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A comparison of activity levels of girls in single-gender and co-ed physical education

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1 **Abstract:**

2 This study examined whether single-gender or mixed-gender PE lessons were more
3 conducive to increasing the physical activity levels of girls. One hundred and twenty
4 girls (12-15 years) wore an wGT3x+ActiGraph accelerometer while participating in
5 basketball games. Time spent in low (LPA), moderate (MPA), vigorous (VPA) and
6 moderate-to-vigorous physical activity (MVPA) were compared between a single-
7 gender and mixed-gender PE lesson. Perceived effort and enjoyment of each lesson
8 were also captured using a three-point scale following the intervention. Girls were
9 found to spend significantly more time in MVPA ($p=0.01$) and VPA ($p=0.006$) in the
10 single-gender environment. Furthermore, girls spent significantly less time in LPA
11 ($p=0.014$). Although girls believed that their effort did not alter with the addition of
12 boys, they did show a preference for taking part in a single-gender environment.
13 Results of this study suggest that segregating PE classes for game-based activities
14 could lead girls to achieve greater health benefits through a higher level of activity.

15 Key Words: females, physical activity, accelerometer, MVPA, enjoyment, mixed-
16 gender sports

1 **Introduction**

2 Participation in physical activity has key benefits to children's physical and
3 mental health through weight management, improved mood and stress control
4 (Janssen and Le Blanc, 2010; Poitres et al., 2016; Strong et al., 2005). Early
5 participation in sport can influence continuation into adulthood (Haerens, Kirk and
6 Cardon, 2011; Kirk, 2005) which may address the issue of decreasing activity levels
7 with age, and associated health problems. Current statistics show that worldwide
8 people are not physically active enough to reap the health benefits (Hallal et al., 2012;
9 WHO, 2018) with 81% of adolescents (age 11-17 years) reportedly failing to meet
10 government guidelines of 60 minutes of moderate-to-vigorous physical activity
11 (MVPA) per day (WHO, 2018). Furthermore, when considering girls specifically there
12 is a marked difference in participation levels. According to World Health Organisation
13 statistics, in most countries and regions worldwide, adolescent girls participate in
14 significantly less physical activity than boys (Currie et al., 2012). Many reasons have
15 been posited for this, including the competitive climate, a belief that it is not feminine,
16 the influence of boys and lack of perceived competence in PE (Mitchell et al., 2015).
17 Regardless of the reasons, insufficient levels of physical activity are likely to lead to
18 future health problems, therefore adolescent girls have become a key target group for
19 practitioners (Okley et al., 2017).

20 Schools are an environment where physical activity can be increased through
21 unorganised playground activity (Colabianchi et al., 2009; Willenberg et al., 2010), and
22 organised physical education (PE) lessons (Wang, 2018). However, a recent
23 systematic review and meta-analysis investigating time spent in MVPA during school
24 PE lessons suggests that secondary school students only spend on average 40.5% of

1 PE lessons participating in MVPA (Hollis et al., 2017). Furthermore, studies have
2 shown girls spend significantly less time than boys in MVPA in PE lessons (Kerr et al.,
3 2018; Slingerland, Oomen and Borghouts, 2011; Smith et al., 2014). This difference
4 in effort between genders, coupled with the knowledge that for many girls PE is the
5 only time they partake in any form of physical activity (McKenzie and Lounsbery, 2009;
6 Westerstahl et al., 2005), suggests the area warrants further investigation. This may
7 allow practitioners to implement more evidence-based strategies to increase the
8 activity levels of girls in PE. Qualitative research has suggested that adolescent girls
9 often prefer single-gender classes in PE (Hills and Croston, 2012; Slingerland et al.,
10 2013; Timkin, McNamee and Coste, 2019) and further investigations have suggested
11 that the effort levels of girls are increased when there are no boys present (Liukkonen
12 et al., 2010; Lyu and Gill, 2011; Taylor et al., 2010); however these findings are limited
13 by their subjective assessment of MVPA.

14 Findings of the only previous study to use a device-based measurement of
15 effort to compare girls' heart rate (HR) response in single-gender and mixed-gender
16 basketball games found no significant differences in HR response between the two
17 environments (Slingerland et al., 2013). The authors did however find that girls'
18 perceived competence increased in the single-gender environment. This finding is of
19 significance as there is often a relationship between perceived competence and effort
20 (Knowles et al., 2009; Lyu and Gill, 2011; Taylor et al., 2010). Nonetheless, there are
21 several noteworthy limitations associated with the study design used by Slingerland
22 and colleagues that limit the interpretation of their findings. For instance, although girls
23 played in single-gender games, boys remained in the class playing on adjacent courts
24 who were able to watch them play. Moreover, all girls took part in mixed-gender games
25 in week one and single-gender games in week two; therefore any changes in activity

1 in week two because of increased competence may be as a result of their participation
2 in the activity in week one.

