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Validation of the 21-item Physical Activity and Leisure Motivation Scale (PALMS) among Finnish late adolescents

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ABSTRACT

Objective: This multi-study investigation examined the validity of the Physical Activity and Leisure Motivation Scale (PALMS) among 16- to 18-year-old Finnish participants. Specifically, we examined factorial structure, reliability, measurement invariance, convergent and predictive validity in respect to reported physical activity.

Methods and Measures: In Study 1, 285 participants completed the 40-item PALMS, and in Study 2, 638 adolescents completed a shorter measure derived from Study 1, along with the Behavioural Regulation in Sport Questionnaire (BRSQ).

Results: Factor analysis in Study 1 indicated that a short seven-factor measure, called PALMS-21, adequately captures adolescent participation motives. Study 2 demonstrated acceptable model fit (factor loadings >.30, RMSEA = .046, SRMR = .040), and reliability values above .740. Factor correlations between PALMS-21 and BRSQ supported convergent validity, with high positive correlations between enjoyment and intrinsic motivation. Measurement invariance was established across gender, age, and sport modality. Results showed evidence of predictive validity of the PALMS-21 in explaining variance in reported physical activity. Mediation analysis demonstrated a positive indirect effect from enjoyment to reported physical activity, *via* intention to be physically active.

Conclusion: Taken together results suggest that the PALMS-21 is a valid and reliable measure of motives to engage in physical activity and sport. As such, the PALMS-21 could be used to provide personalized advice to individuals or to monitor the dynamics in participation motives over time, which could guide the development of effective interventions.

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Introduction

Regular physical activity is associated with multiple beneficial outcomes for health and wellbeing (Bull et al., 2020). However, according to Finland's Report Card (2022), the overall physical activity levels of late adolescents are lower than recommended. The time spent being physically active decreases from primary school to upper secondary school, with only 40% of general upper secondary students engaging in daily unstructured physical activity. The changing trends in leisure time activities, transportation, and screen time use increase physical inactivity, which leads to embracing sedentary lifestyles (WHO, 2020).

Research shows that physical activity levels and sport participation decreases among Finnish across the developmental period from childhood to adolescence, with a substantial decline from the ages 16 to 18 years old (Finland's Report Card, 2022; Kämppi et al., 2018). Physical activity levels have been reported to peak before the puberty after which it starts to decline gradually (Finne et al., 2011).

Motivation, broadly understood as the forces that drive and direct behaviour (Dweck, 2017), is the process that determines whether individuals will initiate and sustain goal-directed behaviour (Roberts & Nerstad, 2020). A motive on the other hand, is the underlying need, desire or reason for engaging in a specific behaviour, and can play a predictive role in the quality of motivation (Ryan & Deci, 2017). Thus, understanding the motives that influence physical activity behaviour is crucial to develop interventions aimed at promoting involvement and keeping people physically active in the course of aging.

Besides life-time transition associated shifts, age-related motivational changes in physical activity behaviours have been found. For example, Brodkin and Weiss (1990) investigated age differences in competitive swimmers on motives related to characteristics of competitive swimming, health/fitness, social status, affiliation, energy release, significant others, and fun. Results indicated that older children (10- to 14-year-olds) and high school/college-age participants (15- to 22-year-olds) evaluated social status as the most important motive for participation in swimming.

Several questionnaires have been used to examine physical activity participation motivation. For example, the Participation Motivation Questionnaire (PMQ; Gill et al., 1983) was developed based on qualitative research with youth athletes to examine motives towards sport and exercise participation. Exploratory factor analyses resulted in eight motives, namely achievement/status, team orientation, fitness, energy release, skill development, affiliation, fun, and a miscellaneous factor. Although it was developed using an empirical approach, the PMQ is atheoretical. Moreover, later research with PMQ failed to replicate the number of motives (Molanorouzi et al., 2014).

Another questionnaire is the Motives for Physical Activity Measure (MPAM, Frederick & Ryan, 1993), which was later revised into the MPAM-R (Ryan et al., 1997). The MPAM-R assesses five motives for physical activity: enjoyment, competence, fitness, appearance, and social. The Exercise Motivation Inventory (EMI; Markland & Hardy, 1993), later revised into the EMI-2 (Markland & Ingledew, 1997), includes 14 factors: stress management, weight management, re-creation, social recognition, enjoyment, appearance, personal developments, affiliation, ill-health, avoidance, competition, fitness, and health pressures. These questionnaires encompass both intrinsic motives

(e.g. enjoyment, competence) and extrinsic motives (e.g. fitness, appearance) as identified by self-determination theory (SDT; Ryan & Deci, 2017). Although these tools were not explicitly developed within the SDT framework, they align with its principles. According to SDT, intrinsically motivated individuals engage in activities inherent satisfaction, while extrinsically motivated individuals are driven by external pressures or rewards. The Goal Content for Exercise Questionnaire (GCEQ; Sebire et al., 2008) was specifically developed within the SDT-framework to measure exercise goals. It consists of five factors classified into intrinsic (i.e. health management, skill development, and social affiliation) and extrinsic (i.e. social recognition, image) higher-order factors.

Within the broad SDT perspective, the organismic integration mini-theory as applied to sport posits that greater persistence, functioning, and wellbeing are manifested when behaviour is autonomously regulated (e.g. *via* intrinsic motivation), whereas burnout, dropout, and other negative outcomes are associated with more controlled forms of motivation (Standage, 2023). Individuals who engage in physical activity for autonomous reasons are more likely to experience it as enjoyable and maintain exercise habits, whereas those driven by controlled reasons tend to distance themselves from physical activity (Wang & Hagger, 2023). Indeed, the intention to be physically active is positively predicted by autonomous motivation in adolescents (Fernández-Espínola et al., 2020).

Another theoretical framework that guides motivation research in sport and exercise settings is achievement goal theory (AGT; Nicholls, 1989). According to AGT there are two types of goal orientations, namely task- and ego-orientation. Task-oriented individuals focus on self-referenced improvement and mastering a task. The derived satisfaction from the intrinsic aspects of learning and performing results in high levels of engagement and effort. In contrast, ego-oriented individuals focus on outperforming others to demonstrate their ability, which usually leads to less adaptive motivational patterns. However, these two goal orientations do not fully represent individuals' range of goals to engage in physical activity.

The existing questionnaires, though useful for understanding participation motives, are limited in scope and often disregard important concomitants of physical activity, such as mental health (e.g. MPAM-R; Ryan et al., 1997), or may not be applicable to competitive sport (e.g. EMI-2; Markland & Ingledew, 199; GCEQ; Sebire et al., 2008). Understanding participation motives in the context of competitive sport is important for developing effective interventions to promote involvement and adherence to sport and physical activity.

