

Research article

Parental Activity as Influence on Children's BMI Percentiles and Physical Activity

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Abstract

Parents play a crucial role in the development of their children's lifestyle and health behaviour. This study aims to examine associations between parental physical activity (PA) and children's BMI percentiles (BMIPCT), moderate to vigorous PA (MVPA) as well as participation in organised sports. Height and body weight was measured in 1615 in German children (7.1 ± 0.6 years, 50.3% male) and converted to BMIPCT. Parental BMI was calculated based on self-reported height and body weight. Children's MVPA and sports participation as well as parental PA were assessed via parental questionnaire. Analysis of covariance (ANCOVA), controlling for age and family income was used to examine the association between parental and children's PA levels as well as BMIPCT. 39.7% of the parents classified themselves as physically active and 8.3% of children were classified as overweight or obese. Lower BMIPCT were observed with both parents being physically active (44.5 ± 26.3 vs. 50.2 ± 26.9 and 52.0 ± 28.4 , respectively). There was no association between parental and children's PA levels but children with at least one active parent displayed a higher participation in organised sports (102.0 ± 96.6 and 117.7 ± 123.6 vs. 73.7 ± 100.0 , respectively). Children of active parents were less likely to be overweight and obese. The lack of association between subjectively assessed parental PA and child MVPA suggests that parental support for PA in children is more important than parents being a role model. More active parents, however, may be more likely to facilitate participation in organised sports. These results underline the importance of the inclusion of parents in health promotion and obesity prevention programmes in children.

Key words: Health and exercise, effects on body weight, health promotion.

Introduction

The high prevalence of childhood obesity is a major concern in Western countries (Lobstein et al., 2004) and in many parts of the developed world (Kelishadi, 2007, Wang and Lobstein, 2006). Besides physiologic and genetic properties as well as nutrition, regular physical activity (PA) is considered an important component in the prevention of childhood obesity. Regular engagement in PA during childhood is a well-documented contributor to health and quality of life (e.g. Andersen et al., 2006, Freedson, 1991; Trost et al., 1997). Insufficient PA on the other hand, has been linked to higher rates of type II diabetes mellitus, hypertension, colon cancer, depression, osteoporosis, and obesity (Pate et al., 1995; Trost et al., 2001), which will increase medical costs (Keszyues et al., 2013) and negatively affect overall public health.

Health behaviours in youth are known to be impacted by a variety of factors (Kettner et al., 2012) with parents being strong determinants of their children's PA behaviour (e.g. Davison et al., 2003; Gustafson and Rhodes, 2006; Jago et al., 2009; Moore et al., 1991). There may be several mechanisms underpinning parental impact such as direct modelling of PA, establishing or eliminating barriers to PA or sports, and positively reinforcing children for participation in sports (Sallis et al., 2000). A recent German study for instance, has shown lower levels of children's PA at weekends, compared to weekdays, suggesting that parents do not engage their children in enough PA (Kettner et al., 2013). Organised sports, which typically are performed on the weekdays, are very popular and highly accessed in Germany. With 1.1 million children at the age of below 6 years participating in German sports clubs (Fehres et al., 2011), extracurricular sports participation is an important component of children's total PA (Cleland et al., 2005). Overall, sports participation has been shown to contribute between 23% and 60% to children's daily moderate to vigorous PA (MVPA) (Wickel and Eisenmann, 2007). Further, sports participation has a positive effect on social behaviour and emotional wellbeing (Morris et al., 2003, Steptoe and Butler, 1996).

There are several reviews (Gustafson and Rhodes, 2006; Trost and Loprinzi, 2011) that addressed the association between parental and children's PA levels, but results have been equivocal. The inconclusive results may be partly attributed to small samples, and different methods used to assess PA but could also be due to a lack of considerations of covariates of PA such as body weight. Still, only little is known about the relationship between parental activity levels and children's participation in organised sports. Since PA and sporting behaviours are established early in life and are likely to be carried over into adulthood (Kraut et al., 2003), a sound understanding of this connection is vital. Identifying parental influences on children's PA behaviours are fundamental to health-related research and will allow recommendations for future guidelines and health-promoting interventions; the purpose of this study was to examine associations between parental PA and children's BMIPCT, as well as MVPA and participation in organised sports.

