Participation in sport in childhood and adolescence: Implications for adult fitness

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Abstract

Objectives: To investigate whether participation in sport during the developmental stages of life are associated with cardiorespiratory fitness (CRF) in adulthood.

Design: Observational longitudinal study.

Methods: Participants were Generation 2 of the Raine Study. Questionnaires related to participation in sport were administered at ages 5, 8, 10, 14 and 17 years. These data were used to develop sex-specific trajectories of sports participation: (for males) Consistent Participators, Drop-Outs and Joiners; and (females) Consistent Participators, Non-Participators and Drop-Outs. At age 28.3±0.6 yrs, participants completed a graded maximal exercise test (i.e. $\dot{V}O_2$peak test). General liner model assessed differences in CRF between trajectories.

Results: 402 participants n=231 (57.5%) male, n=171 (42.5%) female were included in the study. In males, Consistent Participators (all $P<0.001$) and Joiners ($p<0.050$) had greater fitness than Drop-Outs. In females, Consistent Participators had greater fitness than Non-Participators ($p<0.050$), but there were no significant differences in fitness between Consistent Participators and Drop-Outs ($p>0.050$) or Non-Participators and Drop-Outs ($p>0.050$).

Conclusion: Participation in sport during childhood and adolescence is associated with greater fitness in adulthood, compared to individuals who never participate or those that cease participation in adolescence. A simple dichotomous question regarding sports participation over the childhood and adolescent period can be implemented to predict better fitness outcomes in young adulthood. Childhood and adolescence could be an opportune stage in life for parents, schools and governments to facilitate participation in sport and prevent drop out, as it may have an impact on long term risk reduction, with associated health and economic benefits.

Keywords: Sports; Child; Adolescent; Exercise Test; Public Health
Introduction

Cardiovascular diseases (CVD) are the leading causes of global mortality and was responsible for approximately 17.8 million deaths in 2017.¹ Favourable historical trends in their prevalence may soon be compromised by rapid increases in childhood risk factors, including obesity and insufficient physical activity.²,³ It is possible that increased exposure to risk factors in childhood has detrimental consequences in later life.⁴,⁵ Insufficient physical activity is a recognised CVD risk factor⁶ and also contributes to risk conferred by other factors such as hypertension, hyperlipidaemia and obesity.⁷ There is evidence that participation in youth sport has declined in both boys and girls,⁸ and this should be of concern as there is an inverse relationship between physical activity and depression in adolescence.⁹ The full impact that physical inactivity in childhood and adolescence may have on future adult health remains unknown, although a link has been demonstrated between youth sport and metabolic syndrome in later life.¹⁰

Cardiorespiratory fitness (CRF) has consistently been identified as a strong and independent predictor of all-cause and cardiovascular mortality, with lower fitness conferring higher risk.¹¹,¹² The American Heart Association recently suggested that CRF should be assessed in clinical practice, as it may be a stronger predictor of mortality risk than traditional risk factors such as hypertension and high cholesterol.¹¹ The optimal measure of CRF is maximal oxygen uptake (VO₂max), typically assessed by indirect calorimetry during a graded exercise test (GXT). Low VO₂max (<35.1 mL·kg⁻¹·min⁻¹ females, <44.2 mL·kg⁻¹·min⁻¹ males) is associated with the presence of a cluster of CVD risk factors including obesity, hypertension and unfavourable levels of blood lipids,¹³ and the relative risk of overall and CVD related death is ~3 times greater in unfit men compared to fit men.¹⁴

Childhood and adolescence represent different stages of human development and it is suggested that adolescence is a particularly pivotal time in life before maturation when lives can pivot rapidly in positive or negative directions with downstream consequences in adulthood.¹⁵ Behaviours such as participation in physical activity and in sport throughout these stages of life may be factors that could influence the individual in adulthood.¹⁶,¹⁷
A cohort study in Australia recently developed trajectories of sports participation throughout childhood and adolescence, reporting a positive relationship between sports participation and a variety of health-related variables,\textsuperscript{17} including bone mineral density in early adulthood.\textsuperscript{16} However, there is a paucity of data related to participation in sport during childhood and adolescence, and its potential impacts on CRF in adulthood. Evidence in this area may highlight the importance of participation in youth sport and determine whether it is predictive of adult health risk. The aim of this study was to investigate whether trajectories of participation in sport during childhood and adolescence\textsuperscript{16,17} were associated with CRF in adulthood.

