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Project title: Tracking of physical activity behaviours during childhood, adolescence and young adulthood: A systematic review.	
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Structure of final report:

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Summary

Aim
To conduct a systematic literature search to identify studies providing data on the tracking of physical activity behaviours in children and young people.

Methods
Seven bibliographic databases were searched systematically in July-August 2008 using search strategies built around three groups of keywords: physical activity, study type and young people. Studies included in the review had to be prospective, longitudinal studies that reported data on any physical activity behaviour for at least two time-points (two or more years apart). The study was restricted to community-based populations who were 18 years or younger at baseline. Two reviewers independently undertook data extraction from all suitable papers, and performed quality appraisal.

Results
The database search yielded a total of 10,685 titles, from which 59 were included in the review. There were only 15 papers that specifically examined tracking of physical activity behaviours. Tracking co-efficients ranged from -0.11 to 0.59; all indicating low or moderate tracking of physical activity, with no clear differences between males and females. Moderate tracking was observed in studies where follow-up was five years or less. The highest degree of tracking was observed for club sport participation and even over long follow-up, sports training and organized physical activity showed higher tracking than other physical activity behaviours.

Physical activity levels declined consistently during adolescence, as did sports participation. However, the decrease in physical activity was less marked among those who participated in sports in early adolescence, and those who participated with parents or at high levels. The likelihood that young people continue with specific sports over short periods is generally low, but the likelihood that they continue to take part in any team, individual or vigorous activity is higher. There were no studies that evaluated the effect of sports participation during early childhood on later physical activity behaviours.

Conclusions
In general, tracking of physical activity behaviours between childhood, adolescence and young adulthood is low, although there is limited evidence.

The study has confirmed that levels of physical activity decrease with age, indicating the need to develop and test interventions to promote activity. Research is also needed to explore the reasons why adolescents and young adults give up physical activity and participation in sports.

However, several factors in adolescence (participation in organised sports, participation with parents and high levels of participation) do lessen the chances of being inactive at a later age.

Original Aims

To conduct a systematic review of the literature exploring the tracking of physical activity behaviours during childhood, adolescence and young adulthood, to provide information for the design of health promotion interventions.

Research Questions:

1. How does the tracking of physical activity behaviours differ between early childhood, middle childhood, adolescence and young adulthood?
2. What are the characteristics of physical activity behaviours (frequency, duration, type) that are associated with higher levels of tracking?
3. What are the main differences between males and females with respect to tracking of physical activity behaviours?

Methodology

A systematic literature search was carried out to identify studies providing data on the tracking of physical activity behaviours in children and young people.

Search methods: Seven bibliographic databases were searched systematically in July-August 2008 (from inception to a specified end-date): Ovid MEDLINE, CINAHL, EMBASE, PsycINFO, ASSIA, ChildData and the Cochrane library. The searches strategies were built around three keywords: physical activity (using search terms such as 'exercise', 'sports' and 'physical education'); study types (search terms including 'longitudinal studies', 'randomized controlled trials', and ' follow up studies'); young people (search terms including 'child', 'adolescent', and 'boys or girls'). The exact search strategies are presented in Appendix 1. A search log was kept and the references were managed using End Note.

Inclusion and exclusion: Studies included in the review had to be prospective, longitudinal studies that reported data on a physical activity behaviour (sports, leisure, work-related) for at least two time-points (two or more years apart), among young people who were 18 years or less at baseline. The review included observational studies and intervention studies, provided that data were available for a control group (with no intervention). The study was restricted to community-based populations of healthy children and young people (excluding pregnant, sick or clinic populations). Studies published in any language, carried out anywhere in the world, were considered.

One of the reviewers (CM) excluded obviously irrelevant papers after screening the titles. The abstracts for the remaining papers were then obtained and two reviewers (JE, CM) selected those that were potentially eligible. The full texts were obtained and screened again independently by JE and CM. Disagreements were resolved by discussion.

Data extraction and quality appraisal: Two reviewers (CM, AK) independently undertook data extraction from suitable papers, including the physical activity related outcomes, how they were measured, relevant results of statistical tests and the number and age (range) of the study participants. A data extraction form was specifically designed for this (Appendix 2).

The quality of each paper was assessed using a modified version of the 'Effective Public Health Practice project (EPHPP) quality assessment tool for quantitative studies'[1]. From this tool, we identified the most relevant measures of study quality: selection bias, confounders, data collection methods, and withdrawals and dropouts. Papers were graded by CM as strong, moderate or weak accordingly, as shown in Appendix 3. JE cross-checked the results. Disagreements were resolved by discussion.

Analysis: Studies that specifically measured tracking were identified and stratified by age at baseline. The degree of tracking was then compared by sex and type of activity. It became clear from the heterogeneity of the studies that it would not be feasible to pool data. Few data were provided in any of the studies on activity type, unless relating specifically to sports participation. The studies that measured sports participation at baseline (rather than total physical activity) were therefore examined as a separate group. The remaining studies were grouped according to physical activity measure.

Results

The database search yielded a total of 10,685 titles. The process of selection of the papers is shown in Fig 1. After screening the titles and abstracts, 201 papers were identified as potentially eligible for inclusion in the study. A further 17 were identified from reference lists, contacting authors and systematic reviews. The search of ChildData and the Cochrane library produced no potentially eligible papers. There was one study in French which was translated by one of the study team (JE).

Fig 1 shows how the final 59 papers were selected for the review. It was possible to obtain the full text for 217 of the 218 papers. Of these, 29 did not meet the inclusion criteria and 58 were duplicates. There were 34 that did not collect physical activity data in a usable format. In situations where relevant data were collected in the study but were not presented in the paper, the authors were contacted (although 20 did not respond). We performed quality appraisal on 76 papers, with 17 excluded for being of weak quality. The full list of the final 59 papers included in the review is shown in Appendix 4. Reasons for excluding the 17 weak papers are presented in Appendix 5.

The 59 papers were very heterogeneous, particularly in terms of the physical activity behaviour studied and the length of follow-up. There was no standard approach to the measurement of physical activity. Only six studies were carried out in the UK.

Tracking of physical activity

There were 15 papers (13 separate studies)[2-16] that specifically examined tracking of physical activity behaviours and measured this using either a correlation (tracking) co-efficient or stability co-efficient. These are summarised in Table 1. Results from the 10 studies where a tracking co-efficient was given for overall physical activity are shown in Fig 2.[2,3,4,6,9,10,12-15]

The co-efficients ranged from -0.11 to 0.59; all within the range of low (<0.30) or moderate (0.30 to 0.60) tracking. However, the differing lengths of follow-up and the diverse methods used to measure physical activity made it very difficult to compare tracking between studies. Some studies used objective methods of measuring physical activity[2,4,5,7,15]; others relied on observation or self-report[3,6,8-14,16]. There were also different aspects of physical activity behaviour studied: moderate activity, vigorous activity, engagement in specific sports, organized activity and sedentary behaviour. For all these reasons, pooling data from different studies was inappropriate.

A higher co-efficient is likely to be associated with shorter length of follow-up. In this review, moderate tracking for physical activity was only observed in studies where follow-up was five years or less.

Six of the studies presented tracking co-efficients for total physical activity for boys and girls separately[4,10,12-15] (Fig 3). Although no clear pattern emerges, two studies show no tracking of physical activity between girls at 9 and 11 years and adulthood 12[10] and 31[14] years later) (although higher tracking was observed for slightly older girls in middle childhood[10,13]).

Tracking co-efficients for different types of physical activity behaviours are shown in Figs4-6 for early childhood, middle childhood and adolescence. No clear patterns are evident. It has previously been suggested that sedentary behaviours may track more than physical activity, but our results are inconclusive, with three studies reporting higher co-efficients for sedentary behaviours[5,11,12] (two only in boys)[5,12], and three studies reporting lower co-efficients[8,13,14] .

The highest degree of tracking was observed for club sport participation[6] (Table 2) and even over long follow-up, sports training and organized physical activity showed higher tracking than other physical activity behaviours[10,13.]

Four papers from studies carried out in the USA appeared to report higher tracking[3,4,5,12]. It is impossible to know whether this is a spurious effect. Only two studies were from the UK[2,14]. Neither could be easily compared with other studies; one was a small short-term follow-up of very young children, the other had a 31 year follow-up.

Participation in sports

We identified 11 studies that specifically measured participation in sports at baseline (rather than overall physical activity)[17-27] (Table 2), with almost all carried out in adolescents, and none in the UK. The only study in very young children suggested that sports performance at a very young age is not an important predictor of physical activity in middle childhod[17].

The other studies were of three types: studies that investigated whether sports behaviour predicted later physical activity levels[18,21,22,23,24] studies that examined the likelihood of participants continuing in specific sports[19,20], and those that compared proportions participating in specific sports at baseline and follow up[25,26,27].

Participation in sports during adolescence is associated with physical activity levels in late adolescence and young adulthood, for both males and females[18,21-24]. Participation with parents[24], or at high level and with increasing frequency[18], is associated with increased later activity, and the effect may differ by sport type[22]. However, there were no studies that evaluated the effect of sports participation during early childhood on later physical activity behaviours.

The likelihood that young people continue to take part in specific sports over a 4 year period is generally low (only more than 0.5 for basketball, football and weightlifting in boys, and baseball for girls)[19,20]. However, the likelihood that they continue to take part in any team, individual or vigorous activity is much higher over this period, particularly for boys[19].

The other sports participation studies are less useful in terms of tracking, because they assessed the proportions of a defined group who took part at different time-points, but these were not necessarily the same individuals[25-27]. Between 15 and 18 years, proportions of young people taking part in almost every sport decreased[25]. Similarly, individual sports participation at 34 years was generally lower than at 16 years, although the numbers in this Finnish study were very small[27]. There was some evidence to suggest that less structured activities such as running, cycling and walking might increase[22], or remain high[26], from adolescence to adulthood, and these less structured sporting activities may also increase the odds of being active in adulthood[22].

Frequency of physical activity, time spent in physical activity and physical activity scores

The remaining studies were grouped according to how physical activity was measured; whether by frequency of physical activity behaviour[28-38] (Table 3) or time spent carrying out physical activity [39-52] (Table 4). Several studies calculated an overall physical activity level or score for subjects[17,26,30,53-59] (Table 5). The majority of these studies simply provided an overall or mean measurement of physical activity in the populations at two time-points, with no facility to estimate degree of tracking (for which individual measurements are required). Despite this, the studies were retained in the review to provide background data on physical activity levels.

