

Psychosocial Predictors of Change in Physical Activity and Quality of Life in the PESSOA Program: A School-based Intervention Study

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Introduction: Only 36% of 10-11 years Portuguese youngsters meet the recommendations of moderate-to-vigorous physical activity (MVPA) and this number decreases progressively to 4% in the ages of 16-17 years. The aim of this study is to analyze if self-determination theory and social support variables predict change in physical activity (PA) and quality of life (QoL) in a school-based intervention study, the PESSOA Program, which is a cluster randomized controlled trial that addresses mediator variables within an ecological model. **Methods:** The sample was comprised of 1052 youngsters, aged 10-16 years ($M=12.50\pm 1.11$), allocated to control ($n=207$), intervention1 ($n=365$) and intervention2 ($n=480$) groups. Personal and social indicators of psychosocial health were assessed. Predictor variables were selected through hierarchical multiple regression analysis. **Results:** Main results were: a) increases in perceived parental and peer support accounted for the most of the PA positive changes; b) positive changes in PA were associated with increases in autonomous motivation; c) increased perceived parental and peer support, and relatedness, accounted for the most of the QoL positive changes; and, d) competence was the main predictor of positive changes in QoL. **Conclusions:** The findings demonstrated that positive changes in PA and QoL were predicted through the increased perceived social support, the fulfillment of general basic psychological needs, and the endorsement of more autonomous forms of motivation toward PA.

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Key Words: Psychosocial predictors; Self-determination Theory; Physical activity; Quality of life; PESSOA Program

INTRODUCTION

Health and well-being are greatly affected by lifestyle factors such as physical activity (PA) and diet, smoking habits, and hygiene, and these all involve behaviors that are potentially controllable by the individual (35). According to the World Health Organization Report concerning non-communicable diseases, 63% of annual deaths results from these types of diseases; in Portugal it represents 86% (WHO, 59).

Issues related to health related quality of life (QoL) are increasingly important for the way in which young

people negotiate their day-to-day lives and prepare for their future. Obese youth have a reduced QoL, especially in their perceptions regarding physical appearance, athletic competence, and social functioning (21).

Low cardiorespiratory fitness in children is strongly associated with risk factors for development of cardiovascular disease in adults, regardless of country, age, and gender (2). Higher MVPA time by children and adolescents was associated with less cardiometabolic risk factors regardless of the amount of sedentary time (14). A recent Portuguese study with a national representative sample ($N = 4696$) using

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accelerometers showed that only 36% of young people 10-11 years met the recommendations of MVPA, and that number decreased progressively to 4% in the ages of 16-17 years (3). Relative to overweight and obesity, Sardinha and colleagues (41) used the International Obesity Task Force criteria to find that, in a sample of 22048 Portuguese adolescents (aged between 10 and 18 years), about ¼ were overweight and obese.

Research has consistently shown that negative health behavior change is a very difficult task (58). It is also widely recognized that the motivation that underlies attempts to change behavior provides the energy needed to promote change and plays a central role in long-term results (48). Self-Determination Theory (SDT) is a macro-theory of personality, emotion, and human motivation (54), which emphasizes the importance of the development of internal personality resources and behavioral self-regulation (34). At the center of SDT is an organismic-dialectical perspective that focuses on the active, growth-oriented human organism and on the social contexts that either support or undermine people's attempts to master and integrate their experiences into a coherent sense of self (7). SDT emphasizes that social environments that support individuals' basic psychological needs will influence well-being (32) and increase autonomous motivational patterns (18). A specific SDT model for health behavior change predicts that autonomy-supportive contexts will enhance physical health (through increased PA) and well-being (e.g. increased QoL) (58). Autonomy-supportive teachers tend to promote identified regulatory styles in students (31), which in turn leads to stronger intentions to exercise during leisure time (6). On the other hand, being physically active is positively linked to QoL of adolescents (43), which is considered an important outcome measure in health research (13).