3 In light of these limitations, the aim of the present study was to compare MVPA levels
4 in single-gender and mixed-gender PE classes using a crossover design. A
5 subsequent aim was to examine whether the presence or absence of boys impacted
6 upon girls' perceived effort during PE, and session preference. Correspondingly our
7 hypotheses were:

- 8 1. Girls will spend more time in MVPA in a single-gender session, in comparison
9 with a mixed-gender session.
- 10 2. Girls will show a preference for single-gender PE lessons.

11

12 **Methodology**

13 Participants

14 This study took place in one secondary school in the West of Scotland. The
15 school is based in an urban area and accommodates around 1200 children aged 11-
16 18 years. This school was chosen as a result of an existing relationship between the
17 lead researcher and PE staff. Although only one school was sampled, this school has
18 five feeder primary schools, varying in rankings in the Scottish Index of Multiple
19 Deprivation (SIMD) (Scottish Government, 2016), making it reflective of the majority
20 of the local population. Stage sampling was used to select girls from S2-S4 (aged 12-
21 15 years) during core PE lessons. Participants were recruited from five classes during
22 their standard PE time. Parental consent forms and assent forms were distributed to

1 all pupils in these classes (137 in total) along with information sheets. Approval was
2 granted by the University of the West of Scotland Research Ethics Committee.

3 Procedure

4 Participants took part in two basketball sessions (one week apart) during
5 timetabled core PE lessons. At the time of the study basketball was already being
6 taught as part of the curriculum, therefore the girls were familiar with the game and
7 were able to participate fully without the need for additional preceding sessions.

8 Data Collection

9 During the two lessons the girls wore a GT3X+ ActiGraph accelerometer at the hip for
10 the duration of the class. The girls all fitted the devices themselves at the start of each
11 lesson. To ensure accuracy of recording the lead researcher undertook a detailed
12 demonstration and girls were all required to show her the positioning of their device
13 before starting to play. A collection rate of 100 Hertz was used and results were
14 downloaded in one second epochs. The low frequency extension was not applied.
15 Evenson cut-off points were used (Evenson et al., 2008) to signify periods of sedentary
16 behaviour, light physical activity (LPA), moderate physical activity (MPA) and vigorous
17 physical activity (VPA). These cut-points were chosen as these have been shown to
18 provide acceptable classification accuracy (Troost et al., 2011).

19 The basketball sessions were led by the pupils' usual PE teacher. To avoid the
20 influence of teaching style the teachers were briefed prior to the commencement of
21 the study and instructed to simply set up the games and enforce rules, but not to
22 provide any encouragement or feedback. The teachers were also given a schedule to
23 stick to exactly to standardise timings between sessions. A researcher was present

1 throughout all sessions to aid the pupils when fitting the accelerometers, and also to
2 keep timings of games to ensure continuity. All games started and finished at exactly
3 the same time. After allowing time for the pupils to change, fit the accelerometers and
4 organise playing teams, the 30-minute lesson time resulted in 20 minutes of actual
5 game time; five-minute games, separated by one-minute recovery. All data collected
6 before the first game started, after the last game ended, and during rest periods were
7 deleted prior to analysis. The researcher's watch was synced to the computer which
8 initialized the accelerometers to allow accurate removal of break time from the
9 analysis.

10 For the lessons, the participants were divided into two random groups. In the
11 first session group A took part in mixed-gender games and group B took part in single-
12 gender games. To ensure they were completely separate the games hall was
13 sectioned off with a heavy curtain, therefore no pupils were aware of what was going
14 on in the other area. In the second session the situations were reversed with group A
15 taking part in the single-gender games and group B in mixed-gender.

16 Following the intervention participants were given a questionnaire that asked
17 them to report their lesson preference on a three-point scale (single gender, mixed-
18 gender, or no preference) alongside which they were encouraged to add any
19 comments they wished to explain their reasons. Additionally, they were asked to rate
20 their perceived effort level when boys were present, again on a three-point scale (work
21 harder, work less hard, or put in the same effort), along with an opportunity to provide
22 reasons. These scales and associated comments were completely anonymous and
23 were completed independently by the participants.