Research has demonstrated that people engage in physical activity and sport for different motives, such as affiliation in team sports and physical condition in exercisers (Molanorouzi et al., 2015). Promising research was conducted using the Physical Activity and Leisure Motivation Scale (PALMS; Morris & Rogers, 2004), a 40-item revised version of the 73-item Recreational Exercise Motivation Measure (REMM; Rogers & Morris, 2003). A strength of the PALMS over existing instruments is the empirical approach used in its development, which was based on a qualitative approach that aligns with intrinsic-extrinsic motivation and task-ego orientation distinctions based on SDT and AGT perspectives, respectively. The PALMS consists of eight subscales:

mastery, enjoyment, physical condition, affiliation, psychological condition, appearance, others' expectations, and competition/ego. The first two subscales (i.e. mastery and enjoyment) measure intrinsic motivation, while the remaining six subscales measure extrinsic motivation towards sport and exercise. The PALMS has demonstrated good internal consistency, high criterion and construct validity, and is suitable for use in sport contexts (Roychowdhury, 2018).

Significant motivational differences across gender have been found using the PALMS. For example, in a study on 202 Australians involved in a range of physical activities, appearance was the primary motive for engaging in physical activity in females, whereas males prioritised affiliation (RoyChowdhury, 2018). However, gender differences were less pronounced than differences between types of physical activity.

The PALMS has shown robust factor structure and acceptable reliability in different language versions, including Dutch (van Lankveld, 2021), Hebrew (Zach et al., 2012), Malaysian (Molanorouzi et al., 2014), and Spanish (Pérez-de la Cruz et al., 2022). These versions were used with mixed physical activity and age samples. There is also a version for young participants in Chinese (PALMS-Y-C; Abdullah et al., 2019), and Malaysian (i.e. PALMS-Y-M; Kueh et al., 2018) languages. This version, administered to Chinese and Malaysian secondary school students (aged 13.55 ± 0.57 years, and 14.50 ± 1.25 years, respectively), consists of 28 items, excluding the others' expectations subscale.

To understand participation motives and the determinants of physical activity it is important to have reliable and valid instruments that are appropriate for the target population. It is also important to examine measurement invariance to ensure that different samples would interpret the meaning of the items in a similar way. For example, measurement invariance across gender was investigated in a sample of Malaysian participants (Kueh et al., 2018). However, measurement invariance across exercise and sport settings was not investigated.

Thus, the purpose of the present investigation was to validate a measure of motives for participation in sport and leisure time physical activity among Finnish late adolescents. Two studies were conducted to investigate the dimensionality and validity of the PALMS. In Study 1, we examined the psychometric properties and factor structure of the Finnish version of the full PALMS. In Study 2 we sought to confirm the factorial structure of a 21-item Scale derived from Study 1, and to test construct validity, measurement invariance, and predictive validity.

Study 1

The purpose of this study was to examine factor structure and internal consistency of the Finnish version of the PALMS in a sample of high school students. In addition, test-retest reproducibility was examined.

Method

Participants

We recruited participants who were at least 16 years old from a sports high school. They were categorized into two groups: (a) students in the sports specialization

program, who are competitive athletes, and (b) students in the general specialization program, who are regular students not involved in competitive sports. The sample was comprised of 285 adolescents (155 women, 130 men), aged 16–18 years ($M = 16.74$, $SD = 0.67$) recruited from a sports high school in the Central region of Finland. In particular, participants were drawn from two lines of specialization, sports education ($n = 139$) and general education ($n = 146$). Sport class participants engaged in an average of 5.67 days ($SD = 1.34$) of physical activity a week, with 84.2% of the participants reporting engaging in 5 days or more of physical activity a week. General class participants engaged in an average of 3.57 days ($SD = 1.77$) of physical activity, with 34.9% being active 5 days or more.

Measure

The Physical Activity and Leisure Motivation Scale (PALMS; Morris & Rogers, 2004) is a 40-item self-report questionnaire that measures individual motives for participation in physical activity across eight underlying factors. The steam question is 'I undertake physical activity…' and items form the following subscales with 5 items each: mastery ('to get better at an activity'), enjoyment ('because it makes me happy'), affiliation ('because I enjoy spending time with others'), competition/ego ('to be best in the group'), others' expectations ('because people tell me I need to'), psychological condition ('because it helps me relax'), physical condition ('to be physically fit'), and appearance ('to maintain trim, toned body'). Items are assessed on a 5-point Likert type scale ranging from 1 (strongly disagree) to 5 (strongly agree). The PALMS has shown to have good internal consistency with Cronbach's alpha values ranging from .80 to .99 (RoyChowdhury, 2018).

The Finnish version of the questionnaire was developed using a multi-step process involving standardized back-translation procedures (Brislin, 1986) and expert review (Sperber, 2004) to ensure congruence. First, there was direct translation by a dual linguist who was not familiar with the instrument. Second, the translated version was examined by a panel of three academics whose first language was Finnish and were competent in both written and spoken English. Their primary area of research was motivation and they were familiar with instruments measuring physical activity participation motivation, including the PALMS. The panel of experts evaluated the items separately comparing them to the original. The experts together with the first author discussed any discrepancies between items with efforts made to ensure that the underlying meaning in the original instrument remained unchanged. Next, the modified Finnish version was back translated into English by a different dual linguist. Finally, the back translated English version was compared to the original version by the first and third authors to ensure that the meaning and intent of the original items were maintained.

Procedure

Ethics approval for this investigation was received from the [ethical committee name redacted for peer-review] Ethics Committee. The only sports high school in Central Finland was contacted and permission was obtained to administer the questionnaire to students in six classes representing sport (three classes) and general education

(three classes). In Finland, students' family background or socio-economic status do not affect the selection of school, and students usually go to the nearest school. Thus, it can be assumed that the participants were representative of students of similar age. Data collection took place in the classrooms of the high school premises in the presence of a research assistant, at a time agreed with responsible teachers. In Finland, individuals older than 15 years can consent to participate in research, as long as their guardians are informed about the study. Prior to administration of the questionnaire, participants and their parents received information about the study, with voluntary participants returning a written informed consent form. On assessment day, participants were explained that there were no 'right' or 'wrong' answers, they were reminded that they could withdraw from the study without any consequences, and that responses were anonymous. Administration of the questionnaire took about 15 min to complete. The second administration of the questionnaire took place two weeks later with participants from two classes selected by the responsible teachers.

Data analysis

Preliminary analysis involved screening for missing values, inputting errors, outliers, distribution, and multicollinearity. The analytic strategy to examine dimensionality of the Finnish version of the PALMS included the estimation of the following competing models. First, Exploratory Structural Equation Modelling (ESEM), which integrates Exploratory Factor Analysis (EFA) and Confirmatory Factor Analysis (CFA), was conducted. In ESEM factor loadings for each item are estimated while at the same time considering the expected theoretical factor structure (Marsh et al., 2014). Based on existing support to the factorial structure of the PALMS, target rotation was used with ESEM. A Bifactor model was estimated assuming the existence of two general factors (i.e. intrinsic and extrinsic motives) accounting for the shared communality by all the items, and eight specific factors (i.e. mastery, enjoyment, physical condition, affiliation, psychological condition, appearance, others' expectations, and competition/ego), which contribute to a common variance shared within each cluster of items, beyond that of the general factors (Canivez, 2016). Lastly, CFA model was estimated with items only allowed to load on the eight expected factors and cross-loadings being constrained to zero. All models were performed using Mplus 8.5 (Muthén & Muthén, 2017).