**Methods**

Participants in this study were Generation 2 of the Raine Study, whose pregnant mothers were recruited between May 1989 and November 1991. The 2,868 babies which entered the study were subsequently invited to attend follow-up assessments throughout their childhood and adolescence. Parent-reported questionnaire data from this period was recently used to develop trajectories of sports participation.\textsuperscript{16,17} The current study utilised these established trajectories for comparison to newly acquired adult CRF data. Between March 2018 and December 2019, Raine Study participants were invited in chronological birth order (oldest – youngest) to attend our Cardiovascular Exercise Physiology laboratory at The University of Western Australia to take part in a maximal exercise test, in addition to basic anthropometry measurements (i.e. height and weight).

The data used to develop trajectories of sports participation were derived from a single-item question completed by the parents about whether their child participated in organized sport outside of school hours, with a binary yes/no response. This was administered at ages 5, 8, 10, 14 and 17 years, with a minimum of 4 out of the 5 completed assessments needed to be included in the trajectories. This resulted in data from 1,679 (49% female) participants being used in the development of the trajectories. A more comprehensive description of how these trajectories were developed is available elsewhere.\textsuperscript{16,17} In brief,
using LatentGOLD 5.0 software (Statistical Innovations, Belmont, MA, USA) a repeated-measures latent class analysis was conducted including 200 random search start sets with 100 iterations, with sports participation at ages 5, 8, 10, 14 and 17 years as indicator variables to identify the trajectories.

Cardiorespiratory fitness was assessed using a continuous, incremental protocol consisting of 3 minute stages on a motorised treadmill ergometer (Excite Med, Technogym, Cesena, Italy). No specific warm-up was performed prior to the test, as the protocol commenced with 4 walking stages with speed and gradient increasing every 3 minutes. Thereafter, the gradient was fixed at 10% and speed set to 8.0km/hr which increased by 1.0km/hr every 3 minutes until volitional exhaustion. Oxygen consumption (\(\text{VO}_2\)) was measured breath-by-breath throughout the test using indirect calorimetry and was averaged in 30sec epochs (Parvo Medics TrueOne 2400, Salt Lake City, UT, USA). Heart rate was monitored throughout using a Polar H10 monitor (PolarElectro Oy, Kempele, Finland) worn immediately inferior to the sternum by an elasticated strap. It has been suggested that a plateau in \(\text{VO}_2\) is not consistently observed during a GXT\(^{18}\) and as this plateau is the criterion for achievement of \(\text{VO}_2\max\),\(^{19}\) the term \(\text{VO}_2\text{peak}\) will be used hereafter. Attainment of \(\text{VO}_2\text{peak}\) was set as an observed plateau of heart rate despite increased work rate,\(^{18}\) with the highest 30sec \(\text{VO}_2\) value measured during the test used to determine \(\text{VO}_2\text{peak}\). The dependent variables used for analysis were \(\text{VO}_2\text{peak}\) relative to body mass (mL·kg\(^{-1}\)·min\(^{-1}\)), in absolute terms (L·min\(^{-1}\)), and physical performance in terms of time to exhaustion (TTE).

To account for any influence current physical activity / exercise habits may have had on fitness, participants completed the International Physical Activity Questionnaire (IPAQ short form) at the GXT appointment. From this 7-day recall questionnaire, an overall physical activity score was derived using recommended guidelines (METmins.wk).\(^{20}\)

Statistics were conducted using SPSS (Version 25, IBM Corp., Armonk, NY, USA). A univariate General Linear Model was used to compare age, height, weight and the dependent variables derived from the GXT between trajectories of sports participation classes (weighted for probability of membership)\(^{16,17}\) with pairwise comparisons indicating which groups differed significantly from one
another. The same General Linear Model was run again for GXT outcomes and sports trajectories, with IPAQ data included as a covariate, to account for the potential impact of current physical activity levels on fitness. Data are presented as mean ± SD, with statistical significance given at P<0.05.

