Socio-demographic correlates of physical activity and physical fitness in German children and adolescents

Lena Lämmle1, Annette Worth2, Klaus Bös3

1 Department of Sports Psychology, Technische Universität München, 80992 München, Germany
2 Department of Public Health, University of Education Schwäbisch Gmünd, 73525 Schwäbisch Gmünd, Germany
3 Department of Sport and Sports Sciences, Karlsruhe Institute of Technology, Karlsruhe, Germany

Correspondence: Lena Lämmle, Technische Universität München, Department of Sports Psychology, Georg-Brauchle-Ring 60/62, D-80992 Munich, Germany, tel: +49 (89) 289-24669, fax: +49 (89) 289-24555, e-mail: lena.laemmle@tum.de

Aim: Identifying factors that influence children’s and adolescents’ participation in physical activity (PA), as well as their physical fitness (PF), is essential for the development of effective intervention strategies. The aim of this study was to investigate and compare influential socio-demographic factors that affect PA such as socio-economic status (SES), rural–urban differences, immigration and age, as well as the effects of age and PA on PF as differentiated by gender. Subjects and Methods: German children between 6 and 9 years and adolescents between 10 and 17 years of age (n = 2574) participated in the representative, nationwide, cross-sectional ‘Motorik’-Module study between 2003 and 2006. Results: Results revealed that immigrant children and children with a lower SES background were less physically active and that this inactivity subsequently resulted in lower levels of PA as compared with non-immigrant children and children with a higher SES background. PA was further positively associated with age for children. All of these three socio-demographic factors were comparably meaningful for PA. In adolescents, the only PA-relevant socio-demographic parameter was SES with lower PA again resulting in lower PF levels observed in adolescents from lower income families. PF in childhood as well as adolescence was mostly positively affected by age, followed by PA, except for in female adolescents for whom PA and age were nearly equally significant. Conclusions: An intervention aiming to improve PA levels, and consequently PF levels, must, with respect to age and gender, refer to SES, as well as immigration background, but not to rural–urban differences.

Introduction

Physical inactivity is not only a major public health problem, but physical activity (PA) and physical fitness (PF) are also important for healthy growth in children and adolescents.1–3 Despite the health benefits of PA and PF,4,5 there has been a evidence of decreasing levels of PA and PF in recent decades.6–8 Further, PA in childhood is discussed as important for socialization towards a physically active lifestyle.9 It is assumed that PA influences PF.10 PA promotion, therefore, is set quite high on the health policy agenda.11 Despite a growing emphasis on the importance of PA and PF in childhood and adolescence, factors related to German children’s and adolescents’ PA and PF remain unclear. PA is thought to be a multi-factorial behaviour influenced by psychological, social, environmental and demographic variables.12 Research on non-modifiable socio-demographic variables, such as age and gender, suggests that specific subgroups of young people have tendentially lower PA levels and are in more need of interventions or that interventions should be more tailored towards the needs of these groups.13–15 Other socio-demographic variables such as socio-economic status (SES)16 or environmental characteristics such as rural–urban differences17,18 have shown mixed findings with regard to PA. In some cases of socio-demographic variables such as migration, research has only rarely been performed.19 Further, few studies have reported results for both children and adolescents. Gender comparisons have only rarely been considered. From the perspective of different analysis strategies, multivariate analyses have revealed fewer significant results than bi-variate analyses for correlates of PA.13 Thus, to shed light on such inconsistent findings and to fill research gaps, the aim of the present study, was to analyse and compare the impact of SES, rural–urban differences, immigration and age on PA, differentiated for (male and female) children as well as for (male and female) adolescents. As analysis strategies, both bi-variate and path model analyses were considered.

As with PA, age20–21 as well as gender22,23 are non-modifiable demographic variables, thereby also suggesting the existence of subgroups of young people with different performance levels of PF. As modifiable, behavioural variable findings suggest regular engagement in PA is related to the attainment of standards associated with PF.24–26 Consequently, it was of interest to analyse and compare the impact of age and PA on PF as differentiated for (male and female) children, as well as for (male and female) adolescents. In line with the Ecological Systems Theory,27 we aimed to examine whether the following dependencies existed: PA was assumed to be influenced by the exo- or chronosystem factors of SES, rural–urban differences, immigration status and age. PF was assumed to be directly influenced by PA (microsystem) and age (chronosystem). Finding such dependencies would deliver information about subpopulations in which interventions might be more needed or should be more tailored towards the subpopulations’ needs.