Minimum sample size for model fit tests was determined following Myers et al.'s (2016) indications using the root mean square error of approximation (RMSEA) and the R code developed by Preacher and Coffman (2006). The following values were used for all models, $\alpha = .05$, power = .80, null RMSE = .05, alternative RMSE = .04. In addition, the following degrees of freedom were entered, df = 488 (ESEM), df = 706 (Bifactor analysis), and df = 712 (CFA). These resulted in minimum sample sizes of 253 for ESEM, 199 for Bifactor, and 198 for CFA models. Thus, a sample of 285 participants was appropriate to estimate all models.

To determine the fit of a model, we considered different indices of fit that included chi-square (χ^2), the comparative fit index (CFI), the Tucker-Lewis Index (TLI), the standardized root mean square residual (SRMR), and the root mean square error of approximation (RMSEA). A good model fit is inferred when chi-square value is statistically

non-significant; values of CFI, and TLI are close to .95; SRMR is smaller than .08; and RMSEA is smaller than .06 (Hu & Bentler, 1999). Modification indices and standardized residuals were examined to screen for mis-specified items. In examining competing models, fit indices, Akaike's Information Criterion (AIC), Bayesian Information Criterion (BIC), and the parsimony comparative fit index (PCFI) were examined. The model with lower AIC and BIC values and higher PCFI would be preferred (Wang & Wang, 2020). Test-retest reliability was examined by calculating intra-class correlations between each factor at T1 and two weeks later.

Internal consistency values were calculated *via* Cronbach's alpha (α), McDonald's omega (ω), composite reliability (ρ) values, and average variance extracted (AVE). Values between .60 and .70 were considered the lowest limits of acceptability. AVE values larger than .50 suggest adequate convergence of items within the specific construct (Hair et al., 2019). Correlation coefficients were interpreted following Zhu's (2012) recommendations, that is, 0–0.19 = no correlation, 0.20–0.39 = low correlation, 0.40–0.59 = moderate correlation, and 0.60–0.79 = moderately high correlation.

Results

Six cases were identified as outliers (Mahalanobis' distance, $p < .001$), resulting in a final sample of 279 (151 women, 128 men) participants. Mardia coefficients were 431.403 for skewness and 5.773 for kurtosis, which indicated that data were non-normally distributed. Thus, all models (i.e. ESEM, Bifactor, and CFA) were adjusted for non-normality by using the maximum likelihood estimator (MLR) with robust standard errors and corrected chi-square value. Variance inflation factors (VIF) ranged from 1.444 (competition ego) to 1.999 (physical condition), which being below the value of 3 indicated no multicollinearity among the factors (Hair et al., 2019).

ESEM, Bifactor, and CFA results are presented in Table 1. Based on models on the 40-item scale and inspection of modification indices (>8), items with cross-loadings (>.30) on unintended factors, poor factor loadings (< .30), or items with high item residual variances ($\delta > .60$) were considered for deletion. As Table 2 shows, standardized factor loadings of the final 21-item factor scale were above .600 ($\lambda = .640 - .938$), and item residual variances were below .600 ($\delta = .120$ to .590).

Table 1. Fit Indices for the Factor Models of the PALMS from Study 1 ($N = 279$) and Study 2 ($N = 609$).

Model	χ^2 (*df*)	RMSEA (90% CI)	CFI	TLI	SRMR	AIC	BIC	PCFI
Study 1								
ESEM, 8 factors, 40 items	765.377 (488)	.045 (.039–.051)	.954	.926	.024	24510.392	25861.203	.727
Bifactor CFA, 40 items	1840.719 (706)	.076 (.072–.080)	.811	.791	.183	25293.108	25852.315	.177
CFA, 8 factors, 40 items	1442.273 (712)	.061 (.056–.065)	.878	.867	.074	24856.214	25393.633	.183
CFA, 7 factors, 21 items	227.743 (168)	.036 (.023–.047)	.978	.973	.042	11999.470	12304.491	.489
Study 2								
Bifactor CFA, 21 items	930.113 (174)	.084 (.079–.090)	.843	.811	.145	26944.900	27289.022	.378
CFA, 7 factors, 21 items	382.491 (168)	.046 (.040–.052)	.956	.944	.040	26359.416	26730.009	.478

Note. ESEM = Exploratory Structural Equation Modelling, Bifactor CFA = Bifactor model based on CFA, CFA = Confirmatory Factor Analysis, χ^2(df) = chi-square (degrees of freedom), CFI = comparative fit index, TLI = Tucker Lewis fit index, RMSEA = root mean square error of approximation, SRMR = standardized root mean square residual, AIC = Akaike Information Criterion, BIC = Bayesian Information Criterion, PCI = Parsimony Comparative Fit Index.

Table 2. Descriptive Statistics and Factor Loadings of the Brief Version of the PALMS-21 for Study 1 and Study 2 Participants.

Modality	Sample 1 ($N = 279$)				Sample 2 ($N = 609$)			
Item	*M*	*SD*	λ	δ	*M*	*SD*	λ	δ
Mastery								
Tullakseni paremmaksi harrastamassani liikuntamuodossa [Get better at an activity]	4.319	0.891	.848	.280	4.650	0.66	.794	.369
Parantaakseni nykyisiä taitojani [Improve existing skills]	4.248	0.858	.880	.225	4.592	0.603	.783	.387
Jotta liikuntasuoritukseni paranisivat [Do my personal best]	4.197	0.809	.698	.513	4.444	0.726	.717	.485
Enjoyment								
Koska se on hauskaa [Because it is fun]	4.469	0.730	.781	.389	4.645	0.598	.711	.494
Koska nautin liikkumisesta [Because I enjoy exercising]	4.448	0.751	.849	.279	4.689	0.548	.799	.361
Koska pidän siitä [Because I have a good time]	4.450	0.733	.891	.205	4.750	0.523	.851	.275
Affiliation								
Jotta voin olla yhdessä muiden kanssa [Do activity with others]	3.798	0.910	.840	.295	3.857	0.937	.743	.448
Jotta voin olla yhdessä ystävieni kanssa [Do something in common with friends]	3.932	0.949	.938	.120	4.044	0.894	.921	.152
Ollakseni ystävieni kanssa [Be with friends]	3.832	0.980	.923	.149	3.872	0.996	.856	.267
Competition/ego								
Koska suoriudun paremmin kuin muut [Because I perform better than others]	2.638	1.050	.756	.429	2.866	1.137	.683	.534
Ollakseni ryhmän paras [Be best in the group]	2.505	1.156	.863	.254	3.132	1.378	.881	.224
Harjoitellakseni kovemmin kuin muut [Work harder than others]	2.434	1.170	.739	.454	3.036	1.294	.782	.388
Physical Condition								
Koska harjoittelu auttaa minua pysymään fyysisesti terveenä [Because it helps maintain a healthy body]	4.471	0.668	.787	.381	4.562	0.629	.732	.464
Ylläpitääkseni fyysistä terveyttäni [Maintain physical health]	4.459	0.638	.806	.350	4.487	0.605	.800	.361
Koska se pitää minut terveenä [Because it keeps me healthy]	4.201	0.77	.640	.590	4.212	0.801	.715	.488
Psychological Condition								
Koska se auttaa minua rentoutumaan [Because it helps me relax]	3.968	0.779	.677	.541	4.005	0.802	.691	.523
Koska se auttaa hallitsemaan stressiä paremmin [Better cope with stress]	3.767	1.032	.866	.250	3.800	0.995	.789	.378
Koska liikunta vähentää henkisiä paineita [Get away from pressures]	3.731	0.987	.793	.371	3.663	0.979	.652	.575
Appearance								
Koska se saa lihakset näyttämään paremmilta [Define muscle, look better]	3.673	1.090	.867	.249	3.688	1.042	.817	.333
Parantaakseni ulkonäköäni [Improve appearance]	3.559	1.064	.788	.379	3.308	1.168	.774	.401
Koska se auttaa minua ylläpitämään lihakseni kiinteinä [Maintain trim, toned body]	3.652	1.044	.832	.309	3.632	1.052	.827	.316

