Published in the Slovak Republic
European Journal of Physical Education and Sport
Has been issued since 2013.
ISSN: 2310-0133
E-ISSN: 2409-1952
2017, 5(1): 3-8

DOI: 10.13187/ejpe.2017.1.3
www.ejournal7.com

Articles and Statements

Team and Solo Sport: BMI, Fitness and Health Indicators in Irish Adolescents

Karl Cabena [a, *], Patricia Fitzpatrick [a]

[a] UCD School of Public Health, Physiotherapy and Sports Science Woodview House University College Dublin, Ireland

Abstract

Sports participation is indicative of body mass index (BMI), fitness and general health and wellbeing. Little is known, however, about the presence of these indicators across certain sporting groups. The aim of this research is to explore if health indicators differ across Irish adolescents, specifically those who engage in team sports versus those who carry out activities alone, those who practice both team and solo sports, or none at all.

Data were from the Children's Sport Participation and Physical Activity survey of pupils aged 15-18 years. Pupils were asked if they had taken part in a list of sports inside or outside school over the last 7 days. Pupils (n=4122) aged 15.23 ± 1.55 years were stratified into team only (Team-only) (n=303), solo only (Solo-only) (n=751), both team and solo (Both) (n=2882) and Non-participating (n=186) sporting groups. A univariate general linear model was used to determine differences across and between groups.

Males were more likely to play team only sports (66.3 %) and females more likely to play solo only sports (77.5 %). Controlling for age, gender, nationality and social class, there was no significant difference between BMI (F=0.28, p=.84), waist circumference (F=1.30, p=.28), systolic blood pressure (F=1.26, p=.28) or diastolic blood pressure (F=1.26, p=.66) across the sporting groups. Fitness was significantly higher in the team and both groups compared to the Solo and Non-participating groups (F=23.12, p<.001).

Fitness levels in Team and Both Type sports participants were higher compared to those in Solo and Non-participating groups.

Keywords: fitness, BMI, adolescence, team, solo, sport.

1. Introduction

Adolescent overweight and obesity is now an epidemic causing increased risk of stroke, cardiovascular disease and type 2 diabetes mellitus (Ng et al., 2013). As body mass index (BMI) in youth persists into adulthood, adolescence offers a critical juncture for BMI reducing interventions (Rooney et al., 2011). Fitness is internationally measured using the 20-meters shuttle test (beep test) which is predictive of VO_2 max (maximal oxygen uptake) and may be a stronger influence on longevity than BMI (Melo et al., 2011; St Claire Gibson et al., 1998). A group of 10-16 year-old

* Corresponding author
E-mail addresses: karlcabena@gmail.com (K. Cabena), patricia.fitzpatrick@ucd.ie (P. Fitzpatrick)

Portuguese youths were assessed for fitness and BMI by Martins *et al.* who reported that, regardless of BMI, participants with high fitness levels presented (via blood markers) with the lowest cardiovascular risk factors (Martins et al., 2010). Similarly, a study of 5-14 year-old Australian youths found that CV risk factors were greatest in the low fitness-high body fat percentage group with fitness attenuating, while failing to totally eliminate CV risk factors in the high fat % group (Eisenmann et al., 2007). The school setting has the capacity for delivering the majority of the required daily physical activity. That being said, studies indicate that inactivity in adolescents reaches >90 % in some countries (Harrington et al., 2014; Katralli, Goudar, 2012). School-based activity can be divided into team and solo sports. However, little is known about the BMI, fitness levels and health indicators of those who participate in one or the other, both or none at all. Pourranjbar *et al.* found team participants scored more favourably than solo sport participants in the general health questionnaires (GHQs) that assess mental health (Pourranjbar et al., 2012). Karr *et al.* assessed BMI in runners and gymnasts (solo sports) and softball teams (team sport) reporting differences in BMI across all three groups using an omnibus test (Karr et al., 2013). The purpose of this research is to determine differences in BMI, fitness levels and health indicators in adolescent participants in team and solo sports.