Methods

Sample and study

Analyses are based on data retrieved during the ‘Motorik’-Module (MoMo), which was conducted between May 2003 and May 2006. It was a nationwide, cross-sectional study for a more differentiated recording of PA and PF.28 The MoMo test battery was administered to 2574 children and adolescents (435 female and 435 male children, 843 female and 861 male adolescents) with an average age of 11.51 years (SD = 3.36; Age min = 6, Age max = 17). The World Health Organization defines an adolescent as a person between 10 and 19 years of age. Two age groups consisting of children from 6 to 9 years of age and adolescents from 10 to 17 years of age29 were analysed. Participation was voluntary. Participants were chosen nationwide with the use of a stratified two-stage probability sampling procedure. First, a systematic sample of 167 primary sample units was drawn from an inventory of German communities stratified according to the BIK classification system, which measures the grade of urbanization, and the geographic distribution. The number of primary sample units per strata was determined using the Cox procedure for community sampling with sampling probability
proportional to population size. Second, an equal number of addresses per birth cohort were randomly selected from local population registries within selected primary sample units. Finally, a random sample was drawn, including a total of 8–10 children and adolescents per birth cohort, depending on community size. Invitations were sent to their home addresses. Participants were invited to local study centres to fill out questionnaires and take part in the study. The response rate was 66.6% with 5.3% quality-neutral drop-outs and with low variation with regard to the age groups.30 The study was carried out according to the ethical guidelines laid down by the medical ethics committee.

**Measurements**

**Immigration status**
Participants were treated as immigrants (coded as 1) if they emigrated from another country and if at least one parent was not born in Germany, or if both parents were immigrants or had not accepted the German nationality. All other participants were treated as non-immigrants (coded as 2). Information on citizenship, country of birth, year of entry and age at entry was assessed using a questionnaire.

**Rural–urban differences**
Rural areas (coded as 1) were defined as rural (population value: <5000) and provincial areas (population value: 5000–20,000), whereas urban areas (coded as 2) were defined as medium-sized towns (population value: 20,000–100,000) and metropolitan areas (population value: >100,000).28

**Socio-economic status**
The SES information was based on the mean score of parents’ information concerning their school education (What is your graduate level? Please mention only the highest grade) ranging from 1 (without graduation) to 7 (high school diploma); professional qualification (Have you finished an apprenticeship? If yes, which one?) ranging from 1 (without professional qualification) to 7 (university degree); occupation (What is your current main professional position?) ranging from 1 (common labourer) to 7 (leading position); and the net household income (How high is the average monthly household income, that is, the net household income of all members of the household after payroll and social security contributions) ranging from 1 (€<1250) to 7 (>5000 €). The mean score ranged from 1 (low SES) to 7 (high SES). The parent with the higher status, or, in the event of a divorce, the status of the parent where the child was living, was chosen.30

**Physical activity**
PA was assessed using a questionnaire containing previously validated items involving the duration, intensity and frequency of PA in leisure time, school and sports clubs in the past year. The item stems for the PA measures were ‘How long do you…?’ (measured in minutes; duration), ‘How often do you…?’ (a week, a month or a year) and ‘How much effort do you normally forth when you…?’ ranging from 1 (without sweating and breathlessness) to 3 (a lot of sweating and breathlessness; intensity).28 The test–retest reliability in the previous 7-day longitudinal study ranged from \( r_{tt} = 0.72 \) to \( r_{tt} = 0.93 \). Validity was tested with a multi-sensor electronic monitor including a biaxial accelerometer measuring PA (SenseWear Pro 2). Results showed higher correlations \( r_{min} = 0.56, r_{max} = 0.66 \) in comparison with other PA questionnaires.31 For the present analyses, a PA parcel was built. For leisure time, school and sports club activity, only time spent from moderate to vigorous PA in minutes was regarded: frequency, duration and intensity were multiplied by each other and then divided by 12. We divided by 12 to obtain an average value for weekly leisure time, school and sports club activity in minutes. Finally, all three PA measures were added to obtain an overall weekly PA level. Sustained moderate to vigorous PA was documented as associated with positive health outcomes.13

**Physical fitness**
Participants were tested with eight tests of the MoMo test battery32,28 to assess a complete PF profile involving endurance (through a bicycle ergometer test), strength (through push-ups, standing long jump and force plate for high jumps), coordination under precision demands (through standing on one leg and balancing backwards), coordination under time pressure (through jumping sideways) and flexibility (through forward bending of the trunk). The content-related validity of all tests were previously evaluated as good \( (M_{significance} = 1.9, M_{practicability} = 1.7) \) throughout with regard to significance and feasibility as based upon expert ratings. Further, good test–retest reliability coefficients \( (r_{min} = 0.74, r_{max} = 0.96) \) were found. The retest was conducted 4 days after the first test.28 All measures were \( z \)-transformed and a mean score was calculated.

