Published in final edited form as:
Br J Sports Med. 2009 July ; 43(7): 542–544. doi:10.1136/bjsm.2008.049288.

Myopia and later physical activity in adolescence: A prospective study

K Deere[1], **C Williams**[5], **S Leary**[2], **C Mattocks**[1], **A Ness**[2], **SN Blair**[3], and **C Riddoch**[4]

[1]Department of Social Medicine, University of Bristol, Bristol, UK

[2]Department of Oral and Dental Science, University of Bristol, Bristol, UK

[3]Department of Exercise Science, University of South Carolina, South Carolina, USA

[4]Department of Sport and Exercise Science, University of Bath, Bath, UK

[5]Centre for Child and Adolescent Health, University of Bristol, Bristol, UK

Abstract

Objectives—To investigate associations between objectively measured physical activity (PA) and myopia in children.

Methods—Children from the Avon Longitudinal Study of Parents and Children (ALSPAC) were asked to wear a uniaxial accelerometer for seven days. Measures of counts per minute (cpm), minutes spent in moderate to vigorous activity (MVPA) and minutes of sedentary behaviour (msed) were derived from the accelerometer worn at age 12. Children were also examined, at age 10, using an autorefractor to estimate myopia. Social and parental factors were collected from pregnancy and physical measures of the child were recorded at age 12.

Results—4880 children had valid PA and autorefraction data. In minimally adjusted models (age and gender) myopic children were less active than the other children: B= −49.9 cpm (95% CI −73.5, −26.4. p=<0.001). The myopic group spent less time in MVPA than the other children, B= −3.2 minutes MVPA (95% CI −5.2, −1.1. p=0.003) and more time sedentary: B= 15.8 minutes (95% CI 5.8, 25.8. p=0.002). The effect sizes were attenuated by adjustment for social and behavioural confounders although myopia status in the better (least myopic on autorefraction) eye remained strongly associated with cpm and MVPA but less so for sedentary behaviour. B= −36.8 cpm (95% CI –67.8, −5.8. p=0.02), B= −2.7 MVPA (95% CI −5.3, −0.1. p=0.04), B= 10.1 msed (95% CI –2.9, 23.1. p=0.13).

Conclusion—Myopic children may be at risk of having lower levels of PA than their non-myopic peers although the difference was modest.

Keywords

accelerometry; public health; youth; ALSPAC

Correspondence to: Cathy Williams, Vision Research, Centre for Child and Adolescent Health, Barley House Group, Barley House, Oakfield Grove, Bristol BS8 2BN, UK, Cathy.Williams@bristol.ac.uk.

COMPETING INTERESTS

There are no competing interests for any author of this manuscript.

INTRODUCTION

Physical activity in children is an important determinant of health[1 2 3 4]. While studies have examined the association between physical activity and environmental factors[5] and sociodemographic factors[6], few studies have reported on the role of specific physical characteristics such as eyesight that might influence physical activity.

Myopia, or short-sightedness, has been estimated to affect 8.4% of 4–12 year olds in Australia[7] and 9.2% of 5–17 year olds in the U.S.A[8]. Myopia in children has been associated with spending less time playing sports9 and the perception by mothers that their children have poorer sporting ability10. These studies used subjective measures of activity or sporting ability, which may not accurately assess levels of physical activity in children because recall is poor and activity is often sporadic and unplanned10. Objective measurement may provide a more accurate estimate of physical activity in children[11]. We examined the association between objectively measured physical activity and myopia (estimated by autorefraction) in a large prospective study of contemporary children.

METHODS

ALSPAC recruited pregnant women with an expected date of delivery between 1st April 1991 and 31st December 1992 in the former county of Avon (south west of England). Further details are available elsewhere[12] (http://www.alspac.bris.ac.uk). Ethical approval for the study was obtained from the ALSPAC Law and Ethics Committee and Local Research Ethics Committees. Prior to the beginning of each clinic visit the main carer of the child provides informed written consent. For the physical activity measurement the child and main carer gave verbal consent.

Children were invited to attend a clinic at approximately 11 years of age, between January 2003 – January 2005, and this included an objective measurement of physical activity. All children who attended were asked to wear an Actigraph accelerometer, model WAM 7164 (Actigraph LLC, Fort Walton Beach, FL.) for seven days. The Actigraph has been validated in both children and adolescents[13]. Each child was given an Actigraph, which was programmed to start recording at 5 a.m. the next morning, and instructed to return by post in a pre-paid envelope at the end of the monitoring period.

Data from the returned Actigraphs were downloaded and then imported into a Microsoft™ Access 2000 database. Children who did not provide a minimum of 600 minutes valid data on at least three separate days were omitted from the analyses[14]. The analysis considered three physical activity variables. Total physical activity measured as cpm, MVPA and time spent sedentary in minutes.