2. Methods

Dataset and Measures

Dataset

Data was sourced from the post-primary school data of The Children's Sport Participation and Physical Activity (CSPPA) Study and accessed via the Irish Social Science Data Archive (ISSDA), UCD Library, University College Dublin, Belfield, Dublin [11]. Cross-sectional in design, the CSPPA utilised self-report surveys, objective measures and qualitative interviews to assess physical activity (PA) and extracurricular sport in Irish youths aged 15-18 years from March-May 2009. The CSPPA data and associated copyright were developed jointly by Dublin City University (DCU), University Limerick (UL) and University College Cork (UCC), and as such is owned jointly by DCU, UL and UCC.

Measures

BMI (kg/m^2), fitness (total runs completed during the 20-meter shuttle test) (Melo et al., 2011), waist circumference (cm) and systolic and diastolic blood pressure were collected as primary outcomes. The question from CSPPA was phrased "have you taken part in (list of sports) in the last 7 days?" with a yes / no answer possible. Pupils could report participating in more than one sport. Nationality was stratified into Irish or non-Irish birth. Social class was determined in the CSPPA data set by primary household earner's occupation and stratified into 1= (professional and managerial/technical), 2= (non-manual and skilled manual) and 3= (semi-skilled manual and unskilled).

Defining Team and Solo Sports

Previous research by Pourannjbar *et al.* classified team sports as football, volleyball, basketball and running and solo sports as wrestling, karate, tennis and badminton (Pourranjbar et al., 2012). The sports listed in the CSPPA surveys were more extensive than in Pourannjbar et al., thus necessitating novel classifications for the additional sports covered in the surveys. The classification of sports into solo or team has not been widely published. As a result, the sports were allocated subjectively under solo: athletics, badminton, boxing, cue games, cycling, dance, golf/pitch and putt, gymnastics, judo, karate, skiing, squash, swimming, water sports, skating, tennis, dance (Irish and other styles), dance (recreational) and team: basketball, cricket, Gaelic football, hockey, hurling/camogie, soccer, softball, rugby, volleyball.

Validity and Reliability

In the CSPPA study a sub-group was selected (n=293, 30 % male, mean age 12.5 ± 2.1 years) to wear either pedometers or accelerometers; significant correlation ($r=0.37$, $p<0.001$) for reported and actual exercise participation (Woods et al., 2010).

Statistical Analysis

A univariate general linear model, with the four sporting groups and age set as fixed factors and gender, nationality and social class set as covariates, was used to determine any outcome differences between the groups. Dummy variables were automatically created and adjusted group differences were tested by an F test for the 4-level group variable. Forward stepwise methods were

used to determine inclusion of the four potential confounders. Statistical significance was determined at p<.05. SPSS Version 20 was used for statistical analysis.

3. Results

There were 4122 pupils included in this research. The sporting groups consisted of, Team 303 (7.4 %), Solo 751 (18.2 %), Both 2882 (69.9 %) and Non-participants 186 (4.5 %). Soccer, Gaelic Football and cycling were the most popular sports (Table 1) and, excluding hurling/camogie, they recorded the greatest fitness levels.

Table 1. Fitness of participants and popularity of sports during the last 7 days

				Fitness (# of runs)	
	Stratification	**n**	**% of answers that were yes**	**Mean**	**SD**
Soccer	Team	499	54.7	58	26
Gaelic Football	Team	317	34.1	60	26
Cycling	Solo	267	33.4	54	25
Athletics	Solo	286	33.4	53	23
Gymnastics	Solo	249	33	48	24
Basketball	Team	236	31.5	49	23
Cue games	Solo	292	31.4	55	24
Swimming	Solo	269	30.6	48	22
Dance (Recreational)	Solo	215	28.7	49	20
Dance (Irish and Ballet)	Solo	201	24.9	45	25
Hurling/Camogie	Team	133	21.3	64	28
Tennis	Team	154	18.3	50	22
Softball	Team	125	17.9	49	21
Rugby	Team	158	17.7	60	23
Golf	Solo	109	15.3	52	23
Badminton	Solo	98	11.8	47	26
Skating	Solo	105	11.6	50	25
Boxing	Solo	116	11.5	50	23
Water sport	Solo	66	7.7	46	23
Volleyball	Team	59	7.4	47	20
Hockey	Team	52	7.2	52	21
Squash	Team	85	6.2	53	22
Karate	Solo	38	4.9	49	20
Skiing	Solo	32	4.5	55	23
Cricket	Team	44	3.5	50	18
Judo	Solo	16	2.7	50	26

There was no significant difference in BMI, waist circumference, systolic and diastolic between the four sporting groups. Fitness, determined by the number of runs completed in the 20-meter shuttle test, was significantly different across the sporting groups. Pairwise comparisons indicated that fitness levels in the Team and Both groups were significantly greater than in Solo and Non-participants (Table 2).