Lifestyle interventions can lead to improvements in weight and cardio-metabolic outcomes (22). Schools offer continuous, intensive contact with children during their formative years. School-based health education addressing the issues of healthy eating, physical activity, and body-image are the most effective interventions to prevent obesity in youth, according to a meta-analysis by the Cochrane Collaboration (55). Another Cochrane review about school-based physical activity programs for promoting physical activity and fitness in children and adolescents aged 6-18 concluded that these programs have positive effects on behavior and on physical health status measures (9). Growing consensus supports the application of ecological models of behavior to improve understanding of the influences on youth physical activity (38), mainly because there are many environments that will influence people's ability to be active (5).

To our knowledge, school-based studies have been giving more attention to weight change outcomes and/or physical activity levels than to psychosocial predictors of positive change (specifically SDT-proposed), considering personal, social, and physical environmental factors. The identification of these predictors should provide important information to build better interventions to manage sedentary behavior and obesity among youth.

The aim of this study is to investigate SDT-related and social support psychosocial predictors of change in PA and QoL in a school-based intervention study. The researchers hypothesized that changes in PA and QoL are predicted through the increased perceived social support, the fulfillment of general basic psychological needs, and the endorsement of more autonomous forms of motivation toward PA.

Six specific hypotheses were proposed:

1. Positive changes in physical activity are positively associated with changes in social support;
2. Positive changes in physical activity are positively associated with changes in basic psychological needs;
3. Positive changes in physical activity are positively associated with changes in autonomous motivation for exercise
4. Positive changes in health related quality of life are positively associated with changes in social support;
5. Positive changes in health related quality of life are positively associated with changes in basic psychological needs;
6. Positive changes in health related quality of life are positively associated with changes in autonomous motivation for exercise.

MATERIAL AND METHODS

The PESSOA program is a school-based cluster randomized controlled trial that addresses mediator variables, such as personal, social, and physical environmental factors within an ecological model that are related to and influence PA. The first cohort of this study was comprised of thirteen schools of Oeiras town hall (Lisbon, Portugal), and was implemented over a period of twenty-eight months (three school-years) on girls and boys enrolled in the 5th, 6th, and 7th grades. The study will focus only on the last two-years of the study because of incomplete data from the first year (which was used as pilot study to test the suggested methodology and prepare the educational tools required for the project).

Schools were invited by the team responsible for the PESSOA to participate in the study. All schools agreed and gave their consent. The study used a group-

randomized design in which schools were the unit of randomization and students were the unit of analysis. The schools were located in similar neighbourhoods, in regard to the socioeconomic status of the population and as to the recreational facilities. Schools were randomly allocated to one of three different groups: the first (control) group was intervened with a standard protocol with general information regarding dietary and PA behaviors; the second group (practical intervention schools – intervention 1), besides the standard counseling, was provided a 90 min additional weekly session of PA activities; the third group (theoretical and practical intervention schools – intervention 2), in addition to the standard counseling was provided a 90 min additional weekly sessions with health and weight educational program and PA activities, implementing principles (consistent with the tenets of the self-determination theory) and basic knowledge within the components of PA, dietary behavior, and well-being designed to influence healthier choices. A specialist in physical education taught these additional classes. This means that, besides regular physical education classes (PE) based on the Portuguese national program (one 45-minute class plus a 90-minute class), students in the intervention groups also received a standardized set of extra opportunities for further PA.

Participants

The sample was comprised of 1052 children and adolescents (534 boys), aged 10-16 years ($M = 12.50$, $SD = 1.11$) with a BMI of 20.48 ± 3.69 Kg/m², allocated in sample groups by school attendance: control ($n=207$), intervention 1 ($n=365$), and intervention 2 ($n=480$).