Children had their myopia assessed when they were approximately 10 years old at a previous clinic. We used autorefraction, without cycloplegia and used validation studies to guide interpretation of the data[15]. Our myopic group was decided by an autorefractor reading of −1.5 D mean spherical equivalent or more severe (more myopic) in either eye. We used the comparison between the myopic group and the rest of the sample as a model to estimate the strength of associations with myopia. We used a Canon R50 (Clement Clarke, Haag Streit UK, Harlow, UK) autorefractor, which estimated refractive error for each eye separately. The subjects were asked if they wore glasses during a clinic visit at age 10. They were also asked if they wore contact lenses.

Parental data included self-reported maternal and partner’s myopia and ethnicity. The ethnicity of the child was classified as white or non-white. Information on pubertal status at age 11 was derived from a questionnaire completed by the carer.

NIH-PA Author Manuscript

NIH-PA Author Manuscript

The data were analysed using Stata Version 8.0 (Stata Corporation, College Station, Texas). The outcomes were cpm, minutes of MVPA per day and msed per day. The distributions of cpm and MVPA were skewed. For the regression analysis, data were not transformed but robust standard errors were used which allow derivation of confidence intervals and standard errors based on the actual distribution of the outcome variable in the dataset[16]. The two main predictors in the analysis were categorized as myopic based on estimations from the least myopic eye (Best eye) and the most myopic eye (Worst eye), at the 10-year clinic visit.

Multivariable linear regression was used to estimate associations between myopia and physical activity and to adjust for the effects of confounding factors. The results are presented for 2 models. Model 1 was our minimally adjusted model, which included gender and the age at which the Actigraph was worn. Model 2 was our maximally adjusted model additionally adjusting for lowest social class of the parents, maternal education, glasses data, parental myopia and child ethnicity.

RESULTS

A total of 7159 children attended the 11-year clinic. 6622 agreed to wear an Actigraph, 5603 of who provided valid activity data. Of these, 4880 had valid autorefractor data and were used in the analyses. The median total activity (cpm) was 579.3cpm, the median MVPA was 19.7minutes and the average msed was 427.9minutes.

There were 171 myopes in the Best eye model (3.5%) and 274 in the Worst eye model (5.6%). The average age was 11.8 years. Table 1 shows the results from multivariable regressions. The "Best eye" model showed the myopic children to have 49.9cpm ($p=<0.001$) less than their peers per day. They also had 3.2 minutes less MVPA per day than their peers ($p<0.001$) and had 15.8 minutes more sedentary time per day ($p=0.002$). The effect sizes were attenuated by adjustment for social and behavioural confounders but the association remained.

DISCUSSION

We have demonstrated an inverse association between myopia and physical activity in 12-year-old children. After adjustment, children defined as myopic at 10 years of age were less active than their peers at approximately 12 years of age. In general they had lower total activity, lower MVPA and increased sedentary time. This could be because children who wear glasses for myopia are reluctant to participate in physical activity due to the impracticality of wearing glasses during sports or vigorous activities.

We have used an approximation of myopia based on non-cycloplegic autorefraction, rather than accurate refractive measurements. Thus some non-myopic children may have been misclassified as myopic by the autorefractor. In addition, some children will have become myopic between the ages of measurement.

As childhood behaviours have been demonstrated to track into adulthood[17] the reduced activity of the myopic group could give rise to an increased risk of disease associated with low physical activity levels if the associations persist.

CONCLUSIONS

These novel data suggest an increased risk of lower physical activity for myopic children and support the hypothesis that myopes are less active than their peers. This risk could be reduced if interventions were targeted at myopic children to make them aware of the risks of low physical activity. Further studies later in adolescence to test for tracking of these behaviours would further clarify the predictive nature of childhood myopia on the physical activity of children.

Acknowledgments

We are extremely grateful to all the families who took part in this study, the midwives for their help in recruiting them, and the whole ALSPAC team, which includes interviewers, computer and laboratory technicians, clerical workers, research scientists, volunteers, managers, receptionists and nurses.

FUNDING SOURCES

The UK Medical Research Council, the Wellcome Trust and the University of Bristol provide core support for ALSPAC. This research was specifically funded by a grant from National Heart, Lung and Blood Institute (R01 HL071248-01A). The funding body had no influence on the design of the study or the writing of this report.