In these studies, frequency of physical activity peaks at about 10-11 years[29], and then declines[30]. The biggest decrease is between 12 and 15 years[31]. The decline slows after the age of 16 years[31,36] although over longer follow-up, physical activity continues to decline into adulthood[33-35], and those never doing any physical activity increases[38]. Young adults were more likely to become inactive than remain active over time, even if they were active during adolescence[34]. However, perhaps more importantly, adults most likely to be active were those who were active at 16 years[37].

There were 11 studies that measured time spent in physical activity, although follow-up in these studies was generally relatively short[39-52]. While time spent in physical activity increased during early childhood[39-41], there was almost universal decline after the ages of about 10-12 years[42,43-52]. One study suggested that this decline may start slightly later in girls[43]. The increase in physical activity during early childhood was also observed in a study using physical activity scores[54.] After this age, however, again there was a general decline in physical activity [53-55,57-59.]

Sedentary behaviours

Seven of the studies in this review also measured sedentary behaviours (Table 6)[17,28,34,38,51,52,60], although none were carried out in the UK. Very young children with low physical activity levels were more likely to be sedentary in middle childhood[17], and sedentary teenagers were much more likely to remain sedentary than become active in adulthood[34]. Although active teenagers overall were also more likely to become sedentary than remain active, the chance of becoming sedentary was much lower than for those who were already sedentary[34]. Sedentary behaviours increase during the early teenage years[52,] as TV and video watching increase[60], but in slightly older teenagers, it is leisure-time computer use contributes more to sedentary behaviour[51].

Discussion

This review highlights the paucity of data on the tracking of physical activity behaviours from childhood and adolescence into adulthood. In particular, there is almost no evidence from the UK. Despite a commitment to increasing physical activity levels in the Scottish population, there is a huge evidence gap that makes it extremely difficult to know which types of physical activity behaviours can most effectively be targeted at which groups, to promote lifelong healthy physical activity levels.

This limited evidence is set against a backdrop of almost universal decreases in physical activity during the adolescent years. Although public health practitioners are aware of this decrease, this review has confirmed its persistent nature. The dramatic decline in physical activity levels after the ages of about 10-12 years (before which physical activity seems to increase) is evident regardless of the national context, the length of follow-up, the particular measure of physical activity and the intensity of physical activity. Maintaining healthy levels of physical activity in adolescence and beyond therefore remains a priority and a challenge.

There were surprisingly few studies in the review that specifically measured tracking. Tracking relates to the extent to which a behaviour is stable between different ages[61], and requires individual measurements within a study population for at least two separate time-points. The majority of the studies simply presented overall or mean measures of physical activity for the population (or sub-groups) at different time-points, making estimation of tracking impossible.

Even studies that did measure tracking were very heterogeneous, in terms of the diversity of physical activity behaviours, the different methods used to measure them, and the particular choice of tracking co-efficient. Interpreting the tracking co-efficient can be challenging[62]. Also most studies provided only a point estimate of the co-efficient, making it difficult to judge reliability. These reasons made comparing results between studies problematic, and precluded any pooling of data.

Lengths of follow-up in our review ranged from 2 to 31 years. This has a direct effect on the tracking co-efficient[62,63], and it is notable that moderate tracking of physical activity behaviours was generally only observed where follow-up was less than five years. Otherwise, tracking of physical activity was low. The limited data available therefore suggest that physical activity behaviours do not track highly between different age-groups, and certainly not over more than a few years.

Despite low to moderate tracking of physical activity behaviours in all age-groups, active adolescents are slightly more likely than inactive adolescents to remain active, and less likely to become sedentary, in adulthood (even though overall the chances are that they will become inactive).

The importance of structured sports activities during and adolescence is highlighted by this review. High tracking co-efficients were observed for club sport participation[6] and training[10] during teenage years; this was evident despite both studies having long follow-up. There was also an effect of sports participation (with parents[24]) on later overall physical activity[18,21,22]. The mechanism by which this occurs needs to be explored further. It may be that adults continue with or re-start activities that they were previously introduced to. Or they may generally be more confident in participating in any sport or activity and be more committed to healthy physical activity levels. Alternatively, this may simply be a selection effect of individuals who have an interest in physical activity.

Although the actual probability of young people continuing with specific sports is quite low over even short follow-up[19-20], the probability of continuing in any individual or team

sport is higher. Thus it may be advisable to introduce young people to a wide range of activities during adolescence, rather than encouraging them to specialise in one or two.

There were no studies that evaluated the effects of sports participation during early childhood on later physical activity behaviours. This is an important finding because many of the initiatives promoting sports in young people are aimed at children of primary school age.

Conclusions

There are very few studies, particularly in the UK, that provide evidence on the tracking of physical activity behaviours across the life-course. The heterogeneity in the physical activity behaviours studied and the methods used to measure them, make synthesis of the evidence problematic. There is no standard approach to the measurement of physical activity.

There is a substantial and persistent decline in overall physical activity levels after the age of about 10-12 years in males and females.

Tracking of physical activity behaviours, as measured by tracking coefficients, is low to moderate. Moderate tracking is only observed where follow-up is short.

There is a suggestion that structured or organized sports may show higher levels of tracking than general physical activity. However, there were no studies that evaluated the effects of sports behaviour during early childhood on later physical activity behaviours.

Levels of participation in nearly all sports decrease during adolescence. The chances of young people continuing with any specific sport are relatively low, although the chances of them continuing with any individual or team activity are higher. However, adolescents who participate in sports are more likely to be active in late adolescence and young adulthood than those who do not.

Key References

1. Effective Public Health Practice Project quality assessment tool for quantitative studies.Accessed online 05/01/2009. http://www.ahs.uwaterloo.ca/~manske/Presentations/UNB%20workshop/QADictionary2003.pdf

2. Kelly LA, Reilly JJ, Jackson DM, Montgomery C, Grant S, Paton JY. Tracking physical activity and sedentary behavior in young children. *Pediatric Exercise Science* 2007;19:51-60.
3. Sallis JF, Berry CC, Broyles SL, McKenzie TL, Nader PR. Variability and tracking of physical activity over 2 yr in young children. *Medicine and Science in Sports and Exercise* 1995;27:1042-9.
4. Janz KF, Gilmore JM, Burns TL, Levy SM, Torner JC, Willing MC, Marshall TA. Physical activity augments bone mineral accrual in young children: The Iowa Bone Development Study. *Journal of Pediatrics* 2006;148:793-9.
5. Janz KF, Burns TL, Levy SM. Tracking of Activity and Sedentary Behaviors in Childhood: The Iowa Bone Development Study. *American Journal of Preventive Medicine* 2005;29(3):171-178.
6. Richards R, Williams S, Poulton R, Reeder AI. Tracking club sport participation from childhood to early adulthood. *Research Quarterly for Exercise & Sport* 2007;78:413-9.
7. Kristensen PL, Moller NC, Korsholm L, Wedderkopp N, Andersen LB, Froberg K. Tracking of objectively measured physical activity from childhood to adolescence: The European youth heart study. *Scandinavian Journal of Medicine & Science in Sports* 2008;18:171-8.
8. Chen X, Sekine M, Hamanishi S, Yamagami T, Kagamimori S. Associations of lifestyle factors with quality of life (QOL) in Japanese children: a 3-year follow-up of the Toyama Birth Cohort Study. *Child: Care, Health & Development* 2005;31:433-439.
9. Telama R, Yang X, Laakso L, Viikari J. Physical activity in childhood and adolescence as predictor of physical activity in young adulthood. *American Journal of Preventive Medicine* 1997;13:317-23.
10. Telama R, Leskinen E, Yang X. Stability of habitual physical activity and sport participation: a longitudinal tracking study. *Scandinavian Journal of Medicine & Science in Sports* 1996;6:371-8.
11. Pate RR, Trost SG, Dowda M, Ott AE, Ward DS, Saunders R, Felton G. Tracking of Physical Activity, Physical Inactivity, and Health-Related Physical Fitness in Rural Youth *Pediatric Exercise Science* 1999;11:364 - 376.
12. Janz KF, Dawson JD, Mahoney LT. Tracking physical fitness and physical activity from childhood to adolescence: the muscatine study. *Medicine & Science in Sports & Exercise* 2000;32:1250-7.
13. Trudeau F, Laurencelle L, Shephard RJ. Tracking of physical activity from childhood to adulthood. *Medicine & Science in Sports & Exercise* 2004;36:1937-43.
14. Parsons TJ, Power C, Manor O. Longitudinal physical activity and diet patterns in the 1958 British birth cohort. *Medicine and Science in Sports and Exercise* 2006;38:547-54.
15. Raustorp A, Svensson K, Perlinger T. Tracking of pedometer-determined physical activity: a 5-year follow-up study of adolescents in Sweden. *Pediatric Exercise Science* 2007;19:228-38.
16. Anderssen N, Wold B, Torsheim T. Tracking of physical activity in adolescence. *Research Quarterly for Exercise & Sport* 2005;76:119-29.
17. Hallal PC, Wells JC, Reichert FF, Anselmi L, Victora CG. Early determinants of physical activity in adolescence: prospective birth cohort study. *Br Med J* 2006;332:1002-7.

