

The Effect of Transtheoretical Model-Based Online Health Education on Nutrition and Physical Activity Change Processes in Overweight University Students: A Randomized Controlled Trial

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ABSTRACT

Background: Overweight and obesity have emerged as critical global public health issues, as they elevate the risk of non-communicable diseases. The university years constitute a pivotal phase characterized by the prevalence of detrimental food practices and inconsistent physical exercise, hence intensifying associated health concerns. This study seeks to assess the influence of an online health education program, grounded in the Transtheoretical Model, on the dietary and physical activity behavior modification processes of overweight university students.

Methods: This study was designed as a two-arm, parallel, randomized controlled clinical trial. The research was conducted at a foundation university in Turkey, involving 54 overweight students who satisfied the inclusion criteria and participated in training sessions once a week for one month. Participants were randomly assigned to intervention (n=27) and control (n=27) groups. The intervention group had online health education grounded in the Transtheoretical Model for four weeks, while the control group got no intervention. Measurements were taken before and after the test using the Nutrition Change Processes Scale, Exercise Change Processes Scale, and the Transtheoretical Model Stage of Change Form.

Results: The intervention group demonstrated a statistically significant increase in scores on the Nutrition Improvement Processes Scale and Exercise Change Processes Scale ($p<0.05$), while the control group exhibited no significant improvement. A larger percentage of students in the intervention group progressed to the action and maintenance stages compared to those in the control group.

Conclusions: The online health education based on the Transtheoretical Model significantly influenced dietary and physical activity behavior changes among overweight students. The results demonstrate that organized health education initiatives might enhance motivation and facilitate enduring behavioral change among university students. Registration: ClinicalTrials.gov Identifier NCT05482659

Keywords: Healthy Nutrition, Online Education, Overweight, Physical Activity, Transtheoretical Model.

Introduction

Within the scope of the Sustainable Development Goals, the UN has underlined how crucial it is to fight noncommunicable illnesses in order to ensure "Good Health and Well-Being" [1]. Consequently, the prevention of overweight and obesity—two significant risk factors for non-communicable diseases—is crucial for the protection and improvement of public health. As per the World Health Organization's (WHO) 2022 statistics, 43% of the global population is overweight, and over 16% is classified as obese [2]. In Turkey, 56% of people are overweight or obese overall, according to data from 2021 [3].

Overweight and obesity are not only diseases but also major risk factors for diabetes and cardiovascular disorders, various types of cancer, sleep disorders, gastrointestinal and respiratory diseases, musculoskeletal disorders, infertility, and various mental health conditions. They also lower quality of life and increase treatment costs [2, 4]. While obesity-related diseases affect all age groups and socioeconomic classes, studies report that risky health behaviors that lead to chronic diseases and mortality in adulthood often develop during university years [5-7]. According to studies, the following rates of overweight and obesity are common among college students: 48.6% in the US, 12–36% in Europe, 20.8% in Bangladesh, 2.9–14.3% in China, 20–30% in Malaysia, 31% in Thailand, 13–57.6% in Pakistan, 11–37.5% in India, 12.4–16.7% in Colombia, 31.6% in Mexico, 42% in Kuwait, 12.4% in Iran, and 11–40% in Turkey [7–10].

Factors influencing the development of overweight and obesity include age, gender, genetic predisposition, sociocultural factors (education, ethnicity, migration status), and lifestyle behaviors (physical activity and nutrition habits) [11-13]. During university years, environmental changes and increased stress levels trigger risky health behaviors, including unhealthy eating habits, smoking, alcohol consumption, and reduced physical activity [10, 14-16]. Research suggests that high-calorie food consumption among university students has increased, while their nutritional knowledge remains inadequate [17,18]. Promoting a nutritious diet and increasing physical exercise are essential components of adopting healthy lifestyle behaviors in the treatment of overweight and obesity [19]. There are various models that have been developed to provide guidance in facilitating behavior change among individuals [20–22].

The Transtheoretical Model (TTM) was formulated by Prochaska and DiClemente in 1982 to augment individual motivation for behavioral modification [23]. In recent years, TTM has been recognized as an effective, practical, and applicable framework for encouraging behavioral change [24]. According to the model, individuals undergo specific stages of change when acquiring a new behavior. In TTM, an individual's stage of change is determined by their intention and motivation toward adopting a behavior. Each stage requires specific strategies and interventions, known as processes of change [25]. A review of previous studies indicates that TTM-based interventions have positively influenced the behavior change process among individuals with unhealthy eating behaviors and insufficient physical activity levels [24, 26]. However, most TTM-based nutrition and physical activity interventions conducted globally and in Turkey have focused on overweight and obese adults rather than university students [24, 27, 28]. Separate studies conducted in the United States, South Korea, and Malaysia have shown that TTM positively influenced university students' physical activity levels [29-31].

A literature review suggests that TTM-based nutrition and physical activity intervention studies targeting overweight university students remain limited. Since the university period is a critical stage for adopting healthy eating and adequate physical activity behaviors, previous research has recommended implementing intervention programs for university students. Accordingly, this study aims to assess the effectiveness of a health education program, structured based on the stages of change in the Transtheoretical Model, in facilitating nutrition and physical activity behavior change among overweight university students without any chronic diseases.