Measures

A questionnaire was built with scales of published and validated questionnaires to assess personal and social indicators of psychosocial health. Therefore, the questionnaire used: the validated Portuguese version of the Physical Activity Questionnaire – PAQ (50) to assess the **Physical Activity** level; the validated Portuguese version of the Kidscreen – 10 (16) to measure **Quality of Life**; the validated Portuguese version of BPNS (42) to evaluate **Basic Psychological Needs in General Scale**; the validated Portuguese version of the BREQ-2 (30) for the **Behavioural Regulations for Exercise**; and a selection of the parental support, parental encouragement, peer support, and teacher support related items present in the questionnaire used in the Personal and Environmental Associations with Children's Health (PEACH) study (29) to assess **perceived social support**.

The Physical Activity Questionnaire (50) questions concerned: the frequency and intensity of leisure-time physical activity, participation in sport club training, participation in competitive sport events, and common activity during leisure time. The response format is a scale ranging from “never” to “almost every day”.

The KIDSCREEN-10 Index (16) addresses affective symptoms of depressed mood, cognitive symptoms of disturbed concentration, psycho-vegetative aspects of vitality, energy, and feeling well, and psychosocial aspects correlated with mental health, such as the ability to experience fun with friends or getting along well at school. The response format is a Likert-type scale ranging from “never” to “always” or from “not at all” to “extremely”.

The Basic Psychological Needs in General Scale (42) contains twenty-one items and indicates the extent to which the psychological needs of autonomy (7 items), relatedness (6 items), and competence (8 items) are generally satisfied in their life. The response format is a Likert-type scale ranging from “not true at all” to “definitely true”.

The BREQ-2 (30) is grounded in the self-determination theory conceptualization of a continuum of behavioural regulation, reflecting varying degrees of autonomy for a behaviour. It comprises 19 items measuring amotivation and external, introjected, identified, and intrinsic regulations for exercise on a five point Likert-type scale, ranging from “not true for me” to “very true for me”.

To assess perceived social support, the researchers used the four PEACH (29) social support sub-scales: parental social support, parental encouragement, peer support, and teacher support. The response format is a four point Likert-type scale ranging from “hardly ever” or “never” to “everyday”, as a response from questions beginning with “How often does your...(mum or dad / friends / teachers)...”

Standing height and weight were measured in PE classes, following standardized procedures (46).

Statistical and Data Analysis

All analyses were performed using IBM SPSS Statistics version 19. Descriptive analyses, including means and SDs, were calculated for self-reported reports. Analyses of variance (ANOVA) were conducted to compare data between sample groups, and Post Hoc multiple comparisons were applied to compare all groups of participants with each other (Tukey HSD or Games-Howell). General Linear Model analyses with repeated measures by sample group were conducted on outcome variables. Psychosocial changes were expressed by the residuals of the final values regressed in the baseline value for the following variables: Perceived Social Support, General Basic Psychological Needs (autonomy,

Table 1. Baseline and Program scores for Age, BMI, QoL, PA, Perceived Social Support, Satisfaction of Basic Psychological Needs, and Behavioural Regulations for Exercise.

