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ORIGINAL ARTICLE

Longitudinal Associations Between Enjoyment of Physical Education, Cardiorespiratory Fitness, and Muscular Fitness Among Finnish Adolescents

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ABSTRACT

Introduction: Students' experiences in physical education (PE) can shape future physical activity (PA) behaviors. PE enjoyment is associated with PA; however, the relationship between PE enjoyment and fitness has not been extensively investigated. The aim of this study was to examine if changes in PE enjoyment were associated with changes in cardiorespiratory fitness (CRF) and muscular fitness (MF) among Finnish adolescents.

Methods: Study participants were students ($n = 1147$; 11.27 [±0.32] years at baseline) attending public schools in Finland. Data were collected yearly (2017–2021). The 20 m shuttle run assessed CRF, curl-up/push-up tests assessed MF, and the enjoyment subscale of the Sport Commitment Questionnaire-2 measured PE enjoyment. The random intercept cross-lagged panel model, including repeated measures (within-level) and latent levels (between-level) of PE enjoyment, CRF and MF, was tested. Sex, body mass index, moderate to vigorous PA, and peak height velocity were included as covariates in the analysis.

Results: Over 5 years, PE enjoyment decreased, CRF increased until Timepoint 3, and MF remained stable. Positive associations between PE enjoyment and fitness were observed, indicating the greater the PE enjoyment, the higher the fitness. For PE enjoyment, CRF and MF repeated measures were positively associated with measurement of the next year. PE enjoyment was positively related to CRF and MF the years thereafter.

Conclusion: Our findings highlight the importance of quality PE experiences for enjoyment and fitness gains during the transition from primary to secondary school. These findings are important given youth fitness levels are associated with future health status.

1 | Introduction

The health benefits of engaging in regular physical activity (PA) are well established [1]. In line with global trends, evidence from Finland demonstrates a decline in PA participation during late childhood and throughout adolescence [2]. Given engaging in regular PA is essential for the development of health-related fitness [3], this trend is of concern. Health-related fitness components, including cardiorespiratory fitness (CRF) and muscular fitness (MF), are directly associated with improved health status; health-related fitness is a stronger indicator of short- and long-term health outcomes than PA [4].

Schools are key settings for PA and fitness promotion as they provide students with access to facilities, equipment, specialist staff, and the curriculum to support PA [5]. Recently, the World Health Organization's (WHO) Global Action Plan on Physical Activity 2018–2030 [6] was released, with the aim of achieving a 15% relative reduction in insufficient PA prevalence by 2030. For young people, part of the action plan focussed on providing quality PE, positive experiences, and supportive school environments, as quality PE and school-based PA opportunities are important for improving PA participation [6]. Notably, experiences in PE during childhood and adolescence influence PA participation during adulthood. For example, children's memories of PE experiences are associated with their attitudes and intentions to be active in adulthood [7]. The affective component of attitude, specifically evaluating PA as pleasant or unpleasant, has been highlighted as a strong predictor of PA [8]. Taken together, these findings suggest experiences in PE shape current and future PA behaviors; therefore, emphasis on linking PE and enjoyment has the potential to support ongoing PA behavior [7] and subsequently improve fitness.

One of the most important affective outcomes of quality PE is enjoyment. According to Scanlan and Simons, enjoyment is defined as positive general affect reflecting feelings of fun, liking and pleasure. In educational environments such as PE, experiences of enjoyment have been explained using motivational frameworks. The self-determination theory (SDT) [9] is one such framework used to explain motivational approaches in which behaviors are intrinsically or extrinsically motivated based on the degree to which the basic psychological needs of autonomy, competence, and relatedness are satisfied or thwarted. Therefore, the level of enjoyment experienced can occur as an outcome of the motivational process. For example, satisfaction of basic psychological needs in PE leads to intrinsic and extrinsic forms of motivation and in turn greater levels of enjoyment.

In a review of PA correlates for secondary school students in PE [10], enjoyment was found to have a consistent positive association with moderate to vigorous physical activity (MVPA) time in PE. Enjoyable experiences in PE are essential for increasing PA not only during PE lessons, but also in other domains and settings (e.g., during sport training) [11]; however, enjoyment of PE appears to decline over time [12,13]. For example, a longitudinal study of children's enjoyment of PE over 3 years found PE enjoyment decreased significantly from the fourth to sixth grade ($p < 0.001$) and was lower among girls ($p < 0.001$) and students not involved in organized sports ($p < 0.005$) [14]. Although PE can contribute to CRF and MF improvements [15], the longitudinal associations between enjoyment of PE and fitness have not been extensively researched. Limited evidence from small cross-sectional studies suggests enjoyment of PE is positively associated with fitness outcomes. However, previous studies have mainly focused on CRF, demonstrating weak-to-moderate correlations [16–19]. Evidence for the relationship between enjoyment of PE and MF is scarce; weak positive associations between enjoyment toward PE and MF measures (push-ups, trunk lift, curl-ups) were reported in a cross-sectional study [16]. No studies to date have investigated associations between enjoyment of PE, and both CRF and MF using a longitudinal design and large sample size.