Methods

Design: This randomized controlled trial was conducted between June 2021 and May 2022 with a total of 54 students who met the inclusion criteria. An initial assessment (pre-test) was administered to overweight students at the commencement of the intervention, followed by a concluding assessment (post-test) after its conclusion to gather data. The randomized controlled study adhered to the Consolidated Standards of Reporting Trials criteria. This study was registered (registration number: NCT05482659) in the ClinicalTrials database.

Settings and Participants: The study population consisted of 2,520 students from a foundation university in Turkey. The sample size was determined using a repeated-measures two-way ANOVA in G*Power 3.1.9.2 to ensure statistical reliability. Due to the lack of similar prior studies, Cohen's (1988) recommended effect size ($f = 0.25$) was used, with a 0.05 Type I error rate and 0.95 statistical power. As a result, the minimum required sample size was calculated as 54 students (27 in the intervention group and 27 in the control group). The power analysis was conducted by a statistical expert [32]. The sample included participants from all academic years. Since this introduces variation in educational exposure and experience, academic level was considered a potential confounding variable. However, subgroup analysis revealed no statistically significant effect of academic level on outcomes. Participants living either in dormitories or family homes were included in the study, and statistical analysis revealed no significant effect of residence type on study outcomes.

Eligibility criteria for participation in the study:

- Individuals who voluntarily consented to take part in the study.
- Those with no chronic illness,
- BMI between 24.9 and 30,
- Those open to communication and collaboration,
- Those who own and have access to the internet, smartphone, tablet, or computer,
- Those who had not received a similar nutrition or physical activity intervention in the past 6 months.

Exclusion Criteria:

- BMI below 24.9 or above 30,
- Taking any medication,

Interventions: Students meeting the inclusion criteria were provided with an informed consent form via an online questionnaire, and those who voluntarily agreed to participate and fulfilled the eligibility requirements were enrolled in the study ($n=54$). The educational intervention was conducted in January 2022 and February 2022, after the completion of the semester examinations. This timing was selected to ensure that students were not under academic stress and could participate without distractions.

In the subsequent phase, a statistics expert assigned identification numbers to the students, which were then randomly allocated to the intervention and control groups using the Simple Randomization Method (Random Number Table). Participants were not informed about their group assignment (intervention or control) or their stage in the Transtheoretical Model (single-blind method). However, due to the nature of the intervention, the researcher was not blinded.

Students in the intervention and control groups were administered the pre-test survey through an online questionnaire (including the Demographic Information Form, Nutrition Change Processes Scale, Exercise Change Processes Scale, and Stage of Change Identification Form based on the TTM). After the pre-test, students were categorized into five groups according to the results of the Stage of Change Identification Form based on TTM:

- **Precontemplation group:** The person does not plan to modify their behavior within the next six months, has limited awareness, and may be resistant to change.
- **Contemplation group:** The individual has resolved to initiate the healthy activity within the next six months but requires further motivation and confidence enhancement.
- **Preparation Group:** Participants intend to adopt the healthy behavior within the next 30 days, actively seek information, and take steps to prepare for the change.
- **Action Group:** Participants have adopted the healthy behavior for less than six months but remain at risk of relapsing into previous habits.
- **Maintenance Group:** Participants have sustained the healthy behavior for more than six months and require ongoing support to prevent relapse.

Health Education Program: The educational program was developed by the researcher based on expert opinions from a Doctor of Public Health Nursing.

- The education was delivered online, once per week, to the intervention group.
- The content of the education program, structured according to change stages, is presented in Table 1.
- Each student received individualized, online training lasting 30-45 minutes on average.
- The intervention process lasted 30 days in total.
- The control group was not exposed to any experimental intervention.
- **Final Test and Study Conclusion:** Upon completion of the intervention process (30 days after its initiation), the post-test was administered to both groups (Nutrition Change Processes Scale, Exercise Change Processes Scale, and Stage of Change Identification Form based on TTM).
- **Sharing of Educational Content:** After the final test, students who requested access to the health education materials were provided with the content.

The study flowchart is shown in Figure 1.

Measurements: The study data were collected through a questionnaire developed based on a comprehensive literature review. The questionnaire consisted of the Demographic Information Form, Nutrition Change Processes Scale, Exercise Change Processes Scale, and Transtheoretical Model Stage of Change Identification Form. Permission was obtained for the use of the scales in the study.

The Demographic Information Form consists of 16 questions covering students’ sociodemographic characteristics, height-weight values, nutrition, and physical activity habits.