Methods

Baseline data from 1615 children (7.1 ± 0.6 years, 50.3% male), participating in a school-based health-promotion programme in south-west Germany, were analysed (Dreyhaupt et al., 2012). The study was approved by the

ethics committee of the institutional review board and parental consent and child assent were obtained prior to data collection. Children's height and body weight was measured according to standard procedures with children being bare feet and only wearing shorts and a vest. Standing height was measured to the nearest 0.1 cm using a stadiometer (Seca 213, Seca Weighing and Measuring Systems, Hamburg, Germany) and body weight was measured to the nearest 0.05 kg with an electronic scale (Seca 862, Seca Weighing and Measuring Systems, Hamburg, Germany). Subsequently body weight index (BMI) was calculated and converted to BMI percentiles (BMIPCT) using German reference data (Kromeyer-Hauschild et al., 2001). As recommended by AGA (Kromeyer-Hauschild et al., 2001; AGA = German work group for obesity in childhood and adolescence), overweight and obesity was determined above the 90th and 97th percentile, respectively. Children's MVPA was assessed via a previously validated (Opper et al., 2007) parental questionnaire. Specifically, parents were asked to report the number of days per week with children engaging for at least 60 minutes/day of PA that would result in sweating or breathing heavily (equating to MVPA). Further it was asked whether the children participated in any organised or non-organised sports. Parents provided information on the type of sport along with frequency per week and duration by using free text fields in the questionnaire. Based on this information total minutes/week spent in sports was calculated. Parents were asked whether they classify themselves as physically active or not (yes or no) and reported type of their sporting activities along with frequency per week and duration by using free text fields in the questionnaire. In addition parents reported their height (in cm) and body weight (rounded to the next kg) to calculate BMI ($\text{kg}\cdot\text{m}^{-2}$). Migration status was determined whether one of the parents was born abroad or the language the child was spoken to in the first years was other than German. Family income was obtained using a 7 point scale (ranging from below 1250 € until 5000 € or more) and then dichotomised into low income (≥ 1750 €), medium income (1750 € - 3000 €) and high income (above 3000 € per month). Parental level of education (assessed using a 5 point scale ranging from no qualification until high school graduation) was dichotomised into tertiary and elementary/intermediate level of education, considering the highest education of either

parent.

Parental activity groups were created (both physically active, one parent physically active, both inactive) on the basis of the question whether mother and/or father consider themselves as physically active (yes/no). Children's time spent in PA (organised and non-organised) was calculated on the basis of parental responses about times per week and minutes per session.

Statistical analysis

Correlations were calculated to check for plausibility of given data (e.g. parental activity level: yes/no with minutes of sports per week), t-tests were used to analyse differences between two groups (e.g. gender or active/non-active). Associations between parental and children's PA levels, sports participation and BMIPCT were examined using analysis of covariance (ANCOVA), controlling for age, migration, family income and parental education. For MVPA and sports participation BMIPCT were used as additional covariates in an univariate variance analysis. Since children's PA has been shown to differ by gender (Jago et al., 2005, Sisson et al., 2009) all analyses were carried out separately for boys and girls. Kolmogorov-Smirnov-Tests have shown non-normal distributions of the data. Analyses were performed with SPSS Statistics 19 (SPSS Inc., Chicago, IL) with a significance level set at $\alpha \leq 0.05$ using Bonferroni adjustment for multiple comparisons.

Results

Descriptive characteristics are shown in Table 1. There were no gender differences for BMIPCT and parental PA.

More than half of the parents (58% of mothers, 57% of fathers) classified themselves as physically active. Parental answers about their physical activity (yes/no) correlated significantly with their time spent in organised sports ($r_{\text{mother}} = 0.36$, $r_{\text{father}} = 0.35$, $p = 0.001$). Mothers perceiving themselves as physically active engaged in 59.4 ± 92.8 min/week in sports, whereas mothers who classified themselves as inactive participated in 2.3 ± 29.6 min/week in sports. Similarly, inactive fathers spent 3.3 ± 30.1 min/week doing sports whilst fathers who considered themselves as active spent 85.0 ± 140.9 min/week engaging in sports.