24 Analysis

1 As all variables did not follow a normal distribution, a Wilcoxon Signed Rank
2 Test was used to compare differences between activity levels in the two PE lessons.
3 All analyses were conducted using IBM SPSS Statistics v.23 (IBM, Armonk, NY). For
4 all analyses, statistical significance was set at $P < 0.05$. Effect size (ES) statistics were
5 also established based on Cohen's (d) classifications: small ($0.2 \leq d < 0.5$), moderate
6 ($0.05 \leq d < 0.8$), and large ($d \geq 0.8$) ES (Cohen, 1988). For perceived effort and lesson
7 preference percentages were calculated from the three options for each completed
8 scale; indicating how many girls chose each response. Finally, content analysis
9 (Cavanagh, 1997) was utilised to code data into themes based around the study's
10 hypotheses.

11

12 **Results**

13 From the 137 pupils who were approached to participate in the study, 128
14 returned consent and assent forms, and were included in the study. Table 1 shows
15 descriptive statistics for year groups. There were eight pupils absent from school for
16 either one or both sessions; therefore these participants were removed prior to
17 analysing the data, leaving a final sample of 120 (age 14 ± 2 years).

18

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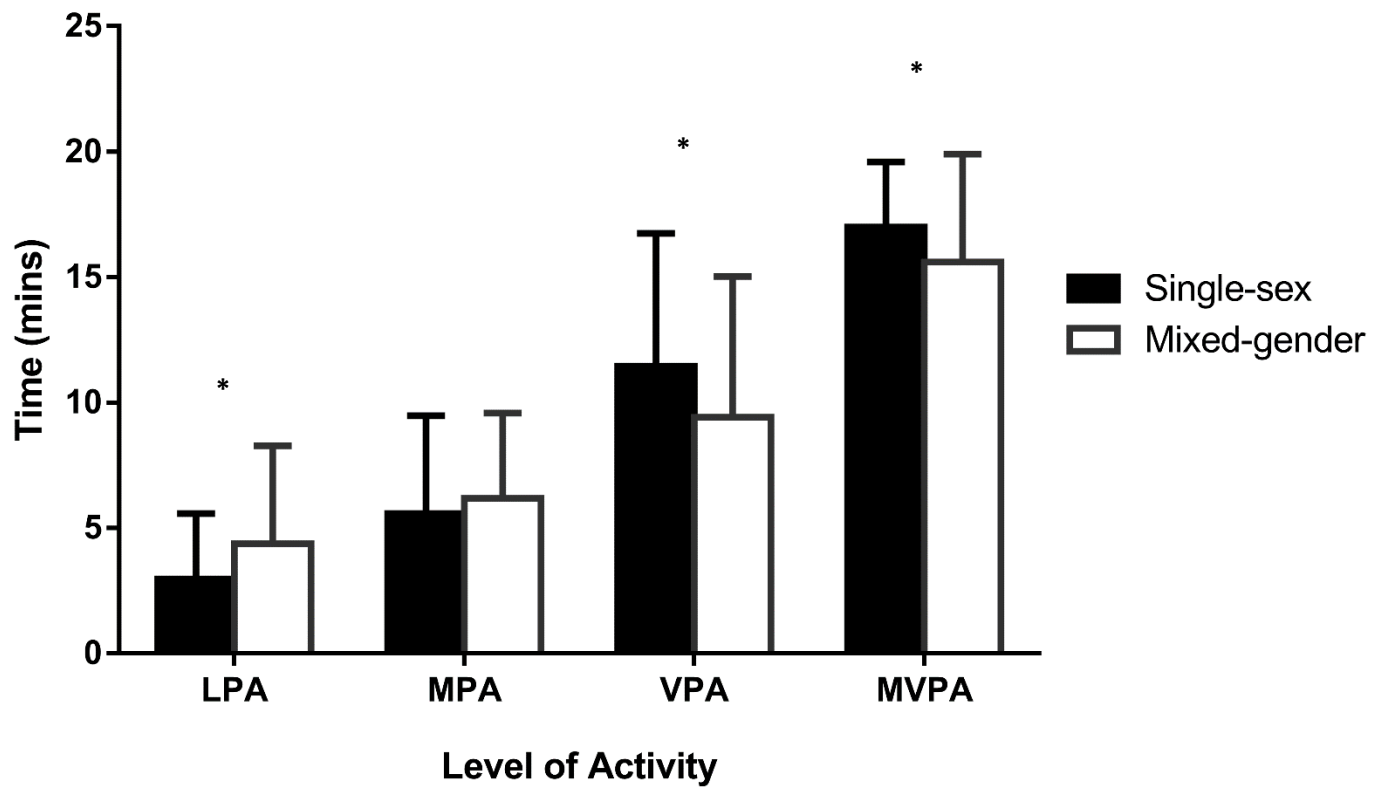
22

