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Abstract

Understanding sport participation and drop-out is important for sport management. Many children sample or play multiple sports and then specialise. However, quantifying these behaviors is challenging. Sport registration databases are potentially useful for this purpose. However, given privacy and data security issues, identification and direct linking of data records of individual participants across sports is not possible. This study demonstrates a feasible methodology for approximate cross-linking of de-identified data and thereby quantifying the extent of sampling behaviour, and hence investigating to what degree the decline in community club-based sport participation observed during adolescence is attributable to a "sampling to specialisation" effect as opposed to drop-out from sport altogether. Participants were registered members of one of eleven state sporting associations in 2015. For this analysis, data (907,150 player records) were amalgamated, and players were categorised by sex, age group and residential postcode. Numbers of individual players were estimated using demographic matching, comparing numbers of registrations and numbers of individual participants across age, sex and region. Results showed that the effect of participants playing multiple sports is highest for ages 5-14, and then participants tend to play fewer sports. This study confirms that the drop-off in community sport participation during adolescence is real and not simply an artefact of sampling behaviour. It is recommended that national sport policy focuses on overall participation across sports, taking into account the sampling and specialising phenomena which naturally occur during childhood and adolescence, rather than merely asking individual sports to increase participation numbers.

Key words: sport, participation, drop-out, sampling, specialising

Introduction

It is well known that participation in sport is popular among children, and that sport participation rates peak during childhood to early adolescence (Australian Sports Commission 2016, Eime, Harvey, Charity and Payne 2016, Wong, Olds et al. 2016). A recent survey of children aged 0-14 years reported sport participation peaking at ages 9-11 (Australian Sports Commission 2016), and other studies of sport participants have reported peak participation at ages 10-14 years (Eime, Harvey, Charity and Payne 2016, Wong, Olds et al. 2016). Recent research reports that nearly a third of sports participants are aged 10-14

years (Eime, Harvey, Charity, Casey et al. 2016). However many people drop out of sport during childhood and adolescence, especially females (Australian Sports Commission 2016, Eime, Harvey, Charity, Casey et al. 2016, Eime, Harvey, Charity and Payne 2016, Wong, Olds et al. 2016) . The sport participation decline is further evident throughout the lifespan, when there is evidence of a shift away from competitive club-based sport towards non-competitive and non-organised forms of leisure-time physical activity (Eime, Sawyer et al. 2015, Australian Sports Commission 2016, Eime, Harvey, Charity and Payne 2016, Harris, Nichols et al. 2017).

In a large recent longitudinal study of over 200,00 children aged 4-12 it was found that most children in a modified sports (introductory) program in the first year of the study did not continue playing that particular sport for throughout a 4-year period (Eime, Casey, Harvey, Charity et al. 2015). Furthermore, two-thirds of those children who dropped out of the sport did so after the first year; it was conjectured that many of these had only a single year or season of participation in that particular sport (Eime, Casey, Harvey, Charity et al. 2015).

Whilst there are a range of intrapersonal, interpersonal, organisational, and environmental and policy factors influencing participation in sport across the lifespan, competency is a key determinant (Crane and Temple 2015, Eime, Casey, Harvey, Sawyer et al. 2015). If people do not perceive themselves as having adequate skills to play, they do not then enjoy playing sport and drop out (Crane and Temple 2015). Sport competency is in turn related to the development of fundamental motor skills (FMS). There has been much research around the importance of FMS for participation in sport (Veldman, Palmer et al. 2017). FMS are learned skills, and children do not develop FMS naturally as part of normal growth and development. That is, they need to be taught, practiced and reinforced (Robinson and Goodway 2009, Veldman, Palmer et al. 2017). Furthermore, FMS development is cumulative and relatively permanent, and sport skills may have an effect on sport participation that persists across the lifespan (Henrique, Re et al. 2016). There is clear evidence that FMS are important for predicting continued sport participation or drop-out in

children (Henrique, Re et al. 2016). This is thought to be associated with those children with advanced FMS being more successful in sport and as a result having more enjoyment than those children with lower FMS. Having fun or enjoyment in sport is also a major predictor of drop-out of sport participation (Crane and Temple 2015, Gardner, Magee et al. 2017).

Whilst a lack of perceived competency and enjoyment may be contributing factors to the drop-out in participation sport, it has been recently acknowledged that the drop-off in late childhood to early adolescence may be partly due to children sampling multiple sports, and then specialising in one (Eime, Casey, Harvey, Charity et al. 2015). This may be further explained through the Developmental Model of Sports Participation (DMSP) (Coté and Vierimaa 2014). Whilst this model is often used to describe the elite sport performance pathway we believe also it is relevant here. Within the DMSP the first stage is the sampling stage at 6-12 years, followed by the specialisation stage at 12-15 years and the investment stage at 15+ years. At age 6-12, sampling is considered beneficial for athletic development because of the exposure to a number of different physical, cognitive, affective and psychosocial environments, reinforcing physical, personal and mental skills required for future sport elite success (Fransen, Pion et al. 2012, Coté and Vierimaa 2014). Conversely, early specialisation often leads to dropout (Fraser-Thomas, Coté et al. 2008). Children who specialise in a single sport, particularly with heavy training, risk burnout, overuse injuries and actual decrease in performance due to overtraining (Myer, Jayanthi et al. 2015). However, previous research has focused predominantly on elite athletes. We do not have knowledge about the extent of sampling and specialisation, or its effect in general community sport participants.

Australian sport policy focuses on increasing participation generally, with no specific mention of sampling and specialising behaviours (Australian Sports Commission 2015). The current policy focuses on achieving annual increases in participation numbers for individual sports, and on talent development for children and youth (Australian Sports Commission 2015). The authors contend that this strategic focus influences sports to prioritise recruitment

over retention, including the development of organised modified sports programs to very young participants, in some sports as young as four years of age (Eime, Harvey, Charity and Payne 2016). The authors have recommended a greater focus on retention strategies, specifically in relation to the sharp decreases in sport participation during adolescence (Eime, Harvey, Charity and Payne 2016).

Sports organisations in Australia tend to work individually, each through their own network of state-based organisations and local sport clubs, with an absence of multi-sport clubs which are more evident in Europe (Breuer, Hoekman et al. 2015). It is conjectured that multi-sport clubs may make the transition of participants across sports easier than with individual sport clubs. It has also been reported that in European countries with larger multi-sports clubs, the sport sector is able to be more innovative and to drive public policy programs more effectively than individual sport clubs (Harris, Mori et al. 2009).

In Australia, community sports clubs are most often run by local volunteers (Eime, Payne et al. 2009). In the Australian state of Victoria, some sports are funded by the Victorian Health Promotion Foundation to focus not just on traditional competitive sport participation, but also on the development of more social and recreational forms of sport participation, in an effort to get more people active through sport (VicHealth 2018).

It is well-known that many children sample or play multiple sports and then specialise. Sampling may involve playing a sequence of different sports or playing multiple sports in the same year. Some of the decline we see in sport during childhood and adolescence may be due to a decline in the number of sports played in a particular year and not necessarily a true drop-out from sport participation (Eime, Casey, Harvey, Charity et al. 2015, Eime, Harvey, Charity, Casey et al. 2016). However, quantifying these behaviors is a challenging task. Population-wide sample surveys can provide direct evidence of the participation patterns of individuals, but sample sizes are determined from a national perspective, and so the capacity to produce estimates with acceptable levels of sampling error for smaller geographical areas or population segments is limited. Also, historically the scope of such

surveys in Australia has generally been limited to persons 15+ years of age (Eime, Sawyer et al. 2015). Furthermore, non-response and refusal rates are high, and recent research has suggested that, in addition to sampling error, estimates of participation counts and rates from such surveys are subject to substantial non-response bias (Harvey, Charity et al. 2018). Sport registration data are prima facie much less susceptible to bias, and as they purport to be complete enumerations of participants in each sport, are not subject to sampling error (Harvey, Charity et al. 2018). When registration data from multiple sports are amalgamated, the aggregated counts are inflated by individuals playing multiple sports in the same year.

Ideally, to quantify this phenomenon would require the capacity to identify individual participants across multiple sports. However, particularly given current awareness of privacy and data security issues, identification and direct linking of data records of individual participants across sports is not possible. The aim of this study was to demonstrate a feasible methodology, based on demographic characteristics, for approximate cross-linking of de-identified data and thereby to use sport registration data to quantify, for each age level, the extent of participation in multiple sports in a given year, and hence to investigate to what degree the decline observed in the per capita rate of aggregated registrations in community club-based sport during later childhood and adolescence is attributable to a reduction in the extent of participation in multiple sports, i.e. a "sampling to specialisation" effect.

Methods

Data for this study were collected as part of the Sport and Recreation Spatial project, a research project funded by government and public health agencies in the Australian state of Victoria to monitor participation in sport and active recreation, for the purpose of informing policy development and program planning in the sport and recreation sector. The data have

been previously described in detail (Eime, Harvey, Charity, Casey et al. 2016, Eime, Harvey, Charity and Payne 2016). Briefly, participants were registered participants in one of eleven state sporting associations (Australian football, basketball, bowls, cricket, football (soccer), golf, gymnastics, hockey, netball, sailing and tennis) in Victoria in 2015.

For this analysis, data for the eleven sports were amalgamated, and registered Victorian players aged 4-100 in 2015 were categorised by sex, age group and residential postcode. Individuals may play more than one sport, and therefore it is possible a player could be registered with more than one sport in any given year. Actual numbers of registrations and estimated numbers of individual players were calculated, to allow comparison of these two indicators across age, sex and region.

