



Original Article

Effect of Educational Multilevel Intervention Based on the Trans-Theoretical Model on Physical Activity Among Students

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Abstract

Introduction: Physical inactivity poses a major public health challenge worldwide, particularly among adolescents. This study aimed to assess the effect of an educational program grounded in the Trans-Theoretical Model (TTM) on physical activity among female high school students.

Methods: This quasi-experimental study was conducted on 70 female eleventh-grade students in Qom, Iran. Participants were allocated to an intervention and a control group (n = 35 per group). Physical activity was assessed using a multi-level approach based on the Trans-Theoretical Model. Data collection was conducted using the International Physical Activity Questionnaire (IPAQ) along with a researcher-developed questionnaire to measure TTM constructs. Data were analyzed via SPSS Version 27 using paired t-tests, independent t-tests, and chi-square tests.

Results: Baseline measurements indicated that the intervention and control groups were comparable in terms of demographic characteristics and key baseline variables ($P > 0.05$). Following the intervention, the intervention group showed significant improvements in physical activity and in the processes of change ($P < 0.05$). In contrast, no significant differences were observed between groups in mean scores for stages of change, decisional balance, or self-efficacy ($P > 0.05$).

Conclusion: The multilevel educational intervention based on the TTM effectively enhanced students' physical activity levels. These findings suggest that integrating behavior change models into school-based educational programs may be an effective strategy for promoting physical activity among adolescents.

Keywords: Health education, Trans-theoretical model, Physical activity, Educational intervention, Adolescent students



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Introduction

Regular physical activity is associated with a lower risk of premature mortality and fewer chronic disease-related complications. It has been shown to decrease the risk of cardiovascular disease, diabetes, hypertension, cancer, and obesity. It also promotes mental health by reducing anxiety and stress (1).

The World Health Organization (WHO) recommends that children and adolescents engage in approximately 60 minutes of moderate-to-vigorous physical activity daily (2). However, physical activity levels have steadily declined over the past two decades across age groups. Recent evidence suggests that more than 90% of adolescents worldwide fail to meet the recommended activity guidelines (3).

A growing body of research suggests that regular physical activity improves cardiorespiratory fitness, mental well-

being, cognitive function, and academic performance in children and adolescents (4). Conversely, insufficient physical activity has been estimated to contribute substantially to the global burden of disease, including 21% of ischemic heart disease, 31% of breast and colon cancers, and 27% of diabetes cases (3).

Rapid urbanization, industrial development, and lifestyle changes in modern societies have led to reduced physical activity and increased rates of obesity and non-communicable diseases. In Iran, increasing rates of overweight and obesity among children and adolescents, closely linked to sedentary behaviors, have been consistently documented (5). Because physical activity habits formed during childhood and adolescence often persist into adulthood, adolescence is a crucial period for interventions designed to promote healthy behaviors,



including regular physical activity (6).

School-based, multicomponent interventions are commonly used to promote physical activity among adolescent girls and have shown promising effectiveness (7). Numerous studies have reported that multilevel interventions can increase physical activity levels. For instance, Kipping et al found that school-based educational programs can significantly improve students' physical activity levels (8). Moreover, the effectiveness of health education interventions largely depends on the appropriate use of established theoretical frameworks and behavior change models (9).

The TTM is one of the most widely used theoretical frameworks for investigating physical activity behaviors (10). Previous studies have shown that educational approaches grounded in this model are highly effective in facilitating behavior modification (5, 11, 12).

In Iran, the CASPIAN study, the first national survey assessing lifestyle behaviors among Iranian children and adolescents, revealed a significant deficiency in moderate-to-vigorous physical activity among girls, with physical activity levels declining sharply during the high school years (13). Given the limited research on the effects of multilevel interventions on adolescent physical activity, the high prevalence of physical inactivity among female students, the critical period for establishing these behaviors, and the strong influence of environmental factors, this study was designed to evaluate the impact of a TTM-based educational program on physical activity levels in this population.

