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Journal of Sports Sciences

ISSN: 0264-0414 (Print) 1466-447X (Online) Journal homepage: www.tandfonline.com/journals/rjsp20

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To cite this article: Ornella Goldstein, Lisa Lefèvre, Thibaut Derigny, François Potdevin, Joanne Maylaender & Christophe Schnitzler (30 Nov 2025): Understanding the differences in boys' and girls' involvement in physical education in French high school context: An ecological approach, Journal of Sports Sciences, DOI: 10.1080/02640414.2025.2594911

To link to this article: https://doi.org/10.1080/02640414.2025.2594911

JOURNAL OF SPORTS SCIENCES
https://doi.org/10.1080/02640414.2025.2594911

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PHYSICAL ACTIVITY, HEALTH AND EXERCISE

Understanding the differences in boys' and girls' involvement in physical education in French high school context: An ecological approach

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ABSTRACT

The World Health Organization advises that adolescents engage in at least 60 minutes of moderate to vigorous physical activity daily. However, a significant proportion of adolescents do not meet this recommendation, with a notable gender gap. Specifically, 92% of girls fall short of this target, compared to 82% of boys. Physical education programs often exacerbate these inequalities. This study aims to investigate, within the ecological framework, the conditions that exacerbate or mitigate gender differences in physical activity engagement during physical education classes. The study is based on a mixed methodology, combining quantitative measures (accelerometers, questionnaires) and qualitative measures (focus groups). Results showed that the odds of girls engaging in high levels of MVPA were substantially lower than those of boys (OR ≈ 0.65), particularly during performance-oriented and opposition activities. Gender disparities were also more pronounced in advantaged and urban schools, whereas rural and lower-SPI contexts showed smaller gaps. Qualitative data revealed that girls often experience social discomfort and judgement, particularly from boys, which undermines their participation. These findings emphasise the importance of rethinking PE practices through an ecological lens by considering the interplay between activity type, school context and social dynamics, to foster more inclusive engagement for all students.

ARTICLE HISTORY
Received 03 November 2025
Accepted 03 November 2025

KEYWORDS
Engagement; gender gap; physical education; physical activity

The promotion of physical activity (PA) has emerged as a critical social and public health issue. The World Health Organization (WHO, 2021) characterizes PA as 'any bodily movement produced by skeletal muscles that require energy expenditure', encompassing activities undertaken during leisure, work, or travel. This is distinct from sedentary behaviour (SB), described as 'any wakeful state with an energy expenditure of ≤1.5 METs while in a sitting, reclining, or lying posture' (WHO, 2021). According to the WHO, children and adolescents should get an average of at least 60 minutes of moderate to vigorous physical activity (MVPA), mostly aerobic, every day of the week, but 81% of adolescents do not meet this recommendation (WHO, 2021). Insufficient PA is linked to substantial health and social concerns, including increased risks of non-communicable diseases such as cardiovascular disease, obesity, type 2 diabetes, and certain cancers (Ekelund et al., 2019). Additionally, PA deficiency is associated with mental health concerns, including higher rates of depression, anxiety, and poor psychological well-being (Rebar et al., 2015). The rise of SB contributes to significant socio-economic burdens. Globally, physical inactivity incurs an estimated $54 billion in direct healthcare costs (WHO, 2021), with France experiencing a parallel economic impact of approximately 17 billion euros annually, predominantly attributed to healthcare expenses.

Alarmingly, PA deficiency is a global phenomenon, affecting approximately 28% of adults, with a higher prevalence among women (32%) than men (23%). This trend is more pronounced among youth, with 81% of adolescents aged 11–17 not meeting WHO PA guidelines (WHO, 2021). Research indicates that PA levels decline from mid childhood through adolescence and then again through adulthood, with this trend being more acute among females (Varma et al., 2017). Studies reveal persistent gender disparities in PA engagement across various cultures and age groups, with girls consistently less active than boys (Apété et al., 2012; Guthold et al., 2020; Kalman et al., 2015). France is no exception to this trend (Rosselli et al., 2020). Physical Education (PE) is the only compulsory PA moment per week for adolescents, making it a good opportunity to educate students about PA (Roetert & Jefferies, 2014). However, PE appears to perpetuate certain gender inequalities. The French PE curriculum implicitly favours

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boys by promoting activities and forms of engagement that correspond to traditional male socialisation. It also values stereotypically masculine behaviours during assessments. This results in girls receiving lower grades than boys (Cogérino, 2003; Vigneron, 2006). Furthermore, teachers tend to favour boys by providing them with more feedback and interaction during PE lessons than girls (Cowley et al., 2021; Wetton et al., 2013). These inequalities act as a barrier to girls' participation in physical activity (PA) during PE lessons.

The ecological model proposed by Bauman et al. (2012) offers a comprehensive framework for understanding the complexity of PA engagement, highlighting the interplay of individual, interpersonal, environmental, and policy factors in shaping PA behaviour. Despite recognizing the gender imbalance in PE engagement, empirical quantification and analysis of its determinants have been limited. Cairney et al. (2014)) explored the psychosocial correlates of PA in youth but did not fully quantify the school-level influences. Similarly, Belanger et al. (2018) examined PA trajectories in children and adolescents, noting gender differences but without a detailed analysis of contextual factors such as school environments or socio-economic status.

This study aims to investigate the conditions that exacerbate or mitigate gender differences in PA engagement during PE classes, within the context of the ecological framework. Our hypotheses are that: (1) boys will show statistically discernible higher physical activity level in PE than girls; (2) the nature of activities will mediate this engagement, with a larger gender gap for activities perceived as masculine and a smaller gender gap for neutral or activities perceived as feminine; (3) socio-cultural and geographical school characteristics will correlate with the gender gap, being less pronounced in advantaged urban areas and more pronounced in disadvantaged urban and rural areas.

Material and methods

Mixed methods design

A convergent mixed methods design was adopted (Creswell & Clark, 2017) combining accelerometer data with focus groups (FG). This approach allows for separate analysis of quantitative and qualitative data before integration, providing a comprehensive understanding of the research problem.