In specifically studying the PE context, rather than overall PA or PA in other settings, the current study makes novel contributions to the body of evidence. Furthermore, our approach to this study is indeed novel given we have addressed gaps in the existing literature such as using a more comprehensive approach to exploring changes to adolescent fitness levels, as both CRF and MF were examined. To address the research question, the random intercept cross-lagged panel model (RI-CLPM) was applied [20]. The RI-CLPM can identify within-person (repeated-level) associations, including individual differences reflecting variance in the predictor and outcome that is stable across waves [20], which is important for accurately interpreting cross-lagged associations. Additionally, gaining an understanding of covariates (i.e., sex, body mass index [BMI], MVPA, and peak height velocity [PHV; maturation]) that potentially influence the relationship between enjoyment of PE and fitness (CRF, MF) is important to address. We tested the covariate effects of sex, BMI, MVPA, PHV (maturation status), given previous research suggests males, healthy BMI, greater MVPA and reaching peak height velocity to be positively associated with fitness. The influence of PHV on PE enjoyment and fitness was noted as lacking in previous studies. We also extend on the previously published works from this research project by including five measurement timepoints (4 years) in the current study.

We have now collected our dataset for 6 years. We have previously published four papers which have a little overlap with the current one [21–24]. These studies used cardiorespiratory and/or MF as (a) independent variables when profiling students' physical performance, or (b) one specific variable investigating associations between fitness, perceived competence, or motor competence in latent growth curve analyses. However, none of these studies used enjoyment in physical education (PE) as variable, which is the main focus of this paper. Therefore, the aim of our study was to examine if changes in enjoyment of PE were associated with changes in CRF and MF among Finnish adolescents, across five timepoints.

2 | Materials and Methods

2.1 | Finnish Schooling System

In the Finnish schooling system comprehensive education usually starts during the year when children turn seven and includes nine grades. Comprehensive school class teachers, who teach Grades 1–6, are specialized in general education. Grade 7–9 teachers are specialized in the subjects they teach (e.g., PE). In our sample, children had the same general education teacher at Grades 5 and 6, and the same PE teacher at Grades 7–9. Typically, children have at least 2 h of obligatory PE each week. Teachers are at liberty to plan their lessons in alignment with national and local curricula. All comprehensive schoolteachers in Finland have a Master's degree. Hereafter, primary school will be used to describe students in Grades 1–6, and secondary school will be used to describe students in Grades 7 and above.

2.2 | Ethics Statement

Ethical approval was granted from the University of Jyväskylä's ethics committee (22082017). Students in Grade 5 from public schools throughout Finland were invited to participate in the study, initially via contact with school principals. The school principals, parents, and study participants provided written informed consent to verify their willingness to participate, and consent forms were collected via classroom teachers.

2.3 | Participants

The study sample included students ($n = 1147$; girls: 582, boys: 565) attending randomly selected public schools located throughout Finland (South: 46%, East: 7%, North:7%, Central: 41%). At baseline, participant's ages ranged from 10.6 to 12.6 years (mean age: 11.27 [0.32]). The study sample participating in data collection at Timepoint 0 represented 2% of all students in Grade 5 nationally (Statistics of Finland, 2017). All samples were representative of their local population. All Grade 5 students at consenting schools were invited to participate in the study.

2.4 | Procedure

Researchers collected data annually during PE lessons throughout 1 week (T0:2017, T1:2018, T2:2019, T3:2020, T4:2021). Students self-reported their demographic information (sex, date of birth) and completed the Enjoyment of Physical Education questionnaire. CRF and MF data were collected by researchers in school gyms. Participants were informed of potential risks associated with fitness testing (provided with warm-up games to minimize injury), that information collected was confidential, study participation had no impact on school achievement, and they could withdraw at any time. In Finland, during the COVID-19 pandemic there was a 2-month closure of schools (mid-March to mid-May 2020), which may have reduced the opportunities for adolescents to participate in PA (Timepoints 2–3). However, this did not coincide with scheduled data collection.

2.5 | Measures

2.5.1 | Enjoyment of Physical Education

To assess participant enjoyment in PE, the enjoyment subscale from the Sport Commitment Questionnaire-2 (Finnish version) [25] was used. The enjoyment subscale is a self-report questionnaire using five items, with the item stem "In my PE classes...", to specifically measure enjoyment in a PE context. Using a Likert scale of 1 (strongly disagree) to 5 (strongly agree), participants rated each statement according to the extent of their agreement (e.g., "Physical education is fun"). A composite score was computed to provide an overall enjoyment value, higher scores indicated greater levels of enjoyment in PE. The Finnish version of the enjoyment scale has been found to be a valid and reliable tool when used with 13-year-old students during PE classes [26]. Cronbach's alpha for the enjoyment scale was high at each timepoint (T0 = 0.94, T1 = 0.95, T2 = 0.95, T3 = 0.94, T4 = 0.93).

