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RESEARCH

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Early life determinants of physical activity in 11 to 12 year olds: cohort study

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ABSTRACT

Objective To examine factors in early life (up to age 5 years) that are associated with objectively measured physical activity in 11-12 year olds.

Design Prospective cohort study.

Setting Avon longitudinal study of parents and children, United Kingdom.

Participants Children aged 11-12 years from the Avon longitudinal study of parents and children.

Main outcome measure Physical activity levels in counts per minute (cpm) and minutes of moderate to vigorous physical activity for seven days measured with a uniaxial actigraph accelerometer.

Results Valid actigraph data, defined as at least three days of physical activity for at least 10 hours a day, were collected from 5451 children. Several factors were associated with physical activity at ages 11-12 years. Regression coefficients are compared with the baseline of "none" for categorical variables: maternal brisk walking during pregnancy (regression coefficient 5.0, 95% confidence interval −8.5 to 18.5; cpm for <1 h/wk and ≥2 h/wk of physical activity 17.7, 5.3 to 30.1), maternal swimming during pregnancy (21.5, 10.9 to 32.1 and cpm for <1 h/wk and ≥2 h/wk of physical activity 24.2, 7.8 to 40.7), parents' physical activity when the child was aged 21 months (28.5, 15.2 to 41.8 and cpm of physical activity for either parent active and both parents active 33.5, 17.8 to 49.3), and parity assessed during pregnancy (2.9, −7.6 to 13.4 and cpm of physical activity for 1 and ≥2 parity 21.2, 7.1 to 35.3).

Conclusions Few factors in early life predicted later physical activity in 11-12 year olds. Parents' physical activity during pregnancy and early in the child's life showed a modest association with physical activity of the child at age 11-12 years, suggesting that active parents tend to raise active children. Helping parents to increase their physical activity therefore may promote children's activity.

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INTRODUCTION

Regular physical activity is beneficial to the health of adults.[1] Although there is less evidence of the benefit to children,[2] some risk factors for diseases in adults are associated with lower levels of physical activity in childhood.[3-5]

Although the literature on psychosocial and environmental factors that influence physical activity in children is extensive, much of it is cross sectional[6] and little is known about early life influences on children's physical activity.[7] We therefore examined factors up to age 5 years that are associated with objectively measured physical activity in a cohort of children aged 11-12 years.

METHODS

The Avon longitudinal study of parents and children (ALSPAC) is a birth cohort that has been described in detail.[8] Briefly, pregnant women in the former Avon health area who had an expected delivery between 1 April 1991 and 31 December 1992 were invited to take part in the study. Overall, 14 541 women were enrolled, totalling 14 062 live births.

From pregnancy and continuing to this day, questionnaires have been sent to the mothers, their partners (the partner at the time the questionnaire was administered may not have been the biological father), and the children inquiring about their health and lifestyle. Since age 7 the children have been invited to research clinics for physiological and psychometric measurements.

Children who attended the clinic at age 11 were asked to wear an actigraph accelerometer (see bmj.com) for seven days. They recorded the times the actigraph was worn each day and when they swam or cycled (the actigraph does not record cycling well and cannot be worn for swimming). Two outcome variables were used: average counts per minute (cpm) over the measurement period, and moderate to vigorous physical activity (>3600 cpm was the cut-off point).[9] We considered data to be valid if recording periods were for at least 10 hours per day for at least three days.[10]

We defined early life as the period from pregnancy to age 5 years as this includes some critical developmental periods: intrauterine period, infancy, and age of adiposity rebound. Age 5 is also the time children start school. Potential risk factors (see bmj.com) were identified as characteristics in early life that were associated with physical activity in childhood,[7] obesity,[11] or other markers of the metabolic syndrome[3 4]; cardiorespiratory fitness or neuromotor function[12]; or activity behaviours that display some tracking from early to later childhood.[7 13]

We recorded socioeconomic variables at 32 weeks' gestation. Mothers were asked to record their highest education level (see bmj.com). Social class was derived from the parents' occupation using the 1991 Office of Population Censuses and Surveys.[14] When the social class of the mother and partner differed, the lower of the two was used.