Reliability scores were acceptable, with lowest α and ω values above .778, and composite reliability above .791 (see Table 3). All AVE estimates were above .50. The results of the test-retest reliability assessment demonstrated good reproducibility of the scale for the group of 31 participants who completed it a second time [Lowest intraclass correlation for Physical Condition (95% CI): ICC = .767 (.512–.888), $p < .001$].

Table 3. Latent Factor Correlations, Reliability Coefficients, and Average Variance Extracted for the PALMS-21.

								Sample 1 ($N = 279$)				Sample 2 ($N = 609$)			
	1	2	3	4	5	6	7	α	ω	ρ	AVE	α	ω	ρ	AVE
1. Mastery	—	.562[§]	.222*	.572[§]	.374*	.178	.232*	.845	.855	.853	.660	.804	.805	.809	.586
2. Enjoyment	.820[††]	—	.306*	.265*	.348*	.358*	.060	.871	.873	.879	.708	.825	.826	.831	.623
3. Affiliation	.428[§]	.524[§]	—	.075	.254*	.242*	.223*	.927	.930	.928	.812	.875	.879	.880	.711
4. Competition/ego	.507[§]	.269*	.174	—	.103	.038	.272*	.824	.831	.830	.621	.823	.839	.828	.618
5. Physical condition	.567[§]	.577[§]	.399*	.156	—	.531[§]	.542[§]	.778	.778	.791	.560	.781	.784	.794	.562
6. Psychological condition	.518[§]	.560[§]	.365*	.170	.609[†]—	.271*	.817	.835	.824	.612	.749	.756	.755	.508	
7. Appearance	.380*	.275*	.222*	.424§	.533§	.297*	—	.870	.870	.868	.688	.844	.844	.848	.650

Note. Sample 1 correlations are below the diagonal and Sample 2 correlations are above, α = Cronbach's alpha values, ω = omega values, ρ = composite reliability, AVE = average variance extracted. Correlation *low, [§]moderate, [†]moderately high, [††]high.

Short discussion

The current study aimed to examine the dimensionality of the PALMS and validate its psychometric properties for use with late adolescents. Confirmatory factor analysis indicated a poor fit to the data for the 40-item PALMS. Indices associated with factor analysis suggested the removal of several items, from different factors, as well as the removal of the Other's expectations factor. Indeed, our data suggests that items in this factor (e.g. 'because it was prescribed by doctor/physio', 'to earn a living', 'to manage medical condition'), may not be suitable for the target group, late adolescents. Item removal resulted in a seven-factor scale including 21 indicators, three items per factor, forming a shorter measure, termed PALMS-21. Good CFA fit indices were obtained with factor loading estimates above recommended values of .40, and AVE values higher than the recommended .50. Results also demonstrated acceptable reliability (α, ω, and ρ), with values about .70. Taken together, the results provide preliminary evidence of dimensionality and construct validity of the PALMS-21 as administered to late adolescents.

Study 2

Using an independent second sample, the aims of Study 2 were to (a) examine the dimensionality of the PALMS-21, (b) test measurement invariance across gender, age, and sport modality, (c) examine convergent validity through correlations with the Behavioural Regulation in Sport Questionnaire (BRSQ), and (d), test the predictive validity of the scale in accounting for variance in reported participations in physical activity. In examining the relationships between participation motives and physical activity, and based on SDT research (Ryan & Deci, 2017), we hypothesized that intrinsic motives (i.e. mastery, enjoyment) would be positive predictors of physical activity. Intention to be physically active is considered a proximal determinant of physical activity behaviour. In line with SDT, intention to be physically active is positively predicted by autonomously regulated behaviour (e.g. *via* intrinsic motivation). Thus, to increase our understanding on the determinants of physical activity, a final aim

of this investigation was to test whether participants' intention to be physically active mediated the relationship between participation motives and reported physical activity.

Method

Participants

Inclusion criteria were similar to study 1, that is participants had to be 16 years old and be competitive athletes or regular students. In order to recruit participants engaged in a broad range of physical activities, a sample of 638 adolescents (377 women, 260 men, one participant did not report gender), aged 16–18 years ($M = 16.97$, $SD = 0.85$) were recruited from five sport high schools under the sports education ($n = 348$), general education ($n = 121$), and several sports clubs in both rural and urban areas ($n = 169$) across Finland. Participants indicated being involved in team sports ($n = 308$, e.g. football, ice-hockey, floorball) or individual sports ($n = 287$, e.g. track and field, swimming, alpine skiing), with 43 who did not report a sport modality. Of the 638, 85% of the participants reported partaking in physical activity five days a week or more.

Measures

A multi-section questionnaire was used to assess motives for participations in physical activity, as measured by the PALMS-21, behaviour regulations, intentions to be physically active, and reported physical activity.

Motives for participation in physical activity and sport. The PALMS-21, derived from Study 1, is comprised by seven factors (with 3 items each) to measure the following motives for participation in physical activity and sport: mastery, enjoyment, affiliation, competition/ego, physical condition, psychological condition, and appearance. Responses are rated on a 5-point Likert type scale ranging from 1 (*strongly disagree*) to 5 (*strongly agree*).

The Behavioural Regulation in Sport Questionnaire (BRSQ). The BRSQ (Lonsdale et al., 2008) is a 24-item scale developed within self-determination theory (Ryan & Deci, 2017) to measure motivation regulations. The BRSQ consists of six subscales that assess intrinsic motivation (e.g. 'because I enjoy it'), integrated regulation (e.g. 'because it is a part of who I am'), identified regulation (e.g. 'because the benefits of sport are important to me'), introjected regulation (e.g. 'because I would feel ashamed if I quit'), external regulation (e.g. 'because if I don't other people will not be pleased with me') and amotivation (e.g. 'but I question why I continue'). Intrinsic motivation and integrated regulation form the autonomous motivation factor, and identified regulation, introjected regulation, and external regulation form the controlled motivation factor, whereas amotivation represents a lack of motivation. Participants respond to the question 'I engage in physical activity/participate in sport…' assessed on a 7-point Likert type scale ranging from 1 (*not at all true*) to 7 (*very true*). Acceptable internal consistency of the Finnish version of the scale has been reported ($\alpha = .87$ for autonomous motivation, $\alpha = .90$ for controlled motivation, and $\alpha = .78$ for autonomous motivation; Ruiz et al., 2017).