Physically active parents (whether both or only one

Table 1. Participant's characteristics, grouped according to their parents' activity levels. Values are means (\pm SD).

	Parents Inactive	One Parent Active	Both Parents Active	Total Sample
N (%)	471 (29.2)	502 (31.1)	642 (39.7)	1615 (100)
Gender (male; %)	242 (51.4)	255 (50.8)	316 (49.2)	813 (50.3)
Age (years) ¹	7.1 (.7)	7.0 (.6)	7.0 (0.6)	7.1 (0.6)
Height (m)	1.24 (.06)	1.24 (.07)	1.24 (.06)	1.24 (.06)
Body Mass (kg) ³	25.1 (4.8)	25.0 (5.4)	24.1 (4.4)	24.7 (4.9)
BMI PCT ³	52.0 (28.4)	50.2 (26.9)	44.5 (26.3)	48.4 (27.3)
Overweight/Obese (%) ³	6.5/4.9	4.5/4.7	4.4/1.6	5.0/3.5
Sports (min/week) ²	73.7 (100.0)	102.0 (96.6)	117.7(123.6)	100.0 (110.5)
Age mother (years) ²	36.1 (5.5)	37.4 (5.6)	38.4 (4.5)	37.4 (5.2)
Age father (years)	39.8 (6.4)	40.4 (5.8)	41.06 (5.3)	40.4 (5.8)
High family income (%) ²	34.0	41.9	60.8	46.5
Higher education (%) ³	22.6	29.9	42.2	32.4

¹ both parents active and one parent active significantly ($p \leq 0.05$) different from inactive parents. ² all groups significantly ($p \leq 0.05$) different from each other. ³ both parents active significantly ($p \leq 0.05$) different from one active parent and inactive parents

parent) had significantly more often children engaging in organised PA than inactive parents ($F = 117.9$, $p = 0.001$). As shown in Figure 1, there was a higher prevalence of overweight or obese children with both parents being inactive ($F = 4.1$, $p = 0.01$). These results also remained after controlling for parental BMI.

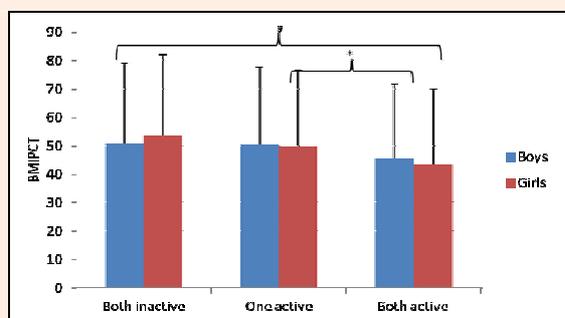


Figure 1. Boys' and girls' BMIPCT according to their parents' activity level; displayed in mean (SD). * $p \leq 0.05$

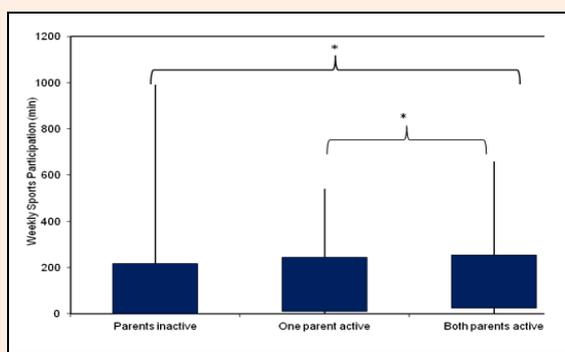


Figure 2. Boy's weekly participation in organised sports, grouped according to their parents' activity level and gender. * $p \leq 0.05$.

Parental PA had no influence on daily time spent at MVPA and time spent in non-organised sports but there was a significant association between perceived parental PA and time spent in organised sports ($F = 22.26$, $p = 0.001$). Even though boys spent more time in organised and non-organised sports these results were significant in boys and girls ($F_{\text{boys}} = 11.87$, $p = 0.001$; $F_{\text{girls}} = 10.88$, $p = 0.001$; Figure 2 and 3). The association was stronger between perceived maternal PA and time spent in organised sports in boys and girls compared to the association between perceived paternal PA and organised sports in children.

