The effect of deprivation on the developmental activities of adolescent rugby union players in Wales

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Abstract

The developmental activities of rugby union players and their interaction with deprivation remain to be elucidated. Five-hundred and ninety elite junior rugby union players (14.8±0.5 years) were split into deprivation quintiles. These players subsequently completed a participant history questionnaire to record their involvement in rugby and other sports. Players accumulated 1,987±1,297 hours in rugby between 6 and 15 years of age. During the mini-rugby stage (6 to 10 years of age), players accumulated an average of 113±105, 89±69, and 43±19 hours per year in rugby play, practice and competition, respectively. Moreover, 461 players engaged in an average of 2 other sports during the mini-rugby stage. During the junior rugby stage (11-15 years of age), players accumulated 179±98, 115±90 and 64±26 hours per year in rugby practice, play and competition, respectively and 538 players took part in 3 other sports. Players who were more deprived accumulated less rugby hours and participated in fewer other sports, but age milestones were not different between deprivation quintiles. There were no differences within developmental activities in rugby between deprivation groups.

Key words: Talent development, deliberate practice, expert performance

Introduction

The activities that youth athletes engage in are one of the key variables influencing later attainment of expert performance. The level of deprivation a child or adolescent experiences may influence their ability to engage in sport and, therefore, to develop into an elite athlete.

Deprivation can create many barriers to sports participation. Those children living in deprived areas are presented with practical and knowledge barriers. Practical barriers include not being able to afford the costs associated with some sports, having little access to facilities, parents not having enough time to devote towards taking their children to sport and safety associated risks of potential crime in the area. Knowledge barriers also can affect sports participation through lack of education in the importance of physical activity and not exposing them to the health benefits. Children's participation in sport in Wales decreases with increased deprivation (Sport Wales, 2013). However, the scientific literature is equivocal, with some reports finding no effect of deprivation on participation in sport during childhood (Voss, Hosking, Metcalf, Jeffery, & Wilkin, 2008), whereas others suggest that several factors associated with deprivation lower access to sport participation (Estabrooks, Lee, & Gyurcsik, 2003; Kamphuis et al., 2008; Nezhad, Rahmati, & Nezhad, 2012; Payne, Townsend, & Foster, 2013). For example, higher levels of deprivation are associated with greater odds of adolescent pupils being physically inactive when compared to the least deprived schools in Canada (Pabayo, Janosz, Bisset, & Kawachi, 2014). In addition, high neighbourhood social fragmentation has been shown to increase the likelihood of children being inactive (Pabayo, Molnar, Cradock, & Kawachi, 2014) and, therefore, sports participation may be negatively affected. Financial income is a key factor within deprivation.

Lower income families have lower physical fitness and lower physical activity in comparison to families from a high socioeconomic status (Lammle, Worth, & Bos, 2012). In Wales, financial cost is related to lower levels of sport participation in areas of high deprivation because although private facilities are reduced in cost in high deprivation areas, public facilities remain at similar costs throughout all deprivation categories (Evans, Cummins, & Brown, 2013). In Australia, low socioeconomic position families take part in less sport compared to their higher positioned counterparts (Maher & Olds, 2011). Moreover, participation in and memberships of sports clubs were found to be positively and significantly associated with socioeconomic status (Vandendriessche et al., 2012). To date, researchers are yet to investigate deprivation and the developmental activities of elite athletes.

Three main pathways of engagement in activities exist during childhood and adolescence for youth athletes. The early specialisation pathway exists when athletes engage in high amounts of practice and competition in their primary sport during childhood, combined with relatively low amounts of play activity or other sports. Early talent identification during childhood is usually associated with this pathway (Baker, Cobley, & Fraser-Thomas, 2009). In contrast, the early diversification pathway involves engagement in play activity across a number of sports during childhood, including some participation in the primary sport. In this pathway, youth athletes are usually late or delayed in specialising solely in their primary sport, such that time spent in sport-specific practice increases in early adolescence. The early engagement pathway occurs when a child participates mainly in play activity in their primary sport, with low amounts of engagement in practice, competition and other sports.