2.5.2 | Cardiorespiratory Fitness

Cardiorespiratory Fitness was assessed by the 20 m shuttle run test [27]. Participants were required to run continuously between two lines set at a distance of 20 m, keeping cadence with a recording (beeps) that increases in pace as the test progresses. The total number of shuttles (laps) achieved while keeping to pace was recorded. The 20 m shuttle run test is the most appropriate field based measure of CRF and has shown suitable reliability and validity for children and adolescents [28].

2.5.3 | Muscular Fitness

Muscular fitness was assessed by the curl-up (sit-up) test and push-up test. For the curl-up test, participants were required to lie on their back, keep heels on mat and slowly curl up, while curling up slide fingertips across a measuring tape until reaching the other side, and then curl back down until their head touches the mat. Performance cadence is guided by a recording. The total number of curl-ups completed correctly while keeping in time with the cadence recording was recorded.

For the push-up test, different protocols for males and females were used. The male's starting position required hands and toes to be on the floor, while the female's starting position required hands and knees on the floor. All other steps for the test are the same for both sexes: head, body, and legs are in a straight line, feet together, arms shoulder-width apart, body lowered until there is a 90° angle in elbows, upper arm parallel to the floor, and back and knees straight while pushing up, until the arms are straight. The total number of correctly completed push-ups was recorded (to a maximum of 60 repetitions).

A composite value combining test results for the curl-up and push-up tests was computed to create an overall MF score. Higher scores indicated greater levels of MF. These MF measures have shown satisfactory reliability and validity for children and adolescents [28].

2.5.4 | Body Mass Index

Height and weight were measured by the schools' nurse at each data collection timepoint. Weight was recorded to the nearest 0.1 kg. Height was recorded to the nearest 0.1 cm. BMI was calculated using the formula weight(kg)/height(m)^2. For each participant, the BMI level variable was computed by adding the Timepoint 0 to 4 BMI scores.

2.5.5 | Moderate to Vigorous Physical Activity

Participants' MVPA was assessed using Actigraph wGT3+ accelerometers. Participants were instructed to wear the accelerometer on their right hip for seven consecutive days. Accelerometers were removed while sleeping and bathing or doing water-based activities. Data were collected as raw accelerations at a 30-Hz frequency and converted into 15-s epoch counts. Data were reduced using Customized Visual Basic Macro for Excel software. A valid day of PA monitoring

TABLE 1 | Model fit indices of confirmatory factor analysis for sport commitment questionnaire-2 (enjoyment subscale) at each timepoint.

	χ^2	df	*p*	CFI	TLI	RMSEA	SRMR
ENJ T0	55.17	5	0.000	0.97	0.94	0.10	0.02
ENJ T1	41.95	5	0.000	0.98	0.97	0.09	0.01
ENJ T2	47.71	5	0.000	0.98	0.95	0.10	0.02
ENJ T3	57.71	5	0.000	0.97	0.94	0.11	0.02
ENJ T4	77.63	5	0.000	0.94	0.88	0.14	0.03

Abbreviations: CFI, Goodness-of-fit fit index; df, degrees of freedom; ENJ, Sport Commitment Questionnaire-2 (enjoyment subscale); RMSEA, root mean square error of approximation; SRMR, standardized root mean square residual; TLI, Tucker–Lewis index.

comprised measured values ≥500 min/day on at least 2 weekdays and 1 weekend day between normal waking hours (i.e., 7:00–23:00). Consecutive zero counts lasting 30 min were defined as nonwear time and values over 20 000 counts per minute considered spurious accelerations and discarded [32]. Cut points from Evenson et al. [33] were used to calculate MVPA (≥2296 cpm).

2.5.6 | Peak Height Velocity

Peak height velocity was calculated in line with protocols from Moore et al. [29]. Maturity offset indicates the number of years the participant is from reaching PHV, and is calculated using age and height, from Timepoint 0 to Timepoint 4. Negative scores suggest the participant has not yet met PHV. A positive score of >1.5 suggests PHV has already been met, whereas a positive score of <1.5 suggests the participant is still undergoing PHV. For each participant, the PHV level variable was computed by adding the PHV scores over time.