Intentions to be physically active. Intention to engage in physical activity was measured on the following two items: 'I intend to engage in active sports and/or vigorous physical activities for at least 30 min during my leisure time', and 'I will try to engage in active sports and/or vigorous physical activities for at least 30 min during my leisure time'. Participants answered the stem question 'On most days next week…'. Responses were assessed on a 6-point Likert type scale ranging from 1 (*strongly disagree*) to 5 (*strongly agree*). These two items were used as a viable alternative to capture the construct of intention without redundancy, thus reducing participant burden. Previous research has demonstrated the appropriateness of using single items to reduce assessment burden while maintaining acceptable levels of reliability and validity (e.g. Milton et al., 2011; O'Halloran et al., 2020).

Physical activity. Self-reported physical activity was assessed using one item from the Health Behaviour in School-aged Children Research Protocol (Currie et al., 2004). Participants were asked to think of a typical week, and to answer the item 'Over the past 7 days, on how many days were you physically active for a total of at least 60 min per day?'. Responses were rated on an 8-point Likert scale ranging from 0 to 7 days.

Procedure

Following procedures approved by the Ethics Committee and similar to study 1, permission to collect data from high schools and clubs was granted after the study purpose and procedures were explained to responsible teachers and coaches. Prior to data collection parents were informed about the study purpose and procedures. Depending on the high-schools and clubs preferences data collection was agreed during or after the school day or prior to or after a practice session. On assessment day, participants were informed of the purpose of the study and procedures, after which they provided informed consent. They were also instructed that there were no 'right' or 'wrong' answers, their participation was voluntary, and responses were anonymous. Data were collected in a quiet classroom at the high-school or club premises under the supervision of research assistants. Completion of the instruments took 30 min.

Data analysis

Data were screened for missing values, inputting errors, outliers, distribution, and multicollinearity. The dimensionality of the PALMS-21 was examined *via* a Bifactor model with the same structure as in Study 1, and CFA, (see input in Supplementary Material 1). Goodness of fit was judged using the same criteria as for Study 1. Descriptive statistics, internal consistency, AVE, and latent factor correlations were also calculated. Model fit was determined considering the same indices of fit as in Study 1. However, as the $\chi 2$ test could be significant in large samples even when absolute differences are trivial (Cheung & Rensvold, 2002), in the case of a significant $\chi 2$, RMSEA was inspected.

To examine measurement invariance, we conducted a series of CFAs imposing equality constraints of each indicator across groups after which we compared more

constraints models against the model with less constraints (Wang & Wang, 2020). Specifically, we first determined a configural model with all parameters freely estimated across groups. A second model was established setting factor loadings to be equal across groups to examine metric or weak factorial invariance. A third model included equality of factor loadings and intercepts across groups to test scalar or strong factorial invariance. Nested models were compared using the Satorra-Bentler Chi-square difference ($\Delta\chi^2$) test adjusting for scaling correction factor for MLR, along with the RMSEA (Hu & Bentler, 1999). Measurement invariance is assumed when $\Delta\chi^2$ values are non-significant. In the case of a significant $\Delta\chi^2$, changes in RMSEA were inspected. Thus, we evaluated the amount of difference between the nested models by comparing RMSEA values. Measurement invariance is assumed for ΔRMSEA $\leq$ .015 (Chen, 2007; Wang & Wang, 2020). To test convergent validity of the PALMS-21, we first examined the dimensionality of the BRSQ. Latent factor correlations between PALMS-21 and BRSQ subscales were calculated for participants involved in sport.

Predictive validity of the PALMS-21 was examined using structural equation modelling. Specifically, a model was estimated where PALMS-21 motives were set as predictors of intention to be physically active, which was calculated based on sums of scores of the two items measuring intention, and reported physical activity, which was the outcome variable. Age and gender were entered as covariates. Adequacy of the models was established using the same criteria used to evaluate model fit. Since bootstrapping is unavailable with MLR, possible mediating effects of the intention to be physically active on the relationship between participation motives and reported physical activity were tested using maximum likelihood estimator (ML) and bias-corrected bootstrap based on 5000 samples. Significant indirect effects are inferred when zero is not included within the upper and lower 95% confidence intervals.

Minimum sample size for model fit was determined following the same procedures used for Study 1. These resulted in a minimum of 526 participants required for Bifactor and 540 for CFA models. A minimum sample size of 406 participants was required for the structural model. Thus, a sample of 638 participants was deemed appropriate to estimate all models.

Results

After data screening, 29 cases were deleted because of missing values or because they were identified as outliers. Mardia coefficients were 1097.107 for skewness and 13.248 for kurtosis indicating that data were non-normally distributed. Thus, measurement models (i.e. Bifactor, and CFA) were estimated using the maximum likelihood estimator (MLR) with robust standard errors and corrected chi-square value to adjust for non-normality. VIF ranged from 1.1281 (competition ego) to 1.5274 (physical condition), indicating no multicollinearity among the factors.

Dimensionality

A Bifactor model of the 21-item PALMS including two general factors (intrinsic, extrinsic) and seven specific motives (mastery, enjoyment, physical condition, affiliation,

psychological condition, appearance, and competition/ego), did not fit data well (see Table 1). A 7-factor CFA, however, did show a good fit to the data. Standardized factor loadings were above .600 (λ = .652 to .921) and item residual variances were below .600 (δ = .152 to .575). Reliability scores were acceptable, with lowest α and ω values above .740, and composite reliability above .755 (see Table 3). All AVE estimates were above .50.

Measurement invariance

Fit indices for all nested models estimated to test the measurement invariance of PALMS-21 subscales are presented in Table 4. Full metric, scalar, and strict invariance with changes RMSEA values meeting the adopted criteria was demonstrated across groups, that is across gender (i.e. male, female), age group comparisons (i.e. 16-, 17- and 18-year-olds), and sport modalities (i.e. team, individual).

Convergent validity of the PALMS-21

Prior to examining convergent validity, CFA on the BRSQ following theoretical dimensionality was conducted on the sample of participants involved in sports (n = 595). A six-factor model comprised of intrinsic motivation, integrated regulation, identified regulation, introjected regulation, external regulation, and amotivation fitted data well, χ^2 (237) = 562.117, CFI = .931, TLI = .920, RMSEA (90% CI) = .048 (.043–.053), SRMR = .048. Convergent validity was examined by estimating latent factor correlations between the PALMS-21 and the BRSQ for participants involved in sports. As Table 5 presents, high positive correlations were observed between enjoyment and intrinsic motivation, moderately high positive correlations between physical condition and identified regulation, and no or negative correlations with PALMS-21 subscales and amotivation.

Table 4. Measurement Invariance of the PALMS-21 (N = 609).