Statistical analysis

We used three models to explore the role of confounders, with cpm as the outcome. Model 1 was adjusted for age and sex. Model 2 was adjusted for age, sex, maternal education, and social class. We included sex and socioeconomic status as potential confounders rather than as potential determinants (see bmj.com). Model 3 was adjusted for the confounders in model 1 but restricted to those with all available data from model 2. Measures of size at birth were additionally adjusted for gestational age. Season of birth was additionally adjusted for season of measurement as all children were seen at about age 11 years and 9 months. Models were run separately for each characteristic. Analysis for models 1 and 2 was repeated with minutes of moderate to vigorous physical activity as the outcome. We repeated analyses in children who did not report swimming or cycling. Analyses were carried out on boys and girls combined. To test for an effect modification of sex we introduced interaction terms (sex×exposure variable) into model 1. When evidence of an interaction existed we did the analyses separately for boys and girls. Moderate skewness was found in the activity variables. We did not transform data for the analyses but we did use robust standard errors to allow derivation of confidence intervals and standard errors on the basis of the actual distribution of the outcome variable in the dataset.[15] We present the results for continuous variables as standardised regression coefficients, adjusted for the standard deviation of cpm for each model. Thus the regression coefficient for continuous variables is the difference in cpm associated with a 1 standard deviation change in the exposure variable. We present the results for categorical variables as normal regression coefficients.

RESULTS

A total of 11 952 children from the Avon longitudinal study of parents and children were invited to participate in study clinics at age 11 years. Of these, 7159 (59.9%) attended, 6622 (92.5%) agreed to wear an actigraph, and 5595 (84.5%) had valid data.[10] Multiple births were dropped from the sample to rule out non-independence in the data, therefore the sample consisted of 2593 boys and 2858 girls, mean age 11. 8 years. Small differences were found between the characteristics of children who did or did not provide valid data (see bmj.com).

The associations between exposure variables and cpm for each model for each of the proposed developmental periods are on bmj.com. Results for models 1 and 2 with moderate to vigorous physical activity as the outcome showed a similar pattern to cpm as the outcome.

None of the birth outcomes was associated with physical activity at ages 11-12 years and this remained unchanged after adjustment for confounders (see bmj.com).

Few of the prenatal characteristics were associated with physical activity (see bmj.com). Mother's body mass index before pregnancy, parents' smoking status during pregnancy, mother's age at birth of the child, mother's physical activity, parity, and season of birth showed modest associations with physical activity. The associations for parents' smoking and maternal age attenuated slightly after adjustment for socioeconomic status, whereas the associations for maternal physical activity during pregnancy strengthened slightly. Partner's body mass index, obesity in the mother and her partner, partner's age at birth, partner's physical activity, and presence of the mother's partner at home were not associated with later physical activity (data not shown).

Associations between characteristics from age 0-2 years and physical activity tended to be modest and remained after adjustment (see bmj.com). Parental activity was associated with later physical activity in the child.

In preschool aged children, only television viewing at 38 and 54 months' follow-up showed any clear, although small, associations. Little evidence was found that time spent outside at 38 and 54 months was associated with later physical activity.

Evidence was found of an interaction in only two of the exposure variables so the results are presented for the analyses of both sexes combined. Sex×brisk walking and sex×motor coordination showed evidence of effect modification ($P=0.020$ and $P=0.008$). See bmj.com for the analyses of boys and girls separately when the exposure variable was modified by sex.

DISCUSSION

Few of the early life factors studied were associated with later physical activity in 11-12 year olds and for those that were, the associations were modest.

None of the birth outcomes was associated with physical activity. A study found that children of low birth weight (<2500 g) reported slightly fewer minutes of weekly activity at age 10-12 than their peers of higher birth weight. The same study, however, reported no difference in sedentary lifestyle by birth weight.[7]

Body mass index of the mother but not her partner was weakly associated with physical activity. Previous studies have been inconsistent. One reported no relation between parental obesity and physical activity in 101girls,[16] whereas a systematic review found that parental obesity was positively associated with physical activity in 4-12 year olds.[6]

Smoking in the mother and her partner were both positively associated with physical activity. The associations were similar and attenuated after

WHAT IS ALREADY KNOWN ON THIS TOPIC

Identifying factors that influence physical activity in childhood may help develop better intervention strategies

Little is known about whether factors in early childhood might influence later physical activity

WHAT THIS STUDY ADDS

Factors in early life have limited influence on later physical activity in 11-12 year olds

Parental physical activity is associated with modest increases in children's activity

Encouraging activity among parents may help children to be active

adjustment, so may result from the social patterning of smoking behaviour. We previously showed a negative association between physical activity and socioeconomic status.[17]

Previous studies have reported a positive association between parental physical activity and children's physical activity although there is some inconsistency.[6] In our study maternal brisk walking and swimming during pregnancy were positively associated with physical activity in the children. It is unlikely that this is due to biological factors in utero but more likely that physical activity during pregnancy is a marker for later maternal physical activity and that this in turn influences children's activity.