2.6 | Data Analysis

Study variables were tested for normal distribution, outliers, and missing values. Descriptive statistics were then calculated, including correlations, means, and standard deviations. Confirmatory factor analysis (CFA) was conducted to test the factor structures of the Enjoyment of PE scale over T0 to T4. The development of CRF, MF, and PE enjoyment mean scores was tested through repeated measures analysis with effect sizes between 5 time points. To address the research question, the RI-CLPM was applied [20]. The RI-CLPM model included the within-level and between-level, estimated based on observed variables. The within-level comprised of each participants' measures of CRF, MF, and enjoyment of PE within-unit fluctuations over five timepoints (i.e., are repeated-level [individual] changes in a variable related to repeated-level [individual] changes in another variable). The between-level variables comprised of random intercepts, representing total levels over time (i.e., are overall-level [group] changes in a variable related to overall-level [group] changes in another variable). For RI-CLPM, Orth et al. [30] propose 0.03 (small effect), 0.07 (medium effect), and 0.12 (large effect) are used as benchmark values when interpreting the size of cross-lagged effects. Sex, BMI, MVPA, and PHV were added as covariates in the model. The chi-square test (χ^2), the root means square error of approximation (RMSEA; 0.08 or less), standardized root means square residual (SRMR; 0.06 or less), comparative fit index (CFI; >0.95), and Tucker–Lewis index (TLI; >0.95) were used to examine model fit [31]. The squared multiple correlations were provided to estimate the effect sizes of study variables; 0.1, 0.3, and 0.5 were considered small, moderate, and large, respectively [32]. The analyses were conducted using SPSS 28.0 and Mplus 8.8 version.

3 | Results

3.1 | Preliminary Analysis

The data were normally distributed. A series of CFAs showed that the factor structure was acceptable within the current sample (Table 1). As the proportion of participants completing all the measurements decreased each year, missing values (4752 out of 14 747) accounted for 32.2% of the data. The missing value analysis ($\chi^2[245] = 279.78$, $p = 0.063$) indicated that the data were missing completely at random (MCAR). The missing values were then estimated using the Full Information Maximum Likelihood Estimation protocol, which produces unbiased parameter estimates and standard errors under MCAR conditions [33].

3.2 | Descriptive Statistics

Participants' means and standard deviations of the observed variables from T0 to T4 are presented in Table 2. Overall, enjoyment of PE decreased slightly over time, mean scores for CRF were indicative of an increase until T3 and thereafter began to decline, and MF variables (curl-up and push-up), BMI, and PHV increased over time. Correlation coefficients of the observed variables at each timepoint are presented in Table 3; the correlation coefficients varied in strength, ranging from weak-to-moderate overtime.

3.3 | Developmental Associations Between Enjoyment of PE, CRF, and MF Over Time

Figure 1 presents 5-year developmental associations between enjoyment of PE, CRF, and MF and at the between-level and within-level, including the covariate effects of sex, BMI, MVPA, and PHV, tested using the RI-CLPM model. The model showed a good fit to the data ($\chi^2[75] = 237.81$, $p < 0.001$, CFI = 0.98,

TABLE 2 | Descriptive statistics of the observed variables at Timepoints 0–4.

Measurement	Time	*N*	Mean (SD)
CRF17	T0	1057	36.06 (18.33)
CRF18	T1	933	40.62 (20.34)***
CRF19	T2	765	39.10 (19.58)
CRF20	T3	673	44.12 (22.02)***
CRF21	T4	436	40.91 (22.14)**
MF(CURL)17	T0	1074	37.85 (0.21.87)
MF(CURL)18	T1	977	39.62 (21.24)
MF(CURL)19	T2	841	39.98 (21.32)
MF(CURL)20	T3	768	43.40 (21.76)**
MF(CURL)17	T4	526	46.67 (22.66)**
MF(PUSH)17	T0	1070	21.58 (12.22)
MF(PUSH)18	T1	969	19.36 (12.99)***
MF(PUSH)19	T2	844	25.56 (13.19)***
MF(PUSH)20	T3	756	27.37 (13.38)**
MF(PUSH)17	T4	501	29.38 (13.38)**
MF (COMBINED)	T0	1038	0.03 (1.65)
MF (COMBINED)	T1	953	0.01 (1.70)
MF (COMBINED)	T2	819	0.00 (1.69)
MF (COMBINED)	T3	735	0.02 (1.71)
MF (COMBINED)	T4	479	0.02 (1.68)
ENJ17	T0	1110	4.07 (1.00)
ENJ18	T1	1002	3.83 (1.07)***
ENJ19	T2	904	3.58 (1.09)***
ENJ20	T3	835	3.44 (1.04)**
ENJ21	T4	743	3.23 (1.06)***
BMI17	T0	1120	18.88 (3.12)
BMI18	T1	1012	19.56 (3.41)***
BMI19	T2	836	20.32 (3.36)***
BMI20	T3	646	21.01 (3.37)***
BMI21	T4	578	21.44 (3.21)*
PHV17	T0	1106	−1.30 (0.78)
PHV18	T1	992	−0.41 (0.87)***
PHV19	T2	839	0.54 (0.90)***
PHV20	T3	648	1.40 (0.86)***
PHV21	T4	577	2.24 (0.81)***
MVPA17	T0	452	58.78 (22.96)
MVPA18	T1	286	55.05 (20.81)*
MVPA19	T2	208	52.90 (21.75)
MVPA20	T3	126	54.41 (21.31)
MVPA21	T4	70	51.64 (24.20)

Note: The asterisk refers to the mean difference between the current and previous timepoint (e.g., T0 vs. T1).
Abbreviations: M, mean; SD, standard deviation.
***$p < 0.001$, **$p < 0.01$, *$p < 0.05$.

