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LEISURE-TIME PHYSICAL ACTIVITY OF ADOLESCENTS WITHIN THE FRAMEWORK OF THE TRANSTHEORETICAL MODEL

Key words: physical activity, transtheoretical model.

ABSTRACT

The aim of the study was to test the application of the transtheoretical model (TTM) in describing leisure-time physical activity of adolescents. The subjects (N=1251) were high-school students, 16-19 years of age (*M* 17.33, *SD* 0.87). The proportion of adolescents in each stage of change was as follows: pre-contemplation 7.59%, contemplation 11.35%, preparation 43.25%, action 13.11%, and maintenance 24.70%. Significantly more males were in the maintenance stage, while significantly more females were in the preparation stage. Self-efficacy, pros and cons, and ten processes of change differed significantly across stages. The large effect sizes were found for most TTM variables except environmental reevaluation and social liberation. In pros as well as in four processes of change (consciousness raising, environmental reevaluation, social liberation and helping relationships) some sex differences were observed. In pros and in social liberation female adolescents scored higher than their male peers. In both cases the differences were observed first of all in the pre-contemplation stage.

INTRODUCTION

Physical activity is one of the factors which already in ancient times was considered to contribute to the development of functional and structural characteristics of a human body [11, 15]. Unfortunately, cultural evolution has caused that many contemporary people are physically too inactive to meet the biological needs of their bodies [11]. As a result many diseases have appeared, known as civilization diseases, which deteriorate the quality of life, contribute to premature death and increase the costs of medical care, e.g. atherosclerosis, hypertension, obesity, non-insulin-dependent diabetes mellitus, osteoporosis, to name but a few.

As most daily activities require only minimal physical effort, it is necessary to voluntarily

increase its level. However, the transition between both kinds of physical activity: "natural" (forced by life needs) and voluntary, is not easy. Not only because of many objective factors (for example, time demands of studying and earning a living), but first of all because, "A human being as opposed to animals unfortunately has a consciousness, which directs his behavior in such a way as to, at all costs, avoid effort because the lack of it means for him a state of bliss" [1, p. 64]. Promotion of physical activity is therefore a significant challenge, which, in order to be successful, has to be based on the knowledge of factors that determine this kind of behavior. Research on determinants (correlates) of physical activity fall into two broad categories: atheoretical and theoretical. The latter is considered the most promising [3]. Its essence is testing theoretical models, which propose which

determinants of physical activity behaviors are most important and how they are related to each other. Contemporary theoretical models include a category known as “dynamic” or “stage” models, in which behavioral changes are perceived as a dynamic process including passing through qualitatively different stages. Understanding their nature would help tailor interventions to the unique features of each stage and therefore make them more individualized. One of the most popular stage models, although not free from criticism (see [2, 8, 20, 33]), is the transtheoretical model (TTM), which is even considered to be “the most important theoretical health promotion development of the decade” (Samuelson cited in [8, p. 55]).

One of the core constructs of the TTM is the construct of stages of change, also known as stages of motivational readiness for exercise or stages for exercise behavior in physical activity sciences [3, 6, 7, 14, 28]. The TTM involves five stages of change: pre-contemplation (an individual is physically inactive and lacks intention to start activity in the foreseeable future, defined in the model as six months); contemplation (an individual is physically inactive, however, wants to become active within the next 6 months); preparation (an individual engages in physical activity, but not at the recommended level), action (an individual is regularly active at the recommended level, but for less than 6 months) and maintenance (an individual is regularly active at the recommended level for more than 6 months). In the original version of the TTM was applied in research on smoking cessation. Apart from the above mentioned stages, a sixth stage called termination was also defined (100% self efficacy, no temptation to return to undesired behavior and a five-year-period of staying at the maintenance stage) [28]. Because of a small number of studies and ambiguity of the results, the question of the TTM application in researching exercise behavior remains open [12, 16]. Also, it is worth mentioning that some authors suggest dividing some stages into sub-stages, which are to reflect transformations within a particular stage. For example, according to T. Gorely and D. Bruce, [17] the contemplation stage could be divided into three sub-stages: 1/ “early contemplators” (high risk of relapse to pre-contemplation because of low self-efficacy and perceiving more cons than pros of exercising); 2/ “middle contemplation” (low self-efficacy and perceiving pros as much as cons of exercising); 3/ “pre-preparation” (high self-efficacy and percei-

ving very few cons of exercising). However, these claims remain to be confirmed by further research.