Materials and Methods

This study utilized a quasi-experimental, two-arm, pre and post-intervention design conducted among eleventh-grade female students in Qom. Due to practical constraints, two secondary schools were purposively selected based on their similar socioeconomic and cultural backgrounds. One school was assigned to the intervention group and the other to the control group. This approach does not constitute a true cluster-randomized trial because having only one cluster per arm prevents us from distinguishing intervention effects from school-level confounding factors.

The sample size was calculated assuming a statistical power of 80%, a 95% confidence interval, and an expected effect size of $r = 0.6$. The minimum sample size for each group was initially estimated at 19 participants per group. To adjust for the cluster design, a design effect of 1.5 was applied, adjusting the target sample size to 30 participants per group. Anticipating 30% attrition to maintain statistical power, the recruitment target was set at 40 students per group. Ultimately, five participants withdrew from each arm, yielding a final analytical sample of 35 students per group.

Due to practical constraints and the pilot nature of the intervention, specific schools were selected, which may limit the generalizability of the findings.

Participants were recruited from two secondary schools with similar socioeconomic and cultural backgrounds. The two schools were randomly assigned to the intervention and control groups using a simple coin-toss procedure.

To reduce baseline differences in access to resources, intervention facilities and educational materials were prepared in advance, and selected sports equipment was provided to the intervention school. Eligible students were enrolled after receiving clear information about the study objectives and procedures.

Inclusion criteria comprised female eleventh-grade students aged 16–17 years who had no physical disabilities or diagnosed cardiovascular, respiratory, or psychological disorders, were able to perform exercises, and had obtained parental consent. Participants were excluded if they did not complete the questionnaire, reported controlled chronic conditions (e.g., hypertension or diabetes), transferred to another school during the study period, or missed more than two educational sessions.

Prior to the study, an in-person meeting was held with parents, and written informed consent was obtained from parents or legal guardians before student participation.

The intervention group received a multi-level program incorporating educational components, community engagement activities, and the establishment of supportive environments designed to promote students' physical activity (Table 1). This intervention was grounded in the TTM, which includes the stages of change, processes of change, decisional balance, and self-efficacy. The model suggests that individuals may exhibit different levels of readiness for change and that behavior modification progresses through five distinct stages: precontemplation, contemplation, preparation, action, and maintenance (10).

Processes of change encompass the activities and strategies that facilitate individuals' progression through the stages of change. They are typically categorized into two main types: cognitive processes, which involve individuals' thoughts and feelings regarding unhealthy behaviors, and behavioral processes, which support the modification of such behaviors (14).

Decisional balance is another central construct of the TTM, reflecting an individual's evaluation of the perceived benefits versus the perceived barriers associated with adopting a behavioral change (15).

Finally, self-efficacy, the fourth construct of the TTM model, refers to an individual's confidence in their ability to plan and execute the actions required to achieve specific behavioral goals, as well as to resist the temptation to relapse (11).

Prior to the intervention, participants completed a comprehensive, standardized questionnaire to collect baseline data. The first section collected demographic information, including age, parental education levels, parental occupations, and other relevant variables.

The questionnaires used in the second, third, and fourth sections were adapted from Marcus et al (16). The second section of the questionnaire assessed participants' stages of physical activity behavior change, classifying them into one of five stages: precontemplation, contemplation, preparation, action, and maintenance. The third section, the Processes of Change Questionnaire, comprised 40 items, with each process assessed via four items on a five-