Family income varied significantly between parental PA groups but did not affect the child's BMIPCT, MVPA or sports participation either. Neither did parental education level and migration status.

Discussion

This study investigated the influence of parental PA on children's PA levels in and outside of organised sports as well as on their BMIPCT. It could be shown that children

of parents who perceive themselves as being physically active have lower BMIPCT values than children of parents who perceive themselves as being inactive. This was especially true for children whose both parents considered themselves as physically inactive. This was also reflected by a higher prevalence of children's overweight and obesity in the group of inactive parents, which may reflect an overall healthier lifestyle in active parents compared to inactive parents (Ricci et al., 2012). In this study, more than half of the parents considered themselves to be physically active, which is considerably more than research has shown previously. A large German Study using questionnaires in more than 15000 adults between 18 and 70 years showed, that only around one third of German adults are at least once a week physically active (Becker et al., 2006). In their research, investigating correlates and reasons for physical inactivity, PA was amongst others influenced by socioeconomic factors such as education and migration. In this study, however, children's BMIPCT values were neither associated with migration nor parental education.

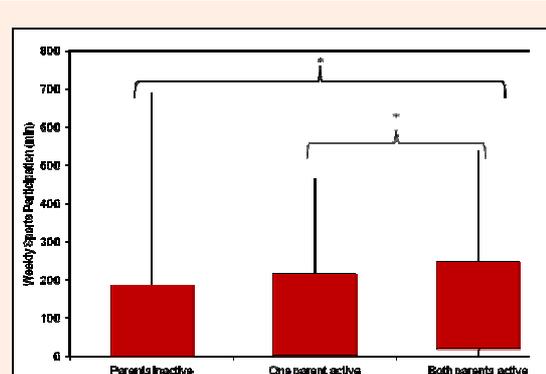


Figure 3. Girl's weekly participation in organised sports, grouped according to their parents' activity level and gender. * $p \leq 0.05$.

Consistent with previous studies (Jago et al., 2010, Sallis et al., 1992, Trost et al., 2003), in the present study no association was found between perceived parental PA and children's time spent in MVPA nor was there any relation between parental PA and time spent in non-organised sports. On the contrary, in a study by Jago et al. (2010) using objective assessments of MVPA, 4- to 7-year old children with two active parents engaged in up to 5.8 times higher activity levels. Also, Fuemmeler et al. (2011) reported that parental MVPA levels were associated with increased childhood MVPA in primary school children. The results of this study however, may support the hypothesis that parental support such as transportation to sport and fitness activities, rather than being a role model, affects activity levels in children (Trost et al., 2003).

Nevertheless, parental perceived PA was related to children's participation in organised sports which confirms the results of recent research (Schmiade and Mutz, 2012). It is also possible that active parents are more likely to enrol their children in organised sports, pay the

according fee and ensure transportation to these clubs (Steptoe and Butler, 1996). Particularly, children with an active mother were more likely to engage in organised sports, possibly highlighting the fact that it is mostly mothers organising their children's sporting activities and providing the necessary transportation (Sayer et al., 2004; Davidson et al., 2003). Mothers seem to be more likely involved in the activity choices of their children and provide a higher level of logistic support (Davison et al., 2003, Bois et al., 2005). Since mothers generally spend more time with their children than fathers (Sayer et al., 2004) it can be assumed, that primarily the mother's attitudes toward a healthy and active lifestyle would influence participation of their children in organised sports. Nonetheless, children's PA levels in organised sports were even higher if both parents considered themselves as physically active. Similar results were found in an Australian study assessing nearly 6000 9- to 15-years olds (Cleland et al., 2005). It was concluded that parental PA is positively associated with children's participation in out of school sports, especially if both parents are physically active. However, Cleland and colleagues (2005) found no parental gender effect; in their study, if only one parent was active, the gender was no independent predictor for children's sports participation. Yet, Yang et al. (1996) concluded that especially paternal PA levels play a significant role in children's PA. In their study, it was suggested that fathers are more important socialising agents than mothers for children's sports activities (Yang et al., 1996). That study, however, consisted of a slightly older sample.