The quantitative component aimed to assess gender disparities in physical activity level during a two-hour PE class, based on students' MVPA measured via accelerometers. The analysis explores how these disparities relate to the type of activity as well as to the school's socio-economic status and environment, to identify the factors most strongly associated with differences in PA levels. The qualitative component consisted of a 30-minute FG (Colucci, 2007) with girls, which aimed to gain in-depth insight into the girls' perceptions of PA by exploring both their motivations and the barriers they experience in PE. Data collection occurred between December 2024 and April 2025 to reduce seasonal bias. School staff, parents, and students were informed about the study protocol in advance. Ethical approval for this study was granted by the university's ethics board in July 2023 (Ref: CER 2023–16).

Participants and context

Public secondary schools in one region of France were selected based on three criteria: (1) socio-economic status, (2) geographical setting and (3) the type of PA taught during the two-hour PE lesson. The French Ministry of Education's Social Position Index (SPI), which classifies schools based on students' socio-economic background, was used as a macroeconomic indicator to ensure socio-economic diversity by categorizing schools as disadvantaged (SPI < 80), average (80–119), or advantaged (≥120). Both urban and rural schools were included to ensure geographical diversity. PE lessons were selected to ensure balanced representation of the French curriculum, which includes the following four categories of activity: (1) Performing at one's best (e.g., athletics or swimming), (2) Adapting movement to varied environments (e.g., climbing or orienteering), (3) Expressing oneself through physical performance (e.g., dance or gymnastics), (4) Leading and mastering confrontation (e.g., team sports, racket sports or combat sports).

Within each school, students aged 11 to 15 from mixed-gender classes were eligible to participate. Written informed consent was obtained from both students and their parents, including agreement to wear an accelerometer during one PE lesson. Each FG included six to eight participants per school and lasted approximately 20 minutes (Colucci, 2007), voluntary participation was the primary criterion for including girls in the FG. They were recruited from the same classes involved in the quantitative phase and were selected in consultation with PE teachers, who used their professional knowledge of their students to ensure as much as possible a diversity of engagement levels – from highly engaged to nearly disengaged.

Data collection

Both quantitative and qualitative data were collected during the same period. First, accelerometric measures

were taken during the two-hour PE lesson, and then FG were conducted either directly after the lesson or during the week after the lesson.

Quantitative component

The research team briefly introduced the study without disclosing its focus on gender differences in PA levels to prevent potential bias. Students were then equipped with ActiGraph accelerometers, model GT3X+ (ActiGraph™, Pensacola, FL, USA), set at 30 Hz sampling rate and worn on the preferred hip using an elastic belt for the duration of the PE lesson. Raw data were downloaded and processed using ActiLife software in 10-second epochs, and Troiano's (2008) wear-time validation algorithm was applied to ensure accuracy, which is typical for studies measuring PA in adolescents (Aibar & Chanal, 2015; Derigny et al., 2022). We used Evenson Children (2008) to determine cut points and MVPA as they were adolescents of 11–15 years of age. The cut points are 0 to 799 for sedentary, 800 to 1679 for light PA intensity, 1680 to 3367 for moderate PA intensity and over 3368 count per minute for vigorous PA intensity.

Qualitative component

FG lasting 15 to 20 minutes. As this research is exploratory, FG were chosen to provide a platform for diverse experiences and viewpoints (Sparkes & Smith, 2009). Discussions covered body image, PE engagement, PA representations, effort perception, teacher relationships, gender interactions, and lesson content. Sessions were audio-recorded, while a second researcher noted participant names, non-verbal cues, facilitator roles, and group atmosphere. Questions were created to cover components of Bauman's system, with a specific focus on individual and interpersonal systems. After introduction, the facilitator asked the questions ranging from general to specific topics presented in Table 1.

Data analysis

We analysed the quantitative data using descriptive and inferential statistics, and we conducted thematic analysis on the qualitative data. We then tested our hypothesis by triangulating the results (Creswell & Clark, 2017), identifying the similarities and differences between the quantitative and qualitative results at the various levels of Bauman's et al. (2012) model. This triangulation approach provided an overview of the factors explaining differences in engagement between girls and boys.

Statistical analyses were performed using R software (version 4.4.2). Given the variability in recording durations across students, we used the dependent variable 'proportion of MVPA', calculated as the ratio of MVPA duration to total recording time. To account for the nested structure of the data (students within classes and schools), we employed a mixed-effects modelling approach. This enabled us to assess the effects of explanatory variables while appropriately modelling variance at the class and school levels. The residuals of the dependent variable were tested for normality using the Shapiro-Wilk test. Since the assumption of normality was violated, we opted for a Generalized Linear Mixed Model (GLMM). In GLMMs, the distribution of the response variable must align with the nature of the observed data. As our response variable is a proportion strictly bounded between 0 and 1, a beta distribution was deemed appropriate. Consequently, a beta-distributed GLMM was applied. This model, reporting odds ratios and their associated 95% confidence intervals, was used to investigate the effects of gender across different activity, as well as the socioeconomic status of the school. The statistical significance threshold was set at 5%. To control the increased risk of Type I error due to multiple testing, p-values were adjusted using the Holm-Bonferroni correction method. To assess the statistical power of our study post hoc, we conducted a retrospective sensitivity analysis based on the characteristics of the achieved sample. The sensitivity analysis was performed using two approaches: (1) a simple analysis treating participants as independent units, and (2) a cluster-adjusted analysis accounting for the hierarchical data structure. We calculated the smallest detectable effect size (Cohen's d) for 80% statistical power with $\alpha = 0.05$. The intraclass correlation coefficient (ICC) was

Table 1. List of the questions.

Q1	Firstly, can you take turns introducing yourselves: first name, age, physical activity, or hobby outside PE and say who you do it with (family, friend, alone)?
Q2	What does commitment to PE mean to you in three words?
Q3	Does your level of commitment vary depending on the activity? Can you see a PA example under the different levels of commitment?
Q4	Had you already done activity X outside PE? If so, did it enable you to be more involved in PE?
Q5	What exercises did you enjoy and what motivated you to take part in the 'X' lesson?
Q6	Do the relationships you have with each other in the class influence your level of commitment to this 'X activity' course?
Q7	Do other people's opinions affect your involvement in this activity, and in what way?
Q8	Free questions, specific to the class, after the observation during accelerometric measures

estimated using one-way ANOVA with schools as the grouping factor, and the design effect was calculated as $1 + (k\text{-}1) \times ICC$, where k represents the average cluster size.

