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Promoting Physical Activity and Reducing Sedentary Behaviors among French Adolescent Girls from Low-Incomes Communities

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Abstract: (1) Background: Despite health benefits of engaging in regular physical activity (PA), adolescents fail to achieve the recommended PA practice (especially among girls with low socio-economic position). Researchers have been prompted to adopt models of social cognition to help identify the role of psychological factors in influencing PA and sedentary behaviors. Thus, this study examined the effects of an intervention promoting PA, reducing sedentary activity among adolescent girls from low-incomes communities, and explored the relationships between core constructs of salient theoretical frameworks (self-determination theory, theory of planned behavior, implicit and explicit attitude towards PA, and sedentary behaviors); (2) Methods: An intervention was delivered to 28 adolescent girls. They reported their scores on a variety of core psychological constructs grounded within the aforementioned theoretical frameworks as well as on several outcomes, such as objective PA (pedometers) and perceived mental and physical health. These scores were gathered both before and after the 8-weeks program; (3) Results: Results revealed changes on external regulation and implicit attitudes toward sedentary behaviors from before to after the program. However, objective PA behavior did not change; (4) Conclusions: Future studies are encouraged to further explore mechanisms of behavior change derived from integrated and socio-ecological theories.

Keywords: implicit attitudes; pedometer; physical activity; sedentary behaviors; self-determination theory; theory of planned behavior

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1. Introduction

Despite the extensive health benefits and protective effects of engaging in regular physical activity (PA) [1], participation levels among many adolescents remain inadequate, with a large proportion failing to achieve the recommended 60 min of daily moderate-to-vigorous PA [2,3] or 10,000 to 11,700 steps/day [4]. Furthermore, sedentary behaviors are more prevalent among girls than boys [5] and among low socio-economic position [3,6]. PA in children and adolescents is also linked to improved mental and physical health, including reduced depressive and anxiety symptoms, improved cognitive function, and increased self-esteem [7,8]. The challenge of objective monitoring of PA in children and adolescents reinforces the importance of using protocols that minimize participant burden and the potential for tampering/reactivity [3]. Pedometers have been recommended for use in PA interventions to motivate individuals to increase their ambulatory PA through instant feedbacks [9]. Establishing successful interventions that improve PA and reduce sedentary behaviors in high priority adolescent girls is thus needed [3].

Researchers have been prompted to adopt models of social cognition to help identify what role various psychological and social factors may have in influencing both of these behavior changes [10]. Because several individuals are either unmotivated or motivated by externally-driven reasons that may not lead to sustained PA, it is needed to look more

closely at goals and self-regulatory features associated with regular participation in PA. Integration of Self-determination theory (SDT) [11] and the theory of planned behavior (TPB) [12] has provided insight into the motivational and social cognition determinants and processes involved in health behavior. Theoretically, researchers have proposed that generalized motivational orientations from SDT serve as determinants of constructs from the TPB (i.e., attitude, subjective norm, and perceived behavioral control) [13,14].

SDT examines the differential effects of qualitatively different types of motivation (along a continuum of self-determination) that can underlie PA behaviors [15]. First, amotivation reflects an absence of motivation and refers to an individual participation in PA without particular reason. External and introjected regulations are viewed as controlled motivation because they describe situations where behaviors are not fully volitional or chosen but rather emitted out of external (rewards or punishments) or internal (guilt, contingent self-worth) pressure. Identified, integrated, and intrinsic regulations represent autonomous motivation because they refer to behaviors adopted for the feeling of enjoyment and interest in the activity and allow individuals to achieve important goals, which are consistent with their deepest values [15]. Furthermore, SDT proposes that social support can promote autonomous motivation [16–18]. During adolescence, parents at home, friends, and peers in the community, and at schools, are potentially relevant persons in terms of PA behaviors as they are the social factors that are most commonly in contact with adolescents [19].

The TPB is a social–cognitive expectancy value model postulating that behavioral intention is the proximal determinant of behavior. The model further postulates that intention is influenced by three conceptually independent constructs: Attitude, subjective norm, and perceived behavioral control (PBC) [12]. Attitude reflects an individual's positive or negative evaluation of performing the behavior. Subjective norm is intended to reflect the perceived social pressure that individuals may feel to perform or not perform a particular behavior. Finally, PBC indicates the perceived ease, or difficulty, of performing the behavior. In the TPB framework, individuals will intend to perform a behavior when they evaluate it positively, believe that important others think they should perform it, and perceive it to be under their own control.

It is noteworthy that the role of implicit and explicit attitudes in health behavior was increasingly studied within the last decade [20,21] and could complement models of social cognition, such as SDT or TPB. On some occasions, behavior is based on explicit, consciously held attitudes, and at other occasions, behavior is based on implicit, automatic ones. Explicit attitudes are evaluative reactions towards social objects measured through self-reports and vulnerable to social desirability concerns [22]. Implicit attitudes are considered to reflect evaluations that people do not want (because of social pressures) or cannot (because they are not aware of) express overtly [22]. Whereas explicit attitudes may guide one's deliberate behavior (as postulated within the TPB), implicit attitudes may guide spontaneous and automatic behavior [23]. From the health psychology perspective, the implicit and explicit attitudes toward PA and sedentary behaviors have been considered as crucial factors in the development, and maintenance, of health behavior [24] and, in particular, PA and sedentary behaviors [20,21,25,26]. For instance, implicit attitudes toward PA are related to the frequency of self-reported PA [27] and higher levels of PA [28]. Considering these two aspects of behaviors' predictors in health behaviors may help to explain why people are likely to engage in healthy versus unhealthy behaviors.