TLI = 0.96, RMSEA = 0.044 CI 95% [0.04, 0.05], SRMR = 0.045). The repeated measures analysis between time points with effect sizes showed that mean scores for CRF increased until T3 then declined ($d = 0.45$, $p < 0.001$). In addition, PE enjoyment decreased over time ($d = 0.61$, $p < 0.001$), whereas MF remained stable ($d = -0.06$, $p = 0.09$).

Standardized results at the between-level showed significant positive correlations for enjoyment of PE and MF, and enjoyment of PE and CRF, indicating the higher the levels of enjoyment in PE, the higher the level of fitness. A significant positive correlation was also observed between CRF and MF. The model indicates males had higher enjoyment of PE and CRF but lower MF than females. BMI was a significant negative predictor of enjoyment of PE, CRF, and MF; the higher the BMI, the lower the enjoyment or fitness value. MVPA was a significant positive predictor of CRF and MF; participants with higher MVPA had a greater level of CRF and MF. PHV was a significant positive predictor of enjoyment of PE, CRF, and MF; participants who were undergoing or had reached PHV had higher enjoyment of PE, CRF, and MF. The squared multiple correlations showed the model significantly explained the variance of enjoyment of PE (7%), CRF (32%), and MF (14%) between (overall) levels.

The standardized results at the within-level showed associations between the repeated measures of enjoyment of PE, CRF, and MF. For enjoyment of PE and MF, repeated measurements were positively associated with measurements the following year, from T0 to T4. For CRF, repeated measures were associated with measurements the following year from T2 to T5.

Cross-lagged associations were observed between enjoyment of PE and fitness variables (CRF and MF). Enjoyment of PE at T1 and T3 was associated with CRF the following years (T2 and T4); enjoyment of PE at T2 and T3 was associated with MF the years thereafter (T3 and T4). The model explained 12%–21% of enjoyment of PE, 7%–25% of CRF, and 7%–34% of MF involving repeated measures (within) over time. Associations were found between MF and CRF; MF at T2 and T3 was associated with CRF the following years (T3 and T4). CRF at T3 was associated with MF at T4.

4 | Discussion

The aim of our study was to examine longitudinal associations between enjoyment of PE, CRF, and MF outcomes among a large sample of Finnish adolescents across five timepoints (2017–2021). Overall, during the 5-year study enjoyment of PE decreased, CRF increased to T3 then began to decrease, and MF remained stable (both curl-ups and push-ups) at each timepoint.

TABLE 3 | Correlations between variables.

	MF (Curl-up)	MF (Push-up)	Enjoyment in PE	SEX	PHV	BMI	MVPA
CRF							
T0	0.329***	0.437***	0.254***	0.215***	−0.244***	−0.456***	0.128**
T1	0.341***	0.412***	0.317***	0.131***	−0.150***	−0.441***	0.042
T2	0.386***	0.455***	0.239***	0.186***	−0.202***	−0.427***	0.209*
T3	0.471***	0.496***	0.252***	0.262***	−0.229***	−0.345***	0.182
T4	0.455***	0.417***	0.310***	0.259***	−0.239***	−0.331***	0.338
MF (Curl-up)							
T0		0.373***	0.080*	−0.107***	0.155***	−0.095**	0.108*
T1		0.459***	0.113***	−0.069*	0.093**	−0.177***	0.076
T2		0.433***	0.144***	−0.027	0.072*	−0.154***	0.093
T3		0.470***	0.231***	0.067	−0.017	−0.184***	0.138
T4		0.443***	0.176***	0.089*	−0.033	−0.136**	0.030
MF (Push-up)							
T0			0.132***	−0.313***	0.173***	−0.290***	0.136**
T1			0.103**	−0.256***	0.153***	−0.297***	0.167**
T2			0.181***	−0.212***	0.083*	−0.281***	−0.006
T3			0.195***	−0.088*	−0.006	−0.192***	0.163
T4			0.225***	0.074	0.152**	−0.180***	0.051
Enjoyment in PE							
T0				0.095**	−0.118***	−0.101***	−0.010
T1				0.067*	−0.100**	−0.097**	−0.030
T2				0.117***	−0.124***	−0.098**	0.024
T3				0.144***	−0.151***	−0.028	0.034
T4				0.216***	−0.212***	−0.076	0.158

***p <0.001, **p <0.01, *p <0.05.

Additionally, this study highlights positive correlations between enjoyment of PE and fitness (CRF and MF) and between CRF and MF levels; enjoyment of PE was related to CRF and MF the years thereafter. Expected covariate effects were observed, indicating males had higher enjoyment of PE and CRF than females, BMI was a significant negative predictor of enjoyment of PE, CRF, and MF, those with higher MVPA had greater CRF and MF, and PHV was a significant positive predictor of and enjoyment of PE, CRF, and MF.