The other TTM constructs refer to mechanisms involved in the transition between stages, and they enable us to understand how the changes occur. These constructs are: 1/ self-efficacy – the extent to which a person believes he or she is able to take action in order to achieve a particular result. As different research studies suggest, self-efficacy tends to increase from pre-contemplation to maintenance; 2/ decisional balance – evaluation of potential benefits (pros) and disadvantages (cons) of a target behavior. An increase in pros and decrease in cons can be observed across stages; 3/ processes of change, which are defined as “covert and overt activities that people use to progress through the stages” [28, p. 39]. Ten processes have been identified and classified into two categories – 1. experiential or cognitive, referring to “the ways in which people’s behavior changes as a result of changing the way they think and changing the way they view their lives and the outside world” [7, p. 80]; and 2. behavioral, related to the ways in which people modify their environments and change their behavior in response to these changes in the environment” [7, p. 80]. Descriptions of the processes of change and sample items are presented in Table 1.

Most of research on the TTM in physical activity sciences has been conducted on adults. However, a great interest in using the model to understand the physical activity of adolescents [9, 18, 19, 24, 25, 27, 29, 34] or even pre-adolescents [10] can also be observed. Testing TTM constructs on adolescents could have practical and significant implications for the content of physical education [26, p. 11].

Studies on physical activity carried out in Poland rarely refer to the question of physical activity determinants, especially on the basis of models of behavioral change. Studies of B. Bik [5] on a health belief model or A. Łuszczynska [19] and K. Sas-Nowosielski [31] on the theory of planned behaviour are exceptions. There is a complete lack of research based on the TTM framework, which was only discussed in papers of A. Łuszczynska [21] and K. Sas-Nowosielski [30]. Therefore, the purpose of the present study was to test the application of the TTM in relation to leisure-time physical activity of Polish adolescents.

Table 1. Processes of change – definition and sample item

Name of the process	Definition	Sample item
Cognitive (experiential)		
Consciousness raising (gathering information)	Increasing awareness about consequences of sedentary lifestyle, increasing knowledge on exercise	I read articles about exercise to learn more about it
Dramatic relief (being moved emotionally)	Experiencing (negative) emotions, which will be reduced if exercise will be taken	I worry that lack of exercise can be harmful to my body
Environmental reevaluation (being a role model)	Cognitive and emotional assessment of how ones behavior influence social environment	I wonder how my inactivity affects those people who are close to me
Self-reevaluation (developing a healthy self-image)	Cognitive and emotional assessment of how ones behavior influence his/her self image, shaping new self-image	I think about the type of person I will be if I exercise
Social-liberation (increasing health alternatives)	Perceiving changes in social attitudes towards active lifestyle, being aware that change in lifestyle is possible and socially acceptable	I find society changing in ways that make it easier to exercise
Behavioral		
Counterconditioning (seeking alternatives)	Substitution of alternative behaviors for the inactive ones	When I feel tired I take some exercise because I know I will feel better afterward
Reinforcement management (rewarding oneself)	Managing contingencies that control one's behavior in order to increase probability of taking desired ones	I reward myself when I exercise
Helping relationships (getting social support)	Gaining social support for exercise	I have someone who provides feedback about my exercises
Stimulus control (using cues)	Reorganization of physical and social environment to support exercising and avoid inactivity	I put things around my home to remind me of exercising
Self-liberation (making a commitment)	Committing oneself to take actions in accordance with one's belief of possibility to lead active lifestyle	I make commitments to exercise

METHODS

Participants and procedures

The research was carried out in the fourth quarter of 2005 by means of diagnostic poll method on a sample of 1,251 high schools students (boys n=435, 34.78%; girls n=816, 65.23%) from the Katowice agglomeration. Their age was between 16 and 19 years (M 17.33, SD 0.87). The subjects were asked to complete anonymous questionnaires and were informed that their participation was voluntary and they could withdraw from completing questionnaires at any moment without giving their reasons. The study was approved by the Committee of Scientific Research of the University School of Physical Education in Katowice.