In sum, the first aim of the present study was to test the effects of an intervention (theoretically grounded within the TPB) promoting PA and reducing sedentary behaviors among French adolescent girls from low-income communities. In order to shed light on the role of various psychological factors, in promoting PA and preventing sedentary behaviors, the second aim of the present study was to examine the relationships between core constructs of salient theoretical frameworks (i.e., SDT, TPB, implicit and explicit attitude towards PA and sedentary behaviors) and several outcomes (health related quality of life (HRQOL), PA using pedometers). In light of the aforementioned theoretical frameworks [11,12,22], and

based on previous studies [9,26,28,29], we could expect that girls will increase their number of daily steps, and psychological variables will be affected by the intervention. Secondly, we hypothesized that PA behaviors, and implicit and explicit attitudes toward PA, will be positively related to high perceived mental and physical health, autonomous forms of motivation, TPB constructs (attitude, subjective norm, perceived behavioral control, and intention) and social support, whereas the opposite pattern of relationships will be observed for implicit attitude toward sedentary behaviors.

2. Materials and Methods

2.1. Study Design

The Sport Dans La Ville Association, school principals, study participants, and their parents provided written informed consent to participate in the 8-weeks program, which commenced in January 2017. Baseline data were collected during the two first sessions. During the first session (the first week), girls had to answer to a 15 min computer measurement of their implicit and explicit measures of attitudes toward PA and sedentary behaviors. Then girls had to wear the pedometer for the first week, and they had to record the number of steps done on their logbook each day. During the second session (at the start of the second week, i.e., 8 days), the logbook and pedometers were brought back to researchers (i.e., the evening). For 20 min, girls have to fill self-reported questionnaires related to TPB, SDT, and HRQOL. Researchers led the third week, the intervention promoting PA behaviors during 30 min. During two weeks, girls had planned opportunities and experienced periods to be more physically active at moderate to vigorous intensity. The fifth week, the intervention, aiming at reducing sedentary behaviors, took place for 30 min. Then, they should plan activities to change sedentary behaviors to light PA behaviors. The 7th week, girls wore the pedometer for one week. Finally, the last and final week, when they brought back their pedometer and logbook, they had to follow the implicit and explicit measures of attitudes toward PA and sedentary behaviors and fill all the self-reported questionnaires. Study design is presented in Figure 1.

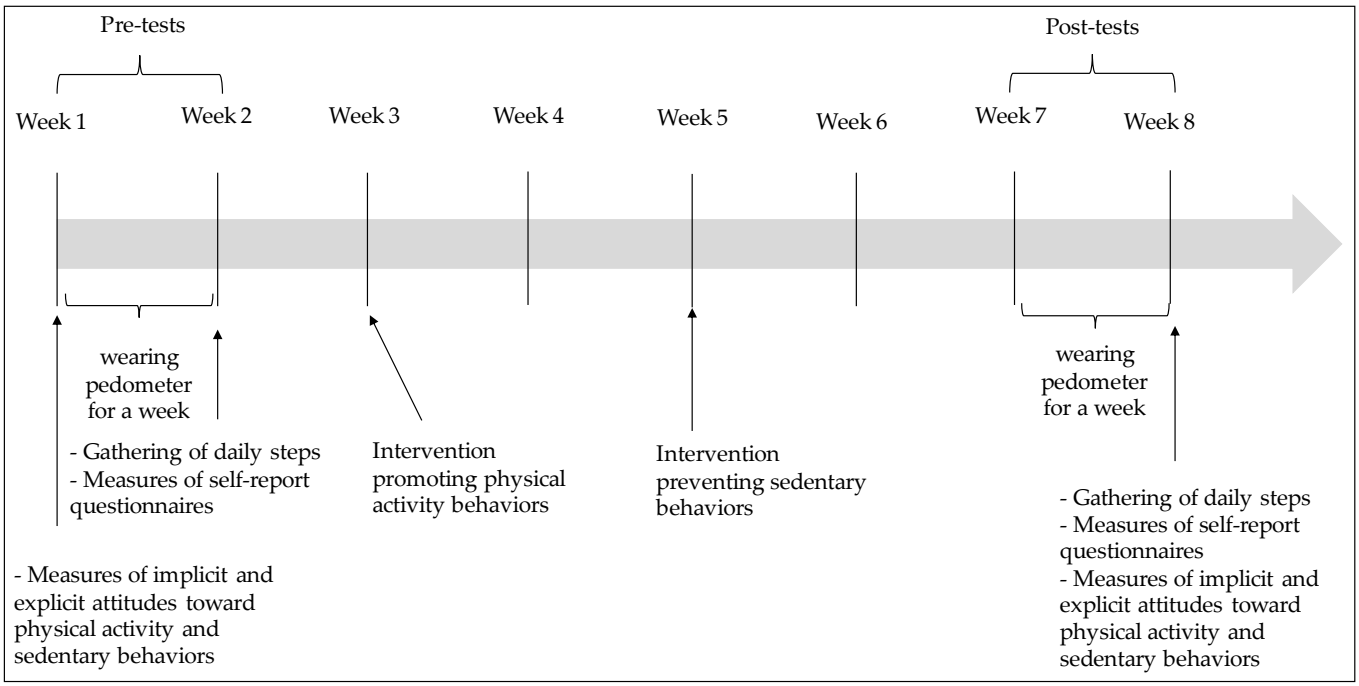

Figure 1. Visual representation of the study design.