The FG data were analysed using a semi-open coding approach informed by Blair's (2015) reflexive methodology. The analytical process involved several key stages. First, the data were familiarised with (i.e., an initial automated transcription was produced using MAXQDA software; the transcripts were then manually reviewed and refined to incorporate important interactional cues, such as silences, repetitions and hesitations; and the transcripts were read and re-read to become immersed in the content). Initial codes were then generated by identifying meaningful units of sense that emerged inductively. These codes were subsequently organised into eight predefined analytical categories (i.e., each code was assigned to one of the following categories: relationship with the body; engagement in PE; representation of sport; relationship to effort; relationship to PA; relationship with the teacher; interactions between girls and boys; and teaching content). Within each category, sub-themes were developed by grouping similar codes to reflect emerging patterns specific to each category. The categories and sub-themes were then reviewed (i.e., verifying the internal consistency and coherence of the sub-themes within each category and adjusting them where necessary to ensure conceptual clarity). Two levels of analysis followed. The first was a within-case analysis (i.e., creating an analysis grid for each FG and aligning the eight categories with Bauman's ecological systems to facilitate contextualized interpretation). The second was a cross-case analysis (i.e., aggregating all codes across the 14 FG for each category).

Methodological justification

A convergent mixed methods design was chosen to leverage the complementary strengths of quantitative and qualitative approaches (Creswell & Clark, 2017). The quantitative component provides objective, measurable and generalizable data on levels of physical engagement in PE, notably through activity measurements based on accelerometers. Meanwhile, the qualitative component offers an in-depth, contextual understanding of students' perceptions, motivations and barriers to participation, particularly among girls. Integrating these two data types within a convergent design enables results to be triangulated and capturing the complexity of girl's engagement dynamics in PE.

Results

Participants

The characteristics of the participants in the quantitative part are summarised in Table 2.

A total of eighty-seven girls participated in the different FG across nine schools. Each group consisted of six to eight volunteer participants aged between 12 and 15 years. All had previously taken part in the quantitative phase of the study, during which they wore accelerometers during a two-hour PE lesson.

Quantitative results

Main quantitative results are presented in Tables 3 and 4.

Analyses revealed significant gender differences in the proportion of time spent in MVPA, depending on the activity type. Specifically, girls were significantly less active than boys during performance activities (OR =

Table 2. Participants' characteristics and stratification across the type of activity, the categories of SPI and Geography.

	Overall n = 462	Female n = 220	Male n = 240
Participants			
Age[a] (in years)	13.69 ± 1.01	13.70 ± 1.10	13.67 ± 0.93
Height[a] (in cm)	163.76 ± 9.01	161.58 ± 7.02	165.74 ± 10.11
Weight[a] (in kg)	59.75 ± 18.08	58.30 ± 17.39	61.08 ± 18.63
Type of activities			
1 (performance activities)	46 (10%)	20 (43%)	26 (57%)
2 (outdoor activities)	104 (23%)	53 (51%)	51 (49%)
3 (artistic activities)	103 (22%)	49 (48%)	54 (52%)
4 (opposition games)	209 (45%)	98 (47%)	111 (53%)
Categories of SPI			
Advantaged	182 (39%)	93 (51%)	89 (49%)
Average	188 (41%)	79 (42%)	109 (58%)
Disadvantaged	92 (20%)	48 (52%)	44 (48%)
Geography			
Rural	203 (44%)	101 (50%)	102 (50%)
Urban	259 (56%)	119 (46%)	140 (54%)

[a]mean ± standard deviation.

Table 3. Percentage of lesson time spent in MVPA (mean ± sd) by activity type and gender.

Activity type	Girls (%, mean ± SD)	Boys (%, mean ± SD)	Diff G – B (pts)
1 (performance activities)	28.9 ± 13.7	38.7 ± 20.5	−9.7
2 (outdoor activities)	39.2 ± 15.3	39.8 ± 16.4	−0.7
3 (artistic activities)	19.4 ± 11.7	23.3 ± 17.0	−3.8
4 (opposition games)	27.1 ± 16.4	38.3 ± 18.4	−11.3

Table 4. MVPA difference by gender according to the type of activity, the categories of SPI and the Geography.

	Comparison	Odds Ratio	95% CI	p-value	Adjusted p-value
Type of activity					
1 (performance activities)	F – M	0.651	[0.51 – 0.83]	< 0.001	0.002
2 (outdoor activities)	F – M	1.037	[0.88 – 1.23]	0.67	0.67
3 (artistic activities)	F – M	0.904	[0.75 – 1.1]	0.307	0.614
4 (opposition games)	F – M	0.639	[0.56 – 0.74]	< 0.001	< 0.001
Categories of SPI					
Advantaged	F – M	0.611	[0.51 – 0.73]	< 0.001	< 0.001
Average	F – M	0.949	[0.83 – 1.08]	0.437	0.437
Disadvantaged	F – M	0.852	[0.7 – 1.04]	0.111	0.222
Geographic Area					
Rural	F – M	1.009	[0.88 – 1.15]	0.9	0.9
Urban	F – M	0.619	[0.53 – 0.72]	< 0.001	< 0.001