Instruments

Questionnaires assessing TTM constructs were translated into Polish in accordance with the translation-back-translation procedure.

Stages of change were assessed with the use of five statements adapted from K.S. Courneya and T.B. Bobick [12]. Participants were asked to mark the statement that best described their current exercise status. Regular exercise was defined as exercising three or more times a week for at least 30 minutes each time and at least at the moderate intensity level (some examples of activities of moderate intensity were provided), excluding obligatory school physical education. Respondents who indicated that they were in the preparation, action or maintenance stage were also asked to provide some information about patterns of their exercising and kind of exercises they do.

Self-efficacy was assessed using the scale adapted from B.H. Marcus and L.A. Forsyth [22] with two additional statements added, related to the specificity of spending leisure-time by adolescents: "Friends urge you to go with them to the pub, to the party etc." and "There is an attractive series or other show on TV". The subjects marked then the

level of confidence of their ability to undertake exercise in presented situations on a 5-point Likert scale (from 1 = “not confident at all” to 5 = “very confident”). Cronbach α of the scale amounted to 0.82.

Decisional balance was assessed using the scale adapted from B.H. Marcus and L.A. Forsyth [22]. Subjects indicated how important – on a 5-point Likert scale (from 1 = “not important at all” to 5 = “extremely important”) for their decision to exercise or not to exercise were arguments for regular exercising (10-item pros subscale) and arguments against it (6-item cons subscale) Cronbach α of the pros subscale was 0.92; Cronbach α of the cons subscale was 0.83.

Processes of change were assessed using a questionnaire adapted from B.H. Marcus and L.A. Forsyth [22] measuring five experiential and five behavioral processes of change (definition of the processes and sample items are presented in Table 1). The participants indicated on a 5-point Likert scale (from 1 = “never” to 5 = “repeatedly”) how often during the past month they experienced situations described in the questionnaire. Cronbach α values ranged from 0.58 (social liberation) to 0.83 (raising consciousness), and in the case of the former, reached below the 0.60 threshold considered by A. Sokołowski and A. Sagan [32] to be acceptable reliability.

Analysis

For each measured construct means and standard deviations were calculated. One-way ANOVAs were conducted to investigate possible differences in self-efficacy, decisional balance, and processes of change across the stages of change. If significant differences were observed post-hoc comparisons

were calculated. To examine the differences between male and female adolescents in the stages of change χ^2 was conducted. All analyses were performed using Statistica 5.0 PL.

RESULTS

Of the 1,251 respondents 237 (18.94%) were classified as inactive (pre-contemplation and contemplation) and 473 (37.81%) as regularly active (action and maintenance). The distribution of the stages of change is presented in Table 2. 203 (42.92%) adolescents classified as regular exercisers declared that they were exercising three to four days a week, 127 (26.85%) four to five days a week, and 93 (19.66%) that they were exercising every day or nearly every day. 50 (10.57%) did not answer the question. Average exercising time amounted to about 1-1.5 hour and the forms of physical activity included exercises at home (calisthenics, stationary bicycle and resistance exercises like push-ups, sit-ups, pull-ups), followed by swimming, aerobics, body-building, jogging, team games, martial arts (capoeira, karate, taekwon-do, judo, ju-jitsu, kick-boxing muay-thai, boxing), le parkour (also known as free running), climbing, tennis, race-walking, table tennis, and dancing. From the adolescents on the preparation stage, 331 (61.18%) answered that they exercised “from time to time”, “variously”, “depending on the amount of their free time” etc.; and 184 (34.01%) declared that they exercised regularly, but below the criterion level, exercising only during weekends (seasonal activities such as swimming, backpacking, cycling, snowboarding, skiing, skating, kayaking) or doing only morning exercises for 10-15 min each time. 26 respondents did not answer the question.