The fact that there is no difference in overall PA between children of active and inactive parents might be due to the fact that the time spent in organised sports does not necessarily equate to MVPA. Leek et al. (2011) showed that participation in organised sports does not ensure 7- to 14-year-old children reaching the recommended PA guidelines on practicing days. In their study, children spent only 46.1% of their practicing time in MVPA and only 24% met current guidelines of 60 minutes of MVPA per day during practice. This may also be due to the fact that a high percentage of children are inactive during practicing time (Katzmarzyk et al., 2001). However, Sigmund et al. (2008) showed that more frequent participation in organised sports is positively related to the amount of weekly PA. They also highlighted that children participating in organised sports, still have significantly higher levels of vigorous PA compared to children not participating in organised sports (Sigmund et al., 2008).

The lack of significance regarding family income on BMIPCT or daily MVPA is in agreement with previous research identifying that parents from all socioeconomic groups encourage their children to be physically active (Brockman et al., 2009). Further, Yang et al. (1996) showed that the father's socioeconomic status does not correlate with boys organised sporting activities. Although it can be suggested that parental support differs depending on socioeconomic backgrounds (Brockman et al., 2009) since children from families with lower income participate less in organised sports (Voss et al., 2008).

However, children from low socioeconomic families may engage in more unstructured PA and free play while children with a higher socio-economic background may receive more logistic and financial support and, therefore, could participate in more organised sports.

Even though the questions used to determine habitual as well as organised and non-organised PA are known as well-established and validated instruments (Kahlert and Brand, 2011), there are some limitations and therefore, the results should be interpreted with caution. PA levels in this study are based on self-report only, which is amongst others known to be influenced by social desirability (Adams et al., 2005). Apart from children's BMIPCT, which were assessed on site, the present study relied on parental report of PA and organised sport as well as parental BMI. It can be assumed that active parents may be more conscious about their activity levels and those of their children and, therefore, their reports may possibly be more accurate. Further, it should be considered that these data are cross sectional which does not allow for causal interpretation. Moreover, there was no information on intensity and actual activity time during organised sports which may influence the outcomes in this study, especially if considering variable intensities of different types of sporting activities. Additionally, it should be noted that the questionnaire was mainly completed by mothers, whereby it is not known if mothers answered the questions on the fathers' PA behaviour with or without consulting them. Due to the large sample size and the detailed questions regarding frequency per week and duration of PA, however, this study may provide some valuable insights into the association between parental and children's PA levels.

Conclusion

In summary, this study shows that parental PA and parents as an active role model have only limited influence on children's daily MVPA. Parental support, on the other hand, may be a crucial aspect in facilitating sufficient PA in children. Parents, who perceive themselves as being active, may also be more likely to facilitate their children's participation in various activities, which was indicated by a higher participation in organised sports. Further, it can be assumed that active parents have an overall healthier lifestyle which is passed along to their children, for example reflected in a healthier diet (Davison and Birch, 2001; Pearson et al., 2009), resulting in lower BMIPCT. However, more research is needed to increase the understanding of the association between the health behaviours of children and their parents. Current results, however, indicate that parental PA is an important factor when it comes to engaging children in sufficient PA, especially in organised sports. It has also been shown that parental PA is associated with childhood BMIPCT, which highlights the necessity of a stronger and active incorporation of parents into intervention programmes that target PA, overweight and healthy lifestyle in children.