0.65, 95% CI [0.51, 0.83], $p < .001$) and opposition games (OR = 0.64, 95% CI [0.56, 0.74], $p < .001$). However, no significant gender differences were observed for outdoor activities or artistic activities. When analysing gender differences in MVPA by category of SPI, significant disparities were only observed among students from advantaged schools (OR = 0.61, 95% CI [0.47, 0.78], $p < .001$). Compared to boys, girls from this group engaged significantly less in MVPA. By contrast, no significant gender differences were detected among students from average or disadvantaged schools. When analysing gender differences in MVPA by geographic area, significant disparities were only observed among students from urban geographic area (OR = 0.62, 95% CI [0.48, 0.79], $p < .001$). Compared to boys, girls from this group engaged significantly less in MVPA. The retrospective sensitivity analysis revealed important insights about our study's statistical power and the impact of hierarchical data structure on effect detection capabilities. Our achieved sample comprised 462 participants (220 girls, 242 boys) distributed across 13 schools and 27 classes, with an average of 35.5 participants per school and 17.1 participants per class. This hierarchical structure significantly influenced our statistical power calculations. The estimated intraclass correlation coefficient (ICC) was 0.558, indicating that approximately 56% of the variance in MVPA engagement was attributable to between-school differences rather than individual differences. This high ICC resulted in a substantial design effect of 21.90, reducing our effective sample size to approximately 21 participants when accounting for clustering. Without adjustment for clustering, our study could detect effect sizes of Cohen's $d \geq 0.270$ with 80% power. However, when properly accounting for the hierarchical structure, only very large effects ($d \geq 1.300$) were detectable with adequate power. The observed main effect of gender ($d = 0.388$) exceeded both thresholds, achieving 98.6% retrospective power. The reduced effective sample size particularly impacted our ability to detect effects in subgroup analyses. Table 5 presents the minimum detectable effect sizes for analyses by activity type, showing that only the largest activity-

Table 5. Sensitivity analysis results by study component.

Analysis Component	Sample Size	Cohen's d Observed	Minimum Detectable d	Achieved Power
Main Effect (Gender)	462	0.388	0.270*/1.300**	98.6%
Activity Type Analysis				
1 (performance activities)	46	0.651	0.60	65.2%
2 (outdoor activities)	104	1.037	0.40	85.1%
3 (artistic activities)	103	0.904	0.40	78.3%
4 (opposition games)	209	0.639	0.30	92.4%
SPI Analysis				
Advantaged	182	0.611	0.35	88.7%
Average	188	0.949	0.35	45.2%
Disadvantaged	92	0.852	0.50	71.8%

specific samples maintained adequate power for detecting moderate effects.

Qualitative results

Qualitative data highlight that engagement or disengagement in PA is complex and depends on a variety of factors across all dimensions of Bauman's et al. (2012) ecological model. Results are based on 14 FG, comprising 87 girls from nine secondary schools; 26 subcategories were generated within ten main categories, which are presented in Table 6.

Individual system

The main factors encouraging girls to participate in PE were enjoying the activity itself and finding competitive situations appealing, whether in team sports or individual challenges. In contrast, a lack of confidence and a fear of being judged were reported as major barriers, often resulting in partial or complete disengagement. The girls' relationship with PA depends largely on personal motivation, though team sports generally sparked shared enthusiasm. Three profiles emerge: girls who enjoy the activity and engage fully; those who dislike the activity and do little or nothing; and those who dislike it but still participate and meet expectations. There was no obvious pattern in the distribution of these profiles across the FG, with each group displaying a balanced spread of the three profiles. The initial perception of the activity also played a role. For some girls, knowing in advance what the session would involve increased their willingness to participate, while for others, it made no difference. Finally, the girls generally had a positive relationship with effort, described as mental or physical exertion, pushing oneself, or giving ones all. The mental dimension – pushing past one's limits – was most often mentioned. Overall, effort was valued and seen as something to pursue.

Table 6. Focus group analysis.

Categories	Subcategories
Individual system	
Engagement	Engagements factors
	Barriers to engagement
	Characteristic of engagement
	Learning context
Relationship to effort	Effort characteristic
	Self-determination
	Effect of practice on effort
Relationship to PA	Type of activity
	Relation to PE activity
Initial perception of activity	Previous knowledge
	Representation of PE
Interpersonal system	
Relationship with the body	Other people's views
	Must show up
Relationship with the teacher	Teacher's pedagogy
	Gender effect
	Nature of relation
Girls and boys' interactions	Nature of the relationship
	Interactions with boys
Relationship to other	Peers' cooperation
	Dealing with other
	Negative interactions
Environmental system	
Course content	Didactic and pedagogy
	Content organization
	Specificity of PE
Environnement	Built
	Natural

Interpersonal system

The interpersonal dimension was the most frequently discussed system. Body image was identified as a significant barrier to engagement, with the idea of being observed often described as unpleasant or stressful. Many girls reported feeling judged, which made them feel uncomfortable, lose confidence, or sometimes stop participating in PE altogether. Only a small minority claimed to be unaffected by these pressures. These feelings were closely linked to relationships with peers, particularly when groupings were imposed. Girls often reported dislike being paired with unfamiliar or disliked peers, especially if they were critical or not committed, leading to frustration or demotivation. However, some girls engage in the same way regardless of their partners. Gendered interactions were a particularly salient theme during the FG. Many girls described boys using strongly negative terms, using adjectives such as 'choleric', 'disgusting' and 'whinger', and complained about boys' behaviours during PE. This suggests that mixed-gender PE can exacerbate discomfort and tension. However, a few highly motivated girls acknowledged that certain boys were more engaged than their female peers, offering a more nuanced perspective. Attitudes towards mixed-gender practice varied among girls contrasted: while some found it demotivating, particularly in contact sports, others reported no significant difference in their experience. Finally, the impact of relationships with teachers appeared to be variable. A positive teacher-student relationship could be motivating; negative or neutral relationships could lead to withdrawal or a lack of effort. While most girls seemed influenced by this dynamic, a minority remained unaffected.

Environmental system

Within the didactic and pedagogical sub-theme, issues relating to group composition and assessment were particularly salient. While some girls were disengaged when groups were imposed or perceived as imbalanced in terms of motivation or level of practice, most saw group work, especially with chosen peers, to enhance their engagement. Grading also played a significant role,

Table 7. Result organised into category and exemplar quotes.