Our findings demonstrate significant moderate positive longitudinal associations for enjoyment of PE and fitness outcomes (CRF and MF), indicating greater enjoyment of PE was associated with higher levels of fitness. This finding was consistent with existing cross-sectional evidence showing adolescents who report greater enjoyment of PE [16–19] also have higher Progressive Aerobic Cardiovascular Endurance Run (PACER) scores, indicating greater CRF according to the Fitnessgram test battery. Colquitt et al. [16] also found significant weak positive associations between enjoyment toward PE and measures of MF (push-ups, trunk lift, curl-ups). It may be that students who had positive experiences in PE are more likely to seek opportunities to be active, thus contributing to their higher levels of fitness. Alternatively, adolescents with higher fitness levels may experience more success in PE and therefore have greater enjoyment. There is evidence to suggest positive experiences in PE may contribute to students engaging in higher intensity PA in PE and during leisure time, previous studies suggest greater fitness levels also allow adolescents to participate in PA/PE more easily [34]. Additionally, our findings indicate that for adolescents the higher the CRF the higher the level of MF, which is not surprising given engaging in PA of higher intensities (e.g., moderate PA and vigorous PA) contributes to both CRF and MF [4].

Findings from the current study indicate overall associations for repeated measures (Timepoint 0 to Timepoint 4) of enjoyment of PE, CRF, and MF, indicating positive enjoyment of PE and fitness detected at one timepoint appears to significantly