To attain expertise in team sports such as rugby, a young player is required to acquire a wide range of skills including affective (working with others), psychomotor (skills and fitness) and cognitive skills (knowledge and understanding) (Davids, Araújo, Correia, & Vilar, 2013). Sports scientists have examined the amount and type of developmental activities engaged in by expert athletes during their development (Baker & Young, 2014; Ford, Coughlan, Hodges, & Williams, 2015). In team sports, expert athletes often start participation during childhood. For example, Australian Football League players started participation at age 8 years (Berry, Abernethy, & Côté, 2008), whereas Association Football players started at age 5 years (Ford et al., 2012). Researchers report the number of hours accumulated in the practice, competition, and play from start age to a later milestone. However, different milestone ages and time periods for accumulated hours have been used across studies, making comparisons difficult. The time period from start age to a key professional milestone, such as a becoming World Champion, are the most appropriate (Ford et al., 2015), but only three studies have used these criteria (Baker & Young, 2014). For these studies, time to expertise ranged from 3,939-4,645 hours accumulated in sport-specific activity, across 10 or more years of activity (Baker, Côté, & Abernethy, 2003; Berry et al., 2008; Ford & Williams, 2008). The developmental activities of team sport players do not appear to follow one set pathway, with variation found between sports and between individuals in sports (Ford et al., 2015). For example, the developmental activities in association football players have been shown to follow the early engagement pathway (Ford et al., 2012), whereas team sport athletes in Australia followed the early diversification pathway (Baker et al., 2003). Moreover, the youth developmental system within a sport and country affects the activities that youth athletes engage in (Ford et al., 2015). No

research has quantified the number of hours accumulated and pathway followed by elite junior rugby union players, or compared developmental activities between groups who differ in deprivation.

Given that rugby is the national sport in Wales and that there are many youth teams, it is hypothesised that the developmental activities will follow the early specialisation or engagement pathways, similar to soccer players in Europe (Ford et al., 2012). Deprivation is also hypothesised to reduce access to resources and opportunities to engage in the activities. We hypothesised that higher levels of deprivation is associated with lower engagement in organised activities such as rugby practice and competition. There are few studies in any sport that report developmental activities of junior elite athletes by deprivation group. This will be the first study to compare participation in developmental activities by elite adolescent rugby union players by level of deprivation.

Methods

Participants

Participants were 590 under-15 youth rugby union players (14.8±0.5 years) in Wales, all of whom were selected to play for one of 26 district squads taking part in the Dewar Shield a national age group competition. Each squad consisted of around 30 players who were considered to be the elite of their age group. The Dewar Shield competition is the beginning of the selection process into elite level rugby in Wales. The competition gives players opportunities to play representative rugby and is used for selection into regional rugby academies at 16 years of age. Players were selected into their respective squads by trained Rugby Union Development Officers. The institutional research ethics committee approved the study (ref number 2012.064) and all coaches and parents gave their consent and players their assent to participate.

Questionnaire

The measure of deprivation in Wales is the Welsh Index of Multiple Deprivation (WIMD). To group participants into specific levels of deprivation, mail code for their current residence were used to acquire a corresponding lower super output area (LSOA) code. These LSOA codes were then used to allocate each player a child WIMD score, which were ranked from most (1) to least deprived (1896).

Participants completed a validated Participation History Questionnaire (PHQ) (Ford et al., 2012), adapted for use with junior rugby union players to assess their history of engagement in developmental activities. The PHQ is a valid and reliable measure of participation history. Participants who completed the questionnaire on two separate occasions returned an intraclass correlation coefficient >0.85 and good 95 per cent limits of agreement. Similar findings were returned when using parental proxy report (Ford, Low, McRobert, & Williams, 2010). The PHQ consists of three sections. The first section comprises six questions on rugby union milestones. Milestones were the age at which the player began to play rugby, engage in supervised training, train regularly, play in league rugby, and partake in non-rugby training. The second section recorded hours per week and months per year spent in four types of rugby activity (match-play, coach-led practice, individual practice-self and peer-led play). Play is defined as an informal activity engaged in for enjoyment and is self-directed (Côté & Hay, 2002). Practise is defined as activity designed to improve performance and is more formal than play. Competition is organised match-play with the aim of winning (Ford & Williams, 2012). The third section recorded participation in athletics, cricket, golf, football, swimming and weight training, as these were the six most popular sports reported from a pilot study with the previous U15 cohort. Participants were required to state which sports they had played

regularly for a period of more than 3 months, not including physical education classes.