The Nutrition Change Processes Scale (NCPS): Developed by Prochaska, Velicer, Rossi, Goldstein, Marcus, Rakowski, Fiore, Harlow, Redding, and Rosenbloom (1987), this scale assesses how experiences influence dietary habits. The Turkish adaptation, validated by Menekli and Fadiloğlu (2012). The scale consists of 12 subdimensions including 48 items evaluated on a 5-point Likert scale, with total scores varying from 48 to

Table 1 Stages of Nutrition and Exercise Change, Change Processes, and Training Content Provided According to the Transtheoretical Model

Stage of Change According to TTM	Change Processes According to TTM	Objective of Training	Content of Training	Method
Precontemplation	Emotional Arousal, Awareness	Increasing awareness of healthy eating and adequate physical activity	What is obesity/overweight, physical activity, and healthy eating? Determining the positive effects of healthy eating and physical activity on health. Healthy lifestyle behaviors	Q&A, Online Lesson
Contemplation	Awareness, Self-Reevaluation, Counter Conditioning	Motivating individuals for healthy eating and physical activity and increasing self-confidence	What is obesity/overweight, physical activity, and healthy eating? Barriers to healthy lifestyle behaviors, healthy eating, and physical activity. Healthy me? Unhealthy me?	Q&A, Online Lesson
Preparation	Self-Agreement, Self-Reevaluation, Environmental Reevaluation, Counter Conditioning	Preparing a plan for healthy eating and physical activity	What is obesity/overweight, physical activity, and healthy eating? Evaluating individuals' conditions related to healthy eating and physical activity and forming a plan	Q&A, Online Lesson
Action	Self-Agreement, Reinforcement (Rewarding), Stimulus Control	Starting a healthy eating and physical activity plan and revising the implementation plan	What is obesity/overweight, physical activity, and healthy eating? Evaluating individuals' conditions and starting a healthy eating and physical activity plan, environmental changes, and the importance of self-reward	Q&A, Online Lesson
Maintenance	Self-Agreement, Reinforcement (Rewarding), Stimulus Control	Preventing relapse into poor nutrition and inactivity	Making a contract, importance of not quitting exercise, stimulus control, evaluating individuals' healthy eating and physical activity plans, importance of self-rewarding	Q&A, Online Lesson

Q&A – Question and Answer.