Table 1. Components of the Multi-Level Educational Intervention

Level / Component	Specific Activities
Educational Materials and Training Sessions	- Distribution of educational materials (pamphlets, posters) displayed throughout the school environment. - Conducting five educational sessions for students. - Sending text messages and sharing instructional videos via the Shad platform to ensure continuous learning, enhance motivation, and provide regular reminders. - Developing short educational slogans for posters (e.g., “Physical Activity: Fitness, Joy, and Better Learning”). - Pre-testing educational materials with a sample of target students to assess clarity, comprehension, acceptability, and perceived effectiveness.
Community Action and Reinforcement Strategies	- Providing virtual training sessions for teachers on strategies to reduce sedentary behavior and encourage physical activity during school breaks. - Negotiating with school staff to optimize morning exercise programs. - Providing students with discount cards for accessible gyms. - Holding an orientation session for students’ mothers to strengthen family support.
Supportive Environment and Advocacy	- Meeting with the school principal to maximize accessibility to sports facilities and facilitate the provision of additional sports equipment. - Coordinating discussions with the Health and Wellness Department of the Education Office and the Sports and Youth Administration of Qom Province to advocate for the establishment of a dedicated school sports space.

point Likert scale ranging from 1 (never) to 5 (always). The fourth section comprised the 16-item Decisional Balance Questionnaire, which evaluated the perceived benefits and barriers of exercise. The validity and reliability of these questionnaires have been previously established in Iran by Roozbahani et al (17).

The fifth section assessed participants’ confidence in performing physical activity under various challenging conditions using Bandura’s 18-item Exercise Self-Efficacy Questionnaire (18), the validity and reliability of which were previously validated in Iran by Norouzi et al (19). In the sixth section, physical activity levels were measured using the short form of the International Physical Activity Questionnaire (IPAQ-SF) (20). The IPAQ-SF contains seven items assessing the duration and frequency of vigorous and moderate physical activity, walking, and sedentary behavior over the past seven days. Its validity and reliability in Iran have been previously confirmed by Moghadam et al (21).

The impact of the program on physical activity outcomes was evaluated two months post-intervention. The educational component consisted of five weekly 45-minute sessions delivered over one month.

Data were analyzed using SPSS version 27. Analysis of covariance (ANCOVA) was employed to control for potential confounding variables. Independent and paired t-tests were conducted to compare the processes of change, decisional balance, self-efficacy, and mean physical activity levels between the intervention and control groups before and after the educational program. Because only one school was assigned to each study arm, multilevel modeling to account for cluster-level variability was not feasible. Therefore, analyses were performed at the individual student level, and the results are interpreted as preliminary pilot findings. Chi-square tests were used to examine changes in the distribution of students across the stages of change over time and to determine whether stage progression differed significantly between the two groups.

Results

A total of 70 female students aged 16–17 years participated in the study. Demographic variables were assessed at

baseline, with no significant differences observed between the intervention and control groups regarding age, body mass index (BMI), household size, parental education and occupation, economic status, or residential facility access. However, access to facilities at the school level differed significantly between the two groups ($P < 0.001$), with students in the control group having greater access to educational and recreational facilities compared to those in the intervention group.

Analysis of the distribution of participants across the stages of change revealed a slight increase in the proportion of students in the action and maintenance stages within the intervention group post-program, whereas a decline was observed in the control group. However, these changes were not statistically significant between the groups at either baseline or post-intervention. Detailed results are presented in Table 2.

As illustrated in Table 3, no significant differences were observed between the two groups in physical activity levels or behavioral processes of change at baseline. After the intervention, the intervention group demonstrated a significant increase in both physical activity and associated behavioral processes of change scores. Conversely, no significant changes were observed in the control group over time. Moreover, the magnitude of improvement was significantly greater in the intervention group compared to the control group, supporting the effectiveness of the educational program.

No statistically significant changes were observed for decisional balance or self-efficacy scores in either group over time, and no statistically significant differences were detected between the intervention and control groups (Table 4).

Multivariate ANCOVA revealed that post-intervention physical activity was significantly influenced by the educational program ($P < 0.001$) and baseline activity levels ($P = 0.002$), after adjusting for residential and school facility access, parental education, parental occupation, and family socioeconomic status (Table 5).