	Control (N=207)				Intervention 1 (N= 365)				Intervention 2 (N=480)			
	Baseline		Final		Baseline		Final		Baseline		Final	
	M	SD	M	SD	M	SD	M	SD	M	SD	M	SD
Age	12.59	0.88	14.38	0.76	12.52	1.10	14.06	1.08	12.45	1.20	13.97	1.24
BMI	20.36	3.14	20.66	2.75	20.39	3.76	20.89	3.72	20.61	3.87	21.33	3.88
Quality of life	50.71	7.70	50.54	8.78	50.86	8.86	49.76	8.27	51.51	9.37	50.72	9.73
Physical Activity	10.40	4.58	9.81	4.91	9.48	4.55	9.33	4.83	9.41	4.69	9.25	5.27
<i>Perceived Social Support</i>												
Parental Social Support	5.32	1.79	5.04	1.96	5.25	1.89	5.04	1.95	5.31	2.00	5.35	2.18
Parental Encouragement	4.87	1.58	4.56	1.68	4.44	1.66	4.19	1.67	4.83	1.69	4.62	1.76
Peer Support	5.85	1.91	5.70	2.23	6.05	2.25	5.87	2.08	6.39	2.42	6.31	2.43
Teacher Support	5.45	1.60	5.31	1.63	6.05	1.99	5.42	1.75	6.05	1.85	6.10	1.86
<i>Satisfaction of Basic Psychological Needs</i>												
Autonomy	33.73	6.19	35.45	6.81	33.62	6.16	33.78	6.29	33.39	6.39	34.21	6.09
Competence	36.13	7.21	36.12	7.23	35.46	6.85	35.22	6.69	35.83	6.74	35.64	6.86
Relatedness	43.44	5.91	42.85	6.43	41.91	6.43	42.64	5.81	42.88	6.38	42.95	5.95
<i>Behavioural Regulations for Exercise</i>												
Amotivation	1.61	3.09	1.77	3.53	2.18	3.44	1.87	3.44	2.07	3.41	2.64	4.11
External	3.08	3.45	3.34	3.60	3.66	3.91	3.08	3.53	3.71	3.68	4.18	4.41
Introjected	4.39	3.29	4.79	3.37	4.01	3.19	3.82	3.33	4.08	3.15	4.09	3.39
Identified	11.81	2.97	11.18	3.27	10.77	3.19	10.53	3.54	10.90	3.31	10.71	3.43
Intrinsic	13.03	3.15	12.30	3.66	12.32	3.57	12.15	3.99	13.12	6.84	12.17	3.95

Abbreviations: BMI, Body Mass Index; M, Mean; SD, Standard Deviation

competence, and relatedness), Behavioral Regulations for Exercise (amotivation, external regulation, introjected regulation, identified motivation, and intrinsic motivation), Quality of Life, and Physical Activity level. Predictor variables were selected through hierarchical multiple regression analysis using the stepwise method after controlling for age and gender. Three blocks were created and entered into the model: first, perceived social support; second, basic psychological needs; and finally, behavioral regulations for exercise, following the tenets of the SDT (49). The assumptions for the regression analysis showed that the Variance Inflation Factor (VIF) values were all well below 10 and the tolerance statistics were all well above 0.2 (17); therefore, there is no multicollinearity within the data, allowing the use of the multiple regression procedure.

RESULTS

Table 1 presents the baseline and interventions results scores of the study sample. On baseline, no statistical differences were found between sample groups on age, BMI, QoL, and PA. The only statistical difference was observed in the control group scores of PA, which was higher ($F_{2,1014} = 3.530$, $P=.03$) than the intervention2 group.

Baseline QoL scores are similar for all sample groups, but higher than the European (47.45 ± 9.73) and the Portuguese (48.88 ± 8.44) scores, obtained with the same instrument in a study of fifteen European countries (16).

Inter-correlations between subscales were assessed and they all presented values similar, but smaller, than the original questionnaire validation studies (19, 26, 29). The higher significant relationships were: BPNS,

Table 2.1. Hierarchical Multiple Regression Analyses Predicting Changes in Physical Activity.

Control	Variable	B	P	Adj. R ²	ΔR ²	P
	1 Age	.11	.115			
	Gender	.04	.603	.017		.092
	2 Parental Support	.28	<.001	.109	.092	<.001
	3 Relatedness	.15	.033	.149	.040	.004
	4 Intrinsic Motivation	.30	<.001	.228	.079	<.001
Intervention 1	Variable	B	P	Adj. R ²	ΔR ²	P
	1 Age	.08	.134			
	Gender	.11	.043	.028		.005
	2 Parental Support	.24	<.001	.131	.103	<.001
	3 Peer Support	.09	.134	.143	.012	.020
	4 Identified Motivation	.26	<.001	.203	.060	<.001
Intervention 2	Variable	B	P	Adj. R ²	ΔR ²	P
	1 Age	.01	.813			
	Gender	.05	.326	.016		.020
	2 Parental Support	.24	<.001	.123	.107	<.001
	3 Intrinsic Motivation	.16	.008	.169	.046	<.001
	4 Peer Support	.16	.002	.205	.036	<.001
	5 Identified Motivation	.13	.018	.259	.054	<.001
	6 Competence	.13	.008	.266	.007	.042
	7 External Regulation	-.11	.023	.274	.008	.023