This study conformed to the Declaration of Helsinki, was granted approval by The University of Western Australia Human Research Ethics Committee (approval #RA/4/20/1038) and all participants provided written, informed consent prior to participation. The funding organisation did not have any role in the collection of data, their analysis and interpretation, or the right to approve or disapprove publication of the finished manuscript.

Results
In total, 469 participants attended the laboratory to undergo a maximal exercise test. Of these, 18 participants did not reach the pre-determined criteria for VO$_2$peak, due to premature voluntary termination of the test (i.e. did not approach estimated maximum heart rate (~±10 beats.min$^{-1}$) or no plateau in heart rate). Therefore GXT data from 451 participants (n=256 male, n=195 female) were suitable for inclusion in the final analysis. Matching Trajectory of Sports Participation data were available for 402 participants (male n=231 (57.5%), female n=171 (42.5%)), which were included in the final analyses.

Sex-specific models were established for males and females which resulted in 3 trajectory groups for each sex. As, differences in sports participation patterns between males and females resulted in the trajectory groups between sexes being non-uniform (see Figure 1). The three male trajectory groups comprised: Consistent Participators (participated in sport at all follow-ups; 55.2%), Drop-Outs (participated in sport at age 5-8 year follow-ups, but discontinued participation by age 10-14 year follow-ups; 36.9%) and Joiners (did not participate in sport at age 5 years, but began participation by age 8-14 year follow-ups; 8.1%). Trajectories of sports participation for male participants also included Consistent Participators (47.5%) and Drop-Outs (ceased participation at approximately 8 –
10yrs of age; 34.3%), but included a Non-Participators group (did not participate in sport at any follow-up 18.1%), as opposed to a Joiners group in males.\textsuperscript{16,17} Details related to the pattern of sports participation across the follow-up periods can be found in Figure 1.

There were no significant differences in age, height or body mass between trajectory groups for males (Consistent Participators n=135, Drop-Outs n=81, Joiners n=15; all p>0.05) or females (Consistent Participators n=88, Drop-Outs n=52, Non-Participators n=31; p>0.05), see Table 1 and 2 respectively.

In male participants, cardiorespiratory fitness was significantly greater in the group of Consistent Participators compared to the group of Drop-Outs ($\Delta 5.0 \pm 1.3 \text{ mL} \cdot \text{kg}^{-1} \cdot \text{min}^{-1}, p<0.001$; $\Delta 0.434 \pm 0.118 \text{ L} \cdot \text{min}^{-1}, p<0.001$; TTE $\Delta 2.1 \pm 0.5 \text{ min}^{-1}, p<0.001$), see Table 1. The Joiners had similar fitness to Consistent Participators and no differences were found for any outcome measured between these groups ($\text{VO}_2\text{peak mL} \cdot \text{kg}^{-1} \cdot \text{min}^{-1} p=0.921$; $\text{VO}_2\text{peak L} \cdot \text{min}^{-1} p=0.786$; TTE min$^{-1} p=0.817$). The Joiners had superior CRF compared to the Drop-Outs, albeit only $\text{VO}_2\text{peak}$ expressed in absolute terms and time to exhaustion reached significance ($\Delta 4.7 \pm 2.6 \text{ mL} \cdot \text{kg}^{-1} \cdot \text{min}^{-1}, p=0.065$; $\Delta 0.496 \pm 0.237 \text{ L} \cdot \text{min}^{-1}, p=0.037$; TTE $\Delta 2.3 \pm 0.9 \text{ min}^{-1}, p=0.015$). When current physical activity levels were accounted for in the model, the results above were maintained: Consistent Participators vs Drop-Outs ($\text{ml} \cdot \text{kg}^{-1} \cdot \text{min}^{-1} p<0.001$, L$^{-1}$min$^{-1} p<0.001$, TTE p<0.001), Joiners vs Drop-Outs (L$^{-1}$min$^{-1} p=0.040$, TTE p=0.023) and Consistent Participators vs Joiners (all non-significant p>0.05). The relative maximum intensity of exercise (i.e. HRmax) reached during the GXT was not significantly different between trajectory groups (all p>0.05).