The number of registrations in each year were direct counts of the total of all registrations for the 11 sports. As the registrations for each sport were de-identified, it was not possible to directly link all data records for a particularly individual. An approximate count of individuals was generated by assuming that two registrations for different sports that were matched on year, sex, date of birth and residential postcode were the same person. Hence, by excluding all but the first occurrence of a particular combination of these four characteristics, estimated counts of individual players were obtained. This was done for each sport separately to provide an indication of 'multiples' per sport, and then for the sample as a whole.

A second player count estimate was also generated by assuming that multiple matching registrations within a sport genuinely represented different individuals (i.e. same-sex twins or children fortuitously matched on demographic characteristics). The 'Multiple' combinations of DOB, postcode and sex within each sport were retained, up to a maximum of five occurrences per sport (arbitrarily chosen in order to exclude blocks of spurious matches due to data quality issues). For example, two players in Sport A and four players in Sport C all with the same details would result in a registration count of six, and individual

counts of one under the first option (referred to as Players 1) and four under the second option (Players 2). The Players 1 count is always less than or equal to the Players 2 count, which in turn is always less than or equal to the registration count.

Results

There were a total of 907,150 registrations, 757,564 unique individuals assuming "valid" multiple individuals within sports as described (Players 2) and 714,054 unique individuals assuming no valid multiple individuals (Players 1). Aggregated across all years and sports, the Players 2 count was 16.5% lower, and the Player 1 count was 21.3% lower, than the count of registrations. These are indicative of the proportion of sports participants who played multiple sports in 2015.

Figure 1a presents the number of registrations and estimated numbers of individual players (under the two exclusion rules) across the lifespan, and Figure 1b shows the corresponding participation rates per the Victorian population in standard age cohorts. The pattern within both figures is the same. The key result is that the excess of registrations over individual players declines with increasing age. That is, the effect of participants playing multiple sports is highest for ages 5-14, and then we see a clear specialisation effect where sports participants play one or fewer sports as they age through 15-29. From age 30 the player and registration rates are almost identical, indicating that these older sports participants are mostly playing one of the sports only.

Insert Figure 1 and Table 1 about here

Figure 2a and 2b present the participation rates for metropolitan and non-metropolitan region. Whilst the participation rate across the lifespan is generally higher in the non-metropolitan region compared to the metropolitan region, the proportional difference between registrations and actual players is very similar.

Insert Figure 2 and Table 2 about here

Figure 3a and 3b present the participation rates for males and females. The overall participation rate is much higher for males than females, and peaking at a registration rate of 81% for males aged 5-9 years and for females of 52% for ages 10-14 years. This corresponds to an actual player participation rate of 51% for males aged 5-14 and 51-52% for females aged 5-14 years. Therefore, whilst the actual player participation rate is very similar for these children for both males and females, males are much more likely than females to play multiple sports during childhood and early adolescence. That is, the sampling effect is much greater for males than for females.

Insert Figure 3 and Table 3 about here

Discussion

The existence of the sampling effect, whereby many younger sport participants play multiple sports in the same year, has often been reported (Fraser-Thomas, Coté et al. 2008, Delorme, Chalabaev et al. 2011), but this is the first study to explore how this actually relates to player numbers and participation rates. This study is unique in quantifying the extent to which younger sports participants sample multiple sports in a single year, identifying the age range over which this behaviour diminishes with increasing age, and demonstrating differences between these patterns for males and females and between metropolitan and non-metropolitan sport participants. Furthermore, the majority of research on sampling and drop-out has been on elite or sub -elite athletes (Fraser-Thomas, Coté et al. 2008, Delorme, Chalabaev et al. 2011, Bridge and Toms 2013), whereas this study examined a population of community-based players.

We have previously speculated that the considerable drop-off in registrations during adolescence, from 15-19 years, could conceivably be due to the sampling effect, and not truly indicative of dropping out of sport altogether (Eime, Harvey and Charity 2016, Eime, Harvey, Charity and Payne 2016). We conjectured that the considerable decline during

adolescence might be attributable to children playing multiple sports when younger, and thereby being counted multiply in aggregated multi-sport participation data, and then during adolescence choosing one sport to specialise in (Eime, Harvey and Charity 2016). The results of the present study show that while sampling does amplify the magnitude of the reduction in total registrations throughout the adolescent and early adult years, it explains only about 25% of the drop-off in the overall registration rate, 40% of the drop-off among males, 20% of the drop-off among females, and 25% for each of metropolitan and non-metropolitan residents.

When examining the estimated player numbers and participation rates only, and not the registrations, it is clear that there is a significant decline in sport participation from age 15-19. Player participation rates peak at 45-46% ages 5-14 before a drop to only 23% from 15-19 years. The participation rate halves from the 10-14 age group (46%) to 23% (15-19%) and then halves again for 20-24 year-olds (12%).

This current study highlights that the drop-off in sport participation during adolescence and into early adulthood is real, and is not simply the effect of sampling. Sampling itself confers a range of benefits, contributing to a range of diverse skills and to improved fitness and motor coordination (Fransen, Pion et al. 2012, Myer, Jayanthi et al. 2015). Fransen et al. showed that for boys, those participating in more than one sport were exposed to a greater number of physical, cognitive, affective, and psycho-social environments than boys playing a single sport only (Fransen, Pion et al. 2012), and concluded that it is important to be sampling and playing multiple sports before the age of 12 rather than early specialisation (Fransen, Pion et al. 2012). There is evidence that a higher degree of sampling for ages 11-15 is significantly associated with increased performance, that is, competing at a national compared to community club level (Bridge and Toms 2013 4724). We know that participation in sport during childhood and adolescence has a lasting positive effect on physical activity (Murphy, Rowe et al. 2016). Furthermore, sports participants are often more active and fitter than participants in non-sport physical activity; however these

associated benefits of sport participation can diminish during adolescence and especially for girls (Telford, Telford et al. 2015). Therefore strategies are needed to keep children and adolescents engaged in sport for health benefits, not only physical but also psychological and social health (Eime, Young et al. 2013).

The sampling and participation rate patterns were broadly similar for both the metropolitan and non-metropolitan regions, and this is consistent with other research (Eime, Harvey, Charity and Payne 2016, Hoekman, Breedveld et al. 2017), however the decline is not as pronounced for the non-metropolitan regions. A higher proportion of people living in non-metropolitan regions remain active through sport during adolescence. This may relate to the culture of community sport in rural and regional communities (Eime, Charity et al. 2015). Further, as adolescents age and become more autonomous in their decisions regarding physical activity there are also more opportunities to participate in a wider range of leisure activities in metropolitan compared to non-metropolitan regions (Craike, Symons et al. 2011).

A concerning pattern is the more severe decline during adolescence for females compared to males. The participation rate for females for ages 15-19 is less than half of that for those aged 1-14 years. It is also very clear from the registration numbers that young males sample or play more sports than females. Firstly, there is evidence of a competency difference between young females compared to males, and we know that competency is a major factor relating to participation in sport (Veldman, Palmer et al. 2017). There is evidence that young girls are less competent at ball skills than young boys (Veldman, Palmer et al. 2017). Further, other research amongst 6-12 year olds reports that playing multiple sports and spending more time playing sport contributes to improved gross motor coordination (Fransen, Pion et al. 2012). Quite simply, by sampling multiple sports children are exposed to a greater number of physical, cognitive, affect and psycho-social environments than those playing only one sport (Fransen, Pion et al. 2012). Secondly these gender differences may also be related to increased opportunities for boys to play multiple sports, relative to girls,

and to parents encouraging boys to play sport more than girls (Wheeler 2012, Eime, Harvey, Charity, Casey et al. 2016). Further to this, in the case of this study higher participation for males compared to females also relates to the traditional gender bias of Australian club-based sport, whereby for several sports, until very recently, females were not able to play in club-based competitions (Eime, Harvey, Charity and Payne 2016).

The main correlates of youth sport attrition include competency and social factors such as enjoyment, support from parents, peers and coaches and a positive social club environment (Eime, Harvey et al. 2013, Balish, McLaren et al. 2014, Henrique, Re et al. 2016, Casey, Eime et al. 2017, Gardner, Magee et al. 2017). Higher sport competency in young childhood is associated with continued sport participation across childhood (Henrique, Re et al. 2016). Competency is a cumulative and relatively permanent phenomenon, which is in contrast to physical activity in general (Henrique, Re et al. 2016). Children exposed to more sports earlier in their life tend to have greater competency and therefore are more likely to continue to participate. Further to this, there is evidence that players who drop out participated in fewer sports than those that continue playing (Fraser-Thomas, Coté et al. 2008).

There is much research evidence that sampling is positive for skill development in children and young people, and for continued sport participation. In Australian sport policy there is no specific mention of sport sampling, with the focus being the broader aim of getting more Australians and particular young Australians participating in sport more often, and in general trying to gain insights into participation trends. (Australian Sports Commission 2015). There is mention of the benefits of sampling for elite athlete development (Australian Sports Commission not dated), but nothing related to the general population. A major focus of the national sport policy is for each sport organisations is to increase participant numbers each year. With this "individual silos" focus, the issue of sampling versus specialisation in children and adolescents, and the implications for overall levels of participation, are not considered.

Beyond the quantification of sampling and specialisation demonstrated in this study, there remain important questions. Whilst we have many insights relating to sampling among elite and sub-elite youth, we do not have evidence from community club-based sport as to whether sampling leads to a greater likelihood of playing sport throughout life. Are the people that maintain participation in sport, albeit only a low proportion, those who have played and sampled many sports in childhood? Is the drop-off in sport participation primarily attributable to 'late sports starters' who have less sport competency than early sport adopters? Beside the modified sports programs for young participants, what are the entry points to competitive sport throughout the lifespan for individuals who do not have specific sports competency? These questions await further research.