between competence and autonomy ($r=.53, p<.001$); BREQ-2, between identified and intrinsic regulations ($r=.61, p<.001$) and between amotivation and external regulation ($r=.55, p<.001$); and PEACH, between parental support and parental encouragement ($r=.38, p<.001$).

General Linear Model analyses with repeated measures by sample group were conducted on Physical Activity and QoL (outcome variables), but no statistical differences were found. They both showed a decreasing trend with age, replicating recent Portuguese studies (3, 27).

Table 2 presents the predictor variables identified through hierarchical multiple regression analysis for the outcome variables PA (Table 2.1) and QoL (Table 2.2) residuals, in all the different sample groups, after controlling for age and gender.

Physical Activity

In the control group, the total model explained a significant 22.80% of the PA score change from baseline to the end of the program ($F_{5,164} = 10.97, p<.001$). Age ($\beta=.11$) and gender ($\beta=.04$) were non-

significant. The other predictor variables were: parental support, which had a positive account on PA score ($\beta=.28$) for a significant 9.20%; relatedness, with a positive account on PA ($\beta=.15$) for a further significant 4%; and intrinsic motivation, which accounted ($\beta=.30$) for a further positive significant 7.90%.

In the Intervention 1 group, the total model explained a significant 20.30% of the PA score change ($F_{5,303} = 16.72, p<.001$). Age ($\beta=.08$) was non-significant, but gender ($\beta=.11$) was significant, and both explained 2.80%. The other significant predictor variables were: parental support, which had a positive account on PA score ($\beta=.24$) for a significant 10.30%; peer support, which accounted ($\beta=.09$) for a further positive significant 1.20%; and identified motivation, which accounted ($\beta=.26$) for a further positive significant 6%.

In the Intervention 2 group, the total model explained a significant 27.40% of the outcome variance ($F_{8,347} = 17.77, p<.001$). Age ($\beta=.01$) and gender ($\beta=.05$) were both non-significant. The other significant predictor variables were: parental support, which had a positive account on PA score ($\beta=.24$) for a significant 10.70%; intrinsic motivation, which accounted ($\beta=.16$) for a

Table 2.2. Hierarchical Multiple Regression Analyses Predicting Changes in Quality of Life.

Control	Variable	β	P	Adj. R ²	ΔR^2	P
	1 Age	-.14	.023			
	Gender	.13	.045	.078		<.001
	2 Parental Support	.14	.029	.114	.036	.005
	3 Relatedness	.36	<.001	.327	.213	<.001
	4 Competence	.22	.004	.357	.030	.004
Intervention 1	Variable	β	P	Adj. R ²	ΔR^2	P
	1 Age	-.12	.018			
	Gender	.07	.200	.030		.003
	2 Relatedness	.18	.002	.069	.039	<.001
	3 Competence	.17	.003	.142	.073	<.001
	4 Peer Support	.12	.035	.170	.028	.001
	5 Intrinsic Motivation	.14	.017	.183	.013	.017
Intervention 2	Variable	β	P	Adj. R ²	ΔR^2	P
	1 Age	.02	.694			
	Gender	.12	.009	.017		.016
	2 Parental Support	.15	.001	.087	.070	<.001
	3 Relatedness	.13	.010	.110	.023	.001
	4 Competence	.19	<.001	.226	.116	<.001
	5 Peer Support	.17	.001	.262	.036	<.001
	6 Autonomy	.19	<.001	.273	.011	.010

further positive significant 4.60%; peer support, which accounted ($\beta=.16$) for a further positive significant 3.60%; identified motivation, which accounted ($\beta=.13$) for a further positive significant 5.40%; competence, which accounted ($\beta=.13$) for a further positive significant 0.70%; and external regulation, which accounted ($\beta=-.11$) for a negative significant 0.80%.