2.2. Intervention

Interventions were made in person by the main researcher. The interventions were delivered in person to the girls' group into a quiet room at the beginning of their usual basketball or soccer training. The message was standardized and rehearsed to ensure the 30 min intervention be delivered in the same way in the different small girls' group. The contents of the eight-week program were highlighted in Table 1.

Table 1. Description of interventions.

Intervention	Promoting Physical Activity Behavior	Reducing Sedentary Behaviors
		Before starting this 2nd intervention, girls are sharing their targeted challenges.
Step 1	Identify light physical activity level to moderate/vigorous with 10 examples of behaviors (e.g., walking with my grand-mother; playing basket-ball during recess; running during Physical Education class; going outside with my dog, climbing stairs in my building)	Identify what are sedentary behaviors with 10 examples of behaviors compared with light PA intensity (e.g., phoning my friend; waking to shops with my friends, walking during recess, sitting while waiting the bus).
Step 2	In the next two weeks, planning in your logbook 3 challenges (minimum of length 10 min, 3 times) that you can do to be more moderately/vigorously physically active. The 10,000 steps/day is the gold standard to achieve.	In the next two weeks, planning in your logbook 3 challenges (minimum of length 10 min, 3 times) that you can do to be more moderately/vigorously physically active.
Step 3	This aim is to identify two barriers that could change your planning and identify what you should do to face this difficulty.	This aim is to identify two barriers that could change your planning and identify what you should do to face this difficulty.
Step 4	Identify the consequences to achieve these challenges: pleasure, playing with my friends, feeling in good shape, sharing time with my sister/brother.	Identify the consequences to achieve these challenges: pleasure, playing with my friends, feeling in good shape, sharing time with my sister/brother.

2.3. Participants

A total of 28 Girls from suburbs of Lyon in France (*Mean age* = 13.35; *SD* = 1.66; *range* = 11–16; *Mean weight* = 50.73 kg; SD = 9.69; *Mean height* = 159.77 cm; SD = 9.62; *Mean body mass index* = 19.73, *SD* = 4.08; *range* = 14.81–27.85) voluntarily participated in the present study. Every Wednesday, physical activities are proposed inside disadvantaged neighborhood area of France by a sport social association (Sport Dans La Ville Association, Lyon, France). The participants belong to this free access program. Regarding parents' employment/work status, 65% of mothers and 25% of fathers are not working (e.g., taking care of children or unemployed). Among parents who are working, there is no farmer, craftsperson, shopkeeper, or head of a company; 5% are middle managers, higher intellectual professions, or liberal professions; 5% have intermediate occupations (e.g., teacher, technician, and supervisor); 50% are employee agent and 40% are laborer. The geographical location of family accommodation crossed with parental employment and work status outline that our sample belong to a low social economic status. Participants' scores were gathered in time 1 (*T*1) for 27 participants and in time 2 (*T*2) for 21 participants (with the exception of PA pedometers scores which was gathered for 11 participants at *T*2). In the present study, retention rate was 77.7% between the first and second measurement times (for pedometers, the retention rate was 40.7%).

2.4. Measures

2.4.1. Physical Activity Level Using Pedometers

The Walk4Life MVP model pedometer was used to quantify PA every day. Girls wore the pedometer during 7 days to capture their habitual activity [30]. Girls recorded daily steps count in a personal logbook. Even if we could not be sure that the level of sedentariness of the enrolled participants before adhering to the study was well-represented by the baseline recording in the first week, the use of pedometers was the only manner to estimate participants' objective level of PA.

2.4.2. Theory of Planned Behavior Measures

The scales measuring TPB constructs were formulated following the recommendations of Ajzen [12,31]. Attitude (5 items) (α $T1 = 0.87$; α $T2 = 0.89$ e.g., "Practicing regular physical activity would be fun"), subjective norm (3 items) (α $T1 = 0.80$; α $T2 = 0.68$ e.g., "Among the people important to me, none would agree that I should engage in regular PA"), perceived behavioral control (4 items) (α $T1 = 0.83$; α $T2 = 0.82$ e.g., "If I decide, I can easily engage in regular PA"), and intentions (4 items) (α $T1 = 0.86$; α $T2 = 0.87$ e.g., "If I decide, I can easily engage in regular PA") were measured with a Likert scale ranging from 1 (strongly disagree) to 7 (strongly agree).