Conclusion

In conclusion, this study confirms that the drop-off during adolescence in community sport participation, as measured by aggregated sport registrations, is real and not simply a consequence of a reduction in sampling behaviour compared to younger participants. It is concerning that, from a peak at ages 10-14, the participation rate halves for the next age group of 15-19 years. Considering the magnitude of this drop-off, sport policy should specifically prioritise retention in sport, and not merely focus on increasing total sport numbers. This requires a longitudinal rather than cross-sectional approach to the monitoring of participation. A policy relating to retention is needed to provide sporting organisations with the lever to make this a priority for their sport-specific strategies.

It is also recommended that national sport policy should focus on overall participation across sports, taking into account the sampling and specialising phenomena which naturally occur during childhood and adolescence, rather than merely asking individual sports to increase participation numbers. From a health perspective, as long as people are regularly physically active, it does not matter if they initially play multiple sports and then subsequently specialise. However, from a policy and planning perspective it is important to know what proportion of the apparent drop-off in late childhood and adolescence, both in individual

sports and in data aggregated across sports, is due to increased specialisation, and what proportion is due to drop-out from sport altogether. In the absence of a common unique participant identifier across sports, this study has demonstrated a feasible methodology, based on demographic characteristics, for approximate cross-linking of de-identified sport registration data and thereby providing a solution to this important gap in the knowledge informing policy development.

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Disclosure statement

The authors have no conflicts of interest

Ethics approval and consent to participate

Ethics approval was granted by the Federation University, Australia Human Ethics Committee. Project number: C13-007.

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References

Australian Sports Commission (2015). Play. Sport. Australia. The Australian Sports Commission's participation game plan. Canberra, Australia, Australian Sports Commission**:** 26.

Australian Sports Commission (2016). AusPlay participation data for the sport sector. Summary of key national findings. Canberra, Australian Sports Commission.

Australian Sports Commission. (not dated). "TThe importance of sport sampling before specialising." Retrieved 30th July, 2018, from https://www.ausport.gov.au/supporting/tips/tip_5.

Balish, S., C. McLaren, D. Rainham and C. Blanchard (2014). "Correlates of youth sport attrition: A review and future directions." Psychology of Sport and Exercise **15**: 429-439.

Breuer, C., R. Hoekman, S. Nagel and H. van der Werff, Eds. (2015). Sport clubs in Europe. A cross-national comparative perspective. Sports economics, management and policy. London, Springer.

Bridge, M. and M. Toms (2013). "The specialising or samping debate: a retrospective analysis of adolescent sports participation in the UK." Journal of Sports Science **31**(1): 87-96.

Casey, M., R. Eime, J. Harvey, N. Sawyer, M. Craike, C. Symons and W. Payne (2017). "The influence of a Healthy Welcoming Environment on participation in club sport by adolescent girls: a longitudinal study." BMC Sports Science, Medicine and Rehabilitation **9**(12).

Coté, J. and M. Vierimaa (2014). "The developmental model of sport particiation: 15 years after its first conceptualization." Review of Science and Sports **29 Supplement**: S63-69.

Craike, M., C. Symons, R. Eime, W. Payne and J. Harvey (2011). "A comparative study of factors influencing participation in sport and physical activity for metropolitan and rural female adolescents." Annals of Leisure Research **14**(4): 355-368.

Crane, J. and V. Temple (2015). "A systematic review of dropout from organized sport among children and youth." European Physical Education Review **21**(1): 114-131.

Delorme, N., A. Chalabaev and M. Raspaud (2011). "Relative age is associated with sport dropout: evidence from youth categories of French basketball." Scandinavian Journal of Medicine & Science in Sports **21**(1): 120-128.

Eime, R., J. Harvey and M. Charity (2016). Sport participation in Victoria, 2015. Melbourne, VicHealth.

Eime, R., J. Harvey, M. Charity, M. Casey, H. Westerbeek and W. Payne (2016). "Age profiles of sport participants." BMC Sports Science, Medicine and Rehabilitation **8**(6).

Eime, R., J. Harvey, M. Charity and W. Payne (2016). "Population levels of sport participation: implications for sport policy." BMC Public Health **16**(1): 1-8.

Eime, R., W. Payne and J. Harvey (2009). "Trends in organised sport membership: Impact on sustainability." Journal of Science and Medicine in Sport **12**(1): 123-129.

Eime, R., N. Sawyer, J. Harvey, M. Casey, H. Westerbeek and W. Payne (2015). "Integrating Public Health and Sport Management: Sport participation trends 2001-2010." Sport Management Review **18**(2): 207-217.

Eime, R., J. Young, J. Harvey, M. Charity and W. Payne (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 & Physical Activity **10**(98).

Eime, R. M., M. M. Casey, J. T. Harvey, M. J. Charity, J. A. Young and W. R. Payne (2015). "Participation in modified sports programs: a longitudinal study of children's transition to club sport competition." BMC Public Health **15**(649): 7.

Eime, R. M., M. M. Casey, J. T. Harvey, N. A. Sawyer, C. M. Symons and W. R. Payne (2015). "Socioecological factors potentially associated with participation in physical activity and sport: A longitudinal study of adolescent girls." Journal of Science and Medicine in Sport **18**(6): 684-690.

Eime, R. M., M. J. Charity, J. T. Harvey and W. R. Payne (2015). "Participation in sport and physical activity: associations with socio-economic status and geographical remoteness." BMC public health **15**(434).

Eime, R. M., J. T. Harvey, M. J. Craike, C. M. Symons and W. R. Payne (2013). "Family support and ease of access link socio-economic status and sports club membership in adolescent girls: a mediation study." Int J Behav Nutr Phys Act **10**(50).

Fransen, J., J. Pion, J. Vandendriessche, B. Vandorpe, R. Vaeyens, M. Lenoir and R. Philippaerts (2012). "Differences in physical fitness and gross motor coordination in boys aged 6-12 years specializing in one versus sampling more than one sport." Journal of Sport Sciences **30**(4): 379-386.

Fraser-Thomas, J., J. Coté and J. Deakin (2008). "Examining adolescent sport dropout and prolonged engagement from a developmental perspective." Journal of applied sport psychology **20**(3): 318-333.

Gardner, L., C. Magee and S. Vella (2017). "Enjoyment and behavioral intention predict organized youth sport participation." Journal of Physical Activity and Health **Ahead of Print**.

Harris, S., K. Mori and M. Collins (2009). "Great Expectations: Voluntary Sports Clubs and Their Role in Delivering National Policy for English Sport." VOLUNTAS: International Journal of Voluntary and Nonprofit Organizations **20**(4): 405.

Harris, S., G. Nichols and M. Taylor (2017). "Bowling even more along: trends towards individual participation in sport." European Sport Management Quarterly **17**(3): 290-311.

Harvey, J. T., M. J. Charity, N. A. Sawyer and R. M. Eime (2018). "Non-response bias in estimates of prevalence of club-based sport participation from an Australian national physical activity, recreation and sport survey." BMC Public Health **18**(1): 895.

Henrique, R., A. Re, D. Stodden, J. Fransen, C. Campos, D. Querioz and M. Cattuzzo (2016). "Association between sports participation, motor competence and weight status: A longitudinal study." Journal of Science and Medicine in Sport **9**(10): 825-829.

Hoekman, R., K. Breedveld and G. Kraaykamp (2017). "Sport participation and the social and physical environment: explaining differences between urban and rural areas in the Netherlands." Leisure Studies **36**(3): 357-370.

Murphy, M., D. Rowe and C. Woods (2016). "Sports participation in youth as a predictor of physical activity: A 5-year longitudinal study." Journal of Physical Activity and Health **13**: 704-711.

Myer, G. D., N. Jayanthi, J. P. Difiori, A. D. Faigenbaum, A. W. Kiefer, D. Logerstedt and L. J. Micheli (2015). "Sport Specialization, Part I Does Early Sports Specialization Increase Negative Outcomes and Reduce the Opportunity for Success in Young Athletes?" Sports Health **7**(5): 437-442.

Robinson, L. and J. Goodway (2009). "Instructional climates in preschool children who are at-risk. Part 1: object-control skill development." Research Quarterly for Exercise and Sport **80**(3): 533-542.

Telford, R. M., R. D. Telford, T. Cochrane, R. B. Cunningham, L. S. Olive and R. Davey (2015). "The influence of sport club participation on physical activity, fitness and body fat during childhood and adolescence: the LOOK Longitudinal Study." Journal of Science and Medicine in Sport **19**(5): 400-406.

Veldman, S., K. Palmer, A. Okely and L. Robinson (2017). "Promoting ball skills in preschool-age girls." Journal of Science and Medicine in Sport **20**(1): 50-54.

VicHealth. (2018). "Physical activity strategy 2018-2023." Retrieved March 9th, 2018, from file:///C:/Users/reime/Downloads/VicHealth%20Physical%20Activity%20Strategy%20(2).pdf.

Wheeler, S. (2012). "The significance of family culture for sports participation." International Review for the Sociology of Sport **47**(2): 235-252.

Wong, H., T. Olds, R. Maddison and L. Foley (2016). "A great sporting nation? Sport participation in New Zealand youth." The New Zealand Medical Student Journal **23**: 18-23.