Parity is a measure of the number of older siblings and we found that physical activity was positively associated with parity. This confirms the findings of a previous study, which reported that birth order was positively associated with physical activity and negatively associated with a sedentary lifestyle in 10-12 year olds.[7]

The association with season of birth is difficult to explain. Children born during summer to winter were more active than those born in spring. Season of birth may have an effect through the age at which children start school. In this study some children were measured at primary school and some at secondary school, where the environments may provide different opportunities for physical activity.

None of the indicators of physical activity at age 0-2 years (activity at six months or time outside at 24 months) was associated with later physical activity. Tracking of physical activity tends to be weak to moderate[13 18] and it may be that these early measures of physical activity lacked precision to detect an association with later physical activity. Parental physical activity at 21 months was associated with children's physical activity when two non-active parents were compared with either or both parents being active. A small association was found with motor coordination at six months.

Few of the characteristics in preschool aged children (2-5 years) were associated with later physical activity. A small association was found with television viewing at 38 and 54 months. One study recently reported no cross sectional association between television viewing and objectively measured physical activity.[19] A meta-analysis that included mainly cross sectional studies reported a weak relation between the two.[20] The modest associations we report here may result from the length of time between measures for television viewing and assessment of physical activity, as other factors may have had a greater influence before follow-up at 11-12 years.

Strengths and limitations of the study

The use of an objective measure of physical activity is a major strength of this study as it provides an accurate estimate of the level of physical activity. The detailed measures available and the large sample size allowed us to test for associations of several potential determinants and allowed adequate exploration of the role of potential confounders.

Some of the variables were based on single questions therefore not validated questionnaires. This may have resulted in attenuated associations with children's physical activity owing to imprecision of measurement.[21] It is also possible that attrition and biased participation in study resulted in an unrepresentative sample. Children who participated in this study were more likely to be from socially advantaged backgrounds,[10] although the magnitude of social patterning in physical activity is small.[17] Several of the characteristics were based on questionnaires in which the questions changed over time, making comparisons difficult.

Conclusions

We have shown that early life factors have limited influence on physical activity in 11-12 year olds. This may have implications when developing guidelines for interventions to increase physical activity. We have also shown that children are slightly more active if their parents are active early in the child's life.

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Competing interests: None declared.

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Poverty and blindness in Pakistan: results from the Pakistan national blindness and visual impairment survey

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ABSTRACT

Objective To explore the association between blindness and deprivation in a nationally representative sample of adults in Pakistan.

Design Cross sectional population based survey.

Setting 221 rural and urban clusters selected randomly throughout Pakistan.

Participants Nationally representative sample of 16 507 adults aged 30 or above (95.3% response rate).

Main outcome measures Associations between visual impairment and poverty assessed by a cluster level deprivation index and a household level poverty indicator; prevalence and causes of blindness; measures of the rate of uptake and quality of eye care services.

Results 561 blind participants (<3/60 in the better eye) were identified during the survey. Clusters in urban Sindh province were the most affluent, whereas rural areas in Balochistan were the poorest. The prevalence of blindness in adults living in affluent clusters was 2.2%, compared with 3.7% in medium clusters and 3.9% in poor clusters (P<0.001). The highest prevalence of blindness was found in rural Balochistan (5.2%). The prevalence of total blindness (bilateral no light perception) was more than three times higher in poor clusters than in affluent clusters (0.24% *v* 0.07%, P<0.001). The prevalences of blindness caused by cataract, glaucoma, and corneal opacity were lower in affluent clusters and households. Reflecting access to eye care services, cataract surgical coverage was higher in affluent clusters (80.6%) than in medium (76.8%) and poor areas (75.1%). Intraocular lens implantation rates were significantly lower in participants from poorer households. 10.2% of adults living in affluent clusters presented to the examination station wearing spectacles, compared with 6.7% in medium clusters and 4.4% in poor cluster areas. Spectacle coverage in affluent areas was more than double that in poor clusters (23.5% *v* 11.1%, P<0.001).

Conclusion Blindness is associated with poverty in Pakistan; lower access to eye care services was one contributory factor. To reduce blindness, strategies targeting poor people will be needed. These interventions may have an impact on deprivation in Pakistan.

INTRODUCTION

The detrimental impact of visual disability on life expectancy and quality of life is well documented,[1 2] and blindness is categorised in the sixth of seven categories of increasing disability.[3] Clear evidence shows that some blinding eye diseases are a direct consequence of poverty,[4] whereas blindness can lead to financial insecurity and social isolation.[5]

The prevalence of blindness is three to four times higher in low income countries than in industrialised countries,[6] and more than 75% of global blindness is either preventable or treatable.[7] However, information