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References

- Adams S.A., Matthews C.E., Ebbeling C.B., Moore, C.G., Cunningham, J.E., Fulton, J. and Hebert, J.R. (2005) The effect of social desirability and social approval on self-reports of physical activity. *American Journal of Epidemiology* **161**, 389-398.
- Andersen L.B., Harro M., Sardinha L.B., Froberg K., Ekelund U., Brage, S. and Anderssen, S.A. (2006) Physical activity and clustered cardiovascular risk in children: a cross-sectional study (The European Youth Heart Study). *Lancet* **368(9532)**, 299-304.
- Becker, S., Klein, T., Schneider, S. (2006) Sportaktivität in Deutschland im 10-Jahres Vergleich: Veränderung und soziale Unterschiede. *Deutsche Zeitschrift für Sportmedizin* **57**, 226-232. (In German: English abstract).
- Bois J.E., Sarazzin P.G., Brustad R.J., Trouilloud D.O. and Cury F. (2005) Elementary schoolchildren's perceived competence and physical activity involvement: the influence of parents' role modelling behaviours and perceptions of their child's competence. *Psychology of Sport and Exercise* **6**, 381-397.
- Brockman R., Jago R., Fox K.R., Thompson, J.L., Cartwright K. and Page A.S. (2009) "Get off the sofa and go and play": Family and socioeconomic influences on the physical activity of 10-11 year old children. *BMC Public Health* **9**, 253.
- Cleland V., Venn A., Fryer J., Dwyer T. and Blizzard L. (2005) Parental exercise is associated with Australian children's extracurricular sports participation and cardiorespiratory fitness: A cross-sectional study. *International Journal of Behavioral Nutrition and Physical Activity* **2(1)**, 3.
- Davison K.K. and Birch L.L. (2001) Child and parent characteristics as predictors of change in girls' body mass index. *International Journal of Obesity and Related Metabolic Disorders* **25(12)**, 1834-1842.
- Davison K.K., Cutting T.M. and Birch L.L. (2003) Parents' activity-related parenting practices predict girls' physical activity. *Medicine and Science in Sports and Exercise* **35(9)**, 1589-1595.
- Dreyhaupt J., Koch B., Wirt T., Schreiber A., Brandstetter S., Kesztyues D., Wartha O., Kettner S., Prokopchuk D., Hundsdörfer V., Klepsch M., Wiedom M., Sufeida S., Fischbach N., Muche R., Seufert T. and Steinacker J.M. (2012) Evaluation of a health promotion program in children: Study protocol and design of the cluster-randomized Baden-Württemberg primary school study [DRKS-ID: DRKS00000494]. *BMC Public Health* **12**, 157.
- Fehres, K., Blessing-Kapelke, U., Tzschoppe, P. and Hartmann, S. (2011) *Mitgliederentwicklung in Sportvereinen – Bestandserhebungen und demografischer Wandel*. 1st edition. Deutscher Olympischer Sportbund. (In German).
- Freedson P.S. (1991) Electronic motion sensors and heart rate as measures of physical activity in children. *Journal of School Health* **6(5)**, 220-223.
- Fuemmeler B.F., Anderson C.B. and Masse L.C. (2011) Parent-child relationship of directly measured physical activity. *International Journal of Behavioral Nutrition and Physical Activity* **8**, 17.
- Gustafson S.L. and Rhodes R.E. (2006) Parental correlates of physical activity in children and early adolescents. *Sports Medicine* **36(1)**, 79-97.
- Jago R., Baranowski T., Baranowski J.C., Thompson D. and Greaves K.A. (2005) BMI from 3-6 y of age is predicted by TV viewing and physical activity, not diet. *International Journal of Obesity* **29 (6)**, 557-564.
- Jago R., Thompson J.L., Page A.S., Brockman R., Cartwright K. and Fox K.R. (2009) Licence to be active: parental concerns and 10 to 11-year-old children's ability to be independently physically active. *Journal of Public Health* **31(4)**, 472-477.
- Jago R., Fox K.R., Page A.S., Brockman R. and Thompson J.L. (2010) Parent and child physical activity and sedentary time: Do active parents foster active children? *BMC Public Health* **10**, 194.
- Kahlert, D. and Brand, R. (2011) Befragungsdaten und Akzelerometermessung im Vergleich – ein Beitrag zur Validierung des MoMo-Aktivitätsfragebogens. *Deutsche Zeitschrift für Sportmedizin* **62(2)**, 36-41. (In German: English abstract).
- Katzmarzyk, P.T., Walker P. and Malina R.M. (2001) A time-motion study of organized youth sports. *Journal of Human Movement Studies* **4**, 325-334.