Discussion

This study examined the effects of a TTM-based multi-

Table 2. Comparison of Stages of Change Between the Intervention and Control Groups at Baseline and Post-Intervention

	Group Stage	Intervention Frequency (%)	Control Frequency (%)	Chi-square values
Pre-test	Pre-contemplation	7 (20.0%)	4 (11.4%)	0.39
	Contemplation	10 (28.6%)	8 (22.9%)	
	Preparation	7 (20.0%)	6 (17.1%)	
	Action	3 (8.6%)	9 (25.7%)	
	Maintenance	8 (22.9%)	8 (22.9%)	
	Total	35 (100%)	35 (100%)	
Post-test	Pre-contemplation	5 (14.3%)	4 (11.4%)	0.82
	Contemplation	10 (28.6%)	8 (22.9%)	
	Preparation	7 (20.0%)	9 (25.7%)	
	Action	7 (20.0%)	5 (14.3%)	
	Maintenance	6 (17.1%)	9 (25.7%)	
	Total	35 (100%)	35 (100%)	
Wilcoxon Values		0.55	0.83	

Table 3. Comparison of Physical Activity and Behavioral Processes of Change Between the Intervention and Control Groups at Baseline and Post-Intervention

Variable		Intervention (Mean ± SD)	Control (Mean ± SD)	Independent t-test
Physical Activity	Before	335.18 ± 172.85	336.30 ± 177.68	0.898
	After	630.71 ± 251.22	348.97 ± 177.94	0.008
Paired t-test		<0.001	0.345	
Mean Difference		295.53 ± 169.49	12.67 ± 22.32	0.001
Processes of Change	Before	3.01 ± 0.74	3.27 ± 0.72	0.13
	After	3.35 ± 0.73	3.27 ± 0.66	0.63
Paired t-test		0.003	0.91	
Mean Difference		0.33 ± 0.63	-0.009 ± 0.50	0.014

Note. SD: Standard deviation; MET: Metabolic equivalent of task.

level educational intervention on the physical activity levels of female high school students in Qom. Changes in total physical activity scores from baseline to two months post-intervention were compared between the groups, revealing a significant difference in the magnitude of change ($P < 0.05$). These results highlight the effectiveness of the TTM-based educational intervention in improving physical activity levels among students in the intervention group. Similar findings have been reported in previous studies, including those by Zhang et al (22) and Pirzadeh et al (5). This effect may be attributed to the intervention's multilevel design, which targeted not only individual behavioral change but also environmental factors, social support, and school policies.

The findings further showed that, after the intervention, students in the intervention group engaged more frequently in the processes of change than those in the control group. Similar results were reported by Mostafavi et al, supporting the present findings (10). Furthermore, Liu et al found that, among the constructs of the TTM, only the processes of change significantly influenced physical activity in the final structural model (11). Since the processes of change were

Table 4. Comparison of Decisional Balance and Self-Efficacy Between the Groups at Baseline and Post-Intervention

Variable		Intervention (Mean ± SD)	Control (Mean ± SD)	Independent t-test
Decision Balance	Before	1.01 ± 1.41	0.99 ± 1.08	0.96
	After	0.92 ± 1.15	1.01 ± 0.98	0.75
Paired t-test		0.72	0.93	
Mean Difference		-0.08 ± 1.33	0.01 ± 1.05	0.741
Self-Efficacy	Before	44.91 ± 29.49	51.32 ± 23.50	0.31
	After	49.70 ± 23.26	48.86 ± 22.71	0.87
Paired t-test		0.15	0.30	
Mean Difference		4.78 ± 19.33	-2.46 ± 14.04	0.078

Note. SD: Standard deviation.

the only TTM construct to reach statistical significance in this study, they appear to have exerted the greatest influence on students' physical activity.

Self-efficacy was another individual factor examined in this study. Although the intervention group showed an increase in mean self-efficacy scores compared to baseline, no improvement was observed in the control group. However, statistical analysis indicated no significant difference between the groups post-intervention. The lack of a statistically significant effect does not necessarily imply that the intervention was ineffective; rather, the intervention period may have been too short to produce meaningful changes in self-efficacy. As enhancing self-efficacy is a gradual process, a longer follow-up period may be required. Similar findings were reported by Fort et al, who observed no significant change in self-efficacy, consistent with the present results (23). In contrast, the findings of Fallahipour et al regarding physical activity self-efficacy differ from those of the present study (13). This discrepancy may be explained by differences in participant characteristics or variations in cultural and social contexts.