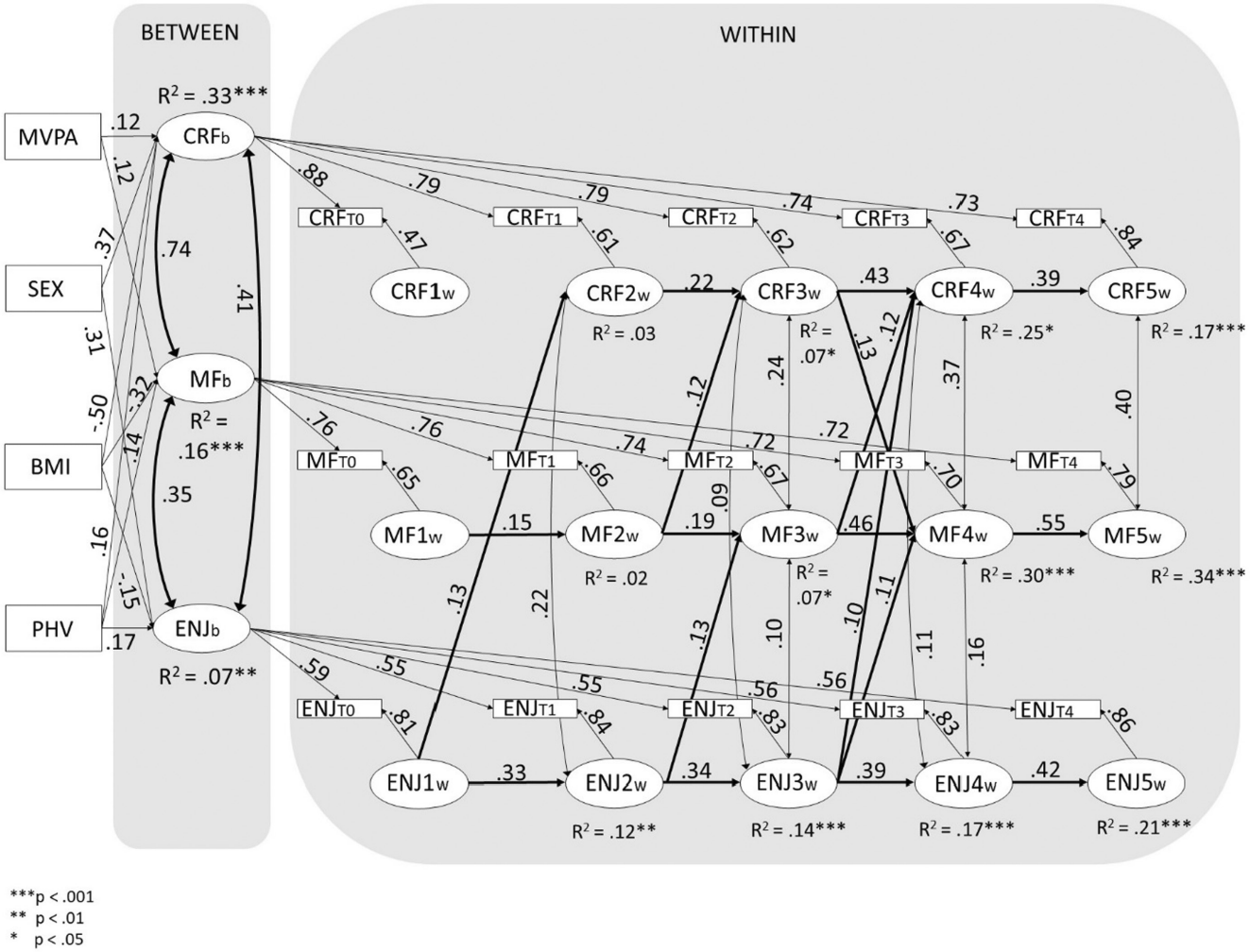

FIGURE 1 | Developmental associations of CRF, MF, and enjoyment variables T0–T4 at the between- (overall) and within-level (repeated measures) levels.

contribute to a sustained effect 1 year on. This is an important finding given fitness levels in youth are related to future health outcomes. More specifically, the origins of cardiometabolic disease risk begin during childhood/adolescence and continue into adulthood [35]. Review-level evidence from longitudinal studies suggests greater CRF during adolescence is associated with reduced cardiovascular disease risk factors 2 years later [36]. Similarly, low MF in adolescence increases the risk of continued low MF during adulthood [37]. A review investigating the predictive validity of health-related fitness in youth found MF to be strongly associated with adiposity [38], and lower MF during childhood/adolescence is a strong marker of compromised metabolic profile, noncommunicable diseases [39], and mortality in adulthood [37]. Therefore, providing enjoyable experiences in PE to support this pattern of sustained fitness throughout adolescence, and opportunities to participate in PA of sufficient intensity for ongoing fitness gains, is essential for future health.

Our findings demonstrate that enjoyment of PE at Timepoint 0 to Timepoint 3 significantly contributed to enjoyment levels the following year, suggesting that positive experiences in PE can have an ongoing effect. Consistent with our findings, numerous studies have shown a decline in attitudes and enjoyment toward PE throughout adolescence [12,13,16], typically occurring during the transition from primary to secondary school, and from middle to senior school [40]. It may be that the increased frequency of sport-based PE, competition, and formal fitness testing which typically begin at this time negatively impacts enjoyment [41].

Interestingly, some cross-lagged associations were observed, mostly between T2–T3 and T3–T4. Enjoyment of PE contributed to CRF 1 year on (T2 and T4), similarly enjoyment of PE was related to MF the years thereafter (T3 and T4). MF at T2 and T3 contributed to CRF the following years. Our findings provide a valuable addition to existing evidence, demonstrating the lasting benefits of providing adolescents with feelings of fun, liking, and pleasure [25] in PE. PE should be perceived by students as interesting, relevant and meaningful, and PE teachers should offer opportunities for success and challenge, and use pedagogy that focuses on enjoyment, value, fun, and competence to influence long-term enjoyment, PA participation, and fitness gains [42]. Interestingly, the importance of positive, fun and enjoyable movement experiences has been noted in other contexts involving adolescents, including coaching [43,44].

Our covariate findings suggest males had higher CRF and enjoyment in PE than females, however lower MF. Higher enjoyment in PE for males has been previously reported [16], consistent with our findings. Previous studies also cite that for females feeling of self-consciousness, physical appearance, social comparisons, and low levels of perceived competence/lack of skill ability as key barriers to participating in PE [45,46]. BMI was a significant negative predictor of CRF, MF, and enjoyment in PE. This finding is in line with previous evidence suggesting those with a higher BMI may have negative social experiences in contexts like school PE, such as bullying or negative self-perceptions (e.g., body image concerns, and insecurities), causing reduced enjoyment [47]. Barriers to PE including physical (e.g., difficulty breathing and muscle pain, fatigue) and social (e.g., lack of social support from friends/family) factors have also been reported to deter PA participation in overweight/obese youth, therefore impacting PE enjoyment and opportunities to improve fitness [48]. MVPA was a significant predictor of CRF and MF, in line with our findings previous studies have shown that more active adolescents have higher CRF [49] and MF levels [50]. PHV was a significant positive predictor of CRF, MF, and enjoyment in PE. Participants who were undergoing or had reached PHV had higher CRF, MF, and enjoyment in PE. The onset of PHV coincides with the beginning of puberty, when changes in height, muscle mass, and physical abilities occur [51]. These physical changes may be advantageous to successful and enjoyable participation in PE and for fitness gains.