- Kelishadi R. (2007) Childhood overweight, obesity, and the metabolic syndrome in developing countries. *Epidemiologic Reviews* **29**, 62-76.
- Kesztyues, D., Schreiber, A., Wirt, T., Wiedom, M., Dreyhaupt, J., Brandstetter, S., Koch, B., Wartha, O., Muche, R., Wabitsch, M., Kilian, R. and Steinacker, J.M. (2013) Economic evaluation of URMEL-ICE, a school-based overweight prevention programme comprising metabolism, exercise and lifestyle intervention in children. *European Journal of Health Economics* **14**, 185-195.
- Kettner, S., Kobel, S., Fischbach, N., Drenowatz, C., Dreyhaupt, J., Wirt, T., Koch, B., Steinacker, J.M. (2013) Objectively determined physical activity levels of primary school children in south-west Germany. *BMC Public Health* **13**, 895.
- Kettner S., Wirt T., Fischbach N., Kobel S., Kesztyues D., Schreiber A., Drenowatz C. and Steinacker J.M. (2012) Handlungsbedarf zur Förderung körperlicher Aktivität im Kindesalter in Deutschland. *Deutsche Zeitschrift für Sportmedizin* **63**, 94-101. (In German: English abstract).
- Kraut A., Melamed S., Gofer D., Froom P. (2003) Effect of school age sports on leisure time physical activity in adults: the CORDIS Study. *Medicine and Science in Sports and Exercise* **35**, 2038-2042.
- Kromeyer-Hauschild K., Wabitsch M., Kunze D., Geller F., Geiß H.C., Hesse Von Hippel A., Jaeger U., Johnsen D., Korte W., Menner K., Müller G., Müller J.M., Niemann-Pilatus A., Remer T., Schäfer F., Wittchen H-U., Zabransky S., Zellner K., Ziegler A. and Hebebrand J. (2001) Perzentile für den Body-Maß-Index für das Kindes- und Jugendalter unter Heranziehung verschiedener deutscher Stichproben. *Monatszeitschrift Kinderheilkunde* **149(8)**, 807-818. (In German: English abstract).
- Leek D., Carlson J.A., Cain K.L., Henrichon S., Rosenberg D., Patrick K. and Sallis J.F. (2011) Physical activity during youth sports practices. *Archives of Pediatrics & Adolescent Medicine* **165(4)**, 294-299.
- Lobstein T., Baur L., Uauy R. and IASO International Obesity Task-Force (2004) Obesity in children and young people: a crisis in public health. *Obesity Reviews* **5 (Suppl 1)**, 4-104.
- Moore L, Lombardi DA, White MJ, Campbell JL, Oliveria SA, Ellison RE (1991) Influence of parents' physical activity levels on activity levels of young children. *Journal of Pediatrics* **118(2)**, 215-219.
- Morris L., Sallybanks J., Willis K. and Makkai T. (2003) *Sport, Physical Activity and Antisocial Behavior in Youth*. Australian Institute of Criminology (Rep. No. 249)
- Opper E., Worth A., Wagner M. and Bös K. (2007) Motorik-Modul (MoMo) im Rahmen des Kinder- und Jugendgesundheits-surveys (KiGGS). Motorische Leistungsfähigkeit und körperlich-sportliche Aktivität von Kindern und Jugendlichen in Deutschland. *Bundesgesundheitsblatt – Gesundheitsforschung - Gesundheitsschutz* **50**, 879-888. (In German: English abstract).
- Pate R.R., Pratt M., Blair S.N., Haskell W.L., Macera C.A., Bouchard C., Buchner D., Eittinger W., Heath G.W., King A.C., Andrea Kriska, Arthur S. Leon, Bess H. Marcus, Jeremy Morris, Ralph S. Paffenbarger Jr, Kevin Patrick, Michael L. Pollock, James M. Rippe, James Sallis and Jack H. Wilmore (1995) Physical activity and public health. A recommendation from the Centers for Disease Control and Prevention and the American College of Sports Medicine. *Journal of the American Medical Association* **273(5)**, 402-407.
- Pearson N., Timperio A., Salmon J., Crawford D. and Biddle S. (2009) Family influences on children's physical activity and fruit and vegetable consumption. *International Journal of Behavioral Nutrition and Physical Activity* **6**, 34.
- Ricci C.L., Brown B.D., Noonan C., Harris K.J., Dybdal L., Parker M. and Gress S. (2012) Parental influence on obesity in Northern Plains American Indian youth. *Family & Community Health* **35(1)**, 68-75.
- Sallis J.F., Alcaraz J.E., McKenzie T.L., Hovell M.F., Kolody B. and Nader P.R. (1992) Parental behaviour in relation to physical activity and fitness in 9-year-old-children. *American Journal of Diseases of Children* **146(11)**, 1383-1388.
- Sallis, J.F., Prochaska, J.J. and Taylor, W.C. (2000) A review of correlates of physical activity of children and adolescents. *Medicine*