18. Telama R, Yang X, Hirvensalo M, Raitakari O. Participation in organized youth sport as a predictor of adult physical activity: A 21-year longitudinal study. *Pediatric Exercise Science* 2006; 17:76-88.
19. Aaron DJ, Storti KL, Robertson RJ, Kriska AM, LaPorte RE. Longitudinal study of the number and choice of leisure time physical activities from mid to late adolescence: implications for school curricula and community recreation programs. *Archives of Pediatrics & Adolescent Medicine* 2002;156:1075-80.
20. Wichstrom L. Predictors of future anabolic androgenic steroid use. *Medicine & Science in Sports & Exercise* 2006;38:1578-83.
21. Pfeiffer KA, Dowda M, Dishman RK, McIver KL, Sirard JR, Ward DS, Pate RR. Sport participation and physical activity in adolescent females across a four-year period. *Journal of Adolescent Health* 2006;39:523-9.
22. Tammelin T, Nayha S, Hills AP, Jarvelin MR. Adolescent participation in sports and adult physical activity. *Am J Prev Med* 2003; 24:1.
23. Tammelin T, Laitinen J, Nayha S. Change in the level of physical activity from adolescence into adulthood and obesity at the age of 31 years. *International Journal of Obesity & Related Metabolic Disorders: Journal of the International Association for the Study of Obesity* 2004;28:775-82.
24. Nelson MC, Gordon-Larsen P, Adair LS, Popkin BM. Adolescent physical activity and sedentary behaviour. Patterning and long-term maintenance. *Am J Prev Med* 2005; 28:259-266.
25. Dovey SM, Reeder AI, Chalmers DJ. Continuity and change in sporting and leisure time physical activities during adolescence. *Br J Sports Med* 1998:53-57.
26. Bratteby LE, Sandhagen B, Samuelson G. Physical activity, energy expenditure and their correlates in two cohorts of Swedish subjects between adolescence and early adulthood. *European Journal of Clinical Nutrition* 2005;59(11):1324-34.
27. Barnekow-Bergkvist M, Hedberg G, Janlert U, Jansson E. Physical activity pattern in men and women at the ages of 16 and 34 and development of physical activity from adolescence to adulthood. *Scandinavian Journal of Medicine & Science in Sports* 1996;6:359-70.
28. Fitzgibbon ML, Stolley MR, Schiffer L, Van Horn L, KauferChristoffel K, Dyer A. Hip-Hop to Health Jr. for Latino preschool children. *Obesity* 2006;14:1616-25.
29. Ness AR. The Avon Longitudinal Study of Parents and Children (ALSPAC)--a resource for the study of the environmental determinants of childhood obesity. *European Journal of Endocrinology* 2004;151 Suppl 3:U141-9.
30. McMurray RG, Harrell JS, Creighton D, Wang Z, Bangdiwala SI. Influence of physical activity on change in weight status as children become adolescents. *International Journal of Pediatric Obesity* 2008;3:69-77.
31. Telama R, Yang X. Decline of physical activity from youth to young adulthood in Finland. *Medicine & Science in Sports & Exercise* 2000;32:1617-22.
32. Parsons TJ, Power C, Manor O. Physical activity, television viewing and body mass index: a cross-sectional analysis from childhood to adulthood in the 1958 British cohort. *International Journal of Obesity* 2005;29:1212-21.
33. Kvaavik E, Tell GS, Klepp K. Predictors and tracking of body mass index from adolescent into adulthood: follow-up of 18 to 20 years in the Oslo Youth Study. *Archives of Pediatrics & Adolescent Medicine* 2003;157:1212-8.
34. Gordon-Larsen P, Nelson MC, Popkin BM. Longitudinal physical activity and sedentary behavior trends: Adolescence to adulthood. *American Journal of Preventive Medicine* 2004;27:277-283.
35. Pietila A, Hentinen M, Myhrman A. The health behaviour of Northern Finnish men in adolescence and adulthood. *International Journal of Nursing Studies* 1995;32:325-38.
36. Aarnio M, Winter T, Peltonen J, Kujajla UM, Kaprio J. Stability of leisure-time physical activity during adolescence – a longitudinal study among 16, 17 and 18 – year old Finnish youth. *Scand J Med Sci Sports* 2002; 12:179-185.
37. Kujala UM, Kaprio J, Rose RJ. Physical activity in adolescence and smoking in young adulthood: a prospective twin cohort study. *Addiction* 2007;102:1151-7.

38. Novak M, Ahlgren C, Hammarstrom A. A life-course approach in explaining social inequity in obesity among young adult men and women. *International Journal of Obesity* 2006;30:191-200.
39. Saakslahti A, Numminen P, Salo P, Tuominen J, Helenius H, Valimaki I. Effects of a three-year intervention on children's physical activity from age 4 to 7. *Pediatric Exercise Science* 2004;16(2):167-80.
40. Metcalf BS, Voss LD, Hosking J, Jeffery AN, Wilkin TJ. Physical activity at the government-recommended level and obesity-related health outcomes: a longitudinal study (Early Bird 37), 2008:772-777.
41. Manios Y, Kafatos A, Mamalakis G, Manios Y, Kafatos A, Mamalakis G. The effects of a health education intervention initiated at first grade over a 3 year period: Physical activity and fitness indices. *Health Education Research* 1998;13:593-606.
42. Nader PR, Bradley RH, Houts RM, McRitchie SL, O'Brien M. Moderate-to-vigorous physical activity from ages 9 to 15 years. *JAMA: Journal of the American Medical Association* 2008;300:295-305.
43. Kahn JA, Huang B, Gillman MW, Field AE, Austin SB, Colditz GA, Frazier AL. Patterns and determinants of physical activity in U.S. adolescents. *Journal of Adolescent Health* 2008;42:369-77.
44. Stein C, Fisher L, Berkey C, Colditz G. Adolescent physical activity and perceived competence: does change in activity level impact self-perception? *Journal of Adolescent Health* 2007;40:462.
45. Nader PR, Stone EJ, Lytle LA, Perry CL, Osganian SK, Kelder S, Webber LS, Montgomery D, Feldman HA, Wu H, Johnson C, Parcel GS, Luipker RV. Three-year maintenance of improved diet and physical activity: the CATCH cohort. *Archives of Pediatrics & Adolescent Medicine* 1999;153:695-704.
46. Duncan SC, Duncan TE, Strycker LA, Chaumeton NR. A cohort-sequential latent growth model of physical activity from ages 12 to 17 years. *Annals of Behavioral Medicine* 2007;33(1):80-9.
47. Baquet G, Twisk JW, Kemper HC, Van Praagh E, Berthoin S. Longitudinal follow-up of fitness during childhood: interaction with physical activity. *American Journal of Human Biology* 2006;18:51-8.
48. Brodersen NH, Steptoe A, Boniface DR, Wardle J. Trends in physical activity and sedentary behaviour in adolescence: ethnic and socioeconomic differences. *British Journal of Sports Medicine* 2007;41:140-4.
49. Manios Y, Kafatos A, Preventive Medicine and Nutrition Clinic University of Crete Research Team. Health and nutrition education in primary schools in Crete: 10 years follow-up of serum lipids, physical activity and macronutrient intake. *British Journal of Nutrition* 2006;95:568-575.
50. Fuchs R, Powell KE, Semmer NK, Dwyer JH, Lippert P, Hoffmeister H. Patterns of physical activity among German adolescents: The Berlin-Bremen study. *Preventive Medicine* 1988; 17:746-763.
51. Nelson MC, Neumark-Stzainer D, Hannan PJ, Sirard JR, Story M. Longitudinal and secular trends in physical activity and sedentary behavior during adolescence. *Pediatrics* 2006;118(6):e1627-34.
52. Kettaneh A, Oppert JM, Heude B, Deschamps V, Borys JM, Lommez A, Ducimetiere P, Charles MA. Changes in physical activity explain paradoxical relationship between baseline physical activity and adiposity changes in adolescent girls: the FLVS II study. *International Journal of Obesity* 2005;29(6):586-93.
53. Baxter-Jones ADG, Eisenmann JC, Mirwald RL, Faulkner RA, Bailey DA. The influence of physical activity on lean mass accrual during adolescence: a longitudinal analysis. *J Appl Physiol* 2008;105:734-741.
54. French SA, Story M, Fulkerson JA, Himes JH, Hannan P, Neumark-Sztainer D, Ensrud K. Increasing weight-bearing physical activity and calcium-rich foods to promote bone mass gains among 9-11 years old girls: Outcomes of the Cal-Girls study. *Int Journal of Behavioural Nutrition and Physical Activity* 2005; 2:8.

55. Kimm SY, Glynn NW, Obarzanek E, Kriska AM, Daniels SR, Barton BA, Liu K. Relation between the changes in physical activity and body-mass index during adolescence: a multicentre longitudinal study. *Lancet* 2005;366(9482):301-7.
56. Yang X, Telama R, Viikari J, Raitakari OT. Risk of obesity in relation to physical activity tracking from youth to adulthood. *Medicine and Science in Sports and Exercise* 2006;38:919-25.
57. Twisk JW, Kemper HC, Mellenbergh GJ, van Mechelen W, Post GB. Relation between the longitudinal development of lipoprotein levels and lifestyle parameters during adolescence and young adulthood. *Annals of Epidemiology* 1996;6:246-56.
58. Benefice E, Garnier D, Ndiaye G. High levels of habitual physical activity in west African adolescent girls and relationship to maturation, growth, and nutritional status: results from a 3-year prospective study. *American Journal of Human Biology* 2001;13:808-20.
59. Godin G, Anderson D, Lambert L, Desharnais R. Identifying factors associated with regular physical activity in leisure time among Canadian adolescents. *American Journal of Health Promotion* 2005;20:20-7.
60. Hardy LL, Bass SL, Booth ML. Changes in Sedentary Behavior among Adolescent Girls: A 2.5-Year Prospective Cohort Study. *Journal of Adolescent Health* 2007;40:158-165.
61. Kue Young T. Population Health. 2005, New York: Oxford University Press. P257.
62. Twisk JWR, Kemper HCG, Mellenbergh GJ. Mathematical and analytical aspects of tracking. *Epidemiologic Reviews* 1994; 16:165-183.
63. Malina RM: Tracking of physical activity and physical fitness across the lifespan. *Res Q Exerc Sport* 1996, 67(3 Suppl):S48-57.