In female participants, cardiorespiratory fitness was significantly greater in the group of Consistent Participators compared to the Non-Participators ($\Delta 4.3 \pm 1.6 \text{ mL} \cdot \text{kg}^{-1} \cdot \text{min}^{-1}, p=0.007$; $\Delta 0.342 \pm 0.104 \text{ L} \cdot \text{min}^{-1}, p=0.001$; TTE $\Delta 1.6 \pm 0.5 \text{ min}^{-1}, p=0.002$), see Table 2. The difference in fitness between the Consistent Participators group and the Drop-Outs only reached statistical significance in relation to TTE ($\Delta 1.1 \pm 0.4 \text{ min}^{-1}, p=0.011$). All other variables were not significantly different between Consistent Participators and Drop-Outs ($\Delta 2.6 \pm 1.4 \text{ mL} \cdot \text{kg}^{-1} \cdot \text{min}^{-1}, p=0.060$; $\Delta 0.151 \pm 0.090 \text{ L} \cdot \text{min}^{-1}, p=0.095$).
There were no significant differences in CRF between the Drop-Outs and Non-Participators ($\Delta 1.7 \pm 1.8 \text{mL} \cdot \text{kg}^{-1} \cdot \text{min}^{-1}, p=0.331; \Delta 0.191 \pm 0.117 \text{L} \cdot \text{min}^{-1}, p=0.104; \text{TTE} \Delta 0.5 \pm 0.6 \text{min}^{-1}, p=0.396$). When current physical activity levels were accounted for in the model, the results above were maintained, as the only significant differences were found between: Consistent Participators vs Non-Participators ($\text{mL} \cdot \text{kg}^{-1} \cdot \text{min}^{-1} p=0.008, \text{L} \cdot \text{min}^{-1} p=0.001, \text{TTE} p=0.003$) and Consistent Participators vs Drop-Outs ($\text{TTE} p=0.012$); all other fitness variables between trajectories were not significant ($p>0.05$). The relative maximum intensity of exercise (HRmax) reached during the GXT was not significantly different between trajectory groups (all $p>0.05$).

**Discussion**

This study drew upon a unique data set derived from the offspring of a pregnancy cohort study, to address an important question regarding participation in sport during childhood and adolescence and its influence on adult fitness levels. This study showed that male and female participants who were consistently involved in sport throughout childhood and adolescence had the greatest cardiorespiratory fitness in adulthood. In males, taking up sport in adolescence is likely to result in fitness levels in adulthood that are comparable to those who consistently participated in sport from an early age. Our study provides impetus for children and adolescents to participate in sport, and also to encourage the uptake of sport during adolescence in those who did not participate in childhood; as it is likely to lead to greater adult aerobic fitness, an important indicator of overall health and an independent predictor of all-cause and CVD risk.$^{11}$