Table 1: Age-specific player numbers by player count estimate

		Age range															
Counts of:	**Region**	**4**	**5-9**	**10-14**	**15-19**	**20-24**	**25-29**	**30-34**	**35-39**	**40-44**	**45-49**	**50-54**	**55-59**	**60-64**	**65-69**	**70+**	**Total**
Registrations	Victoria	24,303	243,264	222,265	103,026	60,982	43,807	32,526	25,112	25,575	21,834	18,894	16,631	17,169	18,883	32,879	907,150
Players 2	Victoria	20,396	182,393	169,974	88,464	54,725	40,583	30,402	23,844	24,380	20,866	18,218	16,139	16,693	18,373	32,114	757,564
Players 1	Victoria	18,905	165,022	155,845	83,807	52,874	39,535	29,790	23,432	23,966	20,536	17,978	15,942	16,498	18,132	31,792	714,054

Table 2: Age-specific player numbers by player count estimate and region

		Age range															
Counts of:	**Region**	**4**	**5-9**	**10-14**	**15-19**	**20-24**	**25-29**	**30-34**	**35-39**	**40-44**	**45-49**	**50-54**	**55-59**	**60-64**	**65-69**	**70+**	**Total**
Registrations	Metropolitan	17,757	166,930	153,977	68,667	41,685	30,251	22,395	16,853	17,828	15,688	13,494	11,439	11,104	11,780	19,271	619,119
Players 2	Metropolitan	14,893	125,487	117,788	59,542	37,651	28,371	21,075	16,158	17,073	15,006	13,000	11,078	10,783	11,441	18,762	518,108
Players 1	Metropolitan	13,791	113,546	107,738	56,042	36,183	27,532	20,588	15,858	16,758	14,751	12,806	10,943	10,663	11,285	18,567	487,051
Registrations	Non-metropolitan	6,546	76,334	68,288	34,359	19,297	13,556	10,131	8,259	7,747	6,146	5,400	5,192	6,065	7,103	13,608	288,031
Players 2	Non-metropolitan	5,503	56,906	52,186	28,922	17,074	12,212	9,327	7,686	7,307	5,860	5,218	5,061	5,910	6,932	13,352	239,456
Players 1	Non-metropolitan	5,114	51,476	48,107	27,765	16,691	12,003	9,202	7,574	7,208	5,785	5,172	4,999	5,835	6,847	13,225	227,003

Table 3: Age-specific player numbers by player count estimate and sex

		Age range															
Counts of:	**Sex**	**4**	**5-9**	**10-14**	**15-19**	**20-24**	**25-29**	**30-34**	**35-39**	**40-44**	**45-49**	**50-54**	**55-59**	**60-64**	**65-69**	**70+**	**Total**
Registrations	Male	15,837	152,170	136,768	67,657	44,053	32,388	24,011	17,571	17,611	15,401	13,553	11,913	11,904	12,998	22,678	596,513
Players 2	Male	12,699	107,872	98,722	56,403	38,714	29,669	22,249	16,601	16,696	14,631	13,014	11,526	11,561	12,606	22,088	485,051
Players 1	Male	11,757	96,567	89,822	53,179	37,281	28,882	21,786	16,325	16,421	14,416	12,826	11,380	11,419	12,428	21,848	456,337
Registrations	Female	8,466	91,094	85,497	35,369	16,929	11,419	8,515	7,541	7,964	6,433	5,341	4,718	5,265	5,885	10,201	310,637
Players 2	Female	7,697	74,521	71,252	32,061	16,011	10,914	8,153	7,243	7,684	6,235	5,204	4,613	5,132	5,767	10,026	272,513
Players 1	Female	7,148	68,455	66,023	30,628	15,593	10,653	8,004	7,107	7,545	6,120	5,152	4,562	5,079	5,704	9,944	257,717

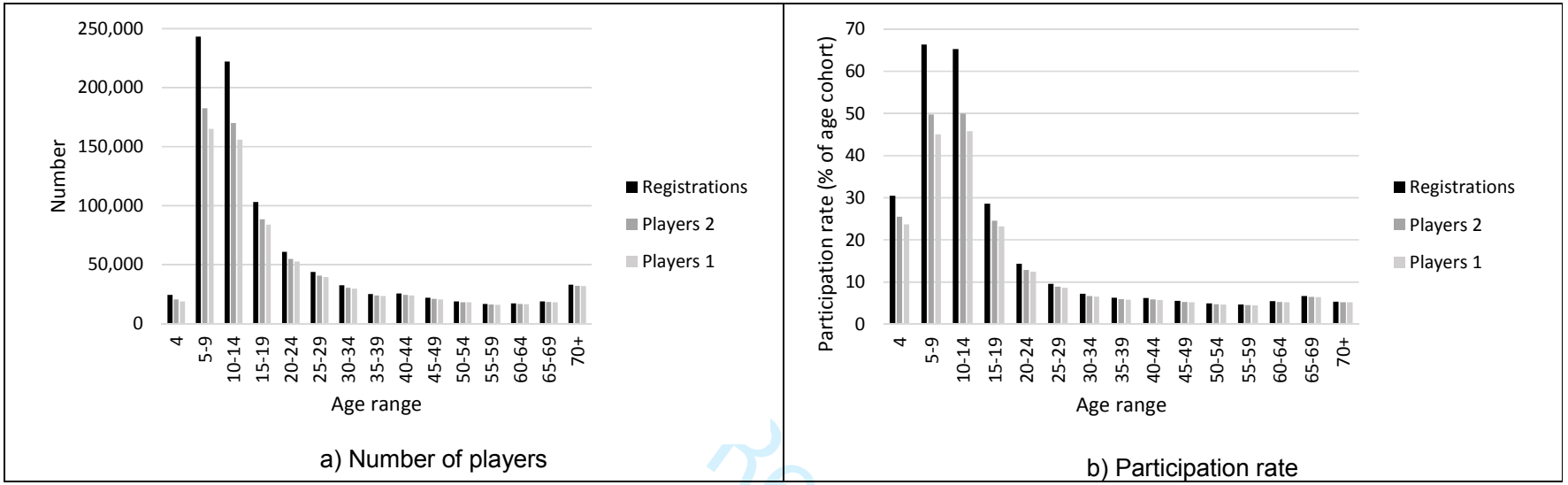

Figure 1.: ~~Age-specific p~~Participation numbers and rates: by age and ~~player count estimate~~estimation method

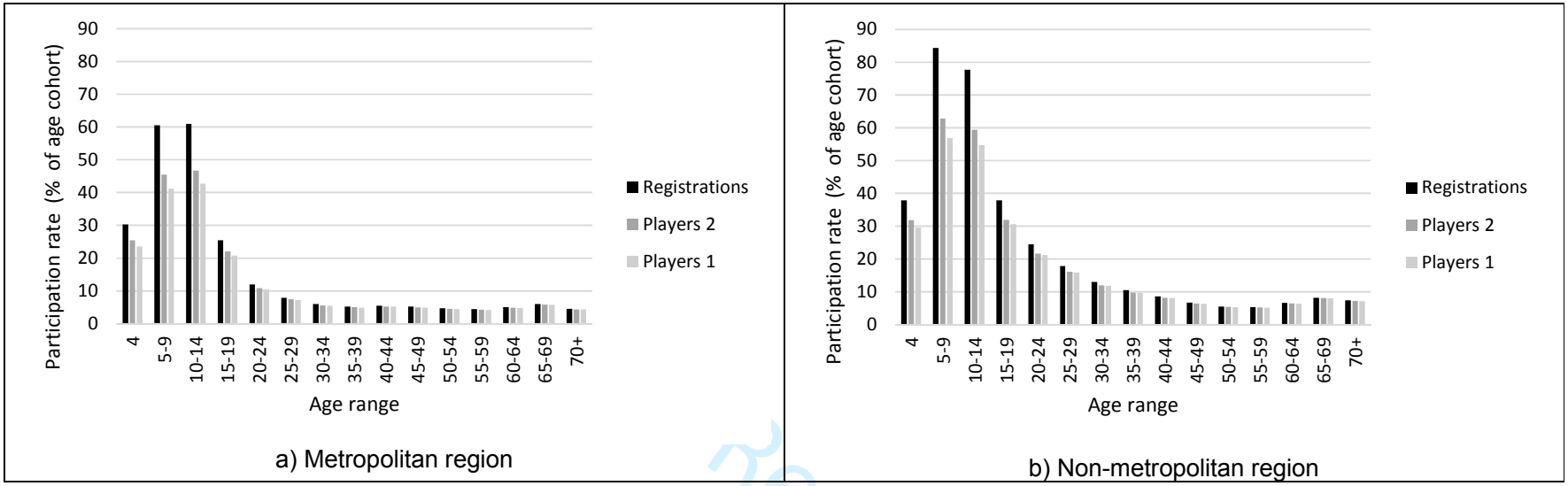

Figure 2. Participation rates: by region, age and estimation method

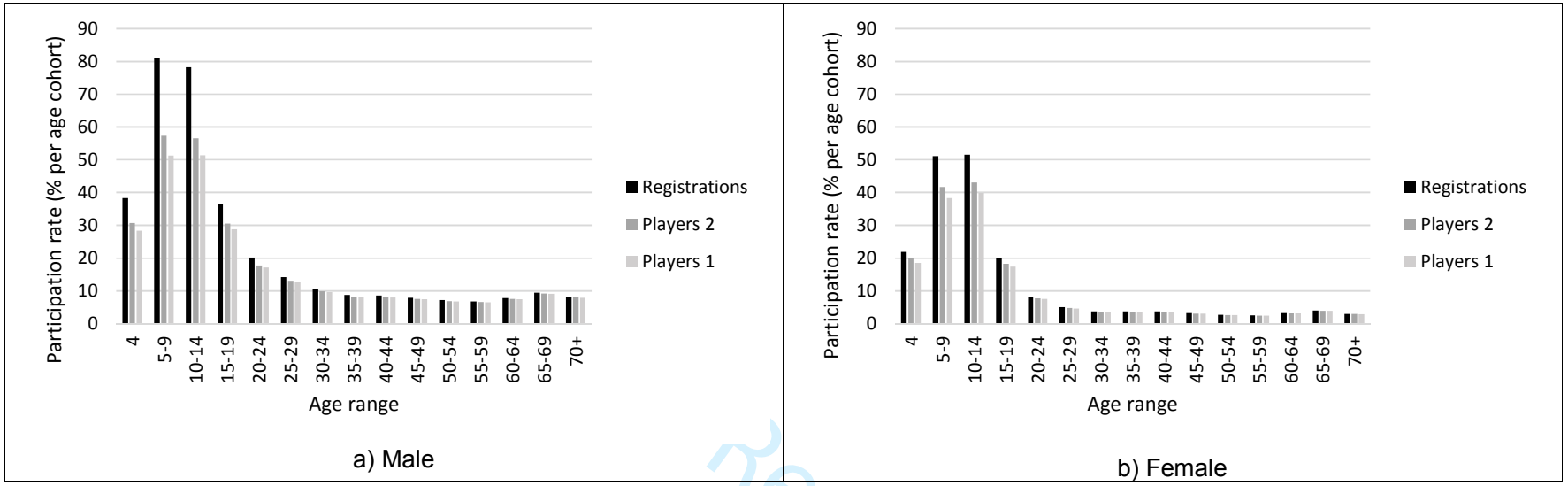

Figure 3. Participation rates: by sex, age and estimation method

Sport drop-out during adolescence: Is it real, or an artefact of sampling behaviour?