Tables

Table 1: Summary table for 15 studies that reported tracking (correlation) or stability co-efficients

Study	N /Age at baseline	Follow-up	Activity	Males	Females	All
Follow-up commencing in early childhood (birth to 8 years)						
Kelly LA *et al.* 2007[2] UK	42 3.8 ± 0.5 yrs	2 yrs	Total physical activity % Moderate/vigorous physical activity % Sedentary behaviour			0.35 0.37 0.35
Sallis JF *et al.* 1995[3] USA	351 4.4 ±0.52 yrs	2 yrs	At home During recess			0.38-0.16 0.29-0.04
Janz KF *et al.* 2006[4] USA	370 5.3 yrs	3 yrs	Overall physical activity (counts/min) Active minutes (freq)	0.33 0.40	0.36 0.40	
Janz KF *et al.* 2005[5] USA	378 5.6 ± 0.5 yrs	3 yrs	Overall physical activity (counts/min) Vigorous physical activity Moderate physical activity TV Viewing Video playing	0.32 0.39 0.40 0.46 0.18	0.38 0.39 0.32 0.52 0.37	
Richards R *et al.* 2007[6] New Zealand	992 7 yrs	14 yrs	All activity Club sport participation			0.09 *0.59*
Follow-up commencing in middle childhood (8 to 12 years)						
Kristensen PL *et al.* 2008[7] Denmark	384 8-10 yrs	5 yrs	Mean physical activity	*0.53*	*0.48*	
Chen X *et al.* 2005[8] Japan	7,794 9.7 yrs	3 yrs	Frequency of physical activity TV viewing Video games	0.34 0.24 0.15	0.27 0.21 0.09	0.31 0.23 0.13
Telama R *et al.* 1997[9] Finland	2,309 9-18 yrs	12 yrs	Physical activity index: 9 yrs 12 yrs 15 yrs 18 yrs	0.15 0.27 0.21 0.21	-0.01 0.27 0.17 0.26	
Telama R *et al.* 1996[10]	2,309	12 yrs	Frequency of physical activity: 9 yrs	0.14	0.06	

Finland	9-18 yrs		12 yr 15 yrs 18 yrs Intensity of physical activity: 9 yrs 12 yr 15 yrs 18 yrs Intensity sports club training: 9 yrs 12 yrs 15 yrs 18 yrs	0.06 0.06 0.27 0.13 0.19 0.24 0.39 0.37 0.36 0.44 0.56	0.20 0.11 0.29 0.06 0.26 0.03 0.22 0.32 0.19 0.24 0.42	
Pate, RR *et al.* 1999[11] USA	181 10.7 + 0.7 yrs	3 yrs	Vigorous physical activity Moderate/vigorous physical activity TV/Games Phone/Homework/Music	0.23 0.08 0.42 0.27	0.23 0.20 0.39 0.17	0.36 0.24 0.41 0.25
Janz, KF *et al.* 2000[12] USA	110 10.8 yrs	5 yrs	Physical activity TV & video game	0.32 0.48	0.43 0.16	
Trudeau F et al. 2004[13] Canada	166 10-12 yrs	22 yrs	Total physical activity TV watching Non-organized total Organized total	0.17 -0.01 0.16 0.26	0.14 -0.11 0.12 -0.03	0.20 -0.02 0.19 0.16
Parsons TJ *et al.* 2006[14] UK	11,407 11 yrs	31 yrs	Activity TV	0.03 0.02	-0.01 -0.02	
Raustorp A *et al.* 2007[15] Sweden	97 12.7 + 0.8 yrs	4 yrs	Total physical activity	0.35	0.06	
Follow-up commencing in adolescence (13 to 18 years)						
Anderssen N *et al.* 2005[16] Norway	557 13.3 yrs	8 yrs	Frequency of physical activity Time spent in physical activity	0.22 0.27 *0.15*	0.18 0.25 *0.09*	
NB Stability co-efficients in italics						

Table 2: Summary table for studies that measured sports participation at baseline

Study	N /Age at baseline	Follow -up	Measurements	Interpretation
Hallal PC *et al.* 2006 Brazil[17]	634 4 years	7 years	Physical activity score at follow up (mins/week) by baseline sports performance	Physical activity score was slightly higher in subjects who had average or above average sports performance at baseline
Telama R *et al.* 2006[18] Finland	2,309 9- 18 years	12 years	Odds ratio for being physically active (*v* inactive) in adulthood by sports behaviour during adolescence	The odds of being a physically active adult increased with increasing sports club training during childhood and adolescence, with competition at increasingly high level and with increased duration of sports club training. The effects were statistically significant in males and females, and the odds ratios were as high as 13 in some cases.
Aaron DJ *et al.* 2002[19] USA	782 12 -15 years	3 years	Positive and negative predictive values of participation at baseline predicting participation at follow-up in a range of sports for males and females.	The PPV of continuing with a specific sport ranged from 0.04 (cycling) to 0.71 (basketball) in males and 0.02 (cycling) and 0.90 (baseball) in females. The PPVs of continuing with any individual or team sport were much higher (0.89 and 0.64 for males and 0.60 and 0.66 for females). NPVs were all higher than 0.60.
Wichstrom L *et al.* 2006[20] Finland	2,924 12 – 20 years	2 years	Positive and negative predictive values of participation at baseline predicting participation at follow-up of power sports in males.	PPV was 0.42, NPV was 0.98
Pfeiffer KA *et al.* 2006[21] USA	429 13 years	4 years	Odds ratio for being physically active (*v* active) at end of follow-up (blocks of moderate/vigorous or vigorous physical activity) by sports behaviour at baseline (8^{th} grade) or 1 year later; in females	In females, the odds ratios of being physically active at follow-up increased (up to double) with increased sports classes in 8^{th} and 9^{th} grade.
Tammelin T *et al.* 2003[22]	7,794 (5,286)	17 years	% of subjects at baseline / follow-up, with odds ratios for being active (*v* inactive) at	Cycling and walking increased over follow-up in males and females, as did gym attendance in males. Cycling,

Finland	14 years		follow-up by sports participation at baseline	walking and running at baseline increased the odds of being physically active at follow-up.
Tammelin T *et al.* 2004[23] Finland	5,706 14 years	17 years	% of subjects classified by change in activity levels over follow-up (sports participation measured at baseline, physical activity levels measured at follow-up)	Over half of males and females were active at baseline and follow-up. Less than 10% were inactive at both time-points. 10% of males and 20% of females became active, but 23% and 17% respectively became inactive.
Nelson *et al*. 2005[24] USA	11,957 14 years	7 years	Odds of meeting activity guidelines in young adulthood by sports behaviour during adolescence.	Skaters and gamers, children who played sports with parents, those who used a recreation centre, those active in school and those with limited TV watching were all more likely to meet activity guidelines in adulthood, than those who watched a lot of TV. The odds ratios were all statistically significant and between 1.8 and 2.6.
Dovey SM *et al.* 1998[25] New Zealand	775 15 years	3 years	No. of participants at baseline and follow-up, for different sports.	Participation in almost every sport decreased in males and females.
Bratteby L-E *et al.* 2005[26] Sweden	160 15 years	6 years	% of subjects at baseline and follow-up for different sports behaviours.	Sports club membership, competitive sport and regular cycling/walking decreased over follow-up, but regular training increased, in males and females.
Barnekow-Bergkvist M *et al.* 1996[27] Finland	425 16 years	18 years	No. of subjects at baseline and follow-up, for different sports.	Participation in almost every sport decreased in males and females.

Table 3: Summary table for studies that measured frequencies of physical activity behaviours

Study	N / Age at baseline	Follow-up	Measurement	Interpretation
Fitzgibbon ML *et al*. 2006[28] USA	199 4 years	2 years	% of subjects carrying out physical activity at baseline and follow-up	Proportions of subjects doing more than 7 sessions per week decreased from 22.4% to 17.8%.
Ness AR. 2004[29] UK	13,971 9 years	5 years	Numbers of subjects carrying out vigorous physical activity at 9,10, 11, 12,,13,14 years	The highest numbers of subjects doing physical activity daily peaked at 10 years. No physical activity peaked at 14 years.
McMurray RG *et al*. 2008[30] USA	456 9-11 years	5 years	Mean no. of sessions per week of moderate and vigorous physical activity in normal weight children	Mean number of sessions of moderate and vigorous physical activity declined by about two-thirds in males and females.
Telama R and Yang X. 2000[31] Finland	2,309 9-18 years	9 years	% decrease in physical activity frequency between 9-12 years, 12- 15 years, 15-18 years, 18-21 years, 21-24 years,24-27 years	There was a decrease in every age-group for males; the biggest decrease was 26.4% between 12-15 years and 15.9% between 15-18 years. These age-groups also showed the biggest decreases for girls, although there were small increases between 9-12, 18-21, 24-27 years
Parsons TJ *et al.* 2005[32] UK	11,407 11 yrs	31 yrs	% of subjects carrying out physical activity at specific frequency levels at 11,16,23,33 and 42 years	The highest proportions of subjects doing physical activity at lowest frequency occurred at the ages of 16 years and 23 years in males and females.
Kvaavik E *et al.* 2003 Norway[33]	485 11-16 years	18 years	% of subjects at baseline / follow-up by frequency of leisure physical activity	The proportions of subjects carrying out leisure time physical activity more than twice a week decreased, and the proportion less than once a month increased.
Gordon-Larsen P *et al.* 2004[34] USA	13,030 11-21 years	7 years	% of subjects classified by activity change over follow-up (active: > 5 sessions of moderate or vigorous physical activity / week)	About half the males and 70% of females were inactive at baseline and remained inactive. 6% of boys and 3% of girls were active and remained active, but if they were active at baseline, they were more likely to become inactive than stay active.
Pietila A *et al.* 1995[35] Finland	1,489 14 years	10 years	% of subjects inactive /active at follow-up (physical activity > or < once a week) by baseline physical activity frequency	71% of subjects active at baseline became inactive. 55% of subjects inactive at baseline stayed inactive.

Aarnio *et al* 2002[36] Finland	1,934 16 years	2.5 years	% of subjects carrying out physical activity at baseline and follow-up at specific frequency levels.	The changes in proportions were all less than 2%.
Kujala UM *et al.* 2007[37] Finland	4,240 16 years	7 years	% of subjects active / occasionally active / inactive at follow-up by activity frequency at baseline	Active subjects at baseline were more likely to be active at follow-up, but only 54% of males and 62% of females stayed active. Inactive subjects were more likely to be inactive at follow-up. Only 7% and 12% became active.
Novak M *et al.* 2006[38] Sweden	1,044 16 years	14 years	% of subjects never doing physical activity at baseline and follow-up	Proportions of males never doing physical activity increased from 11.6% to 28.4%, and in females from 7.2% to 27.2%.