Table 2. Distribution of stages of change among participants of the study

	Precontemplation		Contemplation		Preparation		Action		Maintenance	
	n	%	n	%	n	%	n	%	n	%
Totality of respondents	95	7.59	142	11.35	541	43.25	164	13.11	309	24.70
Female	65	7.97	102	12.50	382	46.81	109	13.36	158	19.36
Male	30	6.90	40	9.20	159	36.55	55	12.64	151	34.71
Female/male difference	$\chi^2_{df=1}=0.46$ p=0.497		$\chi^2_{df=1}=3.08$ p=0.079		$\chi^2_{df=1}=12.17$ p=0.000		$\chi^2_{df=1}=0.13$ p=0.722		$\chi^2_{df=1}=35.94$ p=0.000	

Table 3. Means (standard deviations), one-way ANOVA, post-hoc Tukey test, and effect size results for study variables

	PC	C	P	A	M	F _(4, 1241)	Post hoc (p<0.05)	η ²
Self-efficacy	1.87 (0.70)	2.61 (0.64)	3.11 (0.64)	3.59 (0.70)	4.02 (0.68)	252.17*	PC<C<P<A<M	0.45
Pros	2.24 (0.80)	3.12 (0.67)	3.43 (0.67)	4.04 (0.52)	4.23 (0.52)	234.86*	PC<C<P<A, M P<M	0.43
Cons	3.60 (0.84)	3.26 (0.78)	2.84 (0.72)	2.16 (0.66)	1.89 (0.64)	184.66*	PC>C>P>A>M	0.37
Consciousness raising	1.33 (0.56)	2.05 (0.76)	2.28 (0.85)	2.74 (1.02)	2.99 (1.03)	80.21*	PC<C, P<A, M C<A, M P<M	0.21
Dramatic relief	1.81 (0.82)	2.56 (0.75)	2.80 (0.85)	3.14 (0.90)	3.13 (0.91)	51.24*	PC<C, P<A, M C<A, M P<M	0.14
Environmental reevaluation	1.79 (0.80)	2.27 (0.81)	2.53 (0.81)	2.74 (0.98)	2.88 (0.93)	34.76*	PC<C, P, A, M C<A, M P<M	0.10
Self-reevaluation	2.21 (1.05)	3.15 (0.84)	3.27 (0.80)	3.63 (0.83)	3.56 (0.92)	51.80*	PC<C, P<A, M C<A, M P<M	0.14
Social liberation**	2.47 (1.12)	3.03 (0.80)	3.22 (0.81)	3.47 (0.88)	3.51 (0.89)	30.99*	PC<C, P, A, M C<A, M P<M	0.09
Counterconditioning	1.40 (0.63)	1.93 (0.79)	2.83 (0.80)	3.31 (0.98)	3.62 (0.99)	191.71*	PC<C<P<A<M	0.38
Helping relationships	1.60 (0.70)	2.25 (0.89)	2.61 (0.84)	2.91 (1.03)	3.28 (0.98)	79.17*	PC<C<P<A<M	0.20
Reinforcement management	1.27 (0.48)	1.79 (0.73)	2.58 (0.75)	3.01 (0.87)	3.10 (0.94)	140.08*	PC<C<P<A, M P<M	0.31
Self-liberation	1.93 (0.75)	3.03 (0.85)	3.41 (0.82)	3.85 (0.84)	3.86 (0.91)	111.76*	PC<C<P<A, M P<M	0.27
Stimulus control	1.30 (0.51)	1.70 (0.68)	2.18 (0.79)	2.57 (1.03)	2.75 (1.07)	74.62*	PC<C<P<A, M P<M	0.19

PC – precontemplation; C – contemplation, P – preparation, A – action, M – maintenance

* p<0.05 **because of low reliability the results of this process of change should be treated with caution