4.1 | Practical Implications

Guided by SDT, the SAAFE framework (Supportive, Active, Autonomous, Fair, and Enjoyable) was developed to support planning and delivery of high-quality and enjoyable PA experiences for young people in school and other contexts [52]. To enhance enjoyment, PE teachers can employ a range of strategies to satisfy students' basic psychological needs, promote a task-involving environment, and include task variety [52]. For example, providing students with a rationale for what they are doing, allowing student input and choice, encouraging students to monitor personal improvements, and being empathetic/understanding of students' opinions and perspectives [53]. Preparing and delivering PE experiences that reflect the SAAFE framework increase student's motivation and enjoyment. For instance, using workshops to upskill teachers on implementing the SAAFE teaching principles to motivate students [54], and using a range of active, autonomous and fair teaching strategies have been reported as beneficial [55].

4.2 | Strengths and Limitations

This study addresses gaps highlighted in existing literature and has a number of strengths. To examine changes in PE enjoyment and fitness overtime, we used a longitudinal design (five data collection timepoints) and the RI-CLPM. The RI-CLPM differentiates within-person effects (i.e., are repeated-level [individual] changes in a variable related to repeated-level [individual] changes in another variable) from between-person effects (i.e., are overall-level [group] changes in a variable related to overall-level [group] changes in another variable) with the purpose of identifying intra-individual developmental processes [56]. Importantly, validated enjoyment of PE, fitness and MVPA measures were also used. Study limitations should also be acknowledged. Participant retention declined over time; attrition appears to be a common limitation of longitudinal studies with this population group [57]. For instance, challenges collecting data over an extended period including absenteeism and loss of participants during the transition from primary school to secondary school contributed to attrition in our study [57]. MCAR results indicate no differences in the study variables between students who did and did not have missing values, we did not identify a particular group, sex, age, school or grade, losses appear to be at random.

5 | Conclusion

For adolescents, it appears that enjoyable experiences in PE are essential for increasing PA and subsequently fitness. Overall, during the 5 years enjoyment of PE decreased, CRF increased, and MF remained stable. Our study indicates the greater the enjoyment of PE, the higher the levels of fitness. Enjoyment of PE and fitness detected at one timepoint can contribute to a continued effect in the following years. Interestingly, cross-lagged associations were evident, and enjoyment of PE was related to CRF and MF the years thereafter. The current study highlights the importance of providing adolescents with quality PE experiences, to enhance their enjoyment, especially during the transition from primary to secondary school PE should provide adequate PA opportunities (especially MVPA/VPA) and enhance autonomous motivation. This is important given enjoyment of PE is associated with PA during adulthood and fitness levels in youth are associated with future health status.

6 | Perspectives

Research has shown that for adolescents, enjoyable experiences in the movement context is positively associated with PA [58]; and opportunities to be active are needed for fitness improvements. Our findings highlight the importance of providing enjoyable PE experiences to increase adolescent's fitness levels and emphasize the important role of the PE teacher [59].

Evidence suggests to create learning environments supportive of enjoyment and opportunities for fitness enhancement, students should be provided with access to adequate facilities and equipment, and a range of opportunities to practice skills, including self-paced activities, self-evaluation, and interaction with peers [60–62]. Additionally, autonomy-supportive PE has been shown to enhance student enjoyment can improve student self-efficacy and intrinsic value toward PE, in turn reducing anxiety and fostering enjoyment [12]. This may include targeted PE content intending to satisfy students' basic psychological needs [12]. Girls, older children, and those not involved in organized sports are particularly reliant on PE as an opportunity to accrue health-enhancing PA for fitness, and targeted strategies should be utilized to improve the enjoyment of PE for these particular population groups [14].

While literature demonstrates enjoyment and motivation are relatively difficult to change even when adolescents are exposed to quality PE interventions and programs, it appears that poor experiences in PE have longer lasting effects [63]. Intervention studies are needed to better understand how to affect student enjoyment in PE, especially during the transition from primary to secondary school when a notable decline in PA and enjoyment of PE are evident.

Author Contributions

S.C. involved in conceptualization, writing–original draft, and editing. A.G. involved in formal analysis, and writing–review and editing. I.K. involved in data curation, and writing–review and editing. M.H. involved in data curation, and writing–review and editing. D.R.L. involved in methodology, and writing–review and editing. T.J. involved in funding acquisition, conceptualization, methodology, resources, and writing–review and editing.

Ethics Statement

Ethical approval was granted from the University of Jyväskylä ethics committee (22082017).

Consent

Participants, schools, and parents provided written informed consent to participate in the study. Patients and/or the public were not involved in the design, or conduct, or reporting of this research.

Conflicts of Interest

The authors declare no conflicts of interest.

Data Availability Statement

Additional data are available on request.

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