Table 4: Summary table for studies that measured time spent in physical activities

Study	N / Age at baseline	Follow-up	Measurement	Interpretation
Saakslahti A *et al.* 2004[39] Finland	228 4 years	2 years	Hours of physical activity at weekend at baseline and follow-up	In general, hours of low and high activity physical activity, both indoors and outdoors, increased slightly or remained the same for males and females.
Metcalf BS *et al.* 2008[40] UK	212 5 years	3 years	Mean daily no. of active mins (>=2500 actigraph counts/min) at 5,6,7,8 years	Active minutes increased slightly over follow-up
Manios Y *et al.* 1998[41] Greece	483 6 years	3 years	Hours / week of moderate / vigorous physical activity at baseline and follow-up	Hours per week of moderate / vigorous physical activity increased slightly over follow-up.
Nader PR *et al.* 2008[42] USA	1,032 9 years	6 years	Mean daily mins of moderate / vigorous physical activity at 9, 11, 12, 15 years on weekdays and weekend	Mean daily minutes decreased over follow-up by up to three-quarters for males and females on weekdays and weekend.
Kahn JA *et al.* 2008[43] USA	12,812 9-15 years	2 years	Hours / week of moderate / vigorous physical activity at baseline and follow-up by age at baseline	Hours per week of moderate / vigorous physical activity decreased over a 2 year follow-up for boys aged 10 and over, and girls aged 12 and over.
Stein C *et al.* 2007[44] USA	8,670 9-16 years	2 years	Hours of activity / week at baseline and follow-up	Hours of activity increased slightly in males and decreased slightly in females.
Nader PR *et al.* 1999[45] USA	3,714 10 years	3 years	Mean daily mins of vigorous and total physical activity at 10, 11, 12, 13 years	Mean daily minutes decreased substantially in males and females.
Duncan SC *et al.* 2007[46] USA	10-14 years 371	4 years	Mean days / week of hard and typical physical activity at baseline and follow-up	There was a decrease in the no. of days per week of subjects doing both hard and typical physical activity.
Baquet *et al.* 2006[47] France	158 11 years	4 years	Mins / day of moderate / vigorous physical activity at baseline and follow-up	There was a decrease in minutes per day of moderate / vigorous physical activity for males and females.
Brodersen	5,863	4 years	Mean no. of days / week of vigorous	Median days per week of vigorous physical activity

NH *et al.* 2007[48] UK	11-12 years		physical activity at baseline and at 1,2,3,4 years follow-up	decreased over follow-up for males and females.
Manios Y *et al.* 2006[49] Greece	187 12 years	4 years	Mins / week of moderate / vigorous physical activity at baseline and follow-up	There was a decrease in minutes per week of moderate / vigorous physical activity.
Fuchs R *et al.* 1988[50] Germany	932 12-14 years	2 years	Median hours / week of moderate, vigorous and total physical activity at baseline and follow-up by type of school	Median hours per week decreased for all types of activity for both males and females at 'gym' schools, and for females at 'haupt' schools'. Total and moderate physical activity increased slightly for males at 'haupt' schools.
Nelson MC *et al.* 2006[51] USA	2,516 12 years 15 years	5 years	Hours / week of moderate / vigorous physical activity at baseline and follow-up	There was a decrease in hours per week of moderate / vigorous physical activity for both males and females, at baseline age of 12 years and 15 years.
Kettaneh *et al.* 2005[52] France	436 13 years	2 years	Hours / week of leisure time physical activity at baseline and follow-up	Hours per week of leisure time physical activity decreased for males and females.

Table 5: Summary table for studies that used a physical activity score

Study	N /Age at baseline	Follow-up	Measurements	Interpretation
Studies using PA scores				
Hallal PC *et al.* 2006[17] Brazil	634 4 years	7 years	Median physical activity score at follow-up by baseline physical activity level	The median score was 178 in children with low baseline physical activity level, and 270 /280 in those average or above average at baseline.
Baxter-Jones ADG *et al.* 2006[53] Canada	222 8-15 years	6 years	Physical activity score (1 = low, 5 = high) at biological age (years from peak height volume)	The physical activity score decreased from the age at which peak height volume was attained (biological age) in males and females.
French SA *et al.* 2005[54] USA	30 9 years	2 years	Weight bearing physical activity score at baseline and follow-up in females	The physical activity score increased.
Kimm SYS *et al.* 2005[55] USA	2,287 9-10 years	9 years	Physical activity scores during follow-up in black and white girls, who were inactive, moderately active or active at baseline.	The physical activity score decreased in all black and white girls, regardless of baseline activity level. Active girls at baseline had highest physical activity scores at follow-up.
McMurray RG *et al*. 2008[30] USA	456 9-11 years	5 years	Physical activity score at baseline and follow-up in normal weight children	The physical activity score decreased by over one half in males and females.
Yang X *et al.* 2006[56] Finland	1,319 9-18 years	21 years	% of subjects classified by change in physical activity index over follow-up	About one-fifth of males and females were persistently active or persistently inactive. About one-third either increased or decreased activity levels.
Twisk *et al.* 1996[57] Netherlands	181 13 years	14 years	Total weighted activity score: mean METs / week at 13, 14, 15, 16, 21 and 27 years	Overall, the activity score decreased in males and females over follow-up, although was relatively stable in females between 15 and 21 years.
Benefice E *et al.* 2001[58] Senegal	40 13 years	2 years	PAL units at baseline and follow-up in females	PAL units decreased over follow-up.
Bratteby L-E *et al.* 2005[26]	160 15 years	6 years	Physical activity level at baseline and follow-up	Physical activity levels increased slightly in males and females.

Sweden				
Studies using recommended guidelines for PA				
Godin G *et al.* 2004[59] Canada	740 13 years	2 years	% meeting recommended physical activity levels at baseline and follow-up	The proportions decreased to 23% in males and 13% in females.

Table 6: Summary table for studies that measured sedentary behaviours

Study	N / Age at baseline	Follow-up	Measurement	Interpretation
Hallal PC *et al.* 2006[17] Brazil	634 4 years	7 years	% sedentary lifestyle at follow-up by baseline physical activity level	Two-thirds of children who had below average baseline physical activity were sedentary at follow-up. The proportions were just over one half for those of average or above average baseline physical activity level.
Fitzgibbon ML *et al*. 2006[28] USA	199 4 years	2 years	TV viewing (hrs per day) at baseline and follow-up	TV viewing decreased from 2.6 hours to 2.3 hours over follow-up
Gordon-Larsen P *et al.* 2004[34] USA	13,030 11-21 years	7 years	% of subjects classified by sedentary behaviour change over follow-up (sedentary: > 14 hours TV / week)	44% of males and 29% of females were sedentary at baseline and follow-up. 18% and 29% were active at the two time-points. Nearly one-fifth of males and females were either sedentary and became active, or vice versa.
Hardy LL *et al.* 2007[60] Australia	163 12 years	2.5 years	Mean hours / week of sedentary behaviour at baseline and follow-up in females	Sedentary behaviour in females increased from 35 to 49 hours per week.
Nelson MC *et al.* 2006[51] USA	2,516 12 years[*] 15 years[µ]	5 years	Hours / week at baseline and follow-up of TV / video, or leisure time computer use	TV and video watching increased slightly or remained the same. Leisure time computer use increased in males and females.
Kettaneh *et al.* 2005[52] France	436 13 years	2 years	Hours / week of TV / video at baseline and follow-up	Hours per week of TV and video increased by 5 hours in males and 2 hours in females
Novak M *et al.* 2006[38] Sweden	1,044 16 years	14 years	% of subjects watching several TV programmes daily at baseline and follow-up	Proportions of males watching several programmes daily increased from 40% to 45%, and proportions of females from 17% to 32%.

Figures

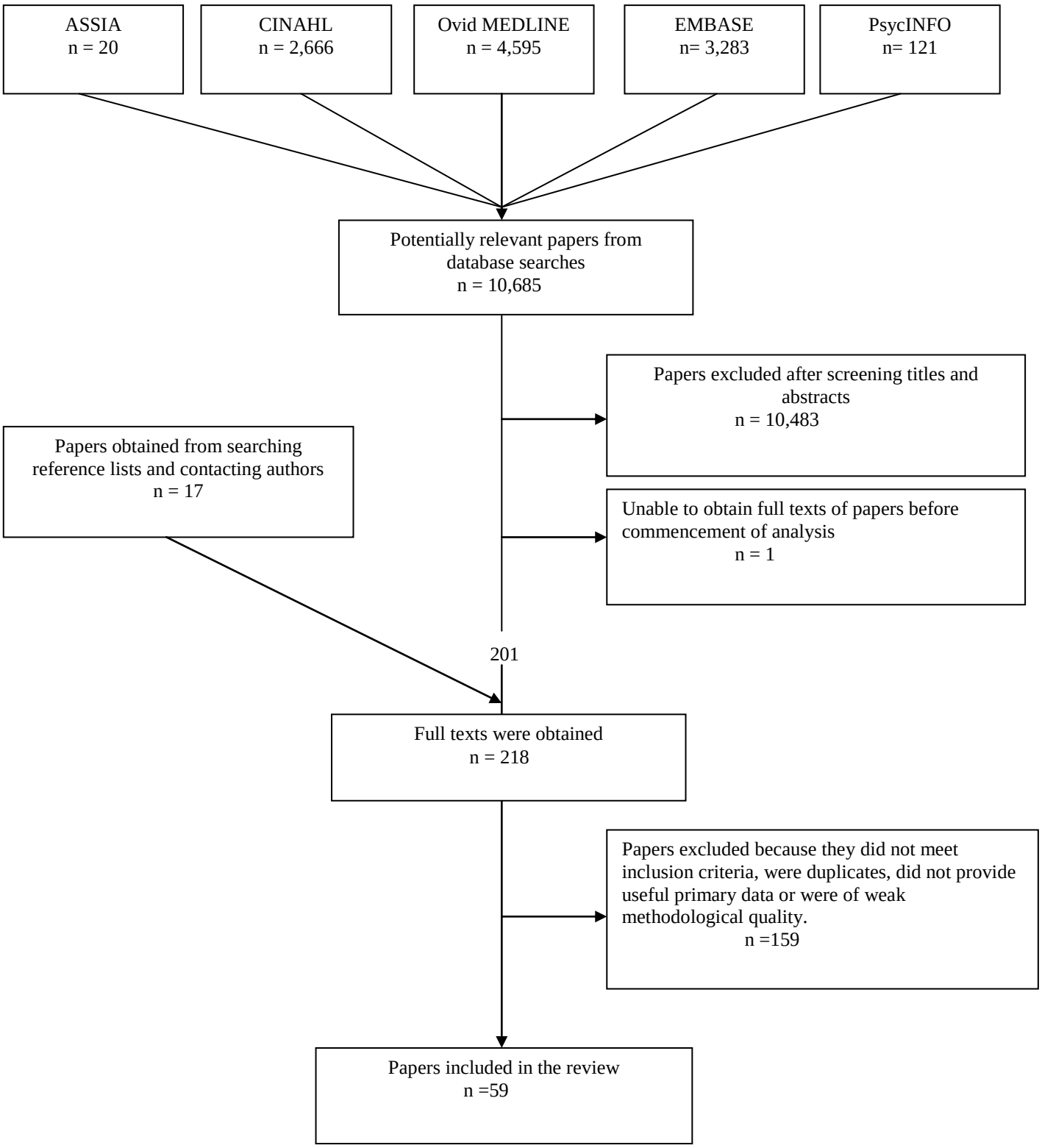


Fig 1: Selection of papers for study

Fig 2: Tracking co-efficients for total physical activity, ordered by length of follow-up and stratified by period of childhood/adolescence.