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Sport drop-out during adolescence: Is it real, or an artefact of sampling behaviour?

Abstract

Understanding sport participation and drop-out is important for sport management. ~~Sport policy focuses on increasing participation overall, and not specifically on retention. It is well known that M~~many children sample or play multiple sports and then specialise. However, quantifying these behaviors is challenging. Sport registration databases are potentially useful for this purpose. However, given privacy and data security issues, identification and direct linking of data records of individual participants across sports is not possible. This study demonstrates a feasible methodology for approximate cross-linking of de-identified data and thereby quantifying the extent of sampling behaviour, and hence investigat~~ed~~ing ~~whether or not, and~~ to what degree~~,~~ the decline in community club-based sport participation observed during adolescence is attributable to a "sampling to specialisation" effect as opposed to drop-out from sport altogether. Participants were registered members of one of eleven state sporting associations in 2015. ~~Individuals may play more than one sport, and therefore be registered with more than one sport in any given year.~~ For this analysis, data (907,150 player records) ~~for the eleven sports~~ were amalgamated, and ~~registered Victorian~~ players were categorised by ~~gender~~sex, age group and residential postcode. ~~In the absence of a common unique identifier across sports, n~~Numbers of individual players were estimated using demographic matching, ~~to allow comparison of~~ comparing numbers of registrations and numbers of individual participants across age, ~~gender~~sex and region. Results showed that the effect of participants playing multiple sports is highest for ages 5-14, and then participants tend to play fewer sports~~ from ages 15-29~~. ~~Nevertheless, while this effect contributes to the reduction in registrations, it does not completely explain it.~~ This study confirms that the drop-off in community sport participation during adolescence is real and not simply an artefact of sampling behaviour

among younger participants. It is recommended that national sport policy focuses on overall participation across sports, taking into account the sampling and specialising phenomena which naturally occur during childhood and adolescence, rather than merely asking individual sports to increase participation numbers.

Key words: sport, participation, drop-out, sampling, specialising

Introduction

It is well known that participation in sport is popular among children, and that sport participation rates peak during childhood to early adolescence (Australian Sports Commission 2016, Eime, Harvey, Charity and Payne 2016, Wong, Olds et al. 2016). A recent survey of children aged 0-14 years reported sport participation peaking at ages 9-11 (Australian Sports Commission 2016), and other studies of sport participants have reported peak participation at ages 10-14 years (Eime, Harvey, Charity and Payne 2016, Wong, Olds et al. 2016). Recent research reports that nearly a third of sports participants are aged 10-14 years (Eime, Harvey, Charity, Casey et al. 2016). However many people drop out of sport during childhood and adolescence, especially females (Australian Sports Commission 2016, Eime, Harvey, Charity, Casey et al. 2016, Eime, Harvey, Charity and Payne 2016, Wong, Olds et al. 2016) . The sport participation decline is further evident throughout the lifespan, when there is evidence of a shift away from competitive club-based sport towards non-competitive and non-organised forms of leisure-time physical activity (Eime, Sawyer et al. 2015, Australian Sports Commission 2016, Eime, Harvey, Charity and Payne 2016, Harris, Nichols et al. 2017).

In a large recent longitudinal study of over 200,00 children aged 4-12 it was found that most children in a modified sports (introductory) program in the first year of the study did not continue playing that particular sport for throughout a 4-year period (Eime, Casey, Harvey, Charity et al. 2015). Furthermore, two-thirds of those children who dropped out of the sport did so after the first year; it was conjectured that many of these had only a single year or season of participation in that particular sport (Eime, Casey, Harvey, Charity et al. 2015).

Whilst there are a range of intrapersonal, interpersonal, organisational, and environmental and policy factors influencing participation in sport across the lifespan, competency is a key determinant (Crane and Temple 2015, Eime, Casey, Harvey, Sawyer et al. 2015). If people do not perceive themselves as having adequate skills to play, they do not then enjoy playing sport and drop out (Crane and Temple 2015). Sport competency is in turn related to the

development of fundamental motor skills (FMS). There has been much research around the importance of FMS for participation in sport (Veldman, Palmer et al. 2017). FMS are learned skills, and children do not develop FMS naturally as part of normal growth and development. That is, they need to be taught, practiced and reinforced (Robinson and Goodway 2009, Veldman, Palmer et al. 2017). Furthermore, FMS development is cumulative and relatively permanent, and sport skills may have an effect on sport participation that persists across the lifespan (Henrique, Re et al. 2016). There is clear evidence that FMS are important for predicting continued sport participation or drop-out in children (Henrique, Re et al. 2016). This is thought to be associated with those children with advanced FMS being more successful in sport and as a result having more enjoyment than those children with lower FMS. Having fun or enjoyment in sport is also a major predictor of drop-out of sport participation (Crane and Temple 2015, Gardner, Magee et al. 2017).

Whilst a lack of perceived competency and enjoyment may be contributing factors to the drop-out in participation sport, it has been recently acknowledged that the drop-off in late childhood to early adolescence may be partly due to children sampling multiple sports, and then specialising in one (Eime, Casey, Harvey, Charity et al. 2015). This may be further explained through the Developmental Model of Sports Participation (DMSP) (Coté and Vierimaa 2014). Whilst this model is often used to describe the elite sport performance pathway we believe also it is relevant here. ~~The DMSP proposes two pathways to elite sport performance: early diversification and early specialisation (Fransen, Pion et al. 2012, Coté and Vierimaa 2014).~~ Within the DMSP the first stage is the sampling stage at 6-12 years, followed by the specialisation stage at 12-15 years and the investment stage at 15+ years. At age 6-12, sampling is considered beneficial for athletic development because of the exposure to a number of different physical, cognitive, affective and psychosocial environments, reinforcing physical, personal and mental skills required for future sport elite success (Fransen, Pion et al. 2012, Coté and Vierimaa 2014). Conversely, early specialisation often leads to dropout (Fraser-Thomas, Coté et al. 2008). Children who specialise in a single sport,

particularly with heavy training, risk burnout, overuse injuries and actual decrease in performance due to overtraining (Myer, Jayanthi et al. 2015). However, previous research has focused predominantly on elite athletes. We do not have knowledge about the extent of sampling and specialisation, or its effect in general community sport participants.

Australian sport policy focuses on increasing participation generally, with no specific mention of sampling and specialising behaviours (Australian Sports Commission 2015). The current policy focuses on achieving annual increases in participation numbers for individual sports, and on talent development for children and youth (Australian Sports Commission 2015). The authors contend that this strategic focus influences sports to prioritise recruitment over retention, including the development of organised modified sports programs to very young participants, in some sports as young as four years of age (Eime, Harvey, Charity and Payne 2016). The authors have recommended a greater focus on retention strategies, specifically in relation to the sharp decreases in sport participation during adolescence (Eime, Harvey, Charity and Payne 2016).

Sports organisations in Australia tend to work individually, each through their own network of state-based organisations and local sport clubs, with an absence of multi-sport clubs which are more evident in Europe (Breuer, Hoekman et al. 2015). It is conjectured that multi-sport clubs may make the transition of participants across sports easier than with individual sport clubs. It has also been reported that in European countries with larger multi-sports clubs, the sport sector is able to be more innovative and to drive public policy programs more effectively than individual sport clubs (Harris, Mori et al. 2009).

In Australia, community sports clubs are most often run by local volunteers (Eime, Payne et al. 2009). In the Australian state of Victoria, some sports are funded by the Victorian Health Promotion Foundation to focus not just on traditional competitive sport participation, but also on the development of more social and recreational forms of sport participation, in an effort to get more people active through sport (VicHealth 2018).

It is well-known that many children sample or play multiple sports and then specialise. Sampling may involve playing a sequence of different sports or playing multiple sports in the same year. Some of the decline we see in sport during childhood and adolescence may be due to a decline in the number of sports played in a particular year and not necessarily a true drop-out from sport participation (Eime, Casey, Harvey, Charity et al. 2015, Eime, Harvey, Charity, Casey et al. 2016). However, quantifying these behaviors is a challenging task. Population-wide sample surveys can provide direct evidence of the participation patterns of individuals, but sample sizes are determined from a national perspective, and so the capacity to produce estimates with acceptable levels of sampling error for smaller geographical areas or population segments is limited. Also, historically the scope of such surveys in Australia has generally been limited to persons 15+ years of age (Eime, Sawyer et al. 2015). Furthermore, non-response and refusal rates are high, and recent research has suggested that, in addition to sampling error, estimates of participation counts and rates from such surveys are subject to substantial non-response bias (Harvey, Charity et al. 2018). Sport registration data are prima facie much less susceptible to bias, and as they purport to be complete enumerations of participants in each sport, are not subject to sampling error (Harvey, Charity et al. 2018). When registration data from multiple sports are amalgamated, the aggregated counts are inflated by individuals playing multiple sports in the same year.