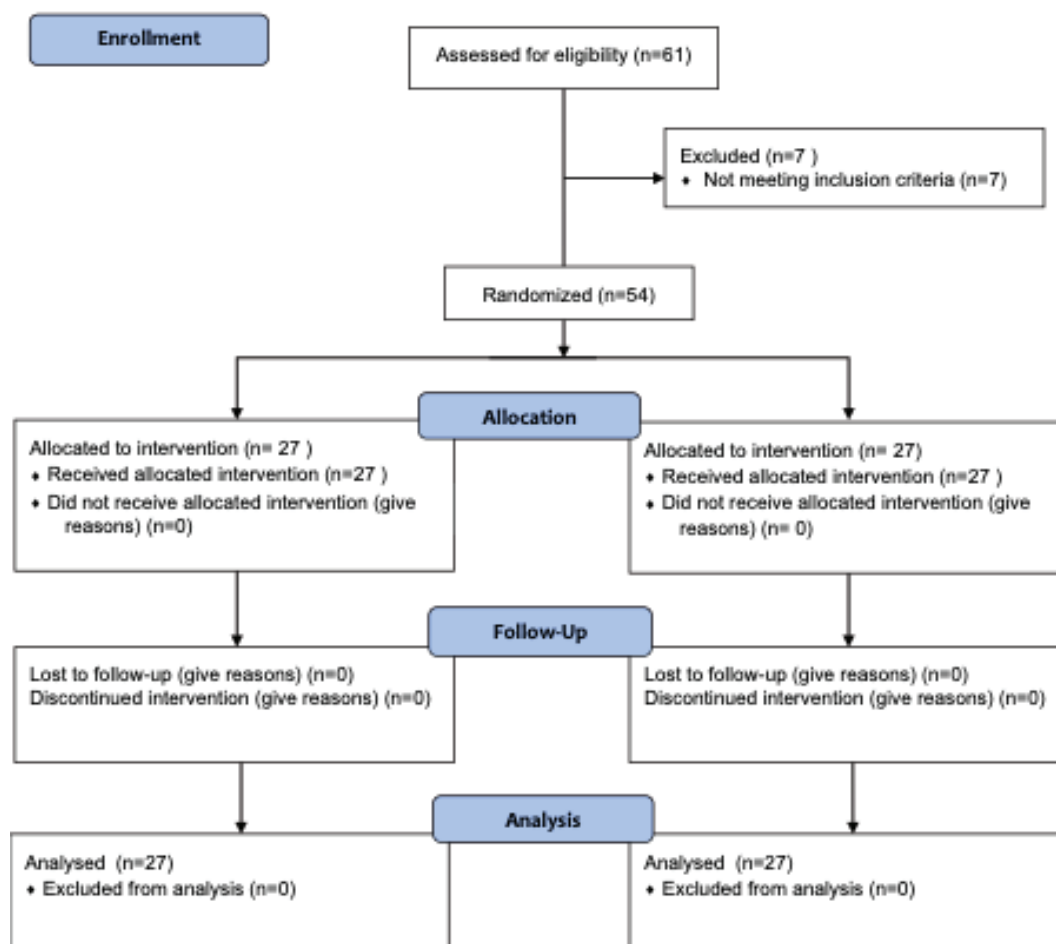


Figure 1 – Research Flowchart According to CONSORT 2010 Flow Diagram

240. In this study, its reliability was found to be Cronbach’s Alpha = 0.93 [33].

The Exercise Change Processes Scale (ECPS): Created by Marcus, Selby, Niaura, and Rossi (1992), this scale evaluates the impact of experiences on exercise habits. Ay and Temel (2015) conducted the Turkish adaptation. The measure has two primary processes (cognitive and behavioral) spanning ten subdimensions, featuring 28 items evaluated on a 5-point Likert scale [34]. Scores range from 28 to 140, with higher scores indicating a greater likelihood of behavioral change. In this study, its reliability was Cronbach’s Alpha = 0.932.

The Transtheoretical Model Stage of Change Identification Form was developed by the researcher based on a literature review to determine the stage of change for overweight individuals according to the Transtheoretical Model. Based on the results of this form, overweight students were classified into five groups: precontemplation, contemplation, preparation, action, and maintenance. Participants were asked, “Are you currently making or planning to make any changes to your nutrition and physical activity behaviors?” Their responses were classified into the following categories:

- “I am disinterested and have no intention of altering my dietary practices or exercise regimen in the forthcoming six months.” (Precontemplation);
- “I am not interested at the moment, but I plan to change my nutrition habits and physical activity level within the next six months.” (Contemplation);
- “I intend to modify my nutrition habits and physical activity level within the next 30 days.” (Preparation).

- “Yes, I have already changed my nutrition habits and physical activity level, but it has been less than six months.” (Action)

- “Yes, I have maintained my nutrition and physical activity behaviors for more than six months.” (Maintenance)

Statistical analysis: The study data were examined utilizing SPSS version 22.0. Descriptive statistics, including mean, standard deviation, median, minimum, and maximum, were employed for continuous data, whilst categorical variables were represented as frequencies and percentages. The Kolmogorov-Smirnov test was employed to evaluate normality, affirming a normal distribution for the Nutrition and Exercise Change Processes Scales. Consequently, parametric tests were utilized: the t-test for independent group comparisons, the paired t-test for repeated measures, and the Chi-square test for categorical comparisons. The threshold for statistical significance was established at $p < 0.05$.

Results

At the commencement of the intervention, the chi-square test was employed to examine the sociodemographic features of the participants, indicating no statistically significant difference between the groups (Table 2, see the next page). Table 2 indicates that a predominant proportion of students in both the experimental (77%) and control (70.4%) groups were female. Furthermore, over fifty percent of the students (66.7%) reported that their income corresponded with their expenses.

Before the intervention, BMI and age values were analyzed, showing no significant differences between the experimental

Table 2 Distribution of Group Characteristics at the Beginning of the Intervention (n=54)

Characteristics	Variables	Intervention (n=27)		Control (n=27)		Statistics	
		n	%	n	%	χ^2	p
Gender	Female	21	77.8	19	70.4	0,386	0,379
	Male	6	22.2	8	29.6		
Economic Status	Income > Expenses	9	33.3	8	29.6	1,059	0,589
	Income = Expenses	18	66.7	18	66.7		
	Income < Expenses	0	0.0	1	3.7		
Smoking Status	Smoker	10	37.0	11	40.7	0,078	0,500
	Non-smoker	17	63.0	16	59.3		
Alcohol Consumption	Yes	6	22.2	3	11.1	1,200	0,234
	No	21	77.8	24	88.9		
Weight Loss Status Before the Study	Yes	13	48.1	7	25.9	2,859	0,079
	No	14	51.9	20	74.1		
Body Satisfaction Status	Yes	12	44.4	15	55.6	0,667	0,293
	No	15	55.6	12	44.4		
Perceived Health Status	Yes	14	51.9	15	55.6	0,074	0,500
	No	13	48.1	12	44.4		
Number of Meals Consumed Per Day	1 meal	1	3.7	0	0.0	5,255	0,262
	2 meals	10	37.0	7	25.9		
	3 meals	11	40.7	16	59.3		
	4 meals	1	3.7	3	11.1		
	5 meals	4	14.8	1	3.7		
Average Daily Sleep Duration	6-8 hours	18	66.7	18	66.7	0,000	1,000
	8-10 hours	8	29.6	8	29.6		
	10-12 hours	1	3.7	1	3.7		
Frequency of Exercise Per Week	Never exercise	5	18.5	11	40.7	7,707	0,052
	Once a week	5	18.5	8	29.6		
	Twice a week	4	14.8	4	14.8		
	Three or more times a week	13	48.1	4	14.8		
Perceived Adequacy of Physical Activity Level	Yes	12	44.4	8	29.6	1,271	0,199
	No	15	55.6	19	70.4		

χ^2 – Chi-Square Analysis, % – Percent, n – Number.