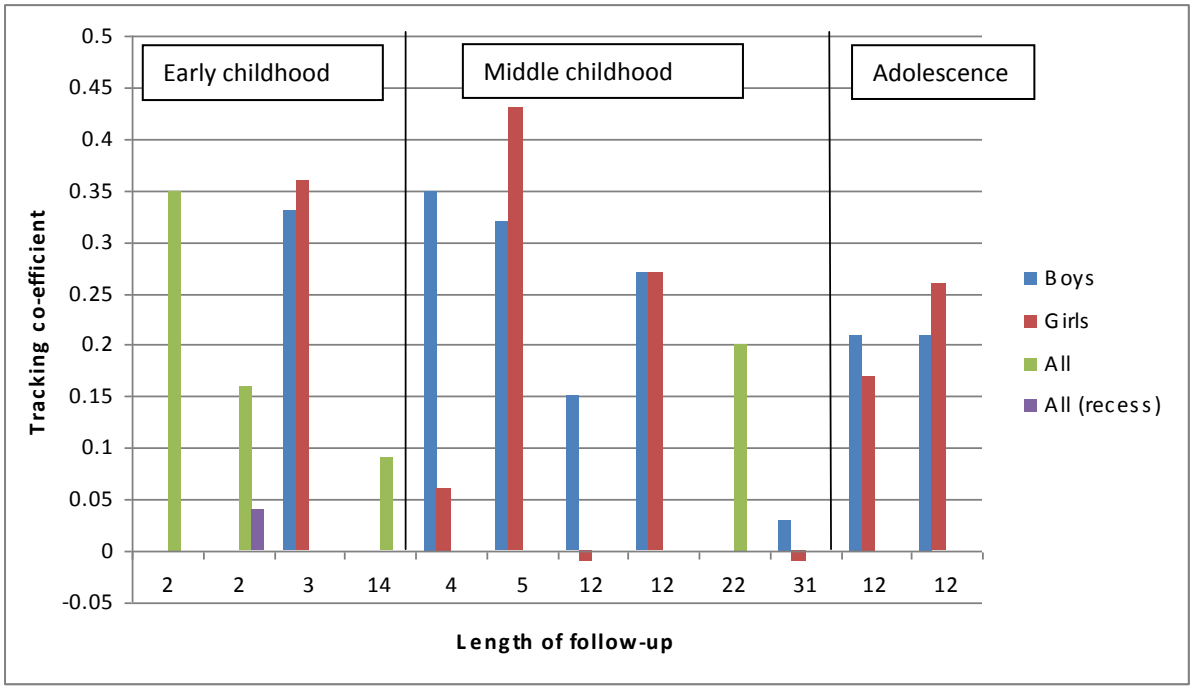


Fig 3: Tracking co-efficients for total physical activity for boys and girls, ordered by length of follow-up and stratified by period of childhood / adolescence.

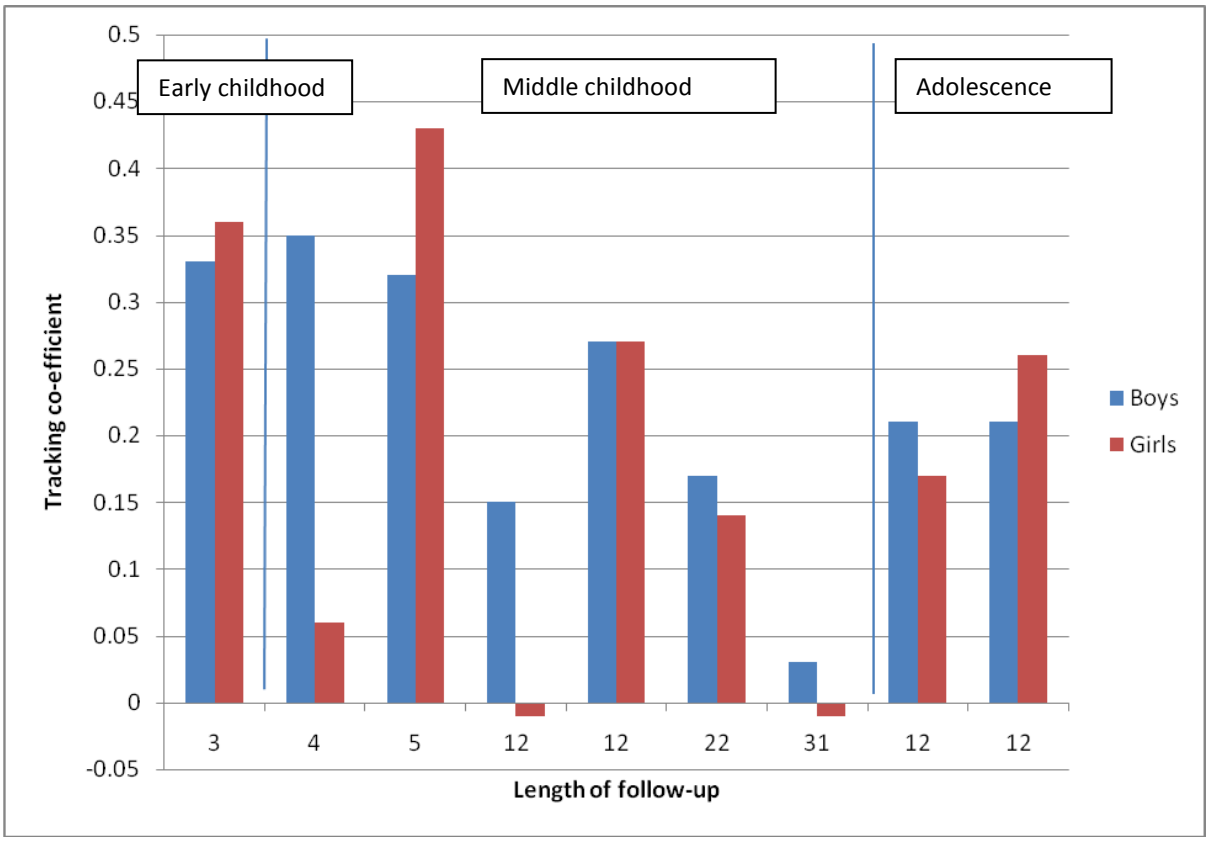


Fig 4: Tracking co-efficients for different types of activity in early childhood, ordered by length of follow-up.

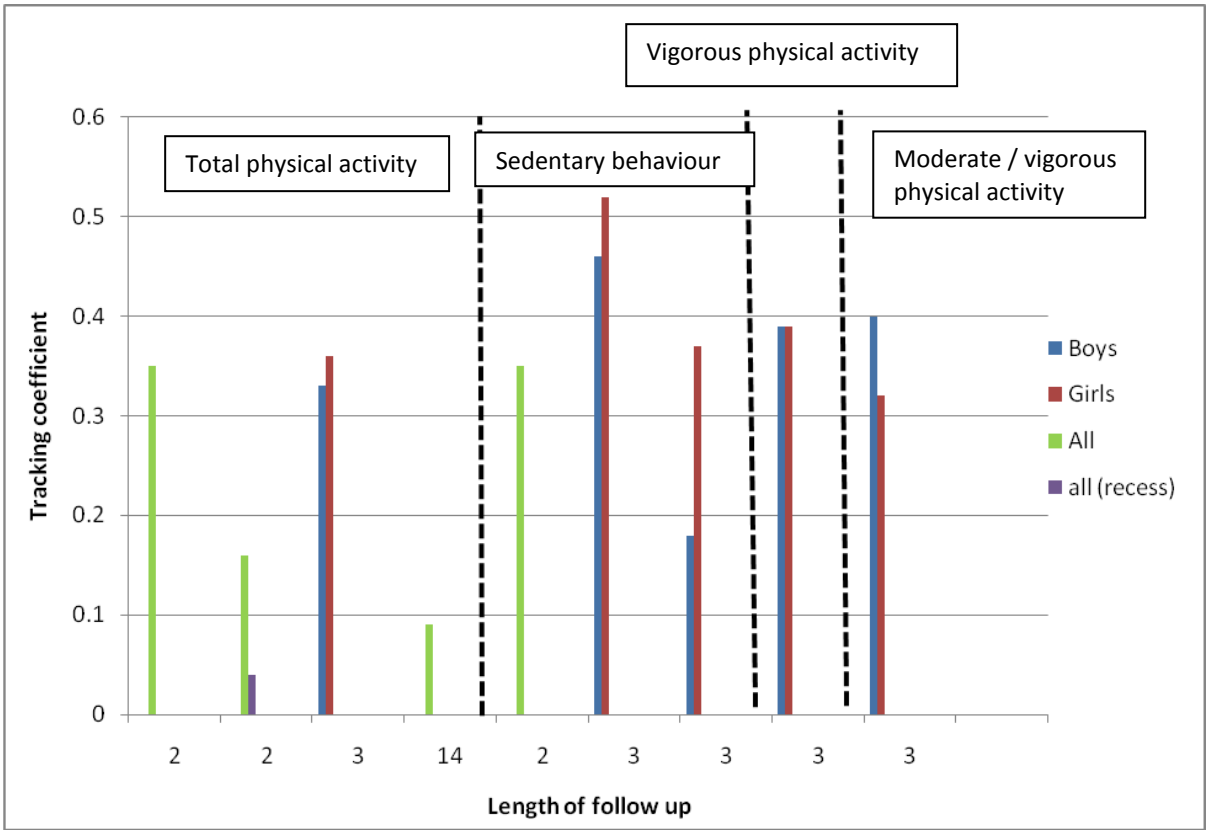
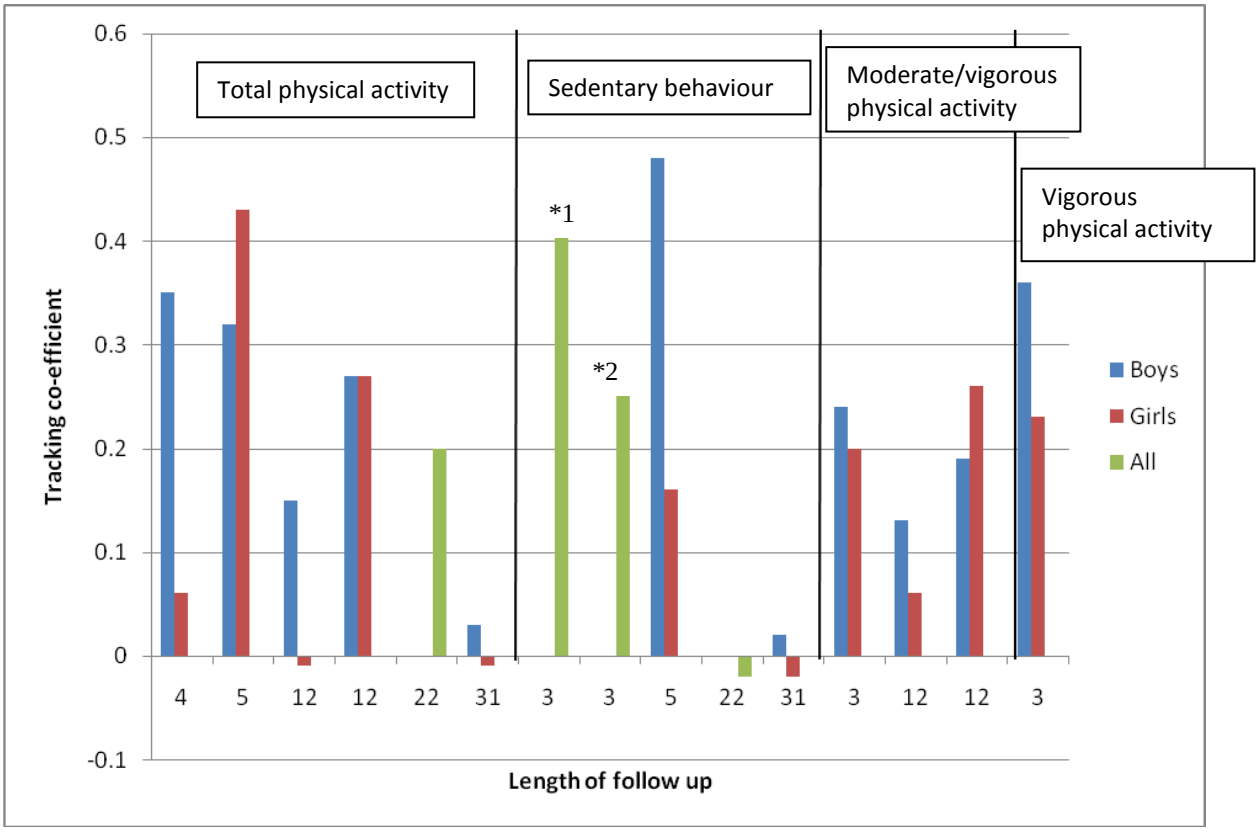