Procedure

The players were supervised whilst completing the PHQ by the lead researcher. Depending on the squad size, 8-40 players completed the PHQ at any one time. Players received a standardised verbal introduction and were then provided with instructions on how to complete the PHQ. The players completed the questionnaire in 30-60 minutes. Once each player completed their questionnaire they were checked for completeness and returned for completion if missing data were found.

Data Analysis

For analysis purposes, each player's WIMD score ranking from most (1) to least deprived (1896) were categorised into five quintiles (quintile 1 = least deprived ranging to quintile 5 = most deprived). These five quintiles were used as an independent variable throughout the analysis process to compare the effect of deprivation on engagement in sport. The activity data was divided into childhood or minis (U6-U10 age groups) and adolescent or junior rugby (U11-U15 age groups) to coincide with the Welsh Rugby Union (WRU) player development pathway. Milestone ages were provided in whole years and are reported as means. To calculate the number of hours per year in each rugby activity a value of 4.3 weeks per month was used. Hours per week were multiplied by weeks per year minus weeks missed through injury to create a total accumulated hours in each year in play, practice (individual and coach-led combined) and competition. Hours per year were summed and then divided by number of years of participation to provide the average number of hours per year for each activity for the minis and junior phases. Additionally,

hours accumulated in rugby activity were taken as a sum of each player's yearly involvement in rugby activities from U6-U15 age groups. The number of other sports was calculated for each individual in both minis and junior phases. Descriptive statistics were calculated for each of the milestones, total number of rugby hours and number of other sports participated in (see Table 1).

A Cronbach's alpha value of 0.81 was achieved suggesting acceptable internal consistency for the PHQ. Analysis of variance (ANOVA) was used to compare differences between deprivation quintiles for each of the milestones. The data were not normally distributed, however, did approach normality. ANOVA tests were still used as per previous research (Glass, Peckham & Sanders, 1972) showing that the false positive rate is not affected by violation of this assumption. Hours in rugby were analysed in 5 deprivation groups x 3 rugby activities (practice, competition, play) factorial ANOVAs for minis and junior age groups separately, with repeated measures on the last factor. Milestones and the number of other sports across deprivation groups were assessed using separate one-way ANOVA with deprivation as a repeated measure. Sphericity violations were corrected using Greenhouse-Geisser procedure. However, if the value of the Greenhouse-Geisser was greater than 0.75, then the Huynh-Feldt procedure was adopted (Girden, 1992). Post-hoc tests using Tukey HSD were used if significant differences were found between groups and the Bonferroni contrast was used for factorial measures. Partial eta squared (η_p^2) was used as a measure of effect size. The alpha level was set at $p \leq 0.05$.

Results

Milestones

The ages at which the players reached rugby-specific milestones are shown by deprivation quintile Table 1. The mean age for starting to play rugby was 7.8±2.5 years. The age at which players started to participate in supervised training was 8.2±2.3 years and training started regularly at a mean age of 8.6±2.4 years. Players took part in organised leagues from the age of 10.4±2.5 years and non-rugby training for the advancement of their rugby at 12.2±1.2 years. There were no significant differences ($p \geq 0.05$) between any of the deprivation groups for any milestone. The age at which players started playing rugby in each deprivation quintile approached significance $F_{4,545}=2.07$, $p=0.08$, $\eta_p^2=0.02$ with the largest difference between quintile 4 and quintile 1, showing that those adolescents in quintile 1 started later than those in quintile 4.