Behaviours such as physical (in)activity, diet and substance use during the developmental stages of life, particularly adolescence, will likely promote similar behaviours in adulthood and contribute to health consequences later in life.$^{15}$ Therefore, promoting positive health behaviours throughout childhood and adolescence may help safeguard adult health, and in the case of physical activity may be associated with greater fitness. There is consistent evidence from longitudinal studies involving large cohorts conducted in different populations, that higher CRF is inversely related to CVD and mortality.$^{11,21-24}$
Maximal oxygen uptake is the gold standard for fitness assessment, reflecting the systemic and integrative physiological capacity of multiple co-dependent organ systems (i.e. heart, lungs, vasculature, skeletal muscles, and blood) to transport and utilise oxygen for the provision of cellular energy. A recent study including males and females found a step-wise decrease in all-cause mortality, as fitness increased from low to elite across five fitness categories.\(^2\) The majority of studies that have reported associations between fitness and risk have measured (or estimated) CRF in older participants (e.g. >50yrs) and documented clinical end-points at follow-up;\(^25\) or repeat tested CRF over time to determine the impact of changes in fitness on subsequent risk.\(^12,26\) These studies provide insight into the impact of fitness when participants are middle-to-older age, but also relatively healthy. In contrast, there is little information regarding early-life factors that may determine fitness in adulthood. Our study brings new light to this knowledge gap, indicating that participating in sport throughout childhood and adolescence is a strong predictor of fitness at age 28 years. As fitness in mid-late adulthood is a strong predictor of risk when elderly\(^11,21\) our findings suggest the downstream health benefits that may be gained in older age as a result of engagement in sport during childhood and adolescence; and of the potential disease and/or mortality risk associated with not participating.

In our male population, a relatively small number of participants (6.5%) took up sport during adolescence (i.e. Joiners). The average fitness of males in this group was similar to those who consistently participated in sport throughout childhood and adolescence, and there were significant differences in time to exhaustion and absolute \(\dot{V}O_2\text{max}\) between Joiners and Drop-Outs. This indicates that adolescence is a critical stage in life to encourage (or maintain) sport participation, and is aligned with hypotheses regarding the pivotal downstream role adolescent behaviours may have on adult outcomes\(^15\). Interestingly, some pioneering studies that have demonstrated a link between CRF and CVD/mortality risk (e.g. Cooper Clinic Aerobics Center Longitudinal Study) have also shown that improving fitness later in life confers protective benefit, compared to maintaining persistent low fitness levels.\(^12,26\) One limitation of these studies is that not all directly measured \(\dot{V}O_2\) using calorimetry.\(^12,26\) In such studies, GXT performance was measured using a standardised exercise protocol with METs estimated from the maximum workload attained. This suggests that overall physical performance is
extremely important as it pertains to predicting risk; and that TTE data in this study provides valuable additional insight to VO₂peak measures.