Although family and peer encouragement served as sources of social support for initiating and maintaining physical activity in this study, no statistically significant changes were observed in the stages of change between pre- and post-test assessments. However, the distribution of students across the stages indicated an increase in the proportion of participants in the action and maintenance stages within the intervention group, whereas a decline was observed in the control group. While these differences were not statistically significant, the observed rise in the action and maintenance stages among students in the intervention group, contrasted with the decline in the control group, suggests a potentially beneficial effect of the educational program.

The lack of statistical significance may be partly due to the overlap of the intervention period with students' examination season. In addition, the limited duration and intensity of the intervention sessions may have been insufficient to produce a strong effect distinguishable from natural variation or minor influences experienced by the control group. Moreover, although the stages of change model is useful for broadly classifying behaviors, within-

Table 5. Multivariate ANCOVA of Post-Intervention Physical Activity Levels

Parameter	B	SE	t	Sig.	95% Confidence Interval		Partial Eta Squared
					Lower Bound	Upper Bound	
Intercept	4136.055	1790.566	2.310	0.024	554.389	7717.720	0.082
Group (intervention vs. Control)	-2081.935	494.412	-4.211	<0.001	-3070.905	-1092.965	0.228
Residential Facility Access	559.581	463.106	1.208	0.232	-366.769	1485.931	0.024
School Facility Access	189.719	479.654	0.396	0.694	-769.732	1149.171	0.003
Father's Education	-272.211	194.864	-1.397	0.168	-661.998	117.576	0.031
Mather's Education	351.288	271.729	1.293	0.201	-192.251	894.828	0.027
Father's Occupation	-189.829	229.615	-0.827	0.412	-649.128	269.470	0.011
Mather's Occupation	-23.703	177.172	-0.134	0.894	-378.101	330.694	0.000
Family Economic Status	151.681	334.053	0.454	0.651	-516.523	819.886	0.003
Baseline MET Score	0.672	0.206	3.257	0.002	0.259	1.084	0.150

Note. ANCOVA: Analysis of covariance; MET: Metabolic equivalent of task; SE: Standard error.

stage movement and subtle behavioral changes may not be fully captured, thereby reducing the likelihood of detecting between-group differences. In addition, external factors, such as school events, weather variation, or general health campaigns, may have affected both groups, complicating the isolation of the intervention's specific effects. Research indicates that individuals who advance by even one stage are approximately twice as likely to successfully initiate subsequent behavioral change (24). Comparable results have been reported by Taghipour et al, consistent with the present study's findings (25). However, the present findings differ from those reported in several other studies (1, 10, 14, 26), a discrepancy that may be partly explained by differences in sample size, given fewer participants in the current study.

The results also indicated that the educational intervention did not significantly improve students' decisional balance. This null finding suggests that, although the multilevel educational program may have enhanced physical activity, it did not substantially alter participants' overall cognitive evaluation of the perceived costs and benefits of being active. Since the intervention primarily emphasized behavior maintenance rather than resolving the initial ambivalence (i.e., weighing pros vs. cons) typical of earlier stages, it may have been more effective for students already in the action or maintenance stages. Accordingly, substantial group-level changes in decisional balance would be less likely if relatively few participants were in the precontemplation or contemplation stages at baseline. Additionally, perceived barriers to physical activity—such as time constraints, perceived effort, fatigue, and social anxiety—are often highly individualized, emotionally salient, and embedded within broader lifestyle and contextual demands. Compared with individualized cognitive-behavioral techniques or individual counseling, a standardized educational program, even a multilevel one, may be insufficient to modify these deeply ingrained personal obstacles. Furthermore, sociocultural norms and expectations in Qom may shape students' decision-making patterns. The lack of significant change in decisional balance before or after the intervention highlights the

need for sustained educational programming and targeted barriers to support behavioral change and habit formation. Consistent with the present findings, Ceylan and Erol reported no significant post-intervention differences in perceived pros and cons between intervention and control groups (26, 27).