Table 4. Correlation coefficient matrix for TTM variables

Variable	1	2	3	4	5	6	7	8	9	10	11	12	13	14
1 Stage		0.67	0.64	-0.61	0.45	0.34	0.31	0.32	0.28	0.60	0.45	0.53	0.46	0.43
2 Self-efficacy			0.56	-0.50	0.39	0.31	0.26	0.28	0.24	0.56	0.38	0.42	0.42	0.37
3 Pros				-0.37	0.44	0.46	0.42	0.54	0.42	0.56	0.39	0.51	0.51	0.39
4 Cons					-0.31	-0.21	-0.14	-0.18	-0.15	-0.42	-0.27	-0.34	-0.32	-0.25
5 Consciousness raising						0.53	0.52	0.42	0.37	0.58	0.57	0.65	0.43	0.63
6 Dramatic relief							0.59	0.60	0.45	0.51	0.43	0.54	0.51	0.47
7 Environmental reevaluation								0.52	0.48	0.46	0.46	0.51	0.34	0.53
8 Self-reevaluation									0.59	0.49	0.40	0.49	0.62	0.33
9 Social liberation										0.48	0.44	0.41	0.50	0.33
10 Counterconditioning											0.56	0.67	0.56	0.54
11 Helping relationships												0.56	0.46	0.52
12 Reinforcement management													0.57	0.64
13 Self-liberation														0.34
14 Stimulus control														

Note: all correlations are significant at $p < 0.05$

Stage distribution turned out to be related to gender ($\chi^2=37.24$, $df=4$, $p=0.000$), but not to age ($\chi^2=13.91$, $df=12$, $p=0.307$). As it can be seen in Table 2 differences between male and female students concerned especially the preparation and maintenance stages, while in the contemplation stage only a tendency toward statistical difference was observed. Female students were more likely to be in the preparation and contemplation stages, and male students were more likely to be in the maintenance stage.

The means, standard deviations, F-tests, post-hoc comparisons and portion of variance explained (η^2) for TTM constructs are shown in Table 3. All of the TTM constructs were significantly correlated with the stages of change. The largest portion of variance was explained by self-efficacy ($\eta^2=0.45$), followed by pros ($\eta^2=0.43$), counterconditioning ($\eta^2=0.38$) and cons ($\eta^2=0.37$). All TTM variables were statistically correlated with the stages of change, with the strongest correlation in self-efficacy ($r=0.67$) and the only negative correlation in the perceived cons ($r=-0.61$). Correlations between variables are shown in Table 4. Self-efficacy increased linearly across stages. A similar increase in pros was observed, with accompanying decrease in cons. Following the suggestions of C.R. Nigg and K.S. Courneya [25] the interaction between pros and cons was calculated for raw scores and after transformation of them into standardized t -scores ($M = 50$, $SD = 10$, one unit of t -scale = $0.1 SD$) as well. The transformation allows for bringing different scales – in this case, pros and cons – to the same scaling technique. Without

standardization the general mean of pros is higher than of cons and in consequence the line for pros across stages is raised, causing a shift in the intersection point with the cons line.

A repeated-measures MANOVA revealed that interaction of pros and cons across the stages of change was significant for raw scores, $F_{(4, 1238)}=416.86$, $p=0.000$, as well as for standardized t -scores, $F_{(4, 1238)}=419.38$, $p=0.000$, therefore in both cases post hoc analyses were performed. For raw scores the pros-minus-cons differences were significant in the pre-contemplation ($p=0.000$), preparation ($p=0.000$), action ($p=0.000$) and maintenance ($p=0.000$) stages; and were not significant in contemplation stage ($p=0.134$) in which the decisional balance point or intersections of pros and cons occurred. For standardized t -scores the pros-minus-cons differences were significant in all stages ($p=0.000$), and the intersection of pros and cons occurred between the contemplation and the preparation stages.