Table 3 Comparison of Students' BMI and Age Averages Between Groups (n=54)

Variables	Intervention (n=27)	Control (n=27)	Statistics	
	M $\pm$ SD	M $\pm$ SD	t	p
BMI	27,7 $\pm$ 1,4	27,4 $\pm$ 1,6	0,824	0,520
Age	21,0 $\pm$ 3,7	20,8 $\pm$ 2,2	0,266	0,791

M – Mean, n – Number, SD – Standard Deviation, t – Independent Samples t-test

(BMI: 27.7 $\pm$ 1.4, age: 21.0 $\pm$ 3.7) and control groups (BMI: 27.4 $\pm$ 1.6, age: 20.8 $\pm$ 2.2) (p > 0.05, Table 3, see the next page).

Nutritional and Exercise Change Stages

Before the intervention, no significant difference was found between the experimental and control groups regarding nutritional and exercise change stages based on the TTM (p > 0.05, Table 3). In the experimental group, most students were in the preparation stage (n=19), while in the control group, the majority were also in preparation (n=20). After the intervention, a significant difference emerged (p = 0.001), with 20 students in

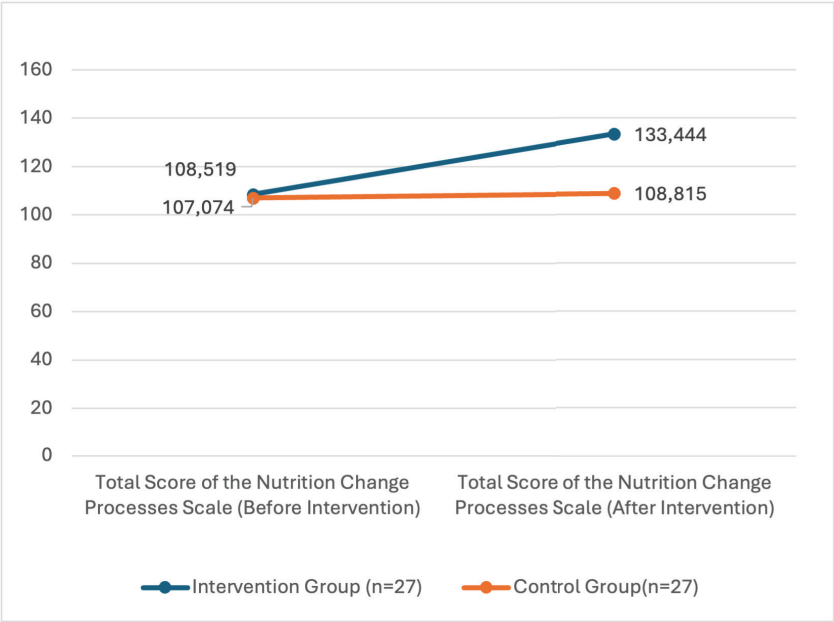


Figure 2 – Comparison of the Mean Scores of the Nutrition Change Processes Scale Between Groups Before and After the Intervention

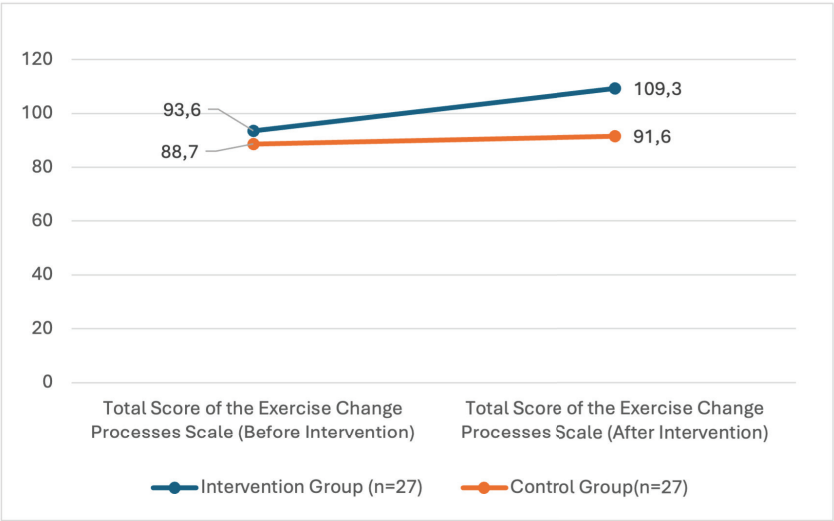


Figure 3 – Comparison of the Mean Scores of the Exercise Change Processes Scale Between Groups Before and After the Intervention

the experimental group progressing to the action stage, whereas the control group showed minimal change (Table 3).

Students’ Nutritional Change Processes

Figure 2 presents the within-group comparison of the NCPS total and subscale mean scores before and after the intervention. In the experimental group, the mean score demonstrated a statistically significant increase from 108.5±30.1 to 133.4±36.8 ($t=3.821$, $p<0.001$). In the control group, the comparison of scores before and after the intervention revealed no statistically significant increase (107.0±27.4 to 108.8±31, $t=-0.801$, $p>0.05$).