Multivariate ANCOVA indicated that the TTM-based multilevel educational intervention significantly increased students' physical activity. Membership in the intervention group was the strongest independent predictor of higher post-intervention activity levels ($P < 0.001$), even after adjusting for relevant sociodemographic and environmental covariates (e.g., facility access, parental education, parental occupation, and family economic status). Baseline physical activity was also a significant predictor ($P = 0.002$), highlighting the influence of pre-existing habits; however, the intervention effect was considerably greater. Although a non-significant trend toward stage progression was observed and decisional balance remained unchanged, the primary behavioral outcome improved significantly. These findings suggest that the intervention may have operated through other TTM-related mechanisms, such as enhancing self-efficacy or engaging behavioral processes of change, rather than through a direct shift in participants' fundamental cost-benefit evaluation. Overall, the findings demonstrate that this multilevel, theory-driven intervention produced measurable behavioral improvements, supporting its effectiveness and potential generalizability across diverse socioeconomic contexts in educational settings (28). To enhance greater progression across the stages of change, future interventions should incorporate more targeted components that directly address perceived barriers and decisional ambivalence.

This study has several limitations. The most significant limitation is the allocation of only one school per study arm. Although the schools were selected based on their similarities, this design cannot rule out confounding variables inherent to each school's unique environment (e.g., administrative attitudes toward sports, facility quality, or peer culture). Consequently, the observed

improvements in the intervention group may partially reflect school-level factors rather than the educational program alone. Conducting the study in only two schools likely conflates the effects of the intervention with school administration, resources, and student culture. Analyzing student-level data while ignoring this contextual hierarchy is statistically problematic, as it can produce overly narrow confidence intervals and increase the risk of Type I errors. Future research must employ a true cluster-randomized design with a minimum of three to four schools per arm to adequately control for cluster-level variability.

The design of the study should include the clustering of three to four schools in each intervention arm. The follow-up lasted only two months, and physical activity was assessed using the self-administered IPAQ, which may be subject to recall errors or social desirability bias. Students in the control school may have been exposed to external programs, and the convenience sampling method limits the generalizability of the findings. Future research should incorporate longer follow-up periods, objective measures of physical activity, and more diverse, randomly selected school samples. Structural factors, such as limited school time for exercise and low prioritization of physical activity, should be addressed through educational policies to support healthy and sustainable activity behaviors among students.

Conclusion

The results of this study indicate that a TTM-based multilevel educational intervention effectively increased physical activity among adolescent girls, primarily by enhancing change processes. No significant changes were observed in stages of change, self-efficacy, or decisional balance, suggesting that these constructs may be less responsive to short-term interventions and could require longer or more intensive programs.

These findings highlight that, while behavior-focused skills can improve in the short term, motivational and decisional constructs appear to evolve more gradually. Consequently, future interventions should incorporate long-term, personalized strategies, such as motivational counseling, peer support, or family involvement, to effectively reinforce self-efficacy and strengthen decision-making over time.

From a practical perspective, these results suggest that integrating multilevel, theory-driven educational programs into school-based health promotion programs can effectively enhance physical activity levels and foster healthier lifestyle behaviors among adolescent girls.

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Competing Interests

The authors declare that they have no conflicts of interests.

Ethical Approval

This study was approved by the Institutional Ethics Committee of Qom University of Medical Sciences (IR.MUQ.REC.1402.204). Ethical procedures included obtaining informed consent from all participants, maintaining anonymity by excluding names from the questionnaires, and providing the control group with an educational session and accompanying pamphlet after data collection to ensure educational equity.