Model	χ^2(df)	CFI	TLI	RMSEA (90% CI)	SRMR	ΔS-B χ^2 (Δdf)	p value	ΔRMSEA
Gender								
Configural	555.625 (336)	0.955	.944	.046 (.039–.053)	.044			
Metric invariance	573.182 (350)	.954	.945	.046 (.039–.052)	.058	18.49 (14)	.185	.000
Scalar invariance	733.170 (364)	.924	.913	.058 (.052–.064)	.075	184.00 (28)	< .001	.012
Strict invariance	627. 136(385)	.950	.946	.045 (.039–.052)	.084	73.70 (49)	.013	.001
Age								
Configural	826.680 (504)	.937	.922	.056 (.049–.063)	.055			
Metric invariance	834.426 (518)	.938	.925	.055 (.048–.062)	.059	9.88 (14)	.771	.001
Scalar invariance	897.626 (560)	.934	.926	.055 (.048–.061)	.062	71.16 (56)	.083	.001
Strict invariance	933.789 (602)	.935	.932	.052 (.046–.059)	.089	119.45 (98)	.069	.004
Sport Type								
Configural	551.567 (336)	.949	.937	.048 (.041–.055)	.049			
Metric invariance	556.014 (343)	.950	.939	.047 (.040–.055)	.051	5.61 (7)	.586	.002
Scalar invariance	621.411 (364)	.939	.930	.051 (.044–.057)	.057	69.47 (28)	< .001	.003
Strict invariance	645.374 (385)	.939	.933	.050 (.043–.056)	.072	9.78 (336)	< .001	.002

Note. χ^2(*df*) = chi-square (degree of freedom), CFI = comparative fit index, TLI = Tucker Lewis fit index, RMSEA = root mean square error of approximation, SRMR = standardised root mean square residual, ΔS-B χ^2 (Δ*df*) = Satorra-Bentler scaled chi-square difference test (degree of freedom difference), ΔRMSEA = RMSEA difference.

Table 5. Latent factor correlations between the PALMS-21 and BRSQ in Study 2, for participants involved in sports ($n = 595$).

	Intrinsic motivation	Integrated regulation	Identified regulation	Introjected regulation	External regulation	Amotivation
1. Mastery	.483[§]	.544[†]	.514[§]	.189	−0.086	−0.205*
2. Enjoyment	.850[††]	.547[†]	.422[§]	−0.118	−0.312*	−0.334*
3. Affiliation	.181	.239*	.286*	.083	.049	.043
4. Competition/ego	.217*	.402[§]	.348*	.322*	.072	.000
5. Physical condition	.198	.276*	.628[†]	.110	−0.007	−0.021
6. Psychological condition	.268*	.315*	.418[§]	.011	−0.048	−0.159
7. Appearance	−0.046	.061	.436[§]	.223*	.143	.145

Note. Correlation *low, [§]moderate, [†]moderately high, [††]high.

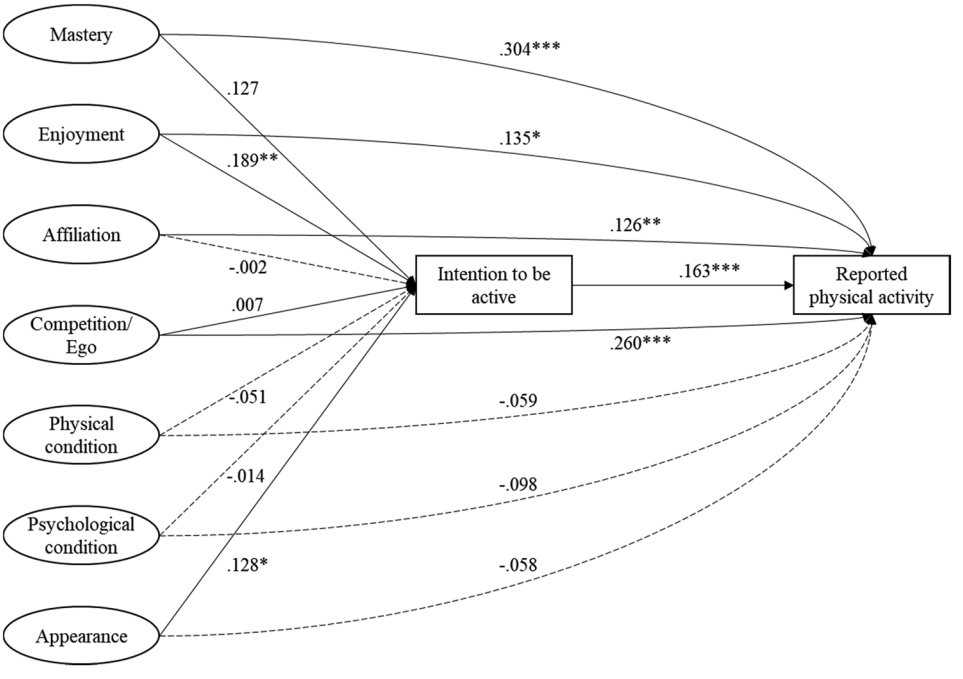

Figure 1. Structural equation model illustrating direct interrelations among motives to participate in physical activity, intention to be physically active and reported physical activity. *$p < .05$, **$p < .01$, ***$p < .001$. $N = 609$. Standardized beta coefficients are presented. Solid lines represent significant positive paths and dash lines represent significant negative paths.

Predictive validity

We examined the validity of the PALMS-21 constructs (i.e. mastery, enjoyment, affiliation, competition/ego, physical condition, psychological condition, and appearance) as predictors of reported physical activity. Direct and indirect paths *via* intention to be physically activity were tested. The model showed good fit to the data, $\chi^2(238) = 573.543$, CFI = .946, TLI = .932, RMSEA = .048, SRMR = .046. Significant paths to reported physical activity were found for mastery, enjoyment, affiliation, and competition/ego (see Figure 1). Mediation analysis demonstrated that enjoyment had a significant positive indirect effect on physical activity, *via* intention to be physically

Table 6. Total, direct, and indirect effects for paths from motives for participation in physical activity to reported physical activity *via* intention to be physically active.

Effect	*β*	*SE*	Bootstrap bias-corrected 95% CI (lower, upper)	
Mastery to Reported Physical Activity (PA)				
Total	.324	.085	.148	.485
Mastery → Intention → Reported PA	.021	.016	−0.003	.064
Mastery → Reported PA	.304	.083	.139	.467
Enjoyment to Reported PA				
Total	.166	.072	.027	.306
Enjoyment → Intention → Reported PA	.031	.019	.006	.084
Enjoyment → Reported PA	.135	.066	.011	.265
Affiliation to Reported PA				
Total	.125	.043	.044	.213
Affiliation → Intention → Reported PA	.000	.009	−0.019	.017
Affiliation → Reported PA	.126	.040	.050	.210
Competition/Ego to Reported PA				
Total	.261	.056	.148	.369
Competition/Ego → Intention → Reported PA	.001	.011	−0.022	.023
Competition/Ego → Reported PA	.260	.054	.150	.366
Physical Condition to Reported PA				
Total	−0.068	.078	−0.212	.096
Physical Condition → Intention → Reported PA	−0.008	.013	−0.043	.012
Physical Condition → Reported PA	−0.059	.075	−0.201	.094
Psychological Condition to Reported PA				
Total	−0.100	.054	−0.208	.003
Psychological Condition → Intention → Reported PA	−0.002	.010	−0.023	.018
Psychological Condition → Reported PA	−0.098	.053	−0.203	.004
Appearance to Reported PA				
Total	−0.037	.058	−0.151	.076
Appearance → Intention → Reported PA	.021	.015	−0.001	.062
Appearance → Reported PA	−0.058	.057	−0.169	.053

Note. * Significance indicated *via* 95% CI. Abbreviations: β = standardized estimate; SE = Standard error; CI = Confidence interval.

active (see Table 6). The path from enjoyment to reported physical activity *via* intention to be physically active was significant.