2.4.3. Motivation

Motivation was measured with the French version of the behavioral regulation in exercise questionnaire (BREQ-2) [32] to which 4 items (e.g., "Because being "sporty" fits my personality well") were added to measure integrated regulation (α $T1 = 0.69$; α $T2 = 0.72$; e.g., "Because being a 'sportsman' fits my personality") [33] because there is no item on this regulation in BREQ 2. The 19 items in this scale measure intrinsic regulation (α $T1 = 0.78$; α $T2 = 0.74$ e.g., "I do physical activity because I like it"), identified regulation (α $T1 = 0.78$; α $T2 = 0.77$ e.g., "Because I enjoy the benefits it brings me"), introjected regulation (α $T1 = 0.60$; α $T2 = 0.63$ e.g., "Because I feel guilty if I don't do it"), external regulation (α $T1 = 0.60$; α $T2 = 0.71$ e.g., "Because my friends/family think I should do it"), and amotivation (α $T1 = 0.78$; α $T2 = 0.54$ e.g., "I don't actually see why I should I should do physical activity"). Subjects responded to the items on a Likert scale ranging from 1 (strongly disagree) to 7 (strongly agree).

2.4.4. Social Support

Social support was operationalized as various supportive behaviors received from friends and family in the previous 3 months that encouraged participation in PA [34]; for example, "did members of your family/your friends take you to places where you could be physically active (for example, sports trainings, or weekend sport?)". Four items for family (α $T1 = 0.70$; α $T2 = 0.57$) and four items for friends (α $T1 = 0.66$; α $T2 = 0.76$) examined the frequency of supportive behaviors using a 5-point Likert-type scale (1 = never, to 5 = always) [34].

2.4.5. Implicit Attitudes toward Physical Activity and Sedentary Behaviors

The Single Category Implicit Association Test (SC-IAT) [35] was used to assess implicit attitudes toward PA and sedentary [25,36]. The test consisted of randomly presented blocks (24 practices trials for blocks 1 and 3 and 72 test trials for blocks 2 and 4 respectively). For PA SC-IAT, participants were asked to sort three types of words (PA, good, bad) into two categories with overlap: PA/good vs. bad (blocks 1 and 2) or good vs. PA/bad (blocks 3 and 4). Categories were presented in green on the upper-left and upper-right corners of the black screen and the stimuli (words) appeared in random order on the center of the screen in white. PA words (walk, jog, bike, move, stand, lift, carry, pull, stretch, play, jump, and throw) were selected to cover a broad range of intensities and to cover lifestyle and leisure activities. The 12 good (e.g., cozy, passion, and brave) and 12 bad stimuli (e.g., inferior, deformed, and danger) were selected from the Affective Norms based on word length and valence ratings [25]. Participants categorized the stimuli by pressing one of two buttons. Following an incorrect selection, a red X would appear above the stimulus until the selection was corrected. The same procedures and scoring methods used for the PA SC-IAT was used for the sedentary behaviors SC-IAT. The good and bad stimuli were the same as those in the PA SC-IAT. The sedentary behaviors stimuli were sit, sofa, recline, computer, driving, chair, couch, and reading [25]. Moreover, the participants carried out a SC-IAT on flowers in order to familiarize themselves with the instrument and procedure. The flower stimuli (e.g., rose, orchid, iris) were the same as those used in seminal implicit association test studies [37]. Responses less than 350 ms were eliminated,

nonresponses were eliminated, and error responses were replaced with the block mean plus an error penalty of 400 ms [38]. Because the 24 practice trials in each stage were truly practice, data from the practice blocks were discarded (Blocks 1 and 3). The average response times of Block 2 (e.g., PA good) were subtracted from the average response times of Block 4 (e.g., PA bad). This quantity was divided by the standard deviation of all correct response times within Blocks 2 and 4. Thus, PA SC-IAT scores, or sedentary behaviors SC-IAT scores, indicate more positive than negative associations with PA or sedentary behaviors, respectively.

2.4.6. Explicit Attitudes toward Physical Activity and Sedentary Behaviors

Explicit attitudes towards PA and sedentary behaviors were measured through a semantic differentiator. PA and sedentary behaviors' categories were rated on seven semantic differentiators (e.g., harmful vs. beneficial; ordeal vs. pleasure; annoying vs. interesting) using a 7-point scale ranging from 1 (negative pole) to 7 (positive pole).

2.4.7. Health Related Quality of Life

The French version [39] of the DUKE Health Profile-Adolescent version (DHP-A) [40] was used to measure adolescents' perceptions of their HRQOL. The 17 items describe the different dimensions of participants' health using a 3-point Likert-type scale. Scores were calculated independently on a standardized scale of 0 to 100 [39], with higher scores indicating better HRQOL. In particular, the dimensions of physical health (5 items), mental health (5 items), social health (5 items), general health (15 items), perceived health (1 item), self-esteem (5 items), anxiety (6 items), depression (5 items), and suffering (1 item) were used in the present study.

2.5. Data Analysis

Due to the violation of normality for some variables, the Spearman's rank-order correlation was used to examine the relationships between the study variables. Effect sizes can be defined as small ($0.3 < r < 0.5$), moderate ($0.5 < r < 0.7$), or large ($0.7 < r$) [41]. Then, a series of Wilcoxon test was performed in order to compare the temporal evolution of the pre-test ($T1$) versus post-test ($T2$) scores of the study variables. This non-parametric test was chosen due to the violation of normality and homogeneity of variance across the two measurement points for some of the study variables.