Students’ Exercise Change Processes

Figure 3 shows the within-group comparison of ECPS total and subscale mean scores pre- and post-intervention. In the

experimental group, the mean score increased significantly from 93.6±17.3 to 109.3±17.8 ($t=-5.662$, $p=0.001$). In the control group, the comparison of scores before and after the intervention revealed no statistically significant increase (88.7±25.2 to 91.6±25.6, $t=-2.016$, $p=0.054$).

Discussion

In this study, the TTM was used as a guide to help individuals adopt healthy eating and regular physical activity behaviors. According to TTM, behavior change occurs through specific stages, and the stage an individual is in reflects their intention and motivation toward change [35]. In our study, when the pre- and post-intervention nutritional and exercise change stages of students in the experimental group were compared,

Table 4 Comparison of Nutrition and Exercise Change Stages Between Groups (n=54)

Nutrition and Exercise Stages of Change		Intervention (n=27)		Control (n=27)		Statistics
		n	%	n	%	
Before Intervention	Precontemplation	0	%0	1	%3,7	$\chi^2=3,026$ $p=0,554$
	Contemplation	4	%14,8	1	%3,7	
	Preparation	19	%70,4	20	%74,1	
	Action	2	%7,4	3	%11,1	
	Maintenance	2	%7,4	2	%7,4	
After Intervention	Precontemplation	0	%0	1	%3,7	$\chi^2=28,836$ $p=0,001^*$
	Contemplation	0	%0	4	%14,8	
	Preparation	4	%14,8	18	%66,7	
	Action	20	%74,1	2	%7,4	
	Maintenance	3	%11,1	2	%7,4	

χ^2 – Chi-Square Analysis, % – Percent, n – Number.

it was found that before the intervention, 14.8% of students were in the contemplation stage and 7.4% in the action stage, whereas after the intervention, these rates changed to 0% and 74.1%, respectively. Additionally, the fact that the education program lasted only one month suggests that TTM-based health education was effective in accelerating students’ transition to healthy lifestyle behaviors in a short period.

Recent research indicates that TTM is an effective approach in promoting healthy eating and physical activity habits. Gereklioglu et al. (2024) found that a TTM-based intervention significantly increased Exercise Change Process Scale (ECPS) scores in their study on adults. Similarly, Abdoli et al. (2025) reported that TTM-based interventions were effective in increasing physical activity levels among female university students. These findings support the results of our study [26, 27, 36-38]. TTM is considered an easily applicable and effective guide for helping students develop healthy eating and exercise habits. One of the most significant advantages of the model is that it evaluates the change process in stages and includes interventions specific to each stage. For instance, while strategies to increase awareness are applied in the contemplation stage, motivational support techniques are used in the action stage. This flexible structure makes TTM more applicable than other behavior change theories.

However, for TTM-based education to be effective, individuals must be adequately supported according to their change processes. If an individual does not receive the necessary psychosocial and environmental support, behavior change may not be sustainable. Particularly due to a lack of motivation or external factors, individuals may revert to their previous habits. Therefore, identifying the stage individuals are in and applying appropriate education strategies tailored to each stage is crucial.

In this study, TTM-based health education was provided online and individually, which can be considered a factor

increasing the feasibility of the intervention. Online health education has gained importance, especially in the post-pandemic period, due to its potential to reach large audiences, flexible scheduling, and individual follow-up advantages [39]. However, some studies have also highlighted the disadvantages of online education. For example, the possibility of participants losing motivation, lack of direct interaction, and varying levels of commitment among students are among the limitations of this method [40].

Conclusion

The study population was limited to students at a private university in Turkey. Therefore, the results can only be generalized to this specific group and cannot be applied to the entire population. It is recommended to use the Transtheoretical Model (TTM)-based health education in behavior change interventions. We suggest conducting further studies with larger sample sizes and longer durations to explore this topic in more depth. Since students from all academic years were included, differences in educational exposure could not be fully controlled and are therefore noted as a potential limitation.

It may be beneficial to develop practical strategies based on participants’ economic, cultural, and social environments to support sustainable behavior change. The intervention in this study lasted one month; thus, longer follow-up periods (at least 3-6 months) are recommended to assess the sustainability of behavior changes. Additionally, studies comparing online education with face-to-face education can provide a better understanding of the effectiveness of this method.