The sport trajectories in our study included a Drop-Out group for males and females. Similar to our findings, others have observed a decline in sports participation rates in both sexes between 10-14 years of age. This suggests the Drop-Out group in our study is not unique to the population studied, and that adolescence is a life-stage often associated with cessation of sport participation. This may be of concern with regards to mental health, as physical activity is inversely associated with depression in adolescence; and women and adolescent girls have higher rates of depression than men and adolescent boys. However, we have previously shown in this cohort that sports trajectories were not associated with indices of mental health (Depression, Anxiety, Stress Scales DASS-21) measured at age 20yrs in females, although depression scores were highest in Drop-Outs in males. Furthermore, there were no “Joiners” in our female population (in contrast to males) instead, a group of “Non-participators” was found. This indicates that unlike boys that may take up sport in adolescence, girls are less likely to do so. Therefore, promoting participation in sport for girls may be particularly important during childhood prior to puberty; and should be maintained throughout childhood and adolescence to encourage consistent participation and avoid drop-out. In this context it should also be emphasised that, even in males, only a small percentage were Joiners. Therefore, despite the apparent differences in sports participation patterns between boys and girls, participation in sports during adolescence should be encouraged for both sexes. It has previously been observed that girls take part in less moderate-to-vigorous physical activity than boys throughout the age range of 6-17yrs; and that children and adolescents with low CRF and physical activity exhibit a range of negative health outcomes compared to their physically active counterparts. Our data suggests that participation in sports throughout youth may have long lasting benefits to fitness in adulthood, which are maintained even when current physical activity levels are accounted for statistically. Therefore, promoting sport participation in both boys and girls throughout childhood and adolescence should be an important focus for government and health researchers.
The magnitude of difference in fitness between the Consistent Participators and Drop-outs/Non-Participators (4-5 mL·kg\(^{-1}\)·min\(^{-1}\)) is within the range associated with clinical outcomes. In that, previous studies have shown that all-cause and CVD risk is reduced by approximately 10-25% for every MET difference (~3.5 mL·kg\(^{-1}\)·min\(^{-1}\)) in CRF.\(^{11,30}\) Furthermore, it may be expected that differences in fitness between trajectory groups may become more disparate as participants age. Analysis of the Raine Study participants in later years of adulthood may have the capacity to address this hypothesis. A limitation of the current study is that participants were at an age when CVD risk is relatively low, although the impact of sport on adult fitness in young adulthood is unlikely to be confounded by underlying comorbidities. Due to differences in sport participation trends between sexes, there were some discrepancies in the trajectory groups between male and female participants, and this does preclude direct comparison between all groups/sexes. However, it is a strength of this study that sex-specific trajectories were developed that will account for between-sex differences in sport participation. The relatively small sample size, particularly in the male Joiners group does represent a limitation, which may account for the lack of statistical significance in all outcomes compared to Drop-Outs. Indeed, it is unfortunate that of the 1,679 potential participants that were included in the development of sports trajectories, only 469 participants underwent the peak exercise test at age 28yrs, and we cannot guarantee that there was no impact of selection bias on our results. However, the percentage split for each trajectory group for males and females are similar to those included in the full participant pool.\(^{17}\) Another limitation pertains to the use of a binary questionnaire to assess sports participation, which does not discern the exact time-point between follow-ups when participation may have commenced or ceased, and lacks detailed information regarding the frequency, type, intensity and modality of sport participation. Whilst the childhood and adolescent years of our Raine Study participants predate the widespread use of valid physical activity tracking devices, our study does indicate that a simple dichotomous question can be implemented by paediatric health professionals over time to predict better objectively measured fitness outcomes in adulthood. This may have implications for clinicians, health branches of government, school teachers and parents regarding the promotion of sport to increase participation and prevent drop out.
Conclusion

We provide novel evidence that highlights the possible importance of participation in sport during childhood and adolescence on CRF in adulthood, which is a strong independent predictor of cardiovascular and all-cause mortality.\textsuperscript{21,30} Continued participation in sport from childhood will likely lead to greater fitness in adulthood; and by extension, better health and reduced risk and healthcare costs. Focused interventions to increase participation in sport during childhood \textit{and} prevent cessation of sports participation during adolescence should be a focus of future policy and practice.
Practical Implications

- A simple dichotomous question regarding sports participation over the childhood and adolescent period can be implemented to predict better fitness outcomes in young adulthood. This is important as aerobic fitness provides an indication of overall health and is a strong predictor of all-cause and cardiovascular mortality.

- Childhood and adolescence could be an opportune stage in life to facilitate participation in sport and efforts should be made to prevent drop-out of sport in adolescence; as this is likely to lead to improved fitness and by extension, potentially better health outcomes later in life.

- Parents, schools and governments could be involved in facilitating participation in sport throughout childhood and adolescence. This may have beneficial effects on population health and the economic healthcare costs, by virtue of inducing greater fitness in adulthood.
Acknowledgements