Of the ten processes of change, counterconditioning explained the most ($\eta^2=0.38$) and social liberation the least ($\eta^2=0.09$) of the variance; the former had also the strongest correlation with the stages of change ($r=0.60$), whereas the latter – the weakest ($r=0.28$). However, because of low reliability of the latter, these results should be treated with caution. All processes of change were significantly related to the stages of change, increasing from precontemplation to maintenance.

In order to examine sex differences in the studied constructs two-way ANOVAs and accom-

panying post hoc tests were conducted. The results revealed that the differences between male and female adolescents occurred in five constructs: pros, raising consciousness, environmental reevaluation, social liberation, and helping relationships. In pros a difference occurred in the pre-contemplation stage, where female adolescents scored higher than male adolescents ($p=0.024$). In environmental reevaluation, although interaction was significant, a post hoc analysis failed to locate differences on either stage. It must be remembered, however, that the Tukey test is considered to be very restrictive; after the Fisher LSD (least significant difference) test was performed, significant differences between males and females occurred in the stages of pre-contemplation ($p=0.006$), preparation ($p=0.025$), action ($p=0.007$) and maintenance ($p=0.007$). In social liberation the difference occurred in the precontemplation stage where females scored higher than males ($p=0.008$). Finally, in helping relationships only a tendency toward differences was revealed in the action stage ($p=0.097$). See Table 5 for details.

adult samples, there is an increasing interest in applying the model to children and youth. Studies on adolescents have been conducted in several countries including Canada [25], New Zealand [27], Korea [19], Brazil [29] and Belgium [13]. However, only in studies of C.R. Nigg and K.S. Courneya [25] and H. Prapavessis, R. Maddison and F. Brading [27] the entire TTM was tested. The present study was the first attempt in Poland to describe leisure-time physical activity of adolescents with the use of the conceptual apparatus offered by the TTM. The purpose of the study was to examine the distribution of stages of readiness to exercise among a sample of high school students and to examine the relationship between the stages and stage predictors (processes of change, self-efficacy, and decisional balance). Overall, the results showed the usefulness of the model in explaining exercise behaviors of Polish adolescents. In our study the majority of adolescents (43.25%) were in the preparation stage, so they declared that their exercising is irregular or below the criterion level 3, or more days a week for at least 20 minutes

Table 5. Differences in TTM constructs in which significant statistical differences between female and male adolescents were observed. One-way ANOVA and post hoc comparisons

Construct	F (4, 1237)	Stage	Means		Post hoc tests	
			Female	Male	Tukey HSD	Fisher LSD
Pros	3.96*	PC	2.412	1.860	*	**
		P	3.472	3.318		*
Consciousness raising	2.72*	P	2.228	2.414		*
		A	2.544	3.148	*	**
		M	2.846	3.136		*
Environmental reevaluation	4.32*	P	2.474	2.656		*
		A	2.612	2.994		*
		M	2.754	3.020		*
Social liberation	4.33*	PC	2.734	1.911	*	**
		P	3.267	3.109		***
Helping relationships	2.39*	A	2.743	3.247	***	**
		M	3.191	3.364		***

* $p<0.05$

** $p<0.001$

*** a tendency toward significant difference

DISCUSSION

The TTM is considered one of the most promising models explaining exercise behaviors. Although most studies have been carried out on

each time. Regular exercising was declared only by about one third of adolescents and nearly every fifth of respondents was inactive, with 7.59% not even thinking to start exercise program in the foreseeable future. Out of the stage predictors in

our study self-efficacy turned out to be the strongest, similarly to the findings of other authors studying adolescent populations [4, 25, 27]. Consistent with theoretical assumptions of the model, self-efficacy distinguished between those in consecutive stages, increasing gradually from precontemplation to maintenance.