Ideally, to quantify this phenomenon would require the capacity to identify individual participants across multiple sports. However, particularly given current awareness of privacy and data security issues, identification and direct linking of data records of individual participants across sports is not possible. The aim of this study was to demonstrate a feasible methodology, based on demographic characteristics, for approximate cross-linking of de-identified data and thereby ~~The aim of this study was~~ to use sport registration data to quantify, for each age level, the extent of participation in multiple sports

in a given year, and hence to investigate ~~whether or not, and~~ to what degree~~,~~ the decline observed in the per capita rate of aggregated registrations in community club-based sport ~~participation~~ during later childhood and adolescence is attributable to a reduction in the extent of participation in multiple sports, i.e. a "sampling to specialisation" effect.

Methods

Data for this study were collected as part of the Sport and Recreation Spatial project, a research project funded by government and public health agencies in the Australian state of Victoria to monitor participation in sport and active recreation, for the purpose of informing policy development and program planning in the sport and recreation sector. The data ~~and~~ have been previously described in detail (Eime, Harvey, Charity, Casey et al. 2016, Eime, Harvey, Charity and Payne 2016). Briefly, participants were registered ~~members of~~participants in one of eleven state sporting associations (Australian football, basketball, bowls, cricket, football (soccer), golf, gymnastics, hockey, netball, sailing and tennis) in ~~the Australian state of~~ Victoria in 2015. ~~Individuals may play more than one sport, and therefore it is possible a player could be registered with more than one sport in any given year.~~

For this analysis, data for the eleven sports were amalgamated, and registered Victorian players aged 4-100 in 2015 were categorised by ~~gender~~sex, age group and residential postcode. Individuals may play more than one sport, and therefore it is possible a player could be registered with more than one sport in any given year. Actual numbers of registrations and estimated numbers of individual players were calculated, to allow comparison of these two indicators across age, ~~gender~~sex and region.

The number of registrations in each year were direct counts of the total of all registrations for the 11 sports. As the registrations for each sport were de-identified, it was not possible to directly link all data records for a particularly individual. An approximate count of individuals was generated by assuming that two registrations for different sports that were matched on year, ~~gender~~sex, date of birth and residential postcode were the same person.

Hence, by excluding all but the first occurrence of a particular combination of these four characteristics, estimated counts of individual players were obtained. This was done for each sport separately to provide an indication of 'multiples' per sport, and then for the sample as a whole.

A second player count estimate was also generated by assuming that multiple matching registrations within a sport genuinely represented different individuals (i.e. same-sex twins or children fortuitously matched on demographic characteristics). The 'Multiple' combinations of DOB, postcode and ~~gender~~sex within each sport were retained, up to a maximum of five occurrences per sport (arbitrarily chosen in order to exclude blocks of spurious matches due to data quality issues). For example, two players in Sport A and four players in Sport C all with the same details would result in a registration count of six, and individual counts of one under the first option (referred to as Players 1) and four under the second option (Players 2). The Players 1 count is always less than or equal to the Players 2 count, which in turn is always less than or equal to the registration count.

Results

There were a total of 907,150 registrations, 757,564 unique individuals assuming "valid" multiple individuals within sports as described (Players 2) and 714,054 unique individuals assuming no valid multiple individuals (Players 1). Aggregated across all years and sports, the Players 2 count was 16.5% lower, and the Player 1 count was 21.3% lower, than the count of registrations. These are indicative of the proportion of sports participants who played multiple sports in 2015.

Figure 1a presents the number of registrations and estimated numbers of individual players (under the two exclusion rules) across the lifespan, and Figure 1b shows the corresponding participation rates per the Victorian population in standard age cohorts. The pattern within both figures is the same. The key result is that the excess of registrations over individual players declines with increasing age. That is, the effect of participants playing multiple sports is highest for ages 5-14, and then we see a clear specialisation effect where sports

participants play one or fewer sports as they age through 15-29. From age 30 the player and registration rates are almost identical, indicating that these older sports participants are mostly playing one of the sports only.

Insert Figure 1 and Table 1 about here

Figure 2a and 2b present the participation rates for metropolitan and non-metropolitan region. Whilst the participation rate across the lifespan is generally higher in the non-metropolitan region compared to the metropolitan region, the proportional difference between registrations and actual players is very similar.

Insert Figure 2 and Table 2 about here

Figure 3a and 3b present the participation rates for males and females. The overall participation rate is much higher for males than females, and peaking at a registration rate of 81% for males aged 5-9 years and for females of 52% for ages 10-14 years. This corresponds to an actual player participation rate of 51% for males aged 5-14 and 51-52% for females aged 5-14 years. Therefore, whilst the actual player participation rate is very similar for these children for both males and females, males are much more likely than females to play multiple sports during childhood and early adolescence. That is, the sampling effect is much greater for males than for females.

Insert Figure 3 and Table 3 about here

Discussion

The existence of the sampling effect, whereby many younger sport participants play multiple sports in the same year, has often been reported (Fraser-Thomas, Coté et al. 2008, Delorme, Chalabaev et al. 2011), but this is the first study to explore how this actually relates to player numbers and participation rates. This study is unique in quantifying the extent to which younger sports participants sample multiple sports in a single year, identifying the age range

over which this behaviour diminishes with increasing age, and demonstrating differences between these patterns for males and females and between metropolitan and non-metropolitan sport participants. Furthermore, the majority of research on sampling and drop-out has been on elite or sub -elite athletes (Fraser-Thomas, Coté et al. 2008, Delorme, Chalabaev et al. 2011, Bridge and Toms 2013), whereas this study examined a population of community-based players.

We have previously speculated that the considerable drop-off in registrations during adolescence, from 15-19 years, ~~may~~ could conceivably be due to the sampling effect, and not ~~a~~ truly ~~significantly~~ indicative ~~issue in terms~~ of dropping out of sport altogether~~'all sport'~~ (Eime, Harvey and Charity 2016, Eime, Harvey, Charity and Payne 2016). We conjectured that the considerable decline during adolescence might be attributable to children playing multiple sports when younger, and thereby being counted multiply in aggregated multi-sport participation data, and then during adolescence choosing one sport to specialise in ~~during adolescence~~ (Eime, Harvey and Charity 2016). The results of the present study show that while sampling does amplify the magnitude of the reduction in total registrations throughout the adolescent and early adult years, it explains only about 25% of the drop-off in the overall registration rate, 40% of the drop-off among males, 20% of the drop-off among females, and 25% for each of metropolitan and non-metropolitan residents.

When examining the estimated player numbers and participation rates only, and not the registrations, it is clear that there is a significant decline in sport participation from age 15-19. Player participation rates peak at 45-46% ages 5-14 before a drop to only 23% from 15-19 years. The participation rate halves from the 10-14 age group (46%) to 23% (15-19%) and then halves again for 20-24 year-olds (12%).

This current study highlights that the drop-off in sport participation during adolescence and into early adulthood is real, and is not simply the effect of sampling. Sampling itself confers a range of benefits, contributing to a range of diverse skills and to improved fitness and motor coordination (Fransen, Pion et al. 2012, Myer, Jayanthi et al. 2015). Fransen et al.

showed that for boys, those participating in more than one sport were exposed to a greater number of physical, cognitive, affective, and psycho-social environments than boys playing a single sport only (Fransen, Pion et al. 2012), and concluded that it is important to be sampling and playing multiple sports before the age of 12 rather than early specialisation (Fransen, Pion et al. 2012). There is evidence that a higher degree of sampling for ages 11-15 is significantly associated with increased performance, that is, competing at a national compared to community club level (Bridge and Toms 2013 4724). We know that participation in sport during childhood and adolescence has a lasting positive effect on physical activity (Murphy, Rowe et al. 2016). Furthermore, sports participants are often more active and fitter than participants in non-sport physical activity; however these associated benefits of sport participation can diminish during adolescence and especially for girls (Telford, Telford et al. 2015). Therefore strategies are needed to keep children and adolescents engaged in sport for health benefits, not only physical but also psychological and social health (Eime, Young et al. 2013).

The sampling and participation rate patterns were broadly similar for both the metropolitan and non-metropolitan regions, and this is consistent with other research (Eime, Harvey, Charity and Payne 2016, Hoekman, Breedveld et al. 2017), however the decline is not as pronounced for the non-metropolitan regions. A higher proportion of people living in non-metropolitan regions remain active through sport during adolescence. This may relate to the culture of community sport in rural and regional communities (Eime, Charity et al. 2015). Further, as adolescents age and become more autonomous in their decisions regarding physical activity there are also more opportunities to participate in a wider range of leisure activities in metropolitan compared to non-metropolitan regions (Craike, Symons et al. 2011).

A concerning pattern is the more severe decline during adolescence for females compared to males. The participation rate for females for ages 15-19 is less than half of that for those aged 1-14 years. It is also very clear from the registration numbers that young males sample

or play more sports than females. Firstly, there is evidence of a competency difference between young females compared to males, and we know that competency is a major factor relating to participation in sport (Veldman, Palmer et al. 2017). There is evidence that young girls are less competent at ball skills than young boys (Veldman, Palmer et al. 2017). Further, other research amongst 6-12 year olds reports that playing multiple sports and spending more time playing sport contributes to improved gross motor coordination (Fransen, Pion et al. 2012). Quite simply, by sampling multiple sports children are exposed to a greater number of physical, cognitive, affect and psycho-social environments than those playing only one sport (Fransen, Pion et al. 2012). Secondly these gender differences may also be related to increased opportunities for boys to play multiple sports, relative to girls, and to parents encouraging boys to play sport more than girls (Wheeler 2012, Eime, Harvey, Charity, Casey et al. 2016). Further to this, in the case of this study higher participation for males compared to females also relates to the traditional gender bias of Australian club-based sport, whereby for several sports, until very recently, females were not able to play in club-based competitions (Eime, Harvey, Charity and Payne 2016).