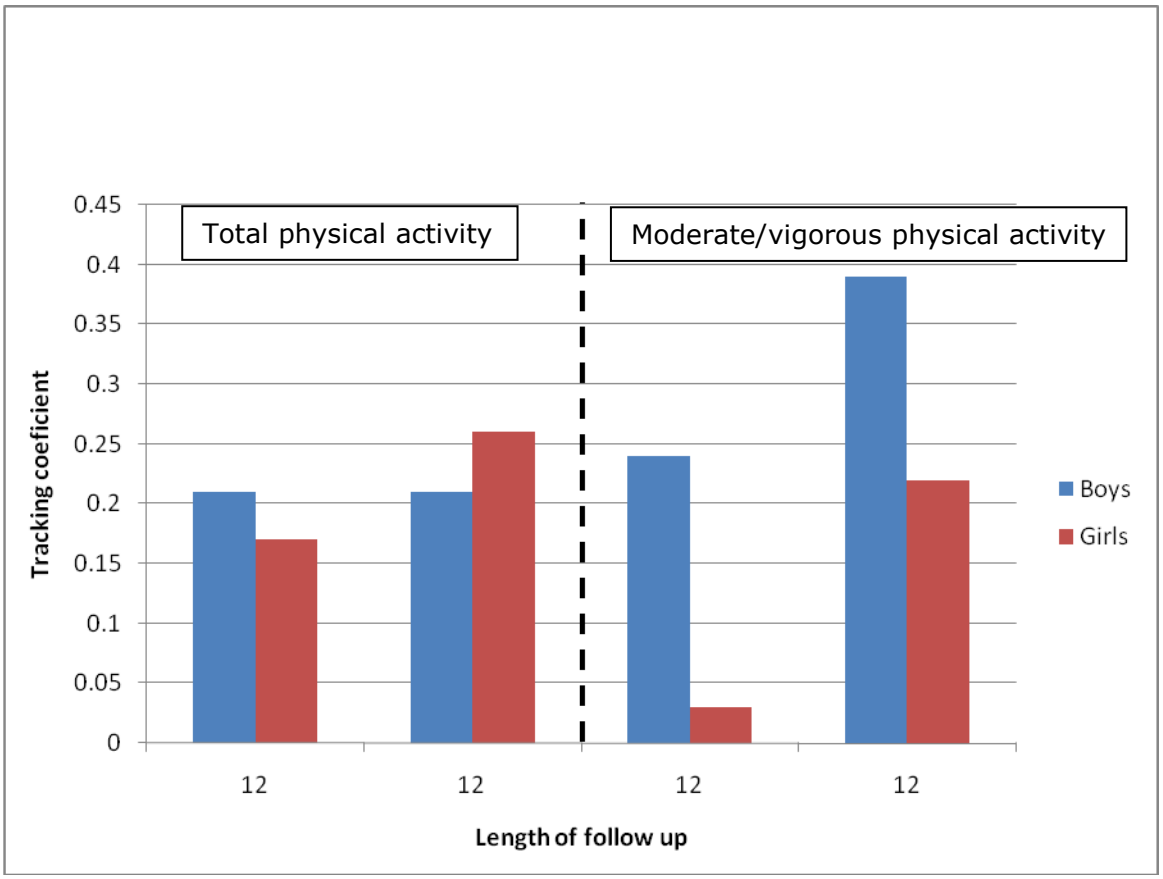
Fig 5: Tracking co-efficients for different types of activity in middle childhood, ordered by length of follow-up.



*1 TV/video

*2 Phone/homework/music

Fig 6: Tracking co-efficients for different types of activity in adolescence, ordered by length of follow-up.



APPENDIX 1

SEARCH STRATEGIES

MEDLINE (1950 – August week 3 2008)

1. exp exercise/
2. exercis$.af.
3. (aerobics or PA or physical inactivity).af.
4. exp PA/
5. (fitness adj (class$ or regime$ or program$)).af.
6. (physical adj (training or education)).af.
7. exp sport$/
8. 1 or 2 or 3 or 4 or 5 or 6 or 7
9. exp Randomized Controlled Trial/
10. exp Intervention Studies/
11. exp longitudinal studies/
12. exp evaluation studies/
13. exp follow up studies/
14. exp prospective studies/
15. prospectiv$.tw.
16. 11 or 13 or 10 or 9 or 12 or 15 or 14
17. exp child/
18. exp adolescent/
19. exp child,preschool/ or child.mp.
20. exp infant/
21. (child$ or adolescen$ or infant$).af.
22. (teenage$ or young people or young person or young adult$).af.
23. (school children or schoolchildren).af.
24. (boys or girls or youth or youths).af.
25. 22 or 21 or 18 or 24 or 23 or 19 or 17 or 20
26. 25 and 8 and 16
27. (animals or (human and animals)).mp.
28. 26 not 27
29. exp neoplasms/
30. exp pregnancy/
31. exp Cardiovascular Physiologic Processes/ or exp Models, Cardiovascular/ or exp Cardiovascular Diseases/ or exp Cardiovascular Physiology/ or exp Cardiovascular System/ or exp Cardiovascular Deconditioning/ or exp Pregnancy Complications, Cardiovascular/ or exp Tuberculosis, Cardiovascular/ or exp Cardiovascular Surgical Procedures/ or exp Cardiovascular Agents/ or exp Cardiovascular Infections/ or exp

Cardiovascular Abnormalities/ or exp Diagnostic Techniques, Cardiovascular/ or exp Syphilis, Cardiovascular/ or exp Cardiovascular Physiologic Phenomena/
32. exp Diabetes Mellitus, Experimental/ or exp Diabetes Insipidus, Nephrogenic/ or exp Diabetes Mellitus, Lipoatrophic/ or exp Diabetes Mellitus, Type 2/ or exp Diabetes Insipidus/ or exp Diabetes Mellitus, Type 1/ or exp Diabetes Insipidus, Neurogenic/ or exp Diabetes, Gestational/ or exp Diabetes Complications/ or exp Diabetes Mellitus/
33. exp "wounds and injuries"/
34. 33 or 32 or 30 or 31 or 29
35. 28 not 34

EMBASE (1980 to 2008 week 31)

1. exp exercise/
2. exercis$.af.
3. exp PA/
4. (aerobics or PA or physical inactivity).af.
5. (fitness adj (class$ or regime$ or program$)).af.
6. (physical adj (training or education)).af.
7. exp sport$/
8. 1 or 2 or 3 or 4 or 5 or 6 or 7
9. Randomized Controlled Trial/
10. exp intervention studies/
11. exp longitudinal studies/
12. exp follow up studies/
13. exp prospective studies/
14. prospectiv$.tw.
15. 9 or 10 or 11 or 12 or 13 or 14
16. exp child/
17. exp adolescent/
18. exp child, preschool/ or child.mp.
19. exp infant/
20. (child$ or adolescen$ or infant$).af.
21. (schoolchildren or schoolchildren).af.
22. (boys or girls or youth or youths).af.
23. 16 or 17 or 18 or 19 or 20 or 21 or 22
24. 8 and 15 and 23
25. (animals or (human and animals)).mp.
26. 24 not 25
27. exp neoplasms/
28. exp pregnancy/