3. Results

3.1. Descriptive Analyses

Table 2 presents the descriptive statistics of the study variables for $T1$ and $T2$. Concerning SDT constructs, the mean scores indicated that participants reported high scores of intrinsic motivation, identified regulation, and introjected regulation as well as moderate scores of integrated regulation and low scores of external regulation and amotivation. Participants also reported moderate scores of family and friend supports. Concerning the TPB constructs, participants reported high scores of intentions, attitude, and PBC and moderate scores of subjective norms. The levels of PA gathered with the pedometers indicated that adolescent girls were rather active. These steps measured habitual school-time and weekend PA level before and after intervention. Descriptive statistics also indicated high scores of both implicit and explicit attitudes toward PA and moderate scores of implicit and explicit attitudes toward sedentary behaviors. Finally, descriptive statistics for HRQOL scores highlighted that participants reported high scores of mental health, social health, general health, self-esteem, anxiety, and depression as well as moderate scores of physical health, perceived health, and suffering.

Table 2. Descriptive statistics of the study variables.

Variables	Time 1	Time 2
	Mean (SD)	*Mean (SD)*
1. Friend support	3.40 (0.84)	3.14 (1.09)
2. Family support	3.44 (0.74)	3.10 (0.77)
3. Amotivation	1.57 (1.04)	1.83 (1.11)
4. Intrinsic motivation	6.05 (1.16)	5.88 (1.21)
5. Integrated regulation	3.79 (1.39)	4.20 (1.13)
6. Identified regulation	5.23 (1.35)	5.47 (1.28)
7. Introjected regulation	5.20 (1.36)	4.90 (1.50)
8. External regulation	2.17 (1.09)	2.70 (1.54)
9. Intentions	4.19 (1.80)	4.00 (2.07)
10. Attitude	5.12 (1.43)	5.17 (1.67)
11. Subjective norms	3.35 (1.28)	3.13 (0.70)
12. Perceived behavioral control	5.10 (1.50)	5.04 (1.44)
13. PA (pedometers)	11,316.42 (3617.91)	12,952.42 (6496.87)
14. Implicit attitude toward physical activity	102.22 (252.79)	102.72 (189.06)
15. Explicit attitude toward physical activity	5.87 (0.91)	5.99 (0.95)
16. Implicit attitude toward sedentary behaviors	55.35 (200.10)	−117.33 (276.85)
17. Explicit attitude toward sedentary behaviors	4.05 (1.38)	4.20 (1.18)
18. Physical health	66.30 (12.14)	69.05 (16.09)
19. Mental health	93.70 (17.35)	89.52 (17.17)
20. Social health	94.07 (15.51)	89.52 (12.44)
21. General health	84.69 (10.05)	82.70 (10.83)
22. Perceived health	65.38 (23.53)	66.67 (32.91)
23. Self-esteem	87.41 (16.31)	84.76 (13.65)
24. Anxiety	86.73 (14.48)	87.70 (17.99)
25. Depression	92.96 (15.14)	90.48 (19.36)
26. Suffering	79.63 (37.36)	90.48 (37.48)

3.2. Correlational Analyses

Table 3 presents the results of correlational analyses for *T*1 variables. Because the patterns of correlations between the study variables in *T*1 and *T*2 are rather close, we only presented the results of correlational analyses of *T*1 for reason of parsimony (for interested readers, results of correlational analyses for *T*2 are available in Supplementary Materials, Table S1).

Friend support was significantly, and positively, related with adaptive constructs from SDT (intrinsic motivation and identified regulation) and TPB (PBC), whereas the only significant correlation for family support was a negative correlation with social health. Intrinsic motivation, integrated regulation and identified regulation were significantly and positively correlated with social health whereas controlled forms of motivation (introjected and external regulations) were not significantly correlated to HRQOL constructs. Amotivation was marginally, and negatively, correlated to mental health. For TPB, subjective norms were marginally correlated with physical health, general health, perceived health, and anxiety as well as significantly and negatively correlated with depression. In contrast, the other TPB constructs (intentions, attitude, and perceived behavioral control) were not significantly correlated to HRQOL constructs.

Table 3. Results of the correlational analyses for Time 1 variables.