Categories	Quotations
Individual system	
Relationship to effort	'The effort is to push yourself, to push your limits, to see how far you can go and how far you can't go. I think it's cool to know what you can do and what you can't do'. (FG2)
Relationship to PA	'I do it because I like it, I like doing it'. (FG8)
Representation of activity	'I think, because you know the basics when you've already seen them, you're already more at ease, so it's easier . . . ' (FG9)
Engagement in PE	'yes, clearly it totally reduces the desire because if I miss something and people make fun of you or look at you strangely, I'm less motivated because I can convince myself that I'm rubbish at it'.(FG14) And 'afterwards, it's often the desire to win as much as possible that motivates me in matches'.(FG14)
Interpersonal system	
Relationship to the body	'I didn't find it at all motivating because, well, having to show up like that, I don't know how, not necessarily motivated'. (FG11)
Girls-boys' interactions	'Well, basically it depends on whether there's contact with it and what sport it is too'. (FG6)
Relationship to the teacher	'I think it has an influence because if it pushes us, it helps us, for example, when we're at least motivated, it encourages us, sometimes we want to carry on more than we want to stop'. (FG13)
Relationship to the other	'Well, for example, people who make fun of the fact that someone is more rubbish than the others, well that's far too demotivating and that means you don't want to play as much'. (FG6)
Environmental system	
Teacher contents	'Well, it's not a sport I necessarily enjoy, so I'm still trying to give my all for my mark, but otherwise I know I won't be doing any outside'. (FG12)

particularly for students who were not naturally interested in PA. For many of these students, marks were a powerful engagement factor. In terms of organising content, several elements appeared to boost motivation. These included competitive formats, such as matches and team-based challenges, alongside as well as fun activities and a varied range of content.

Each category is illustrated by some extracts from the verbatim which are provided in Table 7.

Discussion

The aim of this study was to investigate the factors that influence gender differences in PA engagement during PE classes, through the lens of Bauman's ecological model Bauman et al. (2012). Hypothesis one was supported: across the whole sample, boys accumulated significantly more MVPA than girls. Activity-level analyses also upheld hypothesis two, with the gender gap widening in activities that are culturally coded as masculine and virtually disappearing in tasks that are coded as either neutral or feminine. Hypothesis three was not confirmed. The gender disparity was greatest in urban schools with a high SPI, whereas rural or lower-SPI schools showed smaller differences. While the main gender effect can be considered confirmatory, subgroup analyses by activity type, school socioeconomic index (SPI), and geographic area should be regarded as exploratory due to the absence of an a priori power calculation and limited effective sample size at the school level. This study's originality lies in its integrated approach, which cross-references three key factors – types of activity, the SPI of schools, and geographical location. The mixed-methods design provides an ecological understanding of gender differences in engagement during PE, offering insights that go beyond previous research focused on individual variables.

The validation of the first hypothesis confirms previous findings (Romero-Parra et al., 2023; Tanaka et al., 2018) that boys continue to engage more in PE than girls, as evidenced by higher levels of MVPA during typical PE lessons in the context of this study. However, our odds ratio analyses show that gender differences in PE engagement vary widely depending on context. Interpreting results requires looking beyond statistical significance. Odds ratios show the size of gender disparities, while their 95% confidence intervals reflect the precision and uncertainty of these estimates. Together, they provide a fuller picture of the findings and their practical meaning for gender equity in PE. While some activities reveal minimal gaps ($OR \approx 1.0$), others show marked disparities ($OR < 0.65$). This highlights that gender inequalities in PE are strongly influenced by activity type, school environment, and location. Specifically, factors operating at the individual and interpersonal levels of Bauman's ecological model Bauman et al. (2012) appear to underlie girls' lower engagement in PE classes. At the individual level, lower perceived competence and motivation emerge as key barriers for girls, particularly among those less active outside of school (Guan et al., 2023). These results align with well-documented declines in girls' self-efficacy related to PA during adolescence, which reduce their enjoyment and commitment to PA (Cairney et al., 2012). Moreover, at the interpersonal level, social interactions with peers – especially boys – often hinder girls' participation and motivation in PE (Cowley et al., 2021). These findings are consistent with research showing that girls frequently

experience exclusion and marginalisation in mixed-gender PE classes (Frühauf et al., 2022), where peer dynamics can foster competitive or even hostile environments that limit girls' engagement (Smith et al., 2018). Together, these findings raise important questions about the effectiveness of the French PE curriculum's aim to promote gender equality through mixed-gender classes (Szerdahelyi & Couchot-Schiex, 2020), as well as the persistent influence of socialisation processes and gender norms within PE settings (Metcalfe, 2018).

The second hypothesis of this study was confirmed, emphasising the significant impact of activity type on gender disparities in PE participation. Specifically, activities categorised as 1 (performance activities; OR = 0.65) and 4 (opposition games; OR = 0.64) showed notably lower odds of high MVPA engagement among girls compared to boys, highlighting stronger gender gaps in these competitive contexts. This pattern aligns with the findings of other studies (Delextrat et al., 2020; Wallace et al., 2020), which suggest that the type of activity has an impact on gender differences in engagement. The representation of such activities often socially coded as masculine (Fontayne et al., 2001) are also more closely linked to boys' primary socialisation experiences (Vigneron, 2006). However, the results show that competition and team sports also serve as important motivators for many girls at an individual level. Nevertheless, girls often report negative interactions with boys during these activities, which can reduce their enjoyment and possibly explain the discrepancy between their motivation for these activities and their level of MVPA (Watson et al., 2015; Zarrett et al., 2020). At the policy level, the official French PE curriculum advocates for gender equality by promoting balanced exposure across all four learning areas 1 to 4. Yet, the hidden curriculum implicitly privileges activities related to 1 and 4, thereby reinforcing existing gender gaps in engagement (IGEN, 2016).

Contrary to our third hypothesis, the most pronounced gender gaps appeared in advantaged and urban schools, as reflected by notably low odds ratios indicating substantially lower MVPA engagement among girls.This finding is paradoxical when compared with existing literature, which often associates higher SPI level with better access to PA opportunities for girls (Bohr et al., 2013; Lee & Lim, 2022). Our results show a more pronounced gender gap in the level of MVPA among students from advantaged schools than among those from disadvantaged schools. One possible explanation for this unexpected finding is the specific barriers experienced by adolescents from high-SPI backgrounds. These barriers include academic pressure, fear of judgement in competitive settings and restrictive social norms, particularly among girls. These barriers have been shown to limit girls participation in PA despite them having greater material access (Alliott et al., 2022). In terms of geographical impact, our results is consistent with some existing literature that highlights higher levels of PA among students living in rural areas (Moore et al., 2014).