Quality of Life

In the control group, the total model explained ($F_{5,168} = 20.18, p<.001$) a significant 35.70% of the outcome variation. Age ($\beta=-.14$) and gender ($\beta=.13$) were both significant and explained 7.80%, however, age influence was negative. The other predictor variables were: parental support, which had a positive account on QoL score ($\beta=.14$) for a significant 3.60%; relatedness, which accounted ($\beta=.36$) for a further positive significant 21.30%; and competence ($\beta=.22$), which was responsible for a further positive significant 3%.

In the Intervention 1 group, the total model explained ($F_{6,310} = 12.79, p<.001$) a significant 18.30% of the outcome variation. Age ($\beta=-.12$) was significant, gender ($\beta=.07$) was non-significant, and both explained 3%. Here, age had also a negative influence. The other significant predictor variables were: relatedness, which had a positive account on QoL score ($\beta=.18$) for a significant 3.90%; competence, which accounted ($\beta=.17$) for a further positive significant 7.30%; peer support, which accounted ($\beta=.12$) for a further positive significant 2.80%; and intrinsic motivation, which accounted ($\beta=.14$) for a further positive significant 1.30%.

In the Intervention 2 group, the total model explained ($F_{7,364} = 20.92, p<.001$) a significant 27.30% of the outcome variation. Age ($\beta=.02$) was non-significant, gender ($\beta=.12$) was significant, and both explained 1.70%. The other significant predictor variables were: parental support, which had a positive effect on QoL score ($\beta=.15$) for a significant 7.70%; relatedness, which accounted ($\beta=.13$) for a further positive significant 2.30%; competence, which accounted

($\beta=.19$) for a further positive significant 11.60%; peer support, which accounted ($\beta=.17$) for a further positive significant 3.60%; and autonomy, which accounted ($\beta=.19$) for a positive significant 1.10%.

DISCUSSION

The purpose of this study was to examine specific psychosocial predictors of change in PA and QoL in a school-based intervention study. The main results were: a) increased perceived social support from parents and peers accounted for the most of the PA positive changes; b) positive changes in physical activity were associated with increases in autonomous motivation (identified and intrinsic) for exercise; c) increased perceived social support from parents, peers, and relatedness accounted for the most of the QoL positive changes; and d) an increase in competence was the main predictor of positive changes in QoL in both interventions groups.

Considering the prediction of PA, the researchers have observed that positive changes in parental support was the first social support variable that fitted the model and the one that contributed the largest amount of variance in all sample groups, replicating Welk and colleagues' study (56). These findings are consistent with a recent review that evaluated 103 studies and concluded that parental support was consistently positively and significantly associated with child activity (52). Parental involvement is a well-known strategy/policy used to promote children's PA (22, 23, 57).

The non-instrumental measure of parental support, parental encouragement, was not a significant predictor for changes in PA. This result is contrary to several studies, where a positive relationship was found between parental encouragement and time spent in PA (36, 51), even with long-term increased physical activity (4). In addition, in both intervention groups, changes in peer support positively predicted positive changes in PA. Studies of correlates of youth physical activity (e.g. 38) showed that peer support is a strong and consistent correlate of youth physical activity. The present study's results are in line with existing literature, which suggested that: a) children are more likely to engage in physical activity with peer social support (37); b) peers and friends can help to promote greater physical activity (39, 40); and c) an individual is more likely to engage in an active-sport (10) or regular exercise if his or her friends are also involved (1).