The main correlates of youth sport attrition include competency and social factors such as enjoyment, support from parents, peers and coaches and a positive social club environment (Eime, Harvey et al. 2013, Balish, McLaren et al. 2014, Henrique, Re et al. 2016, Casey, Eime et al. 2017, Gardner, Magee et al. 2017). Higher sport competency in young childhood is associated with continued sport participation across childhood (Henrique, Re et al. 2016). Competency is a cumulative and relatively permanent phenomenon, which is in contrast to physical activity in general (Henrique, Re et al. 2016). Children exposed to more sports earlier in their life tend to have greater competency and therefore are more likely to continue to participate. Further to this, there is evidence that players who drop out participated in fewer sports than those that continue playing (Fraser-Thomas, Coté et al. 2008).

There is much research evidence that sampling is positive for skill development in children and young people, and for continued sport participation. In Australian sport policy there is

no specific mention of sport sampling, with the focus being the broader aim of getting more Australians and particular young Australians participating in sport more often, and in general trying to gain insights into participation trends. (Australian Sports Commission 2015). There is mention of the benefits of sampling for elite athlete development (Australian Sports Commission not dated), but nothing related to the general population. A major focus of the national sport policy is for each sport organisations is to increase participant numbers each year. With this "individual silos" focus, the issue of sampling versus specialisation in children and adolescents, and the implications for overall levels of participation, are not considered.

Beyond the quantification of sampling and specialisation demonstrated in this study, there remain important questions. Whilst we have many insights relating to sampling among elite and sub-elite youth, we do not have evidence from community club-based sport as to whether sampling leads to a greater likelihood of playing sport throughout life. Are ~~those~~ the people that maintain participation in sport, albeit only a low proportion, those who have played and sampled many sports in childhood? Is the drop-off in sport participation primarily attributable to 'late sports starters' who have less sport competency than early sport adopters? Beside~~s~~ the modified sports programs for young participants, what are the entry points to competitive sport throughout the lifespan for individuals who do not have specific sports competency? These questions await further research.

Conclusion

In conclusion, this study confirms that the drop-off during adolescence in community sport participation, as measured by aggregated sport registrations, ~~during adolescence~~ is real and not simply ~~an artefact~~a consequence of a reduction in sampling behaviour compared to~~among~~ younger participants. It is concerning that, from a peak at ages 10-14, the participation rate halves for the next age group of 15-19 years. Considering the magnitude of this drop-off, s~~S~~port policy should specifically prioritise retention in sport, and not merely focus on increasing total sport numbers. This requires a longitudinal rather than cross-

sectional approach to the monitoring of participation. A policy relating to retention is needed to provide sporting organisations with the lever to make this a priority for their sport-specific strategies.

It is also recommended that national sport policy should focus on overall participation across sports, taking into account the sampling and specialising phenomena which naturally occur during childhood and adolescence, rather than merely asking individual sports to increase participation numbers. From a health perspective, as long as people are regularly physically active, it does not matter if they initially play multiple sports and then subsequently specialise. However, from a policy and planning perspective it is important to know what proportion of the apparent drop-off in late childhood and adolescence, both in individual sports and in data aggregated across sports, is due to increased specialisation, and what proportion is due to drop-out from sport altogether. In the absence of a common unique participant identifier across sports, this study has demonstrated a feasible methodology, based on demographic characteristics, for approximate cross-linking of de-identified sport registration data and thereby providing a solution to this important gap in the knowledge informing policy development.

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Not applicable

Disclosure statement

The authors have no conflicts of interest

Ethics approval and consent to participate

Ethics approval was granted by the Federation University, Australia Human Ethics Committee. Project number: C13-007.

This study involves secondary data analysis of de-identified data collected of sports participants collected by ~~the s~~State s~~S~~porting a~~A~~ssociations.

References

Australian Sports Commission (2015). Play. Sport. Australia. The Australian Sports Commission's participation game plan. Canberra, Australia, Australian Sports Commission**:** 26.

Australian Sports Commission (2016). AusPlay participation data for the sport sector. Summary of key national findings. Canberra, Australian Sports Commission.

Australian Sports Commission. (not dated). "TThe importance of sport sampling before specialising." Retrieved 30th July, 2018, from https://www.ausport.gov.au/supporting/tips/tip_5.

Balish, S., C. McLaren, D. Rainham and C. Blanchard (2014). "Correlates of youth sport attrition: A review and future directions." Psychology of Sport and Exercise **15**: 429-439.

Breuer, C., R. Hoekman, S. Nagel and H. van der Werff, Eds. (2015). Sport clubs in Europe. A cross-national comparative perspective. Sports economics, management and policy. London, Springer.

Bridge, M. and M. Toms (2013). "The specialising or samping debate: a retrospective analysis of adolescent sports participation in the UK." Journal of Sports Science **31**(1): 87-96.

Casey, M., R. Eime, J. Harvey, N. Sawyer, M. Craike, C. Symons and W. Payne (2017). "The influence of a Healthy Welcoming Environment on participation in club sport by adolescent girls: a longitudinal study." BMC Sports Science, Medicine and Rehabilitation **9**(12).

Coté, J. and M. Vierimaa (2014). "The developmental model of sport particiation: 15 years after its first conceptualization." Review of Science and Sports **29 Supplement**: S63-69.

Craike, M., C. Symons, R. Eime, W. Payne and J. Harvey (2011). "A comparative study of factors influencing participation in sport and physical activity for metropolitan and rural female adolescents." Annals of Leisure Research **14**(4): 355-368.

Crane, J. and V. Temple (2015). "A systematic review of dropout from organized sport among children and youth." European Physical Education Review **21**(1): 114-131.

Delorme, N., A. Chalabaev and M. Raspaud (2011). "Relative age is associated with sport dropout: evidence from youth categories of French basketball." Scandinavian Journal of Medicine & Science in Sports **21**(1): 120-128.

Eime, R., J. Harvey and M. Charity (2016). Sport participation in Victoria, 2015. Melbourne, VicHealth.

Eime, R., J. Harvey, M. Charity, M. Casey, H. Westerbeek and W. Payne (2016). "Age profiles of sport participants." BMC Sports Science, Medicine and Rehabilitation **8**(6).

Eime, R., J. Harvey, M. Charity and W. Payne (2016). "Population levels of sport participation: implications for sport policy." BMC Public Health **16**(1): 1-8.

Eime, R., W. Payne and J. Harvey (2009). "Trends in organised sport membership: Impact on sustainability." Journal of Science and Medicine in Sport **12**(1): 123-129.

Eime, R., N. Sawyer, J. Harvey, M. Casey, H. Westerbeek and W. Payne (2015). "Integrating Public Health and Sport Management: Sport participation trends 2001-2010." Sport Management Review **18**(2): 207-217.

Eime, R., J. Young, J. Harvey, M. Charity and W. Payne (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 & Physical Activity **10**(98).

Eime, R. M., M. M. Casey, J. T. Harvey, M. J. Charity, J. A. Young and W. R. Payne (2015). "Participation in modified sports programs: a longitudinal study of children's transition to club sport competition." BMC Public Health **15**(649): 7.

Eime, R. M., M. M. Casey, J. T. Harvey, N. A. Sawyer, C. M. Symons and W. R. Payne (2015). "Socioecological factors potentially associated with participation in physical activity and sport: A longitudinal study of adolescent girls." Journal of Science and Medicine in Sport **18**(6): 684-690.

Eime, R. M., M. J. Charity, J. T. Harvey and W. R. Payne (2015). "Participation in sport and physical activity: associations with socio-economic status and geographical remoteness." BMC public health **15**(434).

Eime, R. M., J. T. Harvey, M. J. Craike, C. M. Symons and W. R. Payne (2013). "Family support and ease of access link socio-economic status and sports club membership in adolescent girls: a mediation study." Int J Behav Nutr Phys Act **10**(50).

Fransen, J., J. Pion, J. Vandendriessche, B. Vandorpe, R. Vaeyens, M. Lenoir and R. Philippaerts (2012). "Differences in physical fitness and gross motor coordination in boys aged 6-12 years specializing in one versus sampling more than one sport." Journal of Sport Sciences **30**(4): 379-386.

Fraser-Thomas, J., J. Coté and J. Deakin (2008). "Examining adolescent sport dropout and prolonged engagement from a developmental perspective." Journal of applied sport psychology **20**(3): 318-333.

Gardner, L., C. Magee and S. Vella (2017). "Enjoyment and behavioral intention predict organized youth sport participation." Journal of Physical Activity and Health **Ahead of Print**.

Harris, S., K. Mori and M. Collins (2009). "Great Expectations: Voluntary Sports Clubs and Their Role in Delivering National Policy for English Sport." VOLUNTAS: International Journal of Voluntary and Nonprofit Organizations **20**(4): 405.

Harris, S., G. Nichols and M. Taylor (2017). "Bowling even more along: trends towards individual participation in sport." European Sport Management Quarterly **17**(3): 290-311.

Harvey, J. T., M. J. Charity, N. A. Sawyer and R. M. Eime (2018). "Non-response bias in estimates of prevalence of club-based sport participation from an Australian national physical activity, recreation and sport survey." BMC Public Health **18**(1): 895.