In studies of adolescents, similarly to results obtained from adult samples, the increase in pros and decrease in cons were observed, with their intersection (or decisional balance point) between precontemplation and preparation stages [4, 25]. However, in some studies [19, 27] pros and cons increased and decreased (respectively), but did not intersect. Contrary to the findings of the aforementioned authors, H.A. Hausenblas et al. [18] in their study of middle-school students aged 11-15 found that "support for the pros and cons of decisional balance across the stages of change was not evident" (p. 450), suggesting that for people in this age pros and cons may not be so important in determining the stage of change as for adults. In our study pros and cons of exercise were significantly related to the stages of exercise. Pros increased and cons decreased gradually from precontemplation to maintenance. Similarly to C.R. Nigg and K.S. Courneya [25] study pros and cons were analysed using raw and standard *t* scores. The stage in which pros overweigh cons was the action stage for *t* scores and the preparation stage for raw scores.

Among the earlier studies on adolescents only C.R. Nigg and K.S. Courneya [25] and H. Prapavessis, R. Maddison and F. Brading [27] assessed processes of change across the stages of change. Similarly to these studies, in our study the precontemplators used all the process of change to a lesser degree than individuals in other stages. Similar was also the pattern of changes of consciousness raising, environmental reevaluation, self-reevaluation and social liberation across the stages of change. In counterconditioning and helping relationships, an increase in using them from stage to stage was observed. In the remaining three behavioral processes, namely, reinforcement management, self-liberation and stimulus control differences were insignificant only between the action and the maintenance stages. Within the experiential processes there were no differences in using consciousness raising, dramatic relief and self-reevaluation between the contemplation and preparation stages. Individuals in the action and maintenance stages used these processes signi-

ficantly more frequently than contemplators and irregular exercisers, but they did not differ from each other. These results suggest that such strategies as increasing one's knowledge about physical activity, experiencing negative emotions that can be reduced with an increasing level of physical activity and building one's new self-image are important in moving from the precontemplation to contemplation stage and from irregular to regular exercising. Within environmental reevaluation and social-liberation a significant increase in using these processes of change were observed between the precontemplation and the contemplation stages. Changes between contemplation and preparation, preparation and action, and action and maintenance were insignificant. For both processes medium effects were observed, while the remaining, aforementioned processes displayed greater effects. It can be concluded that such strategies are important for precontemplators to move to the contemplation stage, but of little importance for moving between higher stages.

The findings of this study in relation to the processes of change are generally in line with theoretical assumptions that cognitive processes are most important in earlier stages [28] and typically peak in the preparation stage, while behavioral processes peak in the action stage [23]. In our study all behavioral processes peaked in the action or maintenance stages. Results for the cognitive processes were less in line with the theoretical assumptions, because they all also peaked in the maintenance or action stages; however, in two of them (environmental reevaluation and social liberation) significant differences were found between the two "lowest" stages.

Some sex differences in the TTM constructs were observed in this study. In the stages of change the significant differences were found for maintenance and preparation stages. In the former stage there were nearly twice as many male as female adolescents, in the latter more females than males were classified. In the remaining constructs of TTM sex differences were observed in pros and in four processes of change: consciousness raising, environmental reevaluation, social liberation and helping relationships. Only in pros and in social liberation female adolescents scored higher than their male counterparts. In both cases the differences were observed, first of all, in the precontemplation stage, and when a less conservative post hoc Fisher's least statistical differen-

ces test was conducted also in the contemplation stage.

The study was not without some limitations, which should be emphasized. First, the study was cross-sectional and as such should not be a source of conclusions about causality. Second, the study was based on self-reports, which have well-known limitations, regarding, for example, respondents providing answers that they feel are most socially desirable. Third, the Cronbach alpha values obtained for some processes of change subscales were near the threshold of acceptable reliability, which calls for attention in interpreting the results. Fourth, the preparation stage in this research was defined as exercising some, but not regularly and/or below the criterion level. Although this definition is used in many studies, in many others the preparation stage is defined more as an intentional than behavioral component, so as intending to start exercising within a few weeks.

Despite the limitations the study is noteworthy as it provided evidence for the usefulness of the TTM in explaining exercise behaviors of Polish adolescents, thus broadening the support base for the model on the basis of data obtained from the population that was yet not researched with the use of its framework. More research on the model should be made, with emphasis on longitudinal studies.

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