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References

1. United Nations Turkey. Good Health and Well-Being. Sustainable Development Goal 3. n.d. Accessed: <https://www.globalgoals.org/goals/3-good-health-and-well-being/>
2. WHO, Obesity and overweight. 2024. Accessed: <https://www.clinmedkaz.org/home/instructions-for-authors>
3. Organisation for Economic Co-operation and Development. Obesity, diet and physical activity. Retrieved: 26.02.2025, from <https://www.oecd.org/en/topics/obesity-diet-and-physical-activity.html>
4. Lehnert T, Sonntag D, Konnopka A, Riedel-Heller S, König HH. Economic costs of overweight and obesity. *Best Pract Res Clin Endocrinol Metab.* 2013;27(2):105-115. Epub 2013 Feb 28. PMID: 23731873. <https://doi.org/10.1016/j.beem.2013.01.002>
5. Andargie M, Gebremariam K, Hailu T, Addisu A, Zereabruk K. Magnitude of overweight and obesity and associated factors among public and private secondary school adolescent students in Mekelle City, Tigray Region, Ethiopia, 2019: Comparative cross-sectional study. *Diabetes Metab Syndr Obes.* 2021;14:901-915. PMID: 33688225; PMCID: PMC7936680 <https://doi.org/10.2147/DMSO.S262480>
6. Başçı, A.B., Emiroğlu, O.N. & Kalanlar, B. The effect of a nutrition program based on the Health Behavior Interaction Model on primary school students' nutritional attitudes and behaviors. *J Public Health (Berl.)* 2023. <https://doi.org/10.1007/s10389-023-02101-1>
7. Öcalan D, Ceylantekin Y, Kunduracılar Z, Doğan T. Investigation of the relationship between body mass index, burnout level, and well-being in university students. [In Turkish]. *Turkish Journal of Diabetes and Obesity.* 2020;4(3):270-278. <https://doi.org/10.25048/tudod.685181>
8. Özkan, İ, Adıbelli, D, İlaslan, E, Taylan, S. Relationship between obesity awareness and body mass index in university students. [In Turkish]. *Acıbadem University Journal of Health Sciences.* 2020;11(1):0-0. <https://doi.org/10.31067/0.2020.249>
9. Peltzer K, Pengpid S, Samuels TA, Özcan NK, Mantilla C, Rahamefy OH, Wong ML, Gasparishvili A. Prevalence of Overweight/Obesity and Its Associated Factors among University Students from 22 Countries. *International Journal of Environmental Research and Public Health.* 2014; 11(7):7425-7441. <https://doi.org/10.3390/ijerph110707425>
10. Arslan SA, Daşkapan A, Çakır B. Specification of nutritional and physical activity habits of university students [In Turkish]. *TAF Preventive Medicine Bulletin.* 2016;15(3):171-180. <https://doi.org/10.5455/pmb.1-1436432564>
11. Yang SJ, Choi HY, Chee YK, Kim JA. Prevalence and correlates of obesity and overweight among Asian immigrant women in Korea. *Asia Pac J Public Health.* 2012;24(4):620-630. <https://doi.org/10.1177/1010539511406710>
12. Park JH, Moon JH, Kim HJ, Kong MH, Oh YH. Sedentary lifestyle: Overview of updated evidence of potential health risks. *Korean J Fam Med.* 2020;41(6):365-373. <https://doi.org/10.4082/KJFM.20.0165>
13. Barlow P, Reeves A, McKee M, Galea G, Stuckler D. Unhealthy diets, obesity and time discounting: A systematic literature review and network analysis. *Obesity Reviews.* 2016;17(9):810-819. <https://doi.org/10.1111/obr.12431>
14. Lisha NE, Sussman S. Relationship of high school and college sports participation with alcohol, tobacco, and illicit drug use: A review. *Addictive Behaviors.* 2009;35:399-407. <https://doi.org/10.1016/j.addbeh.2009.12.032>
15. Sogari G, Velez-Argumedo C, Gómez MI, Mora C. College students and eating habits: A study using an ecological model for healthy behavior. *Nutrients.* <https://doi.org/10.3390/nu10121823>
16. Güllü M, Küçükkömürlü S. An investigation of carbohydrate consumption and BMI values of university students [In Turkish]. *Journal of Turkish Studies.* 2020;15(3):1889-1904. <https://doi.org/10.29228/turkishstudies.43012>
17. Şanlıer N, Konaklıoğlu E, Güçer E. Relationship between nutrition knowledge, habits, and behaviors of young people and body mass index [In Turkish]. *Gazi Faculty of Education Journal.* 2009;29(2):333-352.
18. Turganbaeva N, Isakova D, Tayfun A. A study on eating behaviors of university students. [In Turkish]. *Journal of Tourism and Gastronomy Studies.* 2021;9(1):366-376. <https://doi.org/10.21325/jotags.2021.79>
19. Li B, Gao S, Bao W, Li M. Effectiveness of lifestyle interventions for treatment of overweight/obesity among children in China: A systematic review and meta-analysis. *Front Endocrinol (Lausanne).* 2022 Oct 31;13:972954. PMID: 36387871; PMCID: PMC9659900. <https://doi.org/10.3389/fendo.2022.972954>
20. Wright C, Barnett A, Campbell KL, Kelly JT, Hamilton K. Behaviour change theories and techniques used to inform nutrition interventions for adults undergoing bariatric surgery: A systematic review. *Nutr Diet.* 2022 Feb;79(1):110-128. doi: 10.1111/1747-0080.12728. Epub 2022 Feb 8. PMID: 35137502; PMCID: PMC9304301. <https://doi.org/10.1111/1747-0080.12728>
21. Ersin F, Bahar Z. The impact of health promotion models on early breast cancer detection behaviors: A literature review. [In Turkish]. *Dokuz Eylül University Nursing School Electronic Journal.* 2012;5(1):28-38.