1 Table 1. Descriptive characteristics of girls by year group

Year group	Number of girls
S2	46
S3	49
S4	33
Total	128

2

3 Figure 1 shows the amount of time girls spent in the different activity levels
4 between the two class situations. Girls spent significantly more time in MVPA in the
5 single-gender session compared to the mixed-gender session (17.03 ± 2.64 min vs.
6 15.62 ± 4.25 min; $d = 0.40$, $P = 0.01$). The girls also spent significantly more time in
7 VPA in the single-gender session compared to the mixed-gender session (11.45 ± 5.33
8 min vs. 9.43 ± 5.63 min; $d = 0.37$, $P = 0.006$) and significantly less time in LPA (2.98
9 ± 2.62 min vs. 4.38 ± 4.37 min; $d = 0.39$ $P = 0.014$).



1

2 Figure 1. Time spent in each level of activity. LPA = low physical activity, MPA =
 3 moderate physical activity, VPA = vigorous physical activity, MVPA = moderate-
 4 vigorous physical activity. * $P < 0.05$

5

6 In terms of preference, a slight majority of girls stated that they favoured single-
 7 gender activities (n=66, 55%), with only 12 girls (10%) stating a preference for mixed-
 8 gender. The remaining 42 girls (35%) had no preference. Table 2 summarises the
 9 most common reasons in relation to this preference.

10

11

12

1 Table 2. Reasons given by participants for preference of single-gender activities

Theme	Number of girls
Embarrassment / body image	20
Boys 'taking over'/ not passing	23
Intimidation	14
Confidence	11
Perceived competence	8
Competitive climate	5
Friendships	5

2

3 In terms of perceived effort, 19 girls (16%) stated that they put in more effort
4 when boys were present. The majority believed that their effort did not change (n=71,
5 59%), however 30 (25%) of the girls said that they were likely to put in less effort when
6 boys were present; with common reasons provided in table 3. Where girls believed
7 their effort did not change their reason was generally, "why should it?" In those that
8 felt they worked harder when boys were in class they stated factors such as "more
9 competition" and "more of a challenge" as they perceived boys' ability levels to be
10 greater. This finding is worthy of note as it suggests that for some girls a single-gender
11 class may in fact hinder their activity levels.

12

13

14

1 Table 3. Reasons for decreased effort in mixed-gender activities

Theme	Number of girls
Boys taking over	12
Embarrassment	11
Intimidation	10
Perceived Competence	5
Lack of confidence	4

2

3 **Discussion**

4 The main findings of this study are that girls are significantly more active, and
5 enjoy basketball more, in a single-gender PE class.

6 Activity Levels

7 During the study girls spent significantly more time in MVPA when playing in a
8 single-gender environment. This supports the findings of a similar study by Smith,
9 Lounsbery and McKenzie (2014) in which PE lessons were observed, and activities
10 monitored and compared, between different class settings (including single-gender
11 and mixed-gender). The study by Smith, Lounsbery and McKenzie (2014) measured
12 types of activities undertaken throughout lessons by observation. The current study
13 arguably provides more objective data about activity levels through the use of
14 accelerometers. Furthermore, the current study utilised a crossover design in order
15 to limit the influence of confounding variables. As Smith and colleagues' (2014) study
16 observed completely different classes (in different schools) there is a possibility that

1 the variation in activity levels could be a result of different fitness levels and/or attitudes
2 towards PE by the different pupils. With a random crossover design, each participant
3 took part in both sessions; therefore, discrepancies in activity levels cannot be
4 attributed to individual differences.

5 Another interesting finding is that time spent in VPA was significantly increased
6 in the single-gender environment, with no significant difference in MPA between the
7 conditions. MVPA can increase with changes to either MPA or VPA, and in this case
8 it was entirely driven by increased time in VPA. As this is the domain in which most
9 health benefits occur (Janssen and Le Blanc, 2010; Schwarzfischer et al., 2017) this
10 finding should be of real significance to practitioners. Studies have shown that for
11 many adolescent girls, PE is the only time that they undertake any form of physical
12 activity (McKenzie and Lounsbery, 2009; Westerstahl et al., 2005), therefore if higher
13 activity levels can be raised within these sessions the impact upon health may be
14 substantial.