The odds ratio analysis reveals a clear hierarchy of gender disparities across contexts. Competitive activities (performance and opposition games) and advantaged schools show substantial and precise gender gaps disadvantaging girls. In contrast, outdoor and artistic activities, as well as rural schools, exhibit minimal differences with generally precise estimates. These variations highlight the need for context-specific interventions to effectively reduce gender inequalities in PE.

At an individual level, factors such as perceived competence, motivation and enjoyment can directly influence a girl's willingness to participate. The interpersonal level encompasses social dynamics, particularly the quality of relationships with peers, especially boys, and the nature of social interactions during PE. The environmental level considers broader contextual elements related to the school, such as its location (urban or rural) and its Social Positioning Index (SPI). At the political level, structural and curricular elements play a role, including the hidden curriculum and the implementation of mixed-gender practices. Finally, at the global level, more diffused yet powerful influences, such as gender norms and stereotypes, continue to shape girls' experiences of and engagement in PE.

An important methodological insight from our study concerns the impact of the hierarchical structure of our data on statistical power and result interpretation. The high intraclass correlation coefficient (ICC) observed indicates that much of the variance in physical activity engagement is explained at the school level rather than individually. This strong clustering effect significantly reduced our effective sample size and statistical power, particularly for subgroup analyses. Consequently, while the main gender effect was detected with sufficient power, smaller effects, especially within specific activities or school contexts, may have gone undetected. This limitation calls for caution when interpreting null or marginal findings and highlights the need for future research to prioritise larger samples across more schools to adequately capture these nuanced effects. Moreover, transparent reporting of ICC and design effects should become a standard practice to better guide study design and power considerations in school-based physical activity research.

This study has several limitations that should be considered when interpreting the results. Firstly, the

geographical context is specific, focusing only on schools in one region of France, which may limit the generalisability of the findings. Secondly, qualitative data were collected exclusively from girls through voluntary FG, which could introduce selection bias as these participants may not fully represent the diversity of experiences within their classes or schools more broadly. Thirdly, the distribution of the sample across the different type of activity, IPS categories, and geographical areas was not perfectly balanced, which may have limited the representativeness of certain subgroups and potentially influenced the interpretation of observed patterns. Finally, a major limitation of this study is the absence of a formal 'a priori' sample size calculation in our Stage 1 preregistration, which limits the methodological rigour expected in such protocols. Although our retrospective sensitivity analysis indicates sufficient power for the main effects, this shortcoming reduces the strength of evidence supporting secondary and subgroup analyses.

Furthermore, the high intraclass correlation coefficient (ICC = 0.558) observed in our data decreased the effective sample size and thus the power for detecting smaller effects. Consequently, null results in subgroup comparisons should be interpreted with caution, as they may reflect limited statistical power rather than genuine absence of effects.

These findings highlight the urgent need to diversify the range of activities offered in PE lessons, ensuring an equal balance of competitive, collective, artistic and outdoor sports. Collective sports such as Ultimate Frisbee, Korfball and Tchoukball, which promote mixed-gender participation and encourage cooperative play based on interdependent rules, should be made more inclusive for girls (Gubby, 2019; Kato & Sato, 2022). Innovative pedagogical approaches, such as the Teaching Games for Understanding model, could also support this goal (Bracco et al., 2019). Additionally, teacher training should prioritise equipping teachers with the skills needed to manage mixed-gender classes and address gender-related issues, in order to create more inclusive and supportive PE environments (Guerrero & Guerrero Puerta, 2023). From a research perspective, it is important to extend investigations into high schools to establish whether gender disparities persist or evolve with age. Furthermore, targeted quasi-experimental interventions in opposition game could be effective in reducing these disparities and promoting equitable participation.

Conclusion

This study uses Bauman's ecological framework to provide a better understanding of gender disparities in PA during PE classes. While confirming the persistence of higher levels of MVPA among boys, our results emphasise the interaction between the type of activity, the school context, and individual and interpersonal dimensions in shaping these differences. They emphasise the importance of diversifying PE programmes by incorporating cooperative activities that are less gender-stereotyped, as well as innovative pedagogical models such as Teaching Games for Understanding. Combined with targeted teacher training, these approaches could foster more inclusive environments that support girls' motivation and participation. Future research should extend this ecological perspective by examining institutional and policy influences and testing intervention strategies aimed at mitigating gender inequalities at different stages of education. Addressing the various factors that hinder girls' participation in PE is crucial for promoting lifelong PA and equity in PE.

Acknowledgments

The authors would like to thank all participating schools, teachers, and students for their valuable contributions to this study. We also extend our gratitude to the research assistants and collaborators who supported data collection and analysis.

Disclosure statement

No potential conflict of interest was reported by the author(s).

Funding

The author(s) reported there is no funding associated with the work featured in this article.

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Data availability statement

The dataset supporting the conclusions of this article is openly available in Zenodo at: https://doi.org/10.5281/zenodo.15754552

References

Aibar, A., & Chanal, J. (2015). Physical education: The effect of epoch lengths on children's physical activity in a structured

context. *PLOS ONE*, *10*(4), e0121238. https://doi.org/10.1371/journal.pone.0121238

Alliott, O., Ryan, M., Fairbrother, H., & van Sluijs, E. (2022). Do adolescents' experiences of the barriers to and facilitators of physical activity differ by socioeconomic position? A systematic review of qualitative evidence. *Obesity Reviews: An Official Journal of the International Association for the Study of Obesity*, *23*(3), e13374. https://doi.org/10.1111/obr.13374

Apété, G. K., Zitouni, D., Hubert, H., & Guinhouya, B. C. (2012). Compliance of children in Northern France with physical activity recommendations. *Perspectives in Public Health*, *132*(2), 81–88. https://doi.org/10.1177/1757913911419896

Bauman, A. E., Reis, R. S., Sallis, J. F., Wells, J. C., Loos, R. J., & Martin, B. W. (2012). Correlates of physical activity: Why are some people physically active and others not? *Lancet*, *380*(9838), 258–271. https://doi.org/10.1016/S0140-6736(12)60735-1