& *Science in Sports & Exercise* **32(5)**, 963-975.

- Sayer L.C., Bianchi S.M. and Robinson J.P. (2004) Are Parents Investing Less in Children? Trends in Mothers' and Fathers' Time with Children. *American Journal of Sociology* **110**, 1-43.
- Schmiade N. and Mutz M. (2012) Sportliche Eltern, sportliche Kinder. Die Sportbeteiligung von Vorschulkindern im Kontext sozialer Ungleichheit *Sportwissenschaft* **42**, 115-125. (In German: English abstract).
- Sigmund E., Turonova K., Sigmundova D. and Pridalova M. (2008) The effect of parents' physical activity and inactivity on their children's physical activity and sitting. *Acta Universitatis Palackianae Olomucensis Gymnica* **38**, 17-23.
- Sisson S.B., Church T.S., Martin C.K., Tudor-Locke C., Smith S.R., Bouchard C., Earnest C.P., Rankinen T., Newton R.L. and Katzmarzyk P.T. (2009) Profiles of sedentary behavior in children and adolescents: The US National Health and Nutrition Examination Survey. *International Journal of Pediatric Obesity* **4(4)**, 353-359.
- Stephoe A. and Butler N. (1996) Sports participation and emotional wellbeing in adolescents. *Lancet* **347**, 1789-1792.
- Trost S.G., Pate R.R., Saunders R., Ward D.S., Dowda M. and Felton G. (1997) A prospective study of the determinants of physical activity in rural fifth-grade children. *Preventive Medicine* **26(2)**, 257-263.
- Trost S.G., Kerr L.M., Ward D.S. and Pate R.R. (2001) Physical activity and determinants of physical activity in obese and non-obese children. *International Journal of Obesity and Related Metabolic Disorders* **25(6)**, 822-829.
- Trost S.G., Sallis J.F., Pate R.R., Freedson P.S., Taylor W.C. and Dowda M. (2003) Evaluating a model of parental influence on youth physical activity. *American Journal of Preventive Medicine* **25(4)**, 277-282.
- Trost S.G. and Loprinzi P.D. (2011) Parental influences on physical activity behavior in children and adolescents: a brief review. *American Journal of Lifestyle Medicine* **5**, 171-181.
- Voss L.D., Hosking J., Metcalf B.S., Jeffery A.N. and Wilkin T.J. (2008) Children from low-income families have less access to sports facilities, but are no less physically active: cross-sectional study (EarlyBird 35) *Child: Care, Health and Development* **34(4)**, 470-474.
- Wang Y. and Lobstein T. (2006) Worldwide trends in childhood overweight and obesity. *International Journal of Pediatric Obesity* **1(1)**, 11-25.
- Wickel E.E. and Eisenmann J.C. (2007) Contribution of youth sport to total daily physical activity among 6- to 12-yr-old boys. *Medicine & Science in Sports & Exercise* **39(9)**, 1493-1500.
- Yang X.L., Telama R., Laakso L. (1996) Parents' Physical Activity, Socioeconomic Status and Education as Predictors of Physical Activity and Sport among Children and Youths - A 12-Year Follow-Up Study. *International Review for the Sociology of Sport* **31**, 273-229.

Key points

- A higher prevalence of overweight or obese children was found with inactive parents.
- Children's BMI percentiles were lower if both parents were physically active compared to children whose parents were both inactive or only had one physically active parent.
- Parental activity had no influence on daily time spent at MVPA and time spent in non-organised sports.
- There was a significant association between parental physical activity and the number of minutes per week boys and girls participated in organised sports.
- On average, children who had at least one physically active parent spent significantly more time participating in organised sports than children with inactive parents.

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