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
1. Friend support																									
2. Family support	0.26																								
3. Amotivation	−0.27	−0.16																							
4. Intrinsic motivation	0.50 *	0.04	−0.34 ¥																						
5. Integrated regulation	0.21	0.12	−0.32	0.46 *																					
6. Identified regulation	0.52 *	0.08	−0.28	0.85 *	0.53 *																				
7. Introjected regulation	0.39 *	0.06	−0.18	0.73 *	0.48 *	0.70 *																			
8. External regulation	−0.05	0.05	0.08	−0.33 ¥	0.14	−0.18	−0.30																		
9. Intentions	0.02	0.10	−0.35 ¥	−0.02	−0.08	0.11	0.03	−0.04																	
10. Attitude	0.22	0.31	−0.31	0.30	0.21	0.36 ¥	0.33	−0.08	0.79 *																
11. Subjective norms	−0.19	0.05	0.17	−0.40 *	0.10	−0.38 *	−0.32 ¥	0.42 *	−0.04	−0.28															
12. PBC	0.41 *	0.28	−0.32	0.21	0.29	0.27	0.51 *	−0.12	0.52 *	0.74 *	−0.16														
13. PA (pedometers)	0.14	0.23	−0.17	0.21	0.04	0.27	0.39 ¥	0.11	0.01	0.08	−0.10	0.21													
14. IA toward PA	0.22	0.17	−0.08	−0.06	0.38 ¥	0.11	0.07	0.14	0.01	−0.07	0.32	−0.01	−0.11												
15. EA toward PA	0.12	−0.05	−0.16	0.51 *	0.12	0.61 *	0.27	−0.38 ¥	0.23	0.29	−0.23	0.13	−0.17	−0.15											
16. IA toward SB	−0.08	0.06	−0.13	−0.05	0.20	−0.03	0.01	−0.19	0.01	−0.04	−0.03	0.09	0.28	0.05	−0.15										
17. EA toward SB	0.10	0.30	0.08	−0.16	−0.18	−0.31	−0.26	0.05	−0.34 ¥	−0.34 ¥	0.33	−0.40 *	−0.04	0.39 *	−0.27	−0.23									
18. Physical health	−0.35 ¥	−0.11	0.24	0.09	−0.05	0.05	0.12	−0.16	−0.24	−0.07	−0.36 ¥	−0.19	−0.25	−0.27	0.13	−0.04	−0.18								
19. Mental health	0.01	0.14	−0.36 ¥	0.13	0.06	0.02	0.08	−0.10	0.08	0.16	−0.25	0.13	−0.38 ¥	−0.25	0.14	0.22	−0.26	0.42 *							
20. Social health	0.12	−0.52 *	−0.05	0.40 *	0.47 *	0.50 *	0.26	0.01	−0.06	0.09	−0.21	0.07	−0.04	0.03	0.34 ¥	0.20	−0.56 *	0.12	0.03						
21. General health	−0.09	−0.21	−0.10	0.35 ¥	0.30	0.31	0.27	−0.08	−0.12	0.11	−0.36 ¥	0.01	−0.25	−0.25	0.29	0.20	−0.47 *	0.66 *	0.71 *	0.60 *					
22. Perceived health	−0.31	−0.18	−0.01	−0.11	0.08	−0.16	−0.26	0.27	0.06	−0.12	0.34 ¥	−0.26	−0.21	0.15	0.23	0.26	0.13	−0.14	0.18	0.18	0.18				
23. Self-esteem	−0.22	−0.15	−0.03	0.03	0.25	0.07	−0.09	0.09	−0.01	0.05	−0.20	−0.09	−0.06	−0.19	0.00	0.38 ¥	−0.51 *	0.15	0.28	0.52 *	0.56 *	0.34 ¥			
24. Anxiety	−0.20	−0.07	0.05	0.22	0.24	0.28	0.21	−0.20	−0.07	0.04	−0.35 ¥	−0.11	−0.11	−0.15	0.19	0.38 ¥	−0.49 *	0.62 *	0.51 *	0.46 *	0.80 *	0.12	0.70 *		
25. Depression	−0.20	−0.02	−0.29	0.30	0.01	0.24	0.22	−0.26	−0.01	0.14	−0.53 *	0.00	−0.12	−0.35 ¥	0.38 ¥	0.22	−0.34 ¥	0.64 *	0.76 *	0.25	0.81 *	0.15	0.34 ¥	0.63 *	
26. Suffering	−0.31	−0.14	0.17	0.04	−0.03	−0.10	−0.02	−0.13	−0.18	−0.01	−0.14	0.01	0.00	−0.58 *	0.09	0.06	−0.21	0.58 *	0.24	0.12	0.40 *	−0.11	0.03	0.22	0.31

Notes. PBC = perceived behavioral control; IA = implicit attitude; EA = explicit attitude; PA = physical activity; SB = sedentary behaviors; * $p < 0.05$; ¥ $p < 0.10$.

Explicit attitude toward PA was significantly, and positively, correlated with autonomous forms of motivation (intrinsic motivation and identified regulation) and marginally, and negatively, correlated with external regulation (a controlled form of motivation). Implicit attitude toward PA was marginally, and positively, related to identified regulation, significantly, and negatively, related to suffering and marginally, and negatively, related to depression. Although implicit attitude toward sedentary behaviors was non-significantly related to the SDT and TPB constructs, it was marginally and positively related to self-esteem and anxiety. In contrast, explicit attitude toward sedentary behaviors was significantly and negatively related to PBC, social health, general health, and self-esteem and marginally, and negatively, correlated with intentions and attitude. Finally, PA level (pedometers) was marginally, and positively, correlated with introjected regulation and marginally, and negatively correlated, with mental health.

3.3. Pre-Test versus Post-Test—The Effects of the Intervention Program

Results of Wilcoxon tests showed that the scores of external regulation significantly increased from before to after the intervention program ($Z = 2.17$, $p < 0.05$), whereas the scores of implicit attitudes toward sedentary behaviors significantly decreased from before to after the intervention program ($Z = 2.21$, $p < 0.05$). These results are depicted in Figures 2 and 3 respectively.

