the broader systemic impact and long-term sustainability of behavior change. Finally, operational constraints could be a limitation of implementing the intervention at CMHS canteen.

6 Conclusion

This study is expected to make a significant contribution to addressing the dual burden of poor dietary habits and environmental challenges in the UAE. By encouraging a shift toward more sustainable food choices, this intervention holds the potential to positively impact public health outcomes, reduce environmental pressure, and support national food sustainability goals. A key innovative feature of this study lies in its integration of the BCW framework, offering a novel, theory-informed approach to advancing sustainable eating in the region. Grounded in behavioral theory and systematically evaluated using the RE-AIM framework, this study will provide insights into the weaknesses and strengths of the Ta'am Mustadam intervention, which will help in optimizing the intervention in the future. Besides that, it will provide valuable data for designing future larger interventions in a full randomized controlled trial.

Importantly, findings from this study can guide the development of future policies and institutional actions aimed at integrating sustainability into food environments, especially in educational and public service settings. As one of the first structured interventions of its kind in the region, this study can serve as a model for other institutions across the UAE, supporting broader efforts to align dietary behavior change with national strategies for health, environmental protection, and food security.

Data availability statement

The original contributions presented in the study are included in the article/[Supplementary material](#), further inquiries can be directed to the corresponding author.

Author contributions

SZ: Methodology, Writing – review & editing, Conceptualization, Writing – original draft. IE: Writing – review & editing, Methodology. SS: Writing – review & editing. CP: Conceptualization, Methodology, Writing – review & editing.

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Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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Supplementary material

The Supplementary Material for this article can be found online at: <https://www.frontiersin.org/articles/10.3389/fsufs.2025.1656866/full#supplementary-material>

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