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Disclosures

The authors have no conflicts of interest to declare.
References


Table 1. Male Participant Descriptive Data

<table>
<thead>
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<th></th>
<th>Consistent Participants</th>
<th>Drop-Outs</th>
<th>Joiners</th>
</tr>
</thead>
<tbody>
<tr>
<td>n</td>
<td>135</td>
<td>81</td>
<td>15</td>
</tr>
<tr>
<td>(%)</td>
<td>(58.4%)</td>
<td>(35.1%)</td>
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</tr>
<tr>
<td>Mean</td>
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<td></td>
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<tr>
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<td>28.2 (0.5)</td>
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<tr>
<td>Height (cm)</td>
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<td>179.9 (7.1)</td>
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<tr>
<td>Body mass (kg)</td>
<td>83.2 (14.5)</td>
<td>85.2 (18.1)</td>
<td>83.6 (17.5)</td>
</tr>
<tr>
<td>(\dot{V}O_2) (mL.kg(^{-1}).min(^{-1}))</td>
<td>†48.8 (8.0)</td>
<td>43.8 (9.0)</td>
<td>48.6 (8.8)</td>
</tr>
<tr>
<td>(\dot{V}O_2) (L(^{-1}).min(^{-1}))</td>
<td>†3.97 (0.77)</td>
<td>3.54 (0.75)</td>
<td>†4.04 (0.91)</td>
</tr>
<tr>
<td>TTE (mins)</td>
<td>†16.5 (3.0)</td>
<td>14.5 (2.9)</td>
<td>†16.7 (3.8)</td>
</tr>
<tr>
<td>HRmax (beats.min(^{-1}))</td>
<td>188.7 (16.4)</td>
<td>189.2 (7.8)</td>
<td>191.9 (9.3)</td>
</tr>
</tbody>
</table>

General descriptive data of adult male participants and data derived from a treadmill based maximal exercise test: maximal oxygen consumption (\(\dot{V}O_2\)) presented in relative (mL.kg\(^{-1}\).min\(^{-1}\)) and absolute (L\(^{-1}\).min\(^{-1}\)) terms, time to exhaustion (TTE) and maximum heart rate (HRmax). Participants are grouped by trajectories of sports participation during childhood and adolescence. †indicates significant difference from Drop Outs \((P<0.05)\) derived from General Linear Model tests. Data are mean ± SD, N=231 overall.
<table>
<thead>
<tr>
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<th>Consistent Participators</th>
<th>Drop-Outs</th>
<th>Non-Participators</th>
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<tbody>
<tr>
<td>n=88</td>
<td>n=52</td>
<td>n=31</td>
<td></td>
</tr>
<tr>
<td>(51.5%)</td>
<td>(30.4%)</td>
<td>(18.1%)</td>
<td></td>
</tr>
<tr>
<td>Mean ± SD</td>
<td>Mean ± SD</td>
<td>Mean ± SD</td>
<td></td>
</tr>
<tr>
<td>Age (yrs)</td>
<td>28.1 ± 0.5</td>
<td>28.2 ± 0.4</td>
<td>28.2 ± 0.5</td>
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<tr>
<td>Height (cm)</td>
<td>168.7 ± 5.9</td>
<td>167.2 ± 6.9</td>
<td>166.3 ± 7.2</td>
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<tr>
<td>Body mass (kg)</td>
<td>69.7 ± 16.3</td>
<td>74.3 ± 22.3</td>
<td>70.8 ± 18.9</td>
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<tr>
<td>VO_{2} (mL.kg^{-1}.min^{-1})</td>
<td>†37.4 ± 7.5</td>
<td>34.8 ± 7.2</td>
<td>33.1 ± 6.3</td>
</tr>
<tr>
<td>VO_{2} (L^{-1}.min^{-1})</td>
<td>†2.55 ± 0.52</td>
<td>2.40 ± 0.41</td>
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<tr>
<td>TTE (mins)</td>
<td>†*13.1 ± 2.4</td>
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<td>11.5 ± 2.0</td>
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<tr>
<td>HR max (beats.min^{-1})</td>
<td>186.7 ± 7.4</td>
<td>188.5 ± 8.2</td>
<td>188.2 ± 9.6</td>
</tr>
</tbody>
</table>

General descriptive data of adult female participants and data derived from a treadmill based maximal exercise test: maximal oxygen consumption (VO_{2}) presented in relative (mL.kg^{-1}.min^{-1}) and absolute (L^{-1}.min^{-1}) terms, time to exhaustion (TTE) and maximum heart rate (HRmax). Participants are grouped by trajectories of sports participation during childhood and adolescence. †indicates significant difference from Non-Participators and *indicates significant difference from Drop Outs ($P<0.05$) derived from General Linear Model tests. Data are mean ± SD, N=171 overall.
Figure Legends

Figure 1. Sports participation trajectories of females (n=171, top panel) and males (n=231, bottom panel).