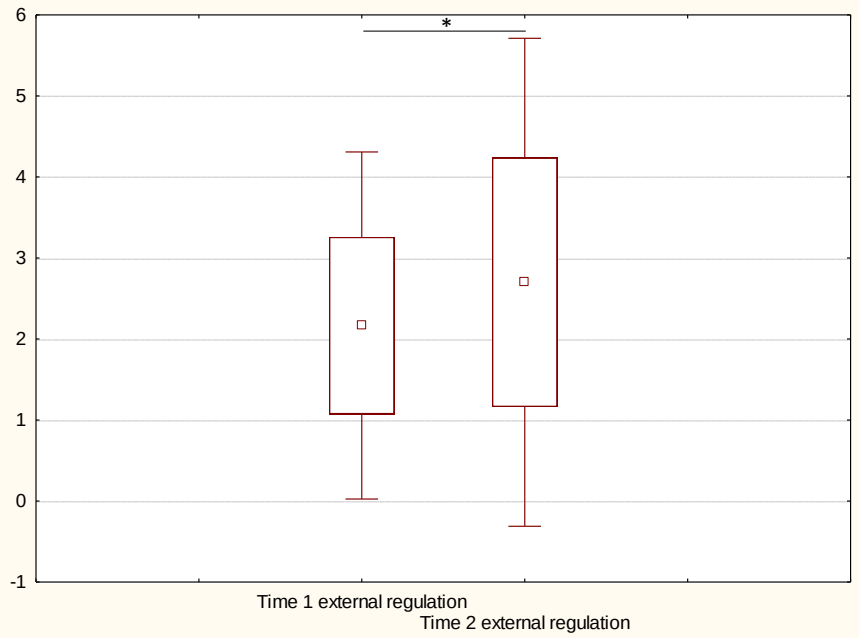

Figure 2. Boxplot of the Time 1 and Time 2 scores of external regulation. Note. * $p < 0.05$.

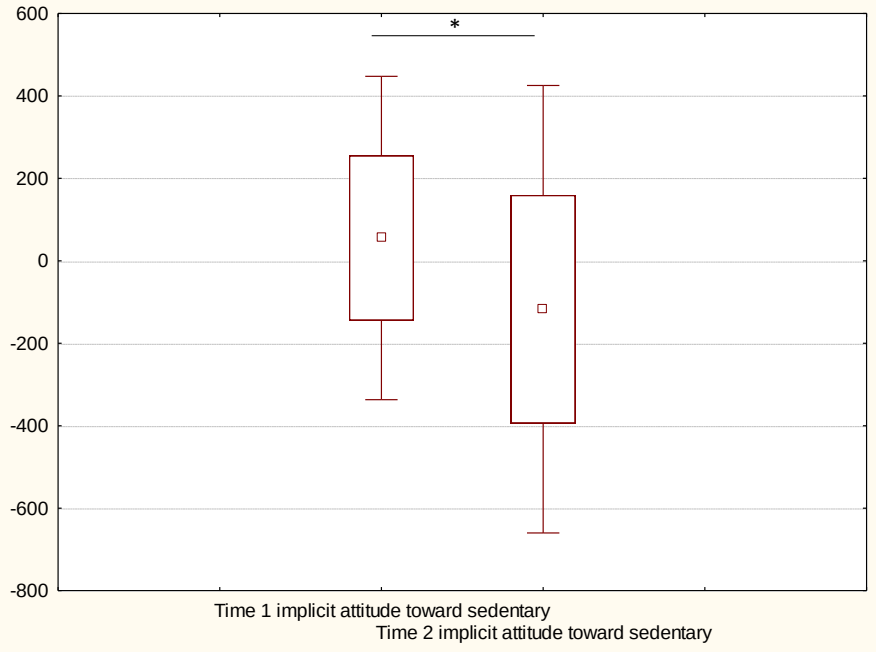

Figure 3. Boxplot of the Time 1 and Time 2 scores of implicit attitudes toward sedentary behaviors. Note. * $p < 0.05$.

4. Discussion

Results of the present study revealed changes on external regulation and implicit attitudes toward sedentary behaviors from before to after the program. Moreover, significant relationships were observed between the constructs of the SDT, TPB, implicit, and explicit attitudes toward PA, sedentary behaviors, and adolescent girls' outcomes (HRQOL, PA level using pedometers). The first eight-week results of this intervention demonstrate the feasibility, and the potential efficiency, of a pedometer program to promote PA and reduce sedentary behaviors in French adolescent girls from suburbs. No interventional study was already tested with French adolescent girls from low-incomes communities. One important promising point is the high participation rate of adolescents not engaged in sport clubs. Thanks to physical education classes at school, and the one-hour weekly PA (e.g., basketball or soccer) proposed by the social association, girls' succeed to reach a mean of 11,316.42 steps before the intervention. Hence, the levels of PA gathered with the pedometers indicated that adolescent girls were rather active as they reported a mean of steps/day corresponding to the practice of 60 min of moderate-to-vigorous PA [4]. Thus, the participants succeed to reach the standard gold of 10,000 steps a day [4]. Even if the change was not significant ($T2$ = 12,952.42 steps) after the intervention, the initial level of daily step was already high. It is also noteworthy that the high standard deviation reported for this variable highlighted that the sample was heterogeneous regarding the level of PA. In particular, the large standard deviation at time 2 (SD = 6496.87 steps) compared to time 1 (SD = 3617.91 steps) means that the intervention does not have the same effect among each individual. Nevertheless, it is noteworthy that the higher standard deviations observed for $T2$ in comparison to $T1$ for PA level (pedometers) could also be partly explained by the smaller sample size in $T2$ in comparison to $T1$ for this variable (11 versus 27 participants). Recent meta-analysis showed that interventions to increase PA in adolescent girls show small but significant effects, suggesting that behavior change may be challenging. Results suggest some approaches that appear to be successful [42].