Table 2. Differences in fitness levels across the four Sporting Groups, controlling for age and gender.

	Team	**Solo**	**Both**	**None**	**Total**
	Mean (SD)	Mean (SD)	Mean (SD)	Mean (SD)	Mean (SD)
Fitness	63.35 (25.67)	37.52 (18.35)	55.37 (25.42)	35.54 (19.20)	51.46 (25.34)
n (%)	76 (9.16)	155 (18.68)	560 (67.47)	43 (4.25)	830
Significance					**ANOVA**
Team vs	-	**p<0.001**	p=0.057	**p<0.001**	F=23.12
Solo vs	-	-	**p<0.001**	p=0.531	**p<0.001**
Both vs	-	-	-	**p<0.001**	

4. Discussion

To our knowledge, this is the first time adolescent fitness levels have been compared in teenagers across sporting types. When controlled for age, gender, nationality and social class, there was no difference in BMI, waist circumference and systolic or diastolic blood pressure between sporting groups. However, fitness levels were significantly higher in Team-only and Both sporting groups after adjustment. The results from the regression analysis were supported by the descriptive fitness means in Table 1. Although the fitness levels are not mutually exclusive, the greatest mean fitness levels were recorded in team sports.

Childhood fitness in adolescence is protective against cardiovascular disease during both adolescence and throughout adulthood (Martins et al., 2010; McIntyre, 2005). Although some suggest that participation rates, particularly among team sports players, reduce later in life, fitness levels are more resilient over the life course (Lunn, 2010, Huotari, 2011). Therefore, this research suggests that pupils participating in team sports are less likely to have indicators of cardiovascular disease now and have greater protection against symptoms in the future compared to those that play solo sports only.

Fitness levels differ across and within sports (Wenger, Bell, 1986). Elite soccer players have recorded VO_2 max of 60 ml/kg/min which differ across positions on the field (Reilly, 2000). Full backs and midfielders recorded higher fitness levels compared to centre backs and the goalkeeper (McIntyre, 2005). Soccer players are also fitter than Gaelic and hurling players (McIntyre, 2005). Both elite and non-elite badminton players have similar fitness levels to soccer players and greater levels than martial arts participants. However, there was no difference between elite and non-elite badminton players on the 20 meter shuttle test (Ooi et al., 2009). The difference observed between sports were most likely due to specific training aimed to maximise performance in that particular sport (Katralli, Goudar, 2012). However, these differences do not support the size of the fitness variance found here. In addition, duration, frequency and intensity of exercise will determine a participant's fitness levels (Wenger, Bell, 1986). These variables were not assessed in this research.

It was not possible to ascertain the contribution of each sport to the fitness levels of the sporting group as the pupils may have participated in multiple sports in the 7 days preceding data collection. However, the most popular sports (1) indicate the source of the differences. The top three sports in the Team-only group were soccer, Gaelic football and basketball. The equivalent in the Solo-only group were recreational and Irish dancing and gymnastics. In addition, the most popular team sports recorded the highest fitness levels and the most popular solo sports recorded some of the lowest. VO_2 max in boys that participated in ballet was reported at 56 ± 4 ml/kg/min which is similar to that seen in the team sports described above (Ahmaidi et al., 1992). However, these boys were competing at a tournament when testing was conducted. They therefore may have

higher skill levels, have undergone more training and be fitter than those ballet dancers that do not compete. Assessing adolescent solo sport females aged 13-16 years, Baldari and Guidetti's reported VO_2 max was significantly higher both in gymnasts (51.7 ± 4.4) and dancers (47.5 ± 3.0) compared to the control group (34.5 ± 2.5) (Baldari, Guidetti, 2001). We did not find similar differences in fitness levels between the Solo-only and Non-participating groups. VO_2 max is a primary differentiator of elite and non-elite sport players (Lorenz, 2013). The difference in Team-only and Solo-only groups may be a result of the extent to which each group's component sports tend towards elitism. While adolescents would not consider themselves elite, their training load may be akin to that of full-time athletes.