REFERENCES

1. Moore LL, Nguyen US, Rothman KJ, et al. Preschool physical activity level and change in body fatness in young children. The Framingham Children's Study. Am J Epidemiol 1995;142(9):982–988. [PubMed: 7572980]
2. Boreham C, Riddoch C. The physical activity, fitness and health of children. J Sports Sci 2001;19(12):915–929. [PubMed: 11820686]
3. Warburton DE, Nicol CW, Bredin SS. Health benefits of physical activity: the evidence. Cmaj 2006;174(6):801–809. [PubMed: 16534088]
4. Berenson GS, Srinivasan SR, Bao W, et al. Association between Multiple Cardiovascular Risk Factors and Atherosclerosis in Children and Young Adults. New England Journal of Medicine 1998;338(23):1650–1656. [PubMed: 9614255]
5. Giles-Corti B, Broomhall MH, Knuiman M, et al. Increasing walking: how important is distance to, attractiveness, and size of public open space? Am J Prev Med 2005;28(2 Suppl 2):169–176. [PubMed: 15694525]
6. Kimm SYS, Glynn NW, Kriska AM, et al. Decline in Physical Activity in Black Girls and White Girls during Adolescence. N Engl J Med 2002;347(10):709–715. [PubMed: 12213941]
7. Junghans BM, Crewther SG. Little evidence for an epidemic of myopia in Australian primary school children over the last 30 years. BMC Ophthalmol 2005;5(1):1. [PubMed: 15705207]
8. Kleinstein RN, Jones LA, Hullett S, et al. Refractive error and ethnicity in children. Arch Ophthalmol 2003;121(8):1141–1147. [PubMed: 12912692]
9. Khader YS, Batayha WQ, Abdul-Aziz SM, et al. Prevalence and risk indicators of myopia among schoolchildren in Amman, Jordan. East Mediterr Health J 2006;12(3–4):434–439. [PubMed: 17037714]
10. Stewart-Brown S, Haslum MN, Butler N. Educational attainment of 10-year-old children with treated and untreated visual defects. Dev Med Child Neurol 1985;27(4):504–513. [PubMed: 4029521]
11. Wareham NJ, Rennie KL. The assessment of physical activity in individuals and populations: why try to be more precise about how physical activity is assessed? Int J Obes Relat Metab Disord 1998;22 Suppl 2:S30–S38. [PubMed: 9778094]
12. Golding J, Pembrey M, Jones R. ALSPAC--the Avon Longitudinal Study of Parents and Children. I. Study methodology. Paediatr Perinat Epidemiol 2001;15(1):74–87. [PubMed: 11237119]
13. Trost SG, Ward DS, Moorehead SM, et al. Validity of the computer science and applications (CSA) activity monitor in children. Med Sci Sports Exerc 1998;30(4):629–633. [PubMed: 9565947]
14. Mattocks C, Ness A, Leary S, et al. Use of accelerometers in a large field-based study of children: protocols, design issues, and effects on precision. J Phys Act Health 2008;5(Suppl 1):S98–S111. [PubMed: 18364528]

15. Williams C, Miller L, Northstone K, et al. The use of non-cycloplegic autorefraction data in general studies of children's development. Br J Ophthalmol 2008;92(5):723–724. [PubMed: 18441189]
16. Kirkwood, BR.; Sterne, JAC. Essential Medical Statistics. Oxford: Blackwell Publishing Ltd.; 2003.
17. Azevedo MR, Araujo CL, Cozzensa da Silva M, et al. Tracking of physical activity from adolescence to adulthood: a population-based study. Rev Saude Publica 2007;41(1):69–75. [PubMed: 17273636]

NIH-PA Author Manuscript
NIH-PA Author Manuscript

Table 1

Multivariable regressions of physical activity variables at age 12 and myopia variables at age 10 for children from the ALSPAC study: myopic versus non-myopic.

Best eye		**cpm**			**MVPA**			**Msed**		
Model	**N**	**β**	**95% CI**	**p**	**β**	**95%CI**	**p**	**β**	**95%CI**	**p**
Minimal Adjustment	4880	−49.9	−73.5, −26.4	<0.001	−3.2	−5.2, −1.1	0.003	15.8	5.8, 25.8	0.002
Maximal Adjustment	3301	−36.8	−67.8, −5.8	0.02	−2.7	−5.3, −0.1	0.04	10.1	−2.9, 23.1	0.13
Worst eye		**cpm**			**MVPA**			**Msed**		
Model	N	β	95% CI	p	β	95%CI	p	β	95%CI	p
Minimal Adjustment	4880	−41.3	−60.5, −22.1	<0.001	−2.5	−4.2, −0.9	0.003	14.6	6.6, 22.6	<0.001
Maximal Adjustment	3301	−39.8	−64.7, −15.0	0.002	−2.5	−4.7, −0.4	0.02	16.0	5.6, 26.3	0.002

Minimal adjustment= gender and age at which monitor worn; Maximal adjustment= model 1 + lowest social class, maternal education, glasses data, parental myopia and child ethnicity