Rugby activity data

Total hours accumulated in rugby activity. Rugby players accumulated 1,987±1,297 hours in the sport between U6 and U15 years. Players (n=337) who began playing within the minis age group accumulated 2,376±1,338 hours in rugby. Players (n=175) who started playing rugby during the junior age group accumulated 1,214±769 rugby hours. There were 115 players who took part in rugby activity every year between U6 and U15 years. These 115 players accumulated 2,805±1,369 rugby hours. There were no significant differences between the deprivation groups for accumulated rugby hours, $F_{4,477}=1.27$, $p=0.28$, $\eta_p^2=0.01$ and effect sizes ranged from 0.01-0.35. No significant differences ($p \geq 0.05$) were found between deprivation quintiles for those starting in minis or junior rugby or for those who played every year from the U6 age group. There was relatively large variation between players in the number of hours accumulated in rugby by 15 years of age. At one end of the spectrum, one player started rugby at 5 years of age and had accumulated 7,585

hours in the sport by 15 years of age, but engaged in 4 other sports during childhood. At the other end of the spectrum, a player started rugby at 12 years of age and had accumulated 206 hours in the sport by 15 years of age, but engaged in 1 other sport during childhood.

Average hours per year in rugby activity across phases. Figure 1 shows the average hours in each rugby activity from U6-U15 age groups. Figures 2(a) to 2(e) contain the average hours in each rugby activity at each age group for each of the five deprivation groups: Quintile 1 (2a), quintile 2 (2b), quintile 3 (2c), quintile 4 (2d) and quintile 5 (2e). During the mini rugby stage, there was a significant main effect for activity, $F_{1.54,228}=62.60$, $p<0.05$, $\eta_p^2=0.11$. Post-hoc tests showed that the average hours per year in play activity (113±105 hours) during the mini rugby stage was greater than in practice (89±69 hours), and average hours in both these activities were greater than competition (43±19 hours). There was no main effect for deprivation, $F_{4,228}=0.63$, $p=0.64$, $\eta_p^2=0.01$, and no Deprivation x Activity group interaction, $F_{6.17,228}=1.70$, $p=0.13$, $\eta_p^2=0.01$. In the junior phase, there was a significant main effect for activity, $F_{1.87,430}=303.00$, $p<0.05$, $\eta_p^2=0.41$. Post-hoc tests show that the average hours per year in practice (179±98 hours) were greater than play (115±90 hours), and both these activities were greater than competition (64±26 hours). There was no main effect for deprivation, $F_{4,430}=0.40$, $p=0.84$, $\eta_p^2<0.01$, and no Deprivation x Activity group interaction, $F_{7.49,430}=1.20$, $p=0.31$, $\eta_p^2=0.01$.

Other sports

Table 2 shows the frequency of the other six sports engaged in during the minis and junior age groups across deprivation quintiles. Out of the 590 players, 34 did not participate in any of the six sports during minis or junior age groups. There were 461 players who engaged in an average of 2 other sports during minis rugby

phase, with 18 players not continuing to engage in any other sport during the junior age group. One or more of the six sports was engaged in by 538 players during the junior rugby phase and of those players the majority engaged in 3 other sports (2.82±1.33). Table 3 shows the number of players who engaged in each of the six sports in minis, junior or both.

During minis rugby there was a significant difference in number of sports between deprivation groups, $F_{4,545}=5.57$, $p<0.05$, $\eta_p^2=0.04$. Post-hoc tests showed that the most deprived in quintile 5 engaged in significantly fewer other sports than those in the three least deprived quintiles (1-3). The number of other sports participated in during junior rugby also revealed a significant difference between deprivation groups, $F_{4,545}=3.02$, $p<0.05$, $\eta_p^2=0.02$. Post-hoc tests show that the most deprived in quintile 5 engaged in significantly fewer of the six sports than those in quintile 1 and 3.