Females, in general, have lower fitness levels than males (Coast et al., 2004). In this research there was a strong gender difference across Team-only and Solo-only sporting groups, with females representing three quarters of the Solo-only group and just one third of the Team-only sporting group. In contrast, gender proportions were similar in the those participating in the Both sporting group and fitness levels of that group were similar to the those participating in the Team-only group.

Fitness levels in the Both group, while lower, were not significantly different from the Team-only group. Participation in solo sports in conjunction with team sports did not significantly lessen the effect of team only participation on fitness levels. Training frequency would be increased in the Both group, thus increasing fitness levels (Wenger, Bell, 1986).

This research is the first to investigate differences in BMI, fitness and health indices in Irish adolescents who participated in Team-only, Solo-only, Both and Non-participating sporting groups. This alone highlights the importance of the research. The sample was representative of the Irish population and was of good size. This research was able to control for possible confounders yielding accurate descriptions of the relationships between variables. The results found a large difference in fitness levels across Team-only and Both sporting groups compared to Solo-only and Non-participating groups, highlighting areas of concern for policy makers.

Schools were asked to volunteer for the study which could lead to selection bias as self-styled "healthy" schools place a high emphasis on physical activity either inside or outside the school. Similarly, each child, and each child's parents, were asked if they consented for their child to participate in the study. Parents nervous of exposing their overweight/obese children to the study may have not consented. The questionnaire was self-reported, bringing with it self-reporting biases. However, the measures used in this analysis were objective. Motion sensor analysis found that a similar amount of pupils, measured (14 %) vs. self-reported (19 %), met exercise recommendations.

Pupils were stratified into groups based on their sporting activity 7 days preceding data collection. It is possible that an elite swimmer could have been tapering or not have training in the last seven days. Additionally, this research did not assess the amount of the team or solo sports that the pupils played. It is possible that the fittest solo sports participants also play some team sports on occasion (i.e. in the last week). Nonetheless, the differential in fitness levels between team and sport participation cannot be ignored and supports the need to tailor sport programs to improve overall fitness among adolescents. However, as there is a decline in team sports participation in later life that is not seen in solo sports (Lunn, 2010), introduction of schoolchildren to both team and solo sports is important to achieve both adolescent fitness and long-term participation.

References

Ahmaidi et al., 1992 – *Ahmaidi S, Collomp K, Caillaud C, Préfaut C.* (1992). Maximal and Functional Aerobic Capacity as Assessed by Two Graduated Field Methods in Comparison to Laboratory Exercise Testing in Moderately Trained Subjects. *Int J Sports Med*. 13:243-8.

Baldari, Guidetti, 2001 – *Baldari C, Guidetti L.* (2001). VO2max, ventilatory and anaerobic thresholds in rhythmic gymnasts and young female dancers. *J Sports Med Phys Fitness*. 41(2):177-82. PMID: 11447359

Coast et al., 2004 – *Coast J. R, Blevins J. S, Wilson B.* (2004). Do Gender Differences in Running Performance Disappear With Distance? *J Appl Physiol*, 29(2): 139-45.

Eisenmann et al., 2007 – *Eisenmann J. C, Welk G. J, Ihmels M, Dollman J.* (2007). Fatness, fitness, and cardiovascular disease risk factors in children and adolescents. Med Sci Sports Exerc. 39(8):1251-6. DOI: 10.1249/MSS.0b013e318064c8b0.

Global Status Report on Noncommunicable Diseases..., 2014 – Global Status Report on Noncommunicable Diseases 2014. Geneva: World Health Organisation.

Harrington et al., 2014 – *Harrington DM, Belton S, Coppinger T, et al.* (2014). Results from Ireland's 2014 report card on physical activity in children and youth. *J Phys Act Health.* 11 (4 Suppl 1): S63-S8. DOI: 10.1123/jpah.2014-0166.

Huotari, 2011 – *Huotari P, Nupponen H, Kujala U. et al.* (2011). Adolescent physical fitness and activity as predictors of adulthood activity. *J Sports Sci.* 29(11): 1135-41. DOI: 10.1080/02640414.2011.585166

Karr et al., 2013 – *Karr TM, Davidson D, Bryant FB, et al.* (2013). Sport type and interpersonal and intrapersonal predictors of body dissatisfaction in high school female sport participants. Body Image 2013;10(2):210. DOI: 10.1016/j.bodyim.2012.11.001.