22. Prochaska JO, Velicer WF. The transtheoretical model of health behavior change. *American Journal of Health Promotion*. 1997;12(1):38-48. <https://doi.org/10.4278/0890-1171-12.1.38>
23. Prochaska JO, Di Clemente CC. Transtheoretical therapy: Toward a more integrative model of change. *Psychotherapy*. 1982;19(3):276-288. <https://doi.org/10.1037/h0088437>
24. Mastellos N, Gunn LH, Felix LM, Car J, Majeed A. Transtheoretical model stages of change for dietary and physical exercise modification in weight loss management for overweight and obese adults. *Cochrane Database of Systematic Reviews*. 2014;2014(2). <https://doi.org/10.1002/14651858.CD008066.pub3>
25. Glanz K, Rimer BK, Viswanath K. Health Behavior and Health Education. Theory, Research and Practice. 4th ed. San Francisco: *Jossey Bass AWiley Imprint*; 2008.
26. Hashemzadeh M, Rahimi A, Zare-Farashbandi F, Alavi-Naeini A, Daei A. Transtheoretical model of health behavioral change: A systematic review. *Iran J Nurs Midwifery Res*. 2019;24(2):83-90. https://doi.org/10.4103/ijnmr.IJNMR_94_17
27. Menekli T, Fadiloğlu Ç, Şenuzun Aykar F. Behavior Change in Obese Individuals: The Transtheoretical Model Approach. [In Turkish]. *İnönü University Journal of Health Services Vocational School*. 2019;1:39-57. <https://doi.org/10.33715/inonusaglik.545565>
28. Küçük S, Türeyen A, Yıldırım Y. Investigation of theory and model use in higher education theses in nursing related to diabetes: Systematic review. [In Turkish]. *Türkiye Klinikleri Journal of Nursing Sciences*. 2023;15(1):275-290. <https://doi.org/10.5336/nurses.2022-89751>
29. Jeon DJ, Kim KJ, Heo M. Factors related to stages of exercise behavior change among university students based on the transtheoretical model. *J Phys Ther Sci*. 2014;26(12):1929-1932. <https://doi.org/10.1589/jpts.26.1929>
30. Han H, Pettee Gabriel K, Kohl HW. Application of the transtheoretical model to sedentary behaviors and its association with physical activity status. *PLoS One*. 2017. <https://doi.org/10.1371/journal.pone.0176330>
31. Liu KT, Kueh YC, Kim Y, Kuan G. Structural relationship in transtheoretical model of behavioural change constructs among students at a Malaysian university campus. *Asian Journal of Sport and Exercise Psychology*. 2021;1(2):83-88. <https://doi.org/10.1016/j.ajsep.2021.09.002>
32. Faul F, Erdfelder E, Lang AG, Buchner A. G*Power 3: A flexible statistical power analysis program for the social, behavioral, and biomedical sciences. *Behav Res Methods*. 2007;39(2):175-191.
33. Menekli T, Fadiloğlu Ç. Validity and Reliability of the Nutrition Change Processes Scale [In Turkish]. *Hacettepe University Faculty of Health Sciences Nursing Journal*. 2015;19(2):1-21. Accessed: <https://dergipark.org.tr/tr/download/article-file/88618>
34. Ay T, Değirmenci B, Temel AB. Adaptation of Transtheoretical Model-Based Exercise Behavior Change Scales for Turkish Adults: A Validity and Reliability Study [In Turkish]. *Izmir University Medical Journal*. 2017;1:29-45.
35. Prochaska JO, Redding CA, Evers KE. The transtheoretical model and stages of change. In: Glanz K, Rimer BK, Viswanath K, editors. *Health Behavior and Health Education: Theory, Research, and Practice*. 4th ed. San Francisco: *Jossey-Bass*; 2008. p. 97-121.
36. Gerekliloğlu C, Topal K, Velipasaoglu H, Aksoy H. The effectiveness of the trans-theoretical model in managing adult obese and overweight individuals. *Pak J Med Sci*. 2024;40(4):685-
37. Abdoli M, et al. Determinants of physical activity among female students based on the transtheoretical model. *Sci Rep*. 2025;15(1):1496. <https://doi.org/10.1038/s41598-024-83055-6>
38. Karintrakul S, Angkatavanich J. A randomized controlled trial of an individualized nutrition counseling program matched with a transtheoretical model for overweight and obese females in Thailand. *Nutr Res Pract*. 2017;11(4):319-326. <https://doi.org/10.4162/nrp.2017.11.4.319>
39. Plotnikoff RC, et al. Effectiveness of interventions targeting physical activity, nutrition and healthy weight for university and college students: A systematic review and meta-analysis. *International Journal of Behavioral Nutrition and Physical Activity*. 2015;12(1):1-10. <https://doi.org/10.1186/s12966-015-0203-7>
40. Mohammed R, Al Al-Muslimawi A. Evaluating the impact of distance learning systems on educational outcomes during the COVID-19 pandemic. *International Journal of Humanities and Social Sciences*. 2024;6(6):2717-8293. <http://dx.doi.org/10.47832/2717-8293.32.2>