Discussion

This is the first study to report differences in time spent in developmental activities of elite junior rugby union players by deprivation group. As hypothesised, greater deprivation affected engagement in sport activity, with the most deprived players participating in fewer other sports compared to the least deprived elite players, albeit with a small effect size. However, there were no differences between deprivation quintiles for age milestones in rugby or hours in the developmental rugby activities. Generally, these data contradicted the school sport survey in Wales that found the more deprived children spent less time participating in sport (Sport Wales, 2013) and other researchers showing negative effects of deprivation on sport participation (Estabrooks et al., 2003; Kamphuis et al., 2008; Nezhad et al., 2012; Payne et al., 2013; Vandendriessche et al., 2012). Rugby union is the national sport

of Wales and, therefore, every community has a rugby club (314 clubs throughout Wales; WRU, 2013), indicating that rugby union is embedded across Wales and accessible to all, independent of deprivation.

Access to resources and opportunities were hypothesised to be negatively related to deprivation, along with lower engagement in organised rugby practice and competition activities. In this respect our findings were equivocal. On the one hand, the most deprived quintile played significantly fewer of the 6 sports other than rugby compared to the 3 least deprived quintiles during childhood, thus supporting findings from other studies (Jiménez Pavón et al., 2010; Nezhad et al., 2012). Moreover, the most deprived quintile played significantly fewer other sports in adolescence compared to quintile 1 and 3. The fact that the least deprived players engaged more often demonstrated that they had the resources to exploit extra opportunities to engage in sports available to them. The least deprived groups greater participation in a range of other sports is likely to be an advantage as participation may promote skill acquisition and transfer across sports that share similar movements (Baker et al., 2003) and may provide health benefits (Eime, Young, Harvey, Charity, & Payne, 2013). Deprived players accumulated fewer hours in rugby when compared descriptively to the least deprived although this was not significant. These data support previous research showing that negative neighbourhood and household factors provide less access to sport participation (Estabrooks et al., 2003; Kamphuis et al., 2008; Nezhad et al., 2012; Payne et al., 2013). This study extends these findings to an elite player sample albeit in rugby union. Conversely, no significant differences between deprivation quintiles were found for any of the rugby milestone ages or for hours in the three developmental rugby activities, a finding that supports some other literature (Voss et al, 2008). In general, differences in participation in

developmental activities of elite rugby players by deprivation in Wales were small. Rugby union is the national sport of Wales and its reach is wide. The game affords greater access for all, with a rugby club and junior programme pervading the majority of communities in Wales.

The developmental activities of the players were expected to follow one of the three pathways outlined in the previous literature, with a greater chance of following the early engagement or the early specialisation. The amount of participation in other sports throughout the mini and junior rugby playing years was relatively low indicating a possible lack of sport diversification. In the junior rugby stage, practice and competition hours increased compared to mini rugby. The number of hours spent in play remained constant from U6-U15 age groups, which deviates from what would be expected in an early engagement or diversification pathway and when compared to a decrease in play throughout adolescence in Association Football (Ford et al., 2012). Play activity during childhood was slightly lower than expected from a sport following the early engagement pathway. On the other hand, the early engagement pathway was more closely linked to the players in this study when compared to the early specialisation or diversification pathway, similar to association football (Ford et al., 2009). The later specialisation into organised rugby may be a function of the constraints of the WRU system because their rugby specialising academies do not begin until the U16 age group. There were fewer opportunities for representative rugby until U15 and, therefore, the system affords late specialisation into formal activities in the sport.

In this study, players accumulated mean 1,987 hours over 7 years in rugby. The amount of hours in rugby by the age where a professional contract may be awarded is, however, likely to reach that outlined for other team sports by adulthood

(3939-4645 hours; Baker et al., 2003; Berry et al., 2008; Ford & Williams, 2008). In the most recent year, these players accumulated 434±224 hours in rugby activities, approximately 11-14 hours per week. Players selected into regional representative teams at U16 age are likely to accumulate increasingly greater hours in practise as they move towards senior rugby. However, there was large variation between players for the number of hours accumulated in rugby by 15 years of age. Moreover, the relatively large number of players selected into U15 squads may explain the variability in engagement in developmental activities. Greater similarity in developmental activities might be expected in a sample of adult professional players when compared to a large group of adolescent players at the start of their elite development.