Henrique, R., A. Re, D. Stodden, J. Fransen, C. Campos, D. Querioz and M. Cattuzzo (2016). "Association between sports participation, motor competence and weight status: A longitudinal study." Journal of Science and Medicine in Sport **9**(10): 825-829.

Hoekman, R., K. Breedveld and G. Kraaykamp (2017). "Sport participation and the social and physical environment: explaining differences between urban and rural areas in the Netherlands." Leisure Studies **36**(3): 357-370.

Murphy, M., D. Rowe and C. Woods (2016). "Sports participation in youth as a predictor of physical activity: A 5-year longitudinal study." Journal of Physical Activity and Health **13**: 704-711.

Myer, G. D., N. Jayanthi, J. P. Difiori, A. D. Faigenbaum, A. W. Kiefer, D. Logerstedt and L. J. Micheli (2015). "Sport Specialization, Part I Does Early Sports Specialization Increase Negative Outcomes and Reduce the Opportunity for Success in Young Athletes?" Sports Health **7**(5): 437-442.

Robinson, L. and J. Goodway (2009). "Instructional climates in preschool children who are at-risk. Part 1: object-control skill development." Research Quarterly for Exercise and Sport **80**(3): 533-542.

Telford, R. M., R. D. Telford, T. Cochrane, R. B. Cunningham, L. S. Olive and R. Davey (2015). "The influence of sport club participation on physical activity, fitness and body fat during childhood and adolescence: the LOOK Longitudinal Study." Journal of Science and Medicine in Sport **19**(5): 400-406.

Veldman, S., K. Palmer, A. Okely and L. Robinson (2017). "Promoting ball skills in preschool-age girls." Journal of Science and Medicine in Sport **20**(1): 50-54.

VicHealth. (2018). "Physical activity strategy 2018-2023." Retrieved March 9th, 2018, from file:///C:/Users/reime/Downloads/VicHealth%20Physical%20Activity%20Strategy%20(2).pdf.

Wheeler, S. (2012). "The significance of family culture for sports participation." International Review for the Sociology of Sport **47**(2): 235-252.

Wong, H., T. Olds, R. Maddison and L. Foley (2016). "A great sporting nation? Sport participation in New Zealand youth." The New Zealand Medical Student Journal **23**: 18-23.

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Sport drop-out during adolescence: Is it real, or an artefact of sampling behaviour?
Rochelle Eime, Melanie Charity, Jack Harvey
International Journal of Sport Policy and Politics

We thank the reviewers for their time and their very thorough reviews and helpful comments, which have guided substantial improvements to the manuscript. Our responses are tabulated below.

Reviewer 1 comments	Author response
Overall this is a well written article, with some interesting findings. The data is substantial and unique in respect to the opportunity to access the data. However, I do feel it needs some work.	Thank you
1. I would suggest to provide more context and discussion- I got the impression after reading it - the main finding was quite simplistic. We wanted to do this, and we found this, but don't really do much beyond that. For this journal I would want to see more implications to policy - and reference some of the policy documents in Australia and Victoria - and some of the programs going on. For example, the authors briefly discuss women and girls as a key focus for drop off - and there are lots of programs happening in Victoria such as Vic Health's new "This Girl Can' and the Victorian State Government's "Change our Game". For this journal, the authors do not engage much in policy implications or current policies which could be leading or promoting sampling behaviour. On this note, the authors make some assumptions that the reader be aware of Australian context.	The paper discusses quite extensively the role that player development pathways may be associated with sampling, specialising and in more general sport participation trends including retention and drop-off. We have included in both the Introduction and Discussion more discussion related to sport policy.
2. Australian sport policy should also be addressed I feel to give context - why might this be a problem around specialising and sampling - and could this because of the national sport policy or in Victoria? I think there needs more discussion here and to tease out some nuances.	We have included more text relating to sport policy. However we believe that the phenomenon of sampling and specialisation is more linked to the sport development and sampling/specialising developmental models presented throughout this paper, rather than an outcome of sport policy.
3. I would also suggest to make reference to how the authors got the data - they discuss they have previously written about it but what stands out to me is how they got access to such a large data set and the ethics associated with it.	Text added (P7). Ethics approval is documented in the relevant declaration at the end of the paper.
4. The discussion and conclusion should have more links to the	We have included more text relating to sport policy.

Australian context and policy imperatives also - I think it's quite simplistic and basic - especially for this journal. Implications for policy and the wider contextual picture would make this article better.	
5. During the introduction and early section, I would also have more background to the Australian and Victorian context - it is quite different to the rest of the world - there are many things which are specific to Australia and the authors on several occasions assume that the reader might know or be aware of the cultural context in Australia.	We have added more information about the Australian and Victorian context of sport.
6. P7. Line 35 I think you mean significant rather than significantly – it reads better this way.	Correct point. However, we have reworded this explanation.
I would advise to make these changes, but would suggest it does need work before being accepted to be published in the article. How much it offers to new developments in the field is questionable too – I think they need to be clearer in what it means in the big picture, beyond sampling behaviour causes drop out. It is important research and can have significant implications for policy and localised policies and participation plans for State Sport Organisations in Australia, but this needs to be drawn out more and articulate better.	We have provided more contextual information and recommendations. We do not say that sampling behaviour causes drop out; rather we show that reduction in sampling behaviour leads to dropout from particular sports, but not necessarily to dropout from sport altogether.
Reviewer 2 comments	
This paper is limited in scope and it seems to me ill conceived, methodologically problematic and adds little new knowledge or insight. As a consequence I am afraid that I have to conclude that I do not think as currently presented that it meets the standard required for publication.	We have revised and extended the last two paragraphs of the Introduction (P6-7) to more clearly explain the context, rationale and aims of the study. This investigation into the extent to which declining registration numbers can be attributed to increased specialisation versus dropout from sport altogether was encouraged and supported by the sport agency of the Victorian government, who regarded it as an important policy issue. As far as we are aware, no quantitative evidence about this issue had been presented prior to the present study.
There is considerable evidence around the impact of sampling and specialisation - particularly as it impacts on performance and elite sport. However, I was encouraged by the start of this paper that said it was going to explore this more fully in the context of 'community club-based sport'. I expected to see a study that built on the evidence	The reviewer has outlined an interesting and worthwhile research question, but notwithstanding the expectation of the reviewer, it is a different question to the question addressed by the present study. See our previous response immediately above.

to show how early sampling behaviours increased the probability for sustained involvement in 'community sport' and the mechanisms for this - whether they are psycho-social and or competency based or as seems likely a synthesis of both of these domains. I was also interested to see how this might vary by social variables of gender, class and age.	There is much discussion about the sampling and specialisation literature and the benefits of sampling for individuals. However, the great majority of this research has related to talent development pathways and elite athletes. How sampling might influence sustained participation in community sport is not known, but this was not the subject of this study.
However the paper sought to explore drop out (or otherwise) through what seems a convoluted process of disaggregating multiple registrations in club based sport to establish 'unique' individuals and then by implication tracing the reduction in numbers of participants and deriving a 'participation rate'. It seems to me that there are a number of problems implicit in this approach - the largest of which is the association that is made between club membership and participation. This excludes any informal or semi-formal (and perhaps even formal non affiliated) participation outside of a club environment. This point is not discussed by the authors or explained or justified. There is also the issue of registration not necessarily equating to participation - they are not the same thing. So we do not know if a registered member is a frequent, infrequent or even lapsed participant. We also do not know if an individual gives up their 'registration' as a club member but still informally participates in a sport or for that matter changes to a sport outside of the 11 included in the sample. There is no mention of what 11 sports are covered by the registrations - this could be important if significant participant sports are excluded or where sport participation is particularly socially skewed.	In the absence of access to a unique identifier (such as name and address) to enable linking of registration records across sports, the process of matching based on date of birth, sex and residential postcode is imperfect, but it is in principle quite straightforward although there is some complexity and nuance in the detail. In Australia, registration with a state sporting association (SSA), generally through an affiliated club, accounts for the great majority of participation in competitive sports. Registration with an SSA is a good proxy for regular participation in competitive sport during the relevant seasons. These unknowns are of course limitations to the study, but they do not completely invalidate it or render it worthless. We have now listed the 11 sports (P7).
The conclusion that there really is drop out from sport into teenage years (and it is not just a consequence of reduction in sampling) is not a profound one. This conclusion could be drawn in much simpler and in more accurate ways by examining sport participation data from social surveys that include the whole population - and not just club based sport and where the problems of double counting individuals is absent.	This conclusion may not be surprising, but the provision of empirical evidence for it, and the quantification of the relative effects of the two mechanisms, is a worthwhile scientific endeavour with practical policy implications. In principle, the result can be triangulated against data from population-wide surveys. However, there are serious limitations to the data from sample surveys. First, all relevant population-wide

	surveys in Australia for which data were available at the time of this study were limited to persons 15+ years of age, thereby omitting a large proportion of the target age group, and no such survey had been conducted for a number of years. While a new national sport and recreation survey established more recently does include some data on children and adolescents younger than 16 years of age, in common with other such population-based surveys, the refusal rate is high, and there is evidence of non-response bias in estimates of participation numbers and rates. We have now alluded to this, including reference to a recently published paper concerning non-response bias (P6).
It would take a major re-write for me to be convinced that this paper has the potential to add useful knowledge and can address the points I raise above. I would, however, not want to totally close down the possibility that there is something that could be published - but it would require a major re-think and re-write.	We hope that the reviewer is prepared to read our responses to the points above, and also the perspective of Reviewer 1, and reconsider this assessment, which we consider to be excessively severe and unjustified.

Additional revisions:
In accordance with conventional terminology in the demographic literature, we have replaced “gender” by “sex” wherever appropriate to do so. We have also revised some table headings and figure captions.