On the other hand, changes in teacher support were not found to be a significant predictor of increases in PA. These results are contrary to the ones obtained in a group randomized controlled trial, where teacher social support showed a significant mediating effect

on physical activity (11). A Cochrane review for school-based physical activity programs for promoting physical activity and fitness in children and adolescents aged 6-18 noticed that the most notable difference between studies reporting a positive effect versus a negative effect was the use of physical education teachers specifically prepared to deliver the intervention in studies reporting a positive effect, versus non specialist teachers in those reporting no effect (9). Not all the PESSOA program intervention providers were physical education teachers, and the preparation of the intervention was only conducted at the start of each school year, which might have not been enough to prepare and differentiate the teachers. In addition, the questionnaire used to assess perceived teacher support refers to the teachers in general and not just those involved in the program. It is the researchers' belief that those facts may have introduced a considerable bias in the evaluation of perceived teacher support, leading to the specific results so different from those presented in the literature review.

As a final remark to this hypothesis, the researchers would like to point out that if they analyze the joint effect of relatedness and parental support on PA changes, following the proposal by Li (24), these variables account the most for the positive PA changes in the control group, while on the intervention groups the relatedness was replaced by peer social support on the prediction of PA changes.

Increased physical activity was positively associated with changes in some of the basic psychological needs: relatedness was positively associated with PA changes (control group); none of the basic psychological needs was associated with positive changes in PA (intervention 1); and competence was positively associated with PA positive changes (intervention 2), but it explained only 0.70 % of variance. In both intervention groups, positive changes in PA were not associated with changes in need satisfaction in general, although it is assumed that as a result of the interventions, peer support worked as a proxy for relatedness, because interventions were designed to promote the quest for joint solutions in the fulfillment of a healthier lifestyle. In addition, basic need satisfaction in general (i.e. a global measure) was assessed instead of a specific measure, and this generic instrument may not have been specific enough to provide information about the particular motivational issues in physical activity contexts.

Positive changes in physical activity were associated with changes in autonomous motivation for exercise in both intervention groups. While in the control group, changes in intrinsic motivation were found to be a significant predictor for increased PA, in intervention 1, the predictor variable that exerted significant

influence on PA was identified motivation. On the other hand, in intervention 2, intrinsic motivation was the first behaviour regulation that entered the model. Furthermore, while changes in identified regulation were a significant positive predictor of changes in PA, changes in external regulation were a significant negative predictor. These results are consistent with the conclusions of a recent systematic review on exercise, physical activity, and self-determination theory (47), which showed consistent support for the importance of autonomous forms of motivation (identified and intrinsic) in fostering physical activity. Furthermore, Ng and colleagues (28), in a Meta-Analysis on SDT applied to health contexts, found that controlled forms of regulation (especially external) were detrimental to health outcomes. External regulation was also found to be negatively associated with PA intentions in a Lim and Wang study (25) with 701 secondary school students.

The present researchers believe that while positive changes in PA on the control group were a result of engaging in an activity for the pleasure and satisfaction inherent to the activity, both of the interventions brought to the adolescents the awareness of sense of choice in doing those activities, because they considered it valuable for themselves, while the participants of intervention 2 maintained the interest and inherent satisfaction of doing the activity.

The regression models explained larger amounts of variance for intervention 2 ($R^2 = 27,4\%$) compared to intervention 1 ($R^2 = 20,3\%$) and the control group ($R^2 = 22,8\%$). All these results suggest that the positive changes in PA of the youngsters in intervention 2 (a 90 min additional weekly sessions with educational and PA activities), might have been positively influenced by the functional significance interpretation of participants, through the endorsement of more autonomous forms of motivation and increased perceived social support, when compared with the control group and intervention 1.