In summary, there were no differences between deprivation groups for developmental activities in rugby union by elite adolescent players. There were few differences in the developmental milestones and activities between elite players by deprivation quintile. However, greater deprivation did affect some developmental activities because the most deprived elite players accumulated fewer hours in rugby and engaged in fewer other sports compared to some of the least deprived elite players. A limitation to this study was that it only collected data on the six most popular other sports for rugby players, whereas the actual number of other sports might have been greater. Developmental activities in rugby were unaffected by level of deprivation in this sample of elite adolescent rugby players; further investigation into those players who achieve professional status may provide a more in depth picture of deprivation in the rugby union developmental pathway.

References

Baker, J., Cobley, S., & Fraser-Thomas, J. (2009). What do we know about early sport specialization? Not much! High Ability Studies, 20, 77-89.

Baker, J., Côté, J., & Abernethy, B. (2003). Sports-specific practice and the development of expert decision-making in team ball sports. Journal of Applied Sport Psychology, 15, 12-25.

Baker, J., & Young, B. (2014). 20 years later: Deliberate practice and development of expertise in sport. International Review of Sport and Exercise Psychology, 7, 135-157.

Berry, J., Abernethy, B., & Côté, J. (2008). The contribution of structured activity and deliberate play to the development of expert perceptual and decision-making skill. Journal of Sport and Exercise Psychology, 30(6), 685-708.

Côté, J., & Hay, J. (2002). Children's involvement in sport: A developmental perspective. In J. M. Silva & D. Stevens (Eds.), Psychological foundations of sport (pp. 484-502). Boston, MA: Allyn and Bacon.

Davids, K., Araújo, D., Correia, V., & Vilar, L. (2013). How small-sided and conditioned games enhance acquisition of movement and decision-making skills. Exercise and Sports Science Review, 41(3), 154-161. doi: 10.1097/JES.0b013e318292f3ec

Eime, R. M., Young, J. A., Harvey, J. T., Charity, M. J., & Payne, W. R. (2013). A systematic review of the psychological and social benefits of participation in sport for children and adolescents: informing development of a conceptual model of health through sport. International Journal of Behavioral Nutrition and Physical Activity, 10, 98. doi: 10.1186/1479-5868-10-98

Estabrooks, P. A., Lee, R. E., & Gyurcsik, N. C. (2003). Resources for physical activity participation: does availability and accessibility differ by

neighborhood socioeconomic status? Annals of Behavioural Medicine, 25(2), 100-104.

Evans, T., Cummins, S., & Brown, T. (2013). Neighbourhood deprivation and the cost of accessing gyms and fitness centres: national study in Wales. Health Place, 24, 16-19. doi: 10.1016/j.healthplace.2013.08.001

Ford, P. R., Carling, C., Garces, M., Marques, M., Miguel, C., Farrant, A., . . . Williams, M. (2012). The developmental activities of elite soccer players aged under-16 years from Brazil, England, France, Ghana, Mexico, Portugal and Sweden. Journal of Sports Sciences, 30(15), 1653-1663. doi: 10.1080/02640414.2012.701762

Ford, P. R., Coughlan, E. K., Hodges, N. J., & Williams, A. M. (2015). Deliberate practice in sport. In J. Baker & D. Farrow (Eds.), The Handbook of Sport Expertise. London: Routledge.

Ford, P. R., Low, J., McRobert, A. P., & Williams, A. M. (2010). Developmental activities that contribute to high or low performance by elite cricket batters when recognizing type of delivery from bowlers' advanced postural cues. Journal of Sport and Exercise Psychology, 32(5), 638-654.

Ford, P. R., Ward, P., & Hodges, N. J. (2009). The role of deliberate practice and play in career progression in sport: The early engagement hypothesis. High Ability Studies, 20, 65-75.

Ford, P. R., & Williams, A. M. (2008). The effect of participation in Gaelic football on the development of Irish professional soccer players. Journal of Sport and Exercise Psychology, 30(6), 709-722.

Ford, P. R., & Williams, A. M. (2012). The developmental activities engaged in by elite youth soccer players who progressed to professional status compared to those who did not. Psychology of Sport and Exercise, 13, 349-352.