Short discussion

Dimensionality and reliability of the PALMS-21 was supported by CFA analyses in Study 2, with acceptable fit indices and factor loading estimates, reliability (α, ω, and ρ), and AVE values which were above the recommended criteria. Full measurement (i.e. metric, scalar, and strict) invariance was established across gender, age, and sport modalities, indicating equivalence across these groups. The pattern of latent factor correlations between PALMS-21 constructs and behaviour regulation subscales was in the expected direction, which demonstrated convergent validity and discriminated between the different motives. Regarding predictive validity of the PALMS-21, mastery, enjoyment, affiliation, and competition/ego were significant predictors of reported physical activity. Intention to be physically active mediated the relationship between enjoyment and reported physical activity.

General Discussion

The transition from adolescence to young adulthood is crucial for sustaining lifelong engagement in physical activity, and understanding individual differences in why

people (might) engage in physical activity is an important first step for guiding physical activity promotion interventions. The two studies presented in this manuscript sought to address some of the issues with existing measurement tools in this area (e.g. validity in teenage populations and response burden of long questionnaires). Specifically, we investigated the factor structure of the PALMS measure among Finnish adolescents in Study 1, and in Study 2 we examined the validity of a shortened 21-item version of the PALMS questionnaire, developed based on the factor structure identified in Study 1.

Support for a shortened 21-item PALMS

In examining the factor structure of the PALMS, we estimated several competing models (i.e. ESEM, Bifactor, and CFA) using all 40 items. This is a strength compared to previous research that only examined the factor structure of the PALMS *via* CFA. An advantage of the analytical strategy employed in the present study over previous work is the comprehensive approach allowing for a more nuanced understanding of the factor structure. In traditional CFA cross-loadings are not allowed, with all items having zero factor loadings on all factors other than the one expected to measure. In contrast ESEM, which is primarily a confirmatory approach, but more flexible than CFA, allows the estimation of all items, while considering the theoretical factor structure. The Bifactor model, on the other hand, allows the simultaneous examination of both general and specific item loadings. Specifically, we tested the possible existence of two general underlying dimensions (intrinsic, extrinsic motives) of the eight specific subscales (mastery, enjoyment, physical condition, affiliation, psychological condition, appearance, others' expectations, and competition/ego).

Findings from Study 1 indicated that neither ESEM, Bifactor, or CFA models exhibited good fit to the data using the full scale. After review of modification indices, factor loadings, and residual errors, we opted for the exclusion of problematic items (two in each subscale), as well as deletion of all items in the Other's expectations subscale. Good fit to the data was obtained for a seven-factor CFA for a 21-item scale. These findings are not surprising considering that we conducted the study with late adolescents aged 16 to 18 years, whereas most previous studies involved a wider range of demographic characteristics, such as age or occupation. Thus, our results indicate that motives such as engaging in physical activity to earn a living, manage a medical condition, or follow a doctor's prescription are uncommon in adolescents and may not be applicable to them. This finding is in line with previous work indicating that items in the Others' expectations subscale are not appropriate for Malaysian adolescents (Kueh et al., 2018). Three items included in the PALMS-21—'do my personal best', 'because I have a good time', and 'because it helps me relax'—were not included in the Malaysian version, which justifies our decision to administer the full version of the scale. Moreover, in the Kueh et al.'s study several residual covariances between items in different factors were correlated. While correlating residual covariances for items measuring similar constructs may improve model fit, it also suggests response dependence, which could be due to measurement artifacts and may not generalize to different samples (Wang & Wang, 2020).

Results from Study 2 indicated that the 21-item version of the scale adequately captures adolescent participation motives. Specifically, the findings confirmed the seven-factor structure of the PALMS-21, with factor loading estimates above the recommended .40. Adequate reliability was demonstrated with composite reliability values higher than .75. AVE values for all factors were higher than the recommended .50, indicating that the latent factors share a high proportion of variance in common. Evidence for discriminant validity was also demonstrated by correlations between latent factors below the recommended value of .85, which indicates that each of the seven factors adequately capture unique motives that do not overlap with others.

Measurement invariance of the PALMS-21

In the present study, measurement invariance of the PALMS-21 was tested over multiple groups, including gender (male vs. female), age (16-, 17-, and 18 year-olds), and sport (team vs. individual). Results provided support for configural invariance, indicating that the patterns of parameter estimates were equivalent across groups. Support for metric, scalar, and strict invariance was also demonstrated. Metric invariance, also called weak invariance refers to the equivalence of factor loadings across groups, indicating that the construct is measured in the same way across groups. Scalar invariance also called strong invariance, requires equivalence of item intercepts and factor loadings across groups and indicates that there is no different item functioning across groups. Thus, our findings suggest that means could be appropriately compared across groups. Strict invariance refers to equivalence of item uniqueness, item intercepts, and factor loadings across groups, indicating that observed factor means and factor invariances could also be appropriately compared across groups. Taken together, measure invariance findings suggest that the underlying factor structure and measurement properties generalize well over multiple groups. Measurement invariance testing is considered an important prerequisite to any form of direct comparisons across groups (Marsh et al., 2013), as it allows to ascertain whether possible differences in specific motives represent genuine between-group differences or differences in the interpretation of the items. To our knowledge, this is the first study that examined invariance of the PALMS across multiple groups including gender, age, and sport types.

Participation motives and behaviour regulations

The patterns of latent factor correlations between the PALMS-21 and the BRSQ on participants involved in sport aligned with SDT assumptions providing strong evidence of convergent validity of the PALMS-21. Specifically, the largest factor correlation with a φ value higher than .80 was observed between intrinsic motivation measured by the BRSQ and enjoyment assessed by the PALMS-21. Positive correlations were also found between enjoyment and mastery with most self-determined forms of motivation. This is in line with the tenets of SDT as applied to sport that posits that self-determined individuals engage in an activity for the inherent enjoyment and satisfaction derived from their participation in the absence of any apparent external reward (Standage, 2023). A positive correlation was also found between physical

condition motives and identified regulation with a φ value higher than .60. This is also in line with the SDT conceptualization as applied to sport. For individuals with identified regulation, the behaviour is regulated *via* a conscious value of the activity in relation to one's aims or goals, in this case, engaging in physical activity to maintain a healthy body or physical health. A positive correlation with a φ value higher than .30 was found between introjected regulation and competition/ego motive. Introjected regulation involves regulating behaviour *via* external contingencies, such as ego/enhancement or pride. Competition/ego motive includes performing better than others, being the best in the group, or working harder than others. In addition, negative correlations were observed between amotivation, which is defined as the lack of motivation, and mastery as well as amotivation and enjoyment. Thus, these patterns of correlations provide strong support for the convergent validity of the PALMS-21.