Considering the prediction of health related quality of life, increases in perceived social support positively influenced positive changes in QoL in all groups. Changes in parental and peer support were the predictor variables that exerted significant influence on QoL changes, but only in the control and intervention 2 groups. In intervention 1, only peer support was found to be a significant positive predictor of changes in QoL. On the other hand, changes in teacher support and in parental encouragement were not found to be significant predictors in any of the groups. Similar to the prediction of positive changes in PA, perceived social support – relatedness plus parental support in control group, and parental and peer support plus relatedness in intervention 2 – accounted for the most of the positive QoL changes,

demonstrating that for these age groups in school context, perceived social support plays a very important role on behaviour (32), with an impact on a broad number of QoL domains (20).

Positive changes in QoL were positively associated with changes in basic psychological needs in all groups. In the control and intervention 1 groups, relatedness and competence were the variables that were positively associated with positive changes in QoL. In the intervention 2 group, changes in the three basic needs were found to be significant positive predictors of changes in QoL. Therefore, intervention 2 provided support to the proposal of Gillison and colleagues (20), where need satisfaction at the contextual level of school can influence the global-level construct of QoL, consistent with the hierarchical model of motivation proposed by Vallerand (53). It is also important to note that changes in competence were the main predictor of positive changes in QoL in both interventions, replicating past studies (e.g., 44) by showing that feeling effective in one's ongoing interactions with the social environment (consistent with the tenets within SDT) is a fundamental issue on the improvement of QoL (12). Changes in perceived autonomy were not a significant predictor in the control and intervention 1 groups, suggesting that only intervention 2 was effective enough on the manipulation of the social environment to exert influence on all basic needs. It is important to remember that intervention 2 included educational sessions designed to discuss and promote joint solutions of identified problems like: a) school-specific advice on selection of school canteen and possible change options; b) how to facilitate active commuting; or c) how to change social and physical aspects of school environment that might impact physical activity engagement.

Positive changes in QoL were associated with changes in autonomous motivation (intrinsic motivation) for exercise, but only in intervention 1. Consistent with this finding are several studies with secondary school students where autonomous motivations were shown to be linked to positive mental health outcomes (33) and autonomous motivation toward exercise positively predicts QoL (45).

Both regression models with the present interventions groups explained lesser amounts of variance in changes of QoL ($R^2 = 18.3\%$ - intervention 1 and $R^2 = 27.3\%$ for intervention 2) when compared to the control group ($R^2 = 35.7\%$). Most part of the variance explained in the control group was a result of changes in relatedness ($\Delta R^2 = 21.3\%$). Both of the interventions changed this association substantially through the introduction of peer support as predictor variable and the increase of explained variance from changes in general competence. The researchers

believe that these interventions changed the way that the students perceived their regulations of behaviours related to PA and the way they experience QoL. Also, although both of the intervention models explained less than the control group model, the predictor variables were more consistent with long-term self-regulations (8, 15) when compared to the usual QoL decreasing trend with age associated with the control group.

This study is subject to some limitations. First, a more direct measure of PA should have been used. Second, the questionnaire to assess teacher support should have been adapted to focus specifically on intervention providers. Finally, in an intervention with this nature and dimension, it would be important to execute a manipulation-check. Future research should aim to assess if intervened adolescents: a) maintained the predictor variables associated with positive changes in PA and QoL (short and long-term); b) increased their PA levels; c) changed their motives for exercise; and d) differed in QoL levels between the interventions and the control group.

The present findings demonstrated that positive changes in PA and QoL were predicted through increased perceived social support, the fulfillment of general basic psychological needs, and the endorsement of more autonomous forms of motivation toward PA. These results, supported on socio-ecological models of behaviour and SDT tenets, suggest that: a) it is important to increase PE time and PA opportunities, especially if there is concern with facilitating the internalization of health behaviours; b) promoting high levels of youngsters' identification keeps one oriented toward the long-term significance; c) relatedness and peer support play an important role in the integration of knowledge, skills, and values; and d) in youngsters, the need for competence is very important in the promotion of QoL, and PA is an excellent opportunity to built it.

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