Belanger, K., Barnes, J. D., Longmuir, P. E., Anderson, K. D., Bruner, B., Copeland, J. L., Gregg, M. J., Hall, N., Kolen, A. M., Lane, K. N., Law, B., MacDonald, D. J., Martin, L. J., Saunders, T. J., Sheehan, D., Stone, M., Woodruff, S. J., & Tremblay, M. S. (2018). The relationship between physical literacy scores and adherence to Canadian physical activity and sedentary behaviour guidelines. *BMC Public Health*, *18*(2), 1042. https://doi.org/10.1186/s12889-018-5897-4

Blair, E. (2015). A reflexive exploration of two qualitative data coding techniques. *Journal of Methods and Measurement in the Social Sciences*, *6*(1), Article 1. https://doi.org/10.2458/v6i1.18772

Bohr, A. D., Brown, D. D., Laurson, K. R., Smith, P. J. K., & Bass, R. W. (2013). The relationship between socioeconomic status and physical fitness in junior high school students. *The Journal of School Health*, *83*(8), 542–547. https://doi.org/10.1111/josh.12063

Bracco, E., Lodewyk, K., & Morrison, H. (2019). A case study of disengaged adolescent girls' experiences with teaching games for understanding in physical education. *Curriculum Studies in Health and Physical Education*, *10*(3), 207–225. https://doi.org/10.1080/25742981.2019.1632724

Cairney, J., Kwan, M. Y., Velduizen, S., Hay, J., Bray, S. R., & Faught, B. E. (2012). Gender, perceived competence and the enjoyment of physical education in children: A longitudinal examination. *International Journal of Behavioral Nutrition and Physical Activity*, *9*(1), 26. https://doi.org/10.1186/1479-5868-9-26

Cairney, J., Veldhuizen, S., Kwan, M., Hay, J., & Faught, B. E. (2014). Biological age and sex-related declines in physical activity during adolescence. *Medicine and Science in Sports and Exercise*, *46*(4), 730–735. https://doi.org/10.1249/MSS.0000000000000168

Cogérino, G. (2003). Faire réussir en EP les filles et les garçons? Approche des problèmes posés L'EPS, c'est pour les filles et les garçons : quoi et comment enseigner pour tenir compte de cette évidence? In G. Carlier (Ed.), *Si l'on parlait du plaisir d'enseigner l'éducation physique* (pp. 281–294). Éditions AFRAPS. https://doi.org/10.3917/afraps.carli.2003.01.0281

Colucci, E. (2007). "Focus groups can Be fun": The use of activity-oriented questions in focus group discussions. *The Qualitative Health Research*, *17*(10), 1422–1433. https://doi.org/10.1177/1049732307308129

Cowley, E. S., Watson, P. M., Foweather, L., Belton, S., Thompson, A., Thijssen, D., Wagenmakers, A. J. M., & externe, L. vers un site, & fenêtre, celui-ci s'ouvrira dans une nouvelle. (2021). *"Girls Aren't Meant to Exercise": Perceived Influences on Physical Activity Among Adolescent Girls-The HERizon Project (No. 1)*, *8*(1), Article 1. https://doi.org/10.3390/children8010031

Creswell, J. W., & Clark, V. L. P. (2017). *Designing and conducting mixed methods research*. SAGE Publications.

Delextrat, A., Esser, P., Beale, N., Bozon, F., Eldridge, E., Izadi, H., Johansen-Berg, H., Wheatley, C., & Dawes, H. (2020). Effects of gender, activity type, class location and class composition on physical activity levels experienced during physical education classes in British secondary schools: A pilot cross-sectional study. *BMC Public Health*, *20*(1), 1590. https://doi.org/10.1186/s12889-020-09698-y

Derigny, T., Schnitzler, C., Remmers, T., Van Kann, D., Gandrieau, J., Seye, N., Baquet, G., & Potdevin, F. (2022). Catch me if you can! How French adolescents seize social occasions and opportunities to be active. *BMC Public Health*, *22*(1), 1332. https://doi.org/10.1186/s12889-022-13746-0

Ekelund, U., Tarp, J., Steene-Johannessen, J., Hansen, B. H., Jefferis, B., Fagerland, M. W., Whincup, P., Diaz, K. M., Hooker, S. P., Chernofsky, A., Larson, M. G., Spartano, N., Vasan, R. S., Dohrn, I.-M., Hagströmer, M., Edwardson, C., Yates, T., Shiroma, E., Anderssen, S. A., & Lee, I.-M. (2019). Dose-response associations between accelerometry measured physical activity and sedentary time and all cause mortality: Systematic review and harmonised meta-analysis. *BMJ*, *366*, l4570. https://doi.org/10.1136/bmj.l4570

Evenson, K. R., Catellier, D. J., Gill, K., Ondrak, K. S., & McMurray, R. G. (2008). Calibration of two objective measures of physical activity for children. *Journal of Sports Sciences*, *26*(14), 1557–1565. https://doi.org/10.1080/02640410802334196

Fontayne, P., Sarrazin, P., & Famose, J.-P. (2001). Les pratiques sportives des adolescents : Une différenciation selon le genre. *STAPS*, *55*(2), 23–37.

Frühauf, A., Hundhausen, F., & Kopp, M. (2022). Better together? Analyzing experiences from male and female students and teachers from single-sex and coeducational physical education classes. *Behavioral Sciences*, *12*(9), 306. https://doi.org/10.3390/bs12090306

Guan, J., Xiang, P., Land, W. M., & Hamilton, X. D. (2023). The roles of perceived physical education competence, enjoyment, and persistence on middle school students' physical activity engagement. *Perceptual and Motor Skills*, *130*(4), 1781–1796. https://doi.org/10.1177/00315125231178341

Gubby, L. (2019). Can korfball facilitate mixed-PE in the UK? The perspectives of junior korfball players. *Sport, Education and Society*, *24*(9), 994–1005. https://doi.org/10.1080/13573322.2018.1519506

Guerrero, M. A., & Guerrero Puerta, L. (2023). Advancing gender equality in schools through inclusive physical education and teaching training: A systematic review. *Societies*, *13*(3), Article 3. https://doi.org/10.3390/soc13030064

Guthold, R., Stevens, G. A., Riley, L. M., & Bull, F. C. (2020). Global trends in insufficient physical activity among adolescents: A pooled analysis of 298 population-based surveys with

1·6 million participants. *Lancet Child and Adolescent Health*, *4* (1), 23–35. https://doi.org/10.1016/S2352-4642(19)30323-2

Inspection générale de l'Éducation nationale. (2016). Inspection générale de l'Éducation nationale [Annual activity report]. Ministère de l'Éducation nationale.