Participation motives, intention, and physical activity

Evidence of predictive validity was demonstrated with a structural model that included PALMS-21 motives as antecedents of reported physical activity (Figure 1). Results indicated that mastery, enjoyment, affiliation, and competition/ego were all positive direct predictors of physical activity, with mastery emerging as the strongest predictor. This finding underscores the importance of these aspects in influencing late adolescents' engagement in physical activity. It concurs with SDT notion that intrinsic motivation, enjoyment, and personal interest reflects higher-quality engagement (Ryan & Deci, 2017), highlighting the significance of skill development and improvement, as well as having fun in the promotion of physical activity. This finding also aligns with the tenets of AGT (Nicholls, 1989) suggesting positive outcomes associated with a focus on improvement and learning. The small to moderate effect of competition/ego motive on physical activity is also in line with tenets of AGT (Nicholls, 1989), which posits that individuals' behaviour can be motivated by a goal of action aimed at demonstrating competence relative to others. This finding suggests that the competition/ego motive may not always have a detrimental effect on physical activity, thus highlighting the complexity of human behaviour and the need to recognize individual's reasons for engaging in specific behaviours.

Mediation analysis results revealed a significant path between the enjoyment motives and physical activity *via* the intention to be physically active. No significant indirect effects of the intention to be physically active were observed between other participation motives and physical activity. Intention, which is viewed as a proximal determinant of physical activity has been found as a predictor of leisure time physical activity. Kalajas-Tilga et al. (2022) showed that perceived autonomy support received from teachers and parents was a positive predictor of autonomous motivation, which in turn was indirectly related to intention toward actual participation in leisure-time physical activity.

Implications

The present study showed evidence that participation motives play an important role as predictors of physical activity. Considering that adolescents' participation in physical activity and sports is declining (Guthold et al., 2020), promoting involvement in and

sustaining engagement in physical activity is of paramount importance to address this issue. Assessing the motives for participation and relating them to patterns of physical activity engagement is a crucial step in developing effective interventions. The PALMS-21, as a reliable and valid measure of motives for participation in physical activity, can be employed to provide personalized advice to individuals. Given that certain aspects, such as monetary or medical reasons, might not play a significant role in physical activity engagement of adolescents, behavioural interventions aimed at promoting physical activity in young populations should focus on motives that resonate with their age, emphasizing fundamental motives such as mastery, enjoyment, social connections, or aesthetic and fitness gains.

Adolescents are at a critical developmental stage where establishing positive physical activity habits can have long-term benefits for their well-being and health. Thus, the assessment of adolescents' motives to engage in physical activity can help align their motivational patterns with appropriate forms of physical activity. Recognising the different motives of individuals can help tailor interventions to better match them with activities that align with their specific motivations. For example, promoting competition-based activities may be more effective in engaging those who value overperforming others, as opposed who prioritize health and fitness. Matching physical activity with personal motivations can increase satisfaction and, consequently, the likelihood of long-term engagement.

Practitioners could also develop motivational profiles by ranking participation motives from the most intrinsic (e.g. mastery, enjoyment) to the least intrinsic (e.g. competition/ego). Using these profiles, they could guide individuals towards activities that resonate with their unique motivations. For instance, those highly motivated by affiliation might prefer team sports to satisfy their need for social connection. Individuals with a prominent appearance motive could be advised to participate in physical activities characterised by aesthetic outcomes and visible fitness gains, such as strength training or gym workouts. Conversely, those seeking psychological well-being might find activities such as yoga or Pilates as more aligned with their need to relax or get away from pressure. Tailoring physical activity or sports recommendations to individual motives can enhance the likelihood of finding genuinely enjoyable activities. This personalized approach is expected to foster sustained engagement, which in turn promotes satisfaction, health, and wellbeing.

The PALMS-21 could also be used to monitor the dynamics in participation motives over time. For instance, an individual initially motivated by competition may start physical activity for an extrinsic reason (e.g. strength training to recover from an injury), but could develop intrinsic motives like mastery or enjoyment. This would allow further understanding of the processes underlying a specific activity over time. Recognizing the shifting motives of late adolescents as they transition to adulthood can guide the timing and content of interventions. Fostering mastery motives during the earlier stages of late adolescence and addressing the unique motivational needs of 18-year-olds may be particularly beneficial. Matching physical activities to individuals' motives could significantly reduce drop-out rates. Activities aligned with personal motives are more likely to sustain interest and commitment, and therefore to decrease drop-out from physical activity and sport. This, in turn, can contribute to the promotion of healthier and more active lifestyles among adolescents.

Limitations and future research directions

The cross-sectional design of the current study is a limitation, as it offers a snapshot of data at a single point in time. This restricts our ability to establish causality or track changes over time. While our findings provide valuable insights into the relationship between motives for physical activity and actual participation in late adolescents, we cannot infer causation. To address this issue, future research should use longitudinal studies to examine how motives for physical activity evolve and influence changes in actual physical activity levels. This approach would provide a better understanding of these dynamics and offer stronger evidence for developing targeted interventions and policies to promote active lifestyles among late adolescents. Research using the PALMS-21 in combination with other measures, such as the tendency to avoid physical activity and sport due to weight, stigma or appearance-related concerns (Bevan et al., 2022), perceived barriers to physical activity (Gunnell et al., 2015), or affective exercise experiences (Ekkekakis et al., 2021), is also recommended to help understand other variables related to physical activity engagement.

Another limitation is the relatively small size of the sample involved in the retest to determine test-retest reliability. Moreover, while we focused on late adolescents and recruited participants from diverse backgrounds and physical activity contexts, future research should replicate our findings across a broader age spectrum. Furthermore, we opted to measure intention to engage in physical activity using two items as a concise alternative to capture the construct without redundancy, thereby reducing participant burden. However, future research could include more items to measure intention as a latent variable, accounting for measurement error.

Finally, the reliance on self-reported measures of physical activity may be subject to recall bias and not always accurately reflect actual activity levels. Future research should incorporate physical activity tracking devices and examine participation motives and other relevant psychological constructs, such as self-efficacy or basic need satisfaction, through the lens of SDT or the trans-contextual theory (e.g. Kalajas-Tilga et al., 2022). The latter is a multi-theory approach that integrates constructs from SDT as well as social cognition theories, offering a more comprehensive understanding of physical activity determinants in these populations.

Conclusions

The two studies presented in this article offer an important contribution to the assessment of participation motives in late adolescents. Our findings provide evidence that the PALMS-21 is a psychometrically sound measure of reasons to engage in exercise and sport among adolescents. Furthermore, our research contributes to a rigorous validation of a short measure that accounts for measurement invariance across multiple groups, allowing for valid and more accurate between-group comparisons of participation motives. To further advance our understanding of the relationship between participation motives and physical activity, future research should incorporate device-measured physical activity. This integration will provide a more comprehensive understanding of how motives translate into actual behaviour to enhance our ability to promote individual engagement in physical activity and sport.

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Data availability statement

Data are available from the first author upon reasonable request.

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