Behavior changes could be impacted by explicit and implicit attitudes toward PA and sedentary behaviors [23]. This study made the challenge to use SC-IAT to evaluate possible changes on implicit attitudes, rarely measured in previous studies. Only the scores of implicit attitudes toward sedentary behaviors significantly decreased after the intervention.

Our eight-week program had integrated one intervention focusing on PA behaviors and then a second intervention on sedentary behaviors. Adolescent girls had to plan three opportunities to decrease sedentary behaviors. About other theoretically psychological variables (grounded within the SDT and TPB frameworks), only the scores of external regulation significantly increased after the intervention. At first glance, this result could be counterintuitive. However, for both interventions, girls had to plan opportunities to be more physically active or decreasing sedentary behaviors. It could be outlined that the initial level of adolescent girls' intrinsic motivation was already high (i.e., 6.05/7; Likert scale). Step numbers collected on pedometers could be perceived as a reward or a pressure to succeed. Then, to change a behavior, to reduce the gap between intention and behavior, planned self-regulatory strategies are often efficient. Initial change is mainly influenced through an extrinsic motivation rather intrinsic motivation [43].

We hypothesized that PA behaviors and implicit and explicit attitudes toward PA will be positively related to autonomous forms of motivation, TPB constructs (attitude, subjective norm, perceived behavioral control, and intention), and social support, whereas the opposite pattern of results was hypothesized for implicit and explicit attitudes toward sedentary behaviors. Results of the correlational analyses revealed some convincing results. Friend support was significantly positively related with a wide variety of adaptive constructs from SDT and TPB, whereas the only significant correlation for family support was a negative correlation with social health. During adolescence, friends are commonly identified as salient members for promoting regular PA participation compared with parents [34]. Intrinsic motivation, integrated regulation and identified regulation were significantly and positively correlated with social health. To be socially connected will positively impact intention and motivation to be physically active [15].

In line with previous empirical studies [20,21,26,27], explicit attitude toward PA was significantly and positively correlated with autonomous forms of motivation and marginally and negatively correlated with external regulation. Implicit attitude toward PA was marginally, and positively, related to identified regulation, significantly, and negatively, related to suffering and depression. These patterns of results, issued from the correlational analyses, reinforce the notion that explicit attitudes are really different from implicit attitudes and confirm that the implicit and explicit attitudes toward PA should be considered as crucial factors in the development and maintenance of health behavior [24]. These two complementary theoretical constructs largely differed [22,23,37].

Some limitations of the present study should be addressed. Firstly, the relatively small sample size might limit the generalizability of the present results. Secondly, the impact of the intervention program is limited because the participants were already partially involved in a PA program. Indeed, they were recruited through a social sport association proposing PA one time a week to the low-income communities around a large French city. Thirdly, currents findings indicate that a large proportion of the variance for PA and intention remains unexplained, and the proposed pathways in the socio-cognitive theories were not fully supported. Fourthly, to improve our understanding of PA behavior with adolescent girls from suburbs, we should consider the heterogeneity of this population. Thus, future studies are encouraged to further explore mechanisms of behavior change derived from integrated and socio-ecological theories.

Supplementary Materials: The following are available online at https://www.mdpi.com/article/10.3390/adolescents1020017/s1, Table S1: Results of the correlational analyses for Time 2 variables.

Author Contributions: Conceptualization, V.N. and E.G.-D.; Methodology, V.N., E.G.-D. and G.M.; Statistical Analysis, G.M.; Investigation, V.N. and B.R.; Writing—Original Draft Preparation, V.N., E.G.-D., G.M. and B.R. All authors have read and agreed to the published version of the manuscript.

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Institutional Review Board Statement: University indicated that the use of a research ethic committee was not mandatory for the type of study conducted. Nevertheless, it is noteworthy that the study was conducted according to the guidelines of the Declaration of Helsinki, was consistent with the ethical principles specified in the APA standards and was approved by the University. Participants (and their parents) who were asked to participate in the study were given details of their required involvement, and were assured about their right to withdraw. They were also provided with consent form describing the aim and the procedure of the study and gave their written consent. Standard verbal and written instructions regarding the content of the questionnaires were then provided. Instructions emphasized the confidentiality of individual responses, and the need for honesty. The participants were assured that the results would be used only for this study and that their privacy would be guaranteed.

Informed Consent Statement: Informed consent was obtained from all participants (and from their parents) involved in the study.

Data Availability Statement: The data presented in this study are available on request from the corresponding author.

Conflicts of Interest: The authors declare no conflict of interest.

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