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References

1. Jalali S, Roozbahani N, Shamsi M. The effectiveness of tailored interactive multimedia software based on the transtheoretical model for the promotion of physical activity behaviours. *Malays J Med Sci* 2022;29(4):140-51. doi:10.21315/mjms2022.29.4.13
2. Bull FC, Al-Ansari SS, Biddle S, Borodulin K, Buman MP, Cardon G, et al. World Health Organization 2020 guidelines on physical activity and sedentary behaviour. *Br J Sports Med* 2020;54(24):1451-62. doi:10.1136/bjsports-2020-102955
3. Asa-Kohnfroody Z, Peyman N, Ghodsikhah F, Shakeri-Nejad G. The effect of education based on planned behavior theory on physical activity of high school girls. *Iran J Health Educ Health Promot* 2020;8(3):210-23. doi:10.29252/ijhehp.8.3.210
4. Sheng J, Shi P, Sun J, Feng X. Predictors of physical activity behavior transitions in children and adolescents: a systematic review based on a transtheoretical model. *J Healthc Eng* 2023;2023:5786841. doi:10.1155/2023/5786841
5. Pirzadeh A, Zamani F, Khoshali M, Kelishadi R. Web-based intervention on the promotion of physical activity among Iranian youth using the transtheoretical model. *J Educ Health Promot* 2020;9:118. doi:10.4103/jehp.jehp_36_20
6. Tamimi H, Noroozi A. Determinants of physical activity in high school girl students: study based on health promotion model (HPM). *J Health* 2016;6(5):527-37. [Persian].
7. Pourranjbar M, Jamalizadeh H, Mehrtash M, Divsalar K. Evaluation of relationship between physical activity and body mass index on postmenopausal women's health status in Kerman province. *Iran J Epidemiol* 2019;15(2):179-87. [Persian].
8. Kipping RR, Howe LD, Jago R, Campbell R, Wells S, Chittleborough CR, et al. Effect of intervention aimed at increasing physical activity, reducing sedentary behaviour, and increasing fruit and vegetable consumption in children: active for life year 5 (AFLY5) school-based cluster randomised controlled trial. *BMJ* 2014;348: g3256. doi:10.1136/bmj.g3256
9. Larki A, Tahmasebi R, Reisi M. Factors predicting self-care behaviors among low health literacy hypertensive patients based on health belief model in Bushehr district, south of Iran. *Int J Hypertens* 2018;2018:9752736. doi:10.1155/2018/9752736
10. Mostafavi F, Ghofranipour F, Feizi A, Pirzadeh A. Improving physical activity and metabolic syndrome indicators in women: a transtheoretical model-based intervention. *Int J Prev Med* 2015;6:28. doi:10.4103/2008-7802.154382
11. Liu KT, Kueh YC, Arifin WN, Kim Y, Kuan G. Application of transtheoretical model on behavioral changes, and amount of physical activity among university's students. *Front Psychol*