29. exp CARDIOVASCULAR NURSING/ or exp CARDIOVASCULAR SYSTEM EXAMINATION/ or exp CARDIOVASCULAR GENE THERAPY/ or exp CARDIOVASCULAR RISK/ or exp CARDIOVASCULAR AUTOREGULATION/ or exp CARDIOVASCULAR SYSTEM TUMOR/ or exp CARDIOVASCULAR AGENT/ or exp CARDIOVASCULAR SURGERY/ or exp ATHEROSCLEROTIC CARDIOVASCULAR DISEASE/ or exp INTERVENTIONAL CARDIOVASCULAR PROCEDURE/ or exp CARDIOVASCULAR RESPONSE/ or exp CARDIOVASCULAR PERFORMANCE/ or exp CARDIOVASCULAR FUNCTION/ or exp CARDIOVASCULAR DISEASE/ or exp CARDIOVASCULAR INFLAMMATION/ or exp CARDIOVASCULAR PARAMETERS/ or exp CARDIOVASCULAR SYSTEM/ or exp CARDIOVASCULAR PROCEDURES/ or exp CARDIOVASCULAR REFLEX/ or exp CARDIOVASCULAR INFECTION/ or exp CARDIOVASCULAR EFFECT/ or exp CARDIOVASCULAR SYMPTOM/ or exp CARDIOVASCULAR MALFORMATION/ or exp CARDIOVASCULAR EQUIPMENT/
30. diabetes.mp.
31. (wounds and injuries).mp.
32. 27 or 28 or 29 or 30 or 31
33. 26 not 32

CINAHL (1982 to August week 2 2008)

1. exp randomized clinical trials/
2. exp intervention studies/
3. exp follow up studies/
4. exp prospective studies/
5. prospectiv$.tw.
6. exp evaluation studies/
7. 1 or 2 or 3 or 4 or 5 or 6
8. exp exercise/
9. exp PA/
10. exercis$.af.
11. (aerobics or PA or physical inactivity).af.
12. (physical training or physical education).af.
13. exp sport$/
14. (fitness adj (class$ or regime$ or program$)).af.
15. 8 or 9 or 10 or 11 or 12 or 13 or 14
16. exp child/
17. exp adolescent/
18. exp child, preschool/ or child.mp.
19. exp infant/
20. (child$ or adolescen$ or infant$).af.

21. (teenage$ or young people or young people or young person or young adult$).af.
22. (schoolchildren or school children).af.
23. (boys or girls or youth or youths).af.
24. 16 or 17 or 18 or 19 or 20 or 21 or 22 or 23
25. 7 and 15 and 24
26. (animals or (human and animals)).mp.
27. 25 not 26
28. exp neoplasms/
29. exp pregnancy/
30. exp CARDIOVASCULAR DISEASES/ or exp CARDIOVASCULAR AGENTS/ or exp CARDIOVASCULAR NURSING/ or exp CARDIOVASCULAR SYSTEM/ or exp TECHNOLOGY, CARDIOVASCULAR/ or exp DIAGNOSIS, CARDIOVASCULAR/ or exp CARDIOVASCULAR ABNORMALITIES/ or exp PREGNANCY COMPLICATIONS, CARDIOVASCULAR/ or exp CARDIOVASCULAR RISK FACTORS/ or exp "CARDIOVASCULAR ALTERATION (SABA CCC)"/ or exp SURGERY, CARDIOVASCULAR/ or exp CARDIOVASCULAR SYSTEM PHYSIOLOGY/ or exp CARDIOVASCULAR CARE/
31. exp "wounds and injuries"/
32. exp diabetes mellitus/
33. 28 or 29 or 30 or 31 or 32
34. 27 not 33

PsycINFO (1806 to July week 5 2008)

1. exp exercise/
2. exercis$.af.
3. exp PA/
4. (aerobics or PA or physical inactivity).af.
5. (fitness adj (class$ or regime$ or program$)).af.
6. (physical training or physical education).af.
7. exp sports/
8. 1 or 2 or 3 or 4 or 5 or 6 or 7
9. exp clinical trials/
10. exp followup studies/
11. exp prospective studies/
12. exp longitudinal studies/
13. prospectiv$.tw.
14. randomized controlled trial.tw.
15. Evaluation study.tw.
16. Intervention study.tw.

17. 9 or 10 or 11 or 12 or 13 or 14 or 15 or 16
18. exp adolescent development/ or exp adolescent attitudes/
19. exp childhood development/ or exp childhood play behavior/
20. 18 or 19
21. 8 and 17 and 20
22. exp neoplasms/
23. exp pregnancy/
24. exp cardiovascular disorders/ or cardiovascular system.mp. [mp=title, abstract, heading word, table of contents, key concepts]
25. exp diabetes insipidus/ or exp diabetes/ or exp diabetes mellitus/
26. exp wounds/
27. exp injuries/
28. 22 or 23 or 24 or 25 or 26 or 27
29. 21 not 28
30. from 29 keep 1-121

ASSIA (August 25th, 2008)

1. ((boys or girls or child) or (adolescen$ or infant or teenager$) or (youth$ or (young person) or (young adult$))) **AND**
2. (((randomized controlled trial) or (intervention studies) or (longitudinal studies)) or ((prospective studies) or (evaluation studies) or (follow up studies))) **AND**
3. (((PA) or exercise or sport$) or (aerobics or (physical inactivity) or (physical education)) or ((fitness class) or (fitness regime) or (physical training)))

APPENDIX 2

DATA EXTRACTION FORM

Paper I.D:						
Today's date:			Reviewer:			
basic INFORMATION						
Main Author:						
Title of paper:						
Year of publication:			Language:			
Source:	❑ Journal article	❑ Technical report	❑ Abstract / presentation	❑ Unpublished dissertation / thesis	❑ Other:	
STUDY CHARACTERISTICS						
Type of study:	❑ tracking of PA	❑ measuring PA as 1^0 outcome	❑ measuring PA as 2^0 outcome	❑ RCT with intervention related to PA	❑ RCT with intervention unrelated to PA	❑ other
Study design:	❑ RCT	❑ Cohort	❑ Other (please specify):			
Where was the study done (country)? :						
Setting:	❑ School	❑ Community wide	❑ Other	❑ n/a		
Study Objective/Aim:						
DESCRIPTION OF THE STUDY						
General study population:						
Recruitment procedures used (participation rates if possible):						
Inclusion criteria						

_____ _____ _____ _____ _____ _____					
Exclusion criteria _____ _____ _____ _____ _____ _____					
DESCRIPTION OF STUDY PARTICIPANTS					
Age (range) at baseline:					
Total number:	Eligible:	At baseline:	End of follow-up:	Included in analysis:	
Sex:					
Ethnicity:					
Geographical region:					
Other:					
OUTCOMES & OUTCOME MEASURES					
What year was baseline data collected? :					
Interval between measurement of outcome(s):					
Number of times outcome was measured:					
PA measures used:					
What was measured at baseline?					
What was measured at follow-up?					
Who measured?	❑ Self	❑ Self & Parent(s)	❑ Parent(s)	❑ Researcher	❑ Other:

How was it measured?	❑ Equipment:	❑ Activity Diary	❑ Self administered questionnaire:	❑ Other:

Were the measurement tool(s) validated?	❑ Yes	❑ No	❑ n/a

How was the validity of self reported behaviour maximized?
RESULTS & ANALYSIS
Statistical methods/ tests used:

Does technique adjust for confounding?	❑ Yes	❑ No	❑ n/a
Unit of analysis:			
Dropout rate:			

Primary outcome/PA/non-PA measure(s)	TIME 1	TIME 2	TIME 3	TIME 4	TIME 5

Age of	Time 1	Time 2	Time 3	Time 4	Time 5

participants					
Author’s conclusions:					
Notes:					
Reviewers comments:					

APPENDIX 3

QUALITY ASSESSMENT TOOL

Paper I.D: _____

Reviewer: _____

Date: _____

COMPONENT RATINGS

A) SELECTION BIAS

(Q1) Are the individuals selected to participate in the study likely to be representative of the target population?

- ❑ Very likely
- ❑ Somewhat likely
- ❑ Not likely
- ❑ Can't tell

(Q2) What percentage of selected individuals agreed to participate/were enrolled?

- ❑ 80 – 100% agreement
- ❑ 60 – 79% agreement
- ❑ Less than 60% agreement
- ❑ Not applicable
- ❑ Can't tell

RATE THIS SECTION See Dictionary	STRONG 1	MODERATE 2	WEAK 3

B) CONFOUNDERS

(Q1) Did the study design address issues pertaining to confounding?

- ❑ Yes
- ❑ No
- ❑ Can't tell

(Q2) Did the study analysis address issues pertaining to confounding?

- ❑ Yes
- ❑ No
- ❑ Can't tell

RATE THIS SECTION	STRONG 1	MODERATE 2	WEAK 3

C) DATA COLLECTION METHODS

(Q1) Were **ALL OTHER** data collection tools shown to be valid and/or reliable?

- ❑ Yes
- ❑ No
- ❑ Can't tell
- ❑ n/a

(Q2) Were the PA data collection tools shown to be valid and/ or reliable?

- ❑ Yes
- ❑ No
- ❑ Can't tell
- ❑ Not all of them

RATE THIS SECTION See Dictionary	STRONG 1	MODERATE 2	WEAK 3

D) WITHDRAWALS AND DROP OUTS

(Q1) Were withdrawals and drop outs reported in terms of numbers and/or reasons per group?

- ❑ Yes
- ❑ No
- ❑ Can't tell

(Q2) Indicate the percentage of participants completing the study.

- ❑ 80 – 100%
- ❑ 60 – 79%
- ❑ Less than 60%
- ❑ Can't tell

RATE THIS SECTION See Dictionary	STRONG 1	MODERATE 2	WEAK 3

	STRONG	MODERATE	WEAK
A-SELECTION BIAS			
B- CONFOUNDERS			
C- DATA COLLECTION METHODS			
D – WITHDRAWALS AND DROP OUTS			
TOTAL			

GLOBAL RATING FOR THIS PAPER (tick one):

- ❑ STRONG (two STRONG ratings with no WEAK ratings)
- ❑ MODERATE (one STRONG rating **or** one WEAK rating)
- ❑ WEAK (two or more WEAK ratings)

With both reviewers discussing the ratings:
Is there a discrepancy between the two reviewers with respect to the component (A-D) ratings?

❑ No ❑ Yes

If yes, indicate the reason for the discrepancy

1 Oversight
2 Differences in interpretation of criteria
3 Differences in interpretation of study

Final decision of both reviewers (tick one):

- ❑ STRONG
- ❑ MODERATE
- ❑ WEAK