Kalman, M., Inchley, J., Sigmundova, D., Iannotti, R. J., Tynjälä, J. A., Hamrik, Z., Haug, E., & Bucksch, J. (2015). Secular trends in moderate-to-vigorous physical activity in 32 countries from 2002 to 2010: A cross-national perspective. *European Journal of Public Health*, *25*(suppl_2), 37–40. https://doi.org/10.1093/eurpub/ckv024

Kato, R., & Sato, Y. (2022). A study on physical education classes for realizing gender equality. *Japan Journal for the Pedagogy of Physical Education*, *38*(1), 1–17. https://doi.org/10.11243/jsppe.38.1_1

Lee, S., & Lim, Y. (2022). The gendered playing field: Family socioeconomic status and national gender inequality in adolescents' out-of-school physical activity. *Social Science and Medicine (1982)*, *305*, 115062. https://doi.org/10.1016/j.socscimed.2022.115062

Metcalfe, S. (2018). Adolescent constructions of gendered identities: The role of sport and (physical) education. *Sport, Education and Society*, *23*(7), 681–693. https://doi.org/10.1080/13573322.2018.1493574

Moore, J. B., Beets, M. W., Morris, S. F., & Kolbe, M. B. (2014). Comparison of objectively measured physical activity levels of rural, suburban, and urban youth. *American Journal of Preventive Medicine*, *46*(3), 289–292. https://doi.org/10.1016/j.amepre.2013.11.001

Rebar, A. L., Stanton, R., Geard, D., Short, C., Duncan, M. J., & Vandelanotte, C. (2015). A meta-meta-analysis of the effect of physical activity on depression and anxiety in non-clinical adult populations. *Health Psychology Review*, *9*(3), 366–378. https://doi.org/10.1080/17437199.2015.1022901

Roetert, E. P., & Jefferies, S. (2014). Embracing physical literacy. *The Journal of Physical Education, Recreation & Dance*, *85*(8), 38–40. https://doi.org/10.1080/07303084.2014.948353

Romero-Parra, N., Solera-Alfonso, A., Bores-García, D., & Delfa de la-Morena, J. M. (2023). Sex and educational level differences in physical activity and motivations to exercise among Spanish children and adolescents. *European Journal of Pediatrics*, *182*(2), 533–542. https://doi.org/10.1007/s00431-022-04742-y

Rosselli, M., Ermini, E., Tosi, B., Boddi, M., Stefani, L., Toncelli, L., & Modesti, P. A. (2020). Gender differences in barriers to physical activity among adolescents. *Nutrition, Metabolism and Cardiovascular Diseases*, *30*(9), 1582–1589. https://doi.org/10.1016/j.numecd.2020.05.005

Smith, J. J., Beauchamp, M. R., Faulkner, G., Morgan, P. J., Kennedy, S. G., & Lubans, D. R. (2018). Intervention effects and mediators of well-being in a school-based physical activity program for adolescents: The 'resistance training for teens' cluster RCT. *Mental Health and Physical Activity*, *15*, 88–94. https://doi.org/10.1016/j.mhpa.2018.08.002

Sparkes, A. C., & Smith, B. (2009). Judging the quality of qualitative inquiry: Criteriology and relativism in action. *Psychology of Sport & Exercise*, *10*(5), 491–497. https://doi.org/10.1016/j.psychsport.2009.02.006

Szerdahelyi, L., & Couchot-Schiex, S. (2020). Mixité, égalité et pratiques en éducation physique et sportive. *Genre Éducation Formation*, *4*(4), Article 4. https://doi.org/10.4000/gef.492

Tanaka, C., Tanaka, M., & Tanaka, S. (2018). Objectively evaluated physical activity and sedentary time in primary school children by gender, grade and types of physical education lessons. *BMC Public Health*, *18*(1), 948. https://doi.org/10.1186/s12889-018-5910-y

Troiano, R. P., Berrigan, D., Dodd, K. W., Masse, L. C., Tilert, T., & McDowell, M. (2008). Physical activity in the United States measured by accelerometer. *Medicine & Science in Sports & Exercise*, *40*(1), 181–188. https://doi.org/10.1249/mss.0b013e31815a51b3

Varma, V. R., Dey, D., Leroux, A., Di, J., Urbanek, J., Xiao, L., & Zipunnikov, V. (2017). Re-evaluating the effect of age on physical activity over the lifespan. *Preventive Medicine*, *101*, 102–108. https://doi.org/10.1016/j.ypmed.2017.05.030

Vigneron, C. (2006). Las desigualdades de éxito entre chicas y chicos en EPS: ¿ determinismo biológico o fabricación escolar? *Recherches en Éducation*, *154*(154), 11–124. https://doi.org/10.4000/rfp.146

Wallace, L., Buchan, D., & Sculthorpe, N. (2020). A comparison of activity levels of girls in single-gender and mixed-gender physical education. *European Physical Education Review*, *26* (1), 231–240. https://doi.org/10.1177/1356336X19849456

Watson, A., Eliott, J., & Mehta, K. (2015). Perceived barriers and facilitators to participation in physical activity during the school lunch break for girls aged 12-13 years. *European Physical Education Review*, *21*(2), 257–271. https://doi.org/10.1177/1356336X14567545

Wetton, A. R., Radley, R., Jones, A. R., & Pearce, M. S. (2013). What are the barriers which discourage 15-16 year-old girls from participating in team sports and how can we overcome them? *Biomed Research International*, *1*, 738705. https://doi.org/10.1155/2013/738705

World Health Organization. (2021). *Who guidelines on physical activity and sedentary behaviour [French version]*. World Health Organization. https://apps.who.int/iris/handle/10665/349728

Zarrett, N., Veliz, P., & Sabo, D. (2020). Keeping girls in the game: Factors that influence sport participation. *Women's sports foundation*. Women's Sports Foundation. https://eric.ed.gov/?id=ED603915