Katralli, Goudar, 2012 – *Katralli J., Goudar S. S.* (2012). Anthropometric profile and special judo fitness levels of Indian judo players. *Asian J Sports Med.* 3(2):113-8.

Lorenz, 2013 – *Lorenz D. S., Reiman M.P., Lehecka B.J., Naylor A.* (2013). What Performance Characteristics Determine Elite Versus Nonelite Athletes in the Same Sport? Sports Health. 5(6):542-7. DOI: 10.1177/1941738113479763.

Lunn, 2010 – *Lunn P.D.* (2010). The sports and exercise life-course: A survival analysis of recall data from Ireland. Soc Sci Med. 70(5):711-9. DOI: 10.1016/j.socscimed.2009.11.006.

Martins et al., 2010 – *Martins C, Silva F, Gaya AR, et al.* (2010). Cardiorespiratory fitness, fatness, and cardiovascular disease risk factors in children and adolescents from Porto. Eur J Sport Science. 10(2):121-7. DOI: DOI: 10.1080/17461390903307842

McIntyre, 2005 – *McIntyre M.C.* (2005). A comparison of the physiological profiles of elite Gaelic footballers, hurlers, and soccer players. *Br J Sports Med.* 2005. 39(7):437-9. DOI: 10.1136/bjsm.2004.013631

Melo et al., 2011 – *Melo X, Santa-Clara H, Almeida JP, et al.* (2011). Comparing several equations that predict peak VO2 using the 20-m multistage-shuttle run-test in 8–10-year-old children. *Eur J Appl Physiol.* 111(5):839-49. DOI: 10.1007/s00421-010-1708-Z.

Ng et al., 2013 – *Ng M, Fleming T, Robinson M, et al.* (2013). Global, regional, and national prevalence of overweight and obesity in children and adults during 1980-2013: a systematic analysis for the Global Burden of Disease Study. Lancet 2014; 384(9945):766-81. DOI: 10.1016/S0140-6736(14)60460-8.

Ooi et al., 2009 – *Ooi C., Tan A., Ghazali K.A., Thompson M., Sompong R., Kwong K. et al.* (2009). Physiological characteristics of elite and sub-elite badminton players. *J Sports Sci.* 27(14):1591-9. DOI: 10.1080/02640410903352907.

Pourranjbar et al., 2012 – *Pourranjbar M, Poursoltani H, Khodadadi MR, Ghorbanzadeh B.* (2012). A Comparative Study on General Health Status of Athlete and Non-athlete Students in Kerman University of Medical Sciences (Sep. 2010-June 2011). Arch App Sci Res. 4(1):623-631. (http://scholarsresearchlibrary.com/aasr-vol4-iss1/AASR-2012-4-1-623-631.pdf). Accessed October 13, 2014.

Reilly, 2000 – *Reilly T., Bangsbo J., Franks A.* (2000). Anthropometric and physiological predispositions for elite soccer. *J Sports Sci.* 18(9):669-83. DOI: 10.1080/02640410050120050.

Rooney et al., 2011 – *Rooney B. L., Mathiason M. A., Schauberger C. W.* (2011). Predictors of obesity in childhood, adolescence, and adulthood in a birth cohort. Matern Child Health J. 15(8):1166-75. DOI: 10.1007/s10995-010-0689-1.

St Claire Gibson et al., 1998 – *St Claire Gibson A, Broomhead S, Lambert MI and Hawley JA.* (1998). Prediction of maximal oxygen uptake from a 20-m shuttle run as measured directly in runners and squash players. J Sports Sciences. 16(4):331-5. 10(2):121-7. DOI: 10.1080/02640419808559361.

Wenger, Bell, 1986 – *Wenger H.A, Bell G.J.* (1986). The Interactions of Intensity, Frequency And Duration Of Exercise Training In Altering Cardiorespiratory Fitness. Sports Med 3: 346-56. DOI: 10.2165/00007256-198603050-00004

Woods et al., 2010 – *Woods C.B., Tannehill D., Quinlan A, et al.* (2010). The Children's Sport Participation and Physical Activity Survey (CSPPA). Dublin: School of Health and Human Performance, Dublin City University and The Irish Sports Council, 2010.