Girden, E. R. (1992). ANOVA: Repeated measures. Stage university paper series on quantitative applications in the social sciences. Newbury Park, CA: Sage.

Glass, G. V., Peckham, P. D., & Sanders, J. R. (1972). Consequences of failure to meet assumptions underlying the fixed effects analyses of variance and covariance. American Educational Research Association, 42(3), 237-288.

Jiménez Pavón, D., Ortega, F. B., Ruiz, J. R., España Romero, V., García Artero, E., Moliner Urdiales, D., . . . Castillo, M. J. (2010). Socioeconomic status influences physical fitness in European adolescents independently of body fat and physical activity: the HELENA study. Nutrición Hospitalaria, 25(2), 311-316.

Kamphuis, C. B., Van Lenthe, F. J., Giskes, K., Huisman, M., Brug, J., & Mackenbach, J. P. (2008). Socioeconomic status, environmental and individual factors, and sports participation. Medicine and Science in Sports and Exercise, 40(1), 71-81. doi: 10.1249/mss.0b013e318158e467

Lammle, L., Worth, A., & Bos, K. (2012). Socio-demographic correlates of physical activity and physical fitness in German children and adolescents. European Journal of Public Health, 22(6), 880-884. doi: 10.1093/eurpub/ckr191

Maher, C. A., & Olds, T. S. (2011). Minutes, MET minutes, and METs: unpacking socio-economic gradients in physical activity in adolescents. J Epidemiol Community Health, 65(2), 160-165. doi: 10.1136/jech.2009.099796

Nezhad, M. A. H., Rahmati, M. M., & Nezhad, M. M. (2012). Relationship between social-economic status of family and adolescents student sport participation. Annals of Biological Research, 3(8), 4012-4016.

Pabayo, R., Janosz, M., Bisset, S., & Kawachi, I. (2014). School social fragmentation, economic deprivation and social cohesion and adolescent physical inactivity: a longitudinal study. PLoS One, 9(6), e99154. doi: 10.1371/journal.pone.0099154

Pabayo, R., Molnar, B. E., Cradock, A., & Kawachi, I. (2014). The relationship between neighborhood socioeconomic characteristics and physical inactivity among adolescents living in Boston, Massachusetts. American Journal of Public Health, 104(11), e142-149. doi: 10.2105/ajph.2014.302109

Payne, S., Townsend, N., & Foster, C. (2013). The physical activity profile of active children in England. International Journal of Behavioral Nutrition and Physical Activity, 10, 136. doi: 10.1186/1479-5868-10-136

Sport Wales. (2013). School sport survey Retrieved 4th December, 2014, from http://www.sportwales.org.uk/media/1195698/state_of_the_nation_october_2013_english.pdf

Vandendriessche, J. B., Vandorpe, B. F., Vaeyens, R., Malina, R. M., Lefevre, J., Lenoir, M., & Philippaerts, R. M. (2012). Variation in sport participation, fitness and motor coordination with socioeconomic status among Flemish children. Pediatric Exercise Science, 24(1), 113-128.

Voss, L. D., Hosking, J., Metcalf, B. S., Jeffery, A. N., & Wilkin, T. J. (2008). Children from low-income families have less access to sports facilities, but are no less physically active: cross-sectional study (EarlyBird 35). Child:

462 Care, Health and Development, 34(4), 470-474. doi: 10.1111/j.1365-
463 2214.2008.00827.x
464 Welsh Rugby Union. (2013). Rugby Development Retrieved 17 Dec 2014, from
465 http://www.wru.co.uk/eng/development/index.php

466 Table 1. Milestones in years of age achieved by the rugby players.

467 Table 2. The number of other sports engaged in and the number of players who
468 engaged in them during minis and junior rugby for each deprivation group.

469 Table 3. The type of other sports engaged in and the number of players who engaged
470 in them.

471 Figure 1. Average hours per year spent by players in the three rugby activities across
472 each age group.

473 Figure 2. Average hours per year spent in the three rugby activities across each age
474 group in (a) quintile 1, (b) quintile 2, (c) quintile 3, (d) quintile 4, (e) quintile 5.