- 2018;9:2402. doi:[10.3389/fpsyg.2018.02402](https://doi.org/10.3389/fpsyg.2018.02402)
12. Fallahipour L, Nazari M, Karimi M, Zare E. Effectiveness of educational intervention based on transtheoretical model on physical activity and menopausal symptoms. *Biomed Res Int* 2022;2022:1791445. doi:[10.1155/2022/1791445](https://doi.org/10.1155/2022/1791445)
 13. Ziaee V, Kelishadi R, Ardalan G, Gheiratmand R, Majdzadeh SR, Mottaghian Monazzam M. Physical activity in Iranian students CASPIAN study. *Iran J Pediatr* 2006;16(2):157-64.
 14. Eskandari N, Araban M, Saki Malehi A. Promoting physical activity in women referred to health centers applying the transtheoretical model. *Iran J Health Educ Health Promot* 2015;3(1):14-22. [Persian].
 15. Jalali S, Roozbahani N, Shamsi M. Determinants of physical activity behaviors among people aged 30 to 50 years: an application of the transtheoretical model. *J Educ Community Health* 2019;6(1):17-23. doi:[10.29252/jech.6.1.17](https://doi.org/10.29252/jech.6.1.17)
 16. Marcus BH, Forsyth LH. *Motivating People to Be Physically Active*. 2nd ed. Champaign, IL: Human Kinetics; 2003.
 17. Roozbahani N, Ghofranipour F, Eftekhari Ardabili H, Hajizadeh E. Factors influencing physical activity among postpartum Iranian women. *Health Educ J* 2014;73(4):466-76. doi:[10.1177/0017896913490511](https://doi.org/10.1177/0017896913490511)
 18. Bandura A. *Self-Efficacy: The Exercise of Control*. 1st ed. New York: WH Freeman and Company; 1997.
 19. Noroozi A, Ghofranipour F, Heydarnia AR, Nabipour I, Tahmasebi R, Tavafian SS. The Iranian version of the exercise self-efficacy scale (ESES) Factor structure, internal consistency and construct validity. *Health Educ J* 2011;70(1):21-31. doi:[10.1177/0017896910374547](https://doi.org/10.1177/0017896910374547)
 20. International Physical Activity Questionnaire (IPAQ) Research Committee. Guidelines for Data Processing and Analysis of the International Physical Activity Questionnaire (IPAQ)-Short and Long Forms. IPAQ; 2005. Available from: <https://sites.google.com/view/ipaq/score>. Updated July 2016. Accessed August 5, 2024.
 21. Moghaddam M, Hajikazemi E, Roozbeh F, Houshyar-Rad A, Hosseini AF. Relationship between physical activity and triceps skin fold thickness in adolescent girl students. *Iran Journal of Nursing* 2011;24(69):62-8. [Persian].
 22. Zhang Y, Yin Y, Liu J, Yang M, Liu Z, Ma X. Impact of combined theory-based intervention on psychological effects and physical activity among Chinese adolescents. *Int J Environ Res Public Health* 2020;17(9):3026. doi:[10.3390/ijerph17093026](https://doi.org/10.3390/ijerph17093026)
 23. Fort MP, Murillo S, López E, Dengo AL, Alvarado-Molina N, de Beausset I, et al. Impact evaluation of a healthy lifestyle intervention to reduce cardiovascular disease risk in health centers in San José, Costa Rica and Chiapas, Mexico. *BMC Health Serv Res* 2015;15:577. doi:[10.1186/s12913-015-1248-7](https://doi.org/10.1186/s12913-015-1248-7)
 24. Karami Daranjani S, Yazdanpanah A, Kharazmi E. The effect of health education program based on trans-theoretical model on promotion of physical activity among children of patients with hypertension and diabetes. *J Health* 2017;8(4):394-407. [Persian].
 25. Taghipour A, Vahedian Shahroudi M, Tabesh H, Safari-Moradabadi A, Alipour Anbarani M. The effect of educational intervention based on the theory of planned behavior and stages of change construct on women's physical activity. *J Educ Health Promot* 2019;8:195. doi:[10.4103/jehp.jehp_45_19](https://doi.org/10.4103/jehp.jehp_45_19)
 26. Ceylan F, Erol S. The effect of a physical activity program using WhatsApp on adolescents' exercise behavior. *J Sch Nurs* 2024;40(6):662-74. doi:[10.1177/10598405221132207](https://doi.org/10.1177/10598405221132207)
 27. Middelkamp J, van Rooijen M, Wolfhagen P, Steenbergen B. The effects of a self-efficacy intervention on exercise behavior of fitness club members in 52 weeks and long-term relationships of transtheoretical model constructs. *J Sports Sci Med* 2017;16(2):163-71.
 28. Sutherland RL, Campbell EM, Lubans DR, Morgan PJ, Nathan NK, Wolfenden L, et al. The physical activity 4 everyone cluster-randomized trial: 2-year outcomes of a school physical activity intervention among adolescents. *Am J Prev Med* 2016;51(2):195-205. doi:[10.1016/j.amepre.2016.02.020](https://doi.org/10.1016/j.amepre.2016.02.020)