15 Findings in the current study contrast with another previous study which found
16 no significant difference in actual activity levels between single-gender and mixed-
17 gender basketball games in PE (Slingerland et al., 2013). Although device-based
18 measures of PA were used in both, the discrepancy in findings may be due to the key
19 difference in the studies' designs. For instance, In Slingerland and colleagues' (2013)
20 study, although the basketball games observed were single-gender, boys remained
21 present in the class and could observe the girls whilst participating in their session. As
22 previous studies have inferred that girls' lack of activity can be attributed to feelings of
23 embarrassment and intimidation when boys are watching them (Casey et al., 2009), it
24 is reasonable to assume that this could be the reason for the different findings evident

1 between Slingerland and colleagues to that of our own. Nonetheless, further work is
2 necessary to confirm our initial assertions. Our findings are also in contrast to those
3 reported by McKenzie et al. (2004) who found that girls actually had higher activity
4 levels in mixed-gender classes. However, like the study by Smith, Lounsbery and
5 McKenzie (2014), McKenzie et al. (2004) observed different groups of students in a
6 range of PE lessons, thus it cannot be ruled out that there were other confounding
7 variables involved in the findings such as different fitness levels, attitudes towards
8 sport, and the activity offered by the teacher, in each class. These conflicting findings,
9 however, suggest that further, more extensive, studies should be undertaken to
10 provide more conclusive evidence.

11 Perceived effort

12 When asked about perceived effort most girls stated that their effort did not alter
13 with the introduction of boys to the class. This contrasts with previous studies in which
14 girls have admitted to avoiding activity in the presence of boys (Casey et al., 2009;
15 Moe, 2006). However, when analysing the accelerometer data, it did not appear to
16 support the participants' perceptions that their effort did not alter. The use of
17 accelerometers to capture activity levels is a strength of this study and highlights the
18 disparity between perceived, and actual, intensity of activity. Moreover, with the
19 majority (59%) of girls stating that their effort did not alter between the conditions,
20 when in fact in many cases it did, this provides further evidence of the limitations of
21 using self-reporting questionnaires to measure effort. In the present study the girls
22 appeared to be unaware that their effort changed between the conditions. This
23 suggests that they did not deliberately work harder in the single-gender environment,
24 but subconsciously became more involved in the activity when boys were removed.

1 This is an important finding as previous interventions have tended to result from self-
2 reporting of activity and preference. Therefore, the results of the present study
3 suggest that girls may not actually be aware of the effect that the presence of boys
4 has on their activity levels in PE.

5 Strengths and limitations

6 There are some key strengths and limitations to this study that should be
7 acknowledged. Through using accelerometers to measure activity levels, we were
8 able to provide a more objective analysis of the intensity of activity undertaken during
9 each of the sessions. Previous studies tend to use observation tools such as SOFIT,
10 and self-reporting questionnaires, which may fail to accurately capture the effort girls
11 provide during their mixed-gender and single-gender sessions. Another strength of
12 this study is in its crossover design which limits the possibility that any differences are
13 related to the participants' individual characteristics, or increased competence in the
14 activity, since all girls took part in both parts of the study. Collecting subjective
15 feedback from the participants concerning effort is also a strength of this study which
16 provided evidence of the disparity that may be evident between perceived and actual
17 effort. In terms of limitations, firstly the study took place in one school in South
18 Ayrshire, Scotland, which limits the generalisability of our findings. Secondly, due to
19 access restrictions with the school, the study took place over a short period of time.
20 With just a single, acute change to PE delivery, it is not clear whether increased MVPA
21 would be apparent following a longer-term intervention. Thirdly, this study presents
22 findings only in relation to modified basketball games. Since PE includes a wide range
23 of activities including individual sports such as racket sports and less traditional

1 physical activities such as dance and aerobics, it is unclear whether the findings
2 reported here would be similar in these activities.

3

4 **Conclusion**

5 Overall, this study partially supports the findings of Smith, Lounsbery and
6 McKenzie (2014), suggesting that single-gender PE may be more appropriate for
7 maximising activity levels for adolescent girls within the school curriculum. Results of
8 this study show that girls spend significantly more time in MVPA and VPA in a single-
9 gender PE environment and that the majority prefer to take part in games when boys
10 are not present. Future work may wish to further investigate actual effort levels of girls
11 in single-sex and mixed-gender environments, in a range of sports and activities, in
12 order to confirm the findings reported herein.

13

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