**Statistical analysis**
Path analysis was conducted with AMOS 16.0 using maximum likelihood measurements. The assumption of multivariate normality could not be confirmed by the Mardia test (multivariate kurtosis = 4.695, c.r. = 10.611, \( P < 0.001 \)). Therefore, a Bollen–Stine bootstrap procedure (1000 samples) was conducted to obtain a corrected \( \chi^2 \)-value for the \( \chi^2 \)-test.

**Results**

**Descriptive statistics**
For a sample description, table 1 provides raw-score means, standard deviations or percentages for the model variables (except for the z-score for PF and age).

**Model of socio-demographic data, PA and PF**
The multi-group analyses (figures 1, 2 and table 2) revealed differences for children and adolescents and for female and male adolescents with an acceptable model fit, but not for female and male children.

**Children**
Less PA was associated with lower SES and immigration background (table 2). PA was not influenced by rural–urban differences. Further, older participants were more physically active.

PF was mainly influenced by age. Older participants performed better on PF, and more PA was associated with better PF.

Four per cent of the PA variance could be explained as related to the socio-demographic variables (SES 3.5%, immigrations status 0.5%). PA (3%) and age (23%) explained 26% of the variance of PF.

**Adolescents**
Less PA was associated with lower SES. PA was neither influenced by immigration status, nor by rural–urban differences, nor by age.

PF was mainly influenced by age. Older participants performed better on PF, and more PA was associated with better PF.
One per cent of the PA variance could be explained as related to the socio-demographic variables (mainly the SES variable). PA (8%) and age (15%) explained 23% of the variance of PF.

Male adolescents

Less PA was associated with lower SES. PA was not influenced by immigration status, rural–urban differences or age.

PF was mainly influenced by age. Older participants performed better on PF, and more PA was associated with better PF.

One percent of the PA variance could be explained as related to the socio-demographic variables (mainly the SES variable). PA (6%) and age (26%) explained 32% of the variance of PF.

Female adolescents

Less was PA associated with lower SES. PA was not influenced by immigration status, rural–urban differences or age.

PF was nearly equally influenced by age and PA. Older participants performed better on PF, and more PA was associated with better PF.

One percent of the PA variance could be explained as related to the socio-demographic variables (mainly the SES variable). PA (6%) and age (8%) explained 14% of the variance of PF.

Discussion

Using national survey data, differences for German children and adolescents as well as gender effects in adolescence were found, but no gender differences were found in childhood for socio-demographic factors affecting PA and PF. Whereas for the differences between children and adolescents, the effect of immigration status on PA and the effect of age on PA seemed to be causal, the differences between female and male adolescents seemed to be caused by the effect of age on PF. Further, it was shown that no differences for the two analysis strategies emerged in these data. However, missing responses could have impacted the underlying data if the missing data had contained higher rates for inactive participants and participants with a lower PF. Further, future research should analyse how other specific living conditions (like communities) impact the present findings.

Even though research on the correlation of SES and PA in childhood and adolescence has not been consistent, more recent research has suggested lower levels of PA in families with lower SES, which is in accordance with the present findings. It was shown that there was no gender difference for the effect of SES on PA in childhood and it seemed that there was also no such difference in adolescence. However, past research rather suggests a stronger relation between SES and PA for females. Possible moderators such as neighbourhood safety are needed to explain the inconsistent findings.

Research on rural–urban differences and PA in children and adolescents has indicated inconsistent findings, suggesting that more focus should be placed on this topic. The present data revealed no impact of rural–urban differences on PA levels of German children and adolescents. To shed light on these inconsistent findings, PA should be considered in a more differentiated fashion because factors explaining these differences could consist of the way students get to school, the distance to school and regular activities.

Research on the impact of immigration status on the PA of children and adolescents has been rare, and there is a lack of information on age and gender effects. The present analyses revealed an impact of immigration status on PA for children, but not for adolescents, and no differences between boys and girls in childhood and probably not in adolescence. Future research in both age groups with possible moderators or even mediators such as cultural values in childhood are needed to explain these initial findings.

A review from 2000 revealed inconsistent results for PA from the ages of 4–12 years, whereas adolescents aged 13–18 years demonstrated a negative association between age and PA. However, there has been evidence in more recent studies for a decrease in PA as children age and the reduction in PA has been shown to be greater in girls.
Table 2 Model of socio-demographic data, PA and PF

<table>
<thead>
<tr>
<th>Model fit</th>
<th>χ²</th>
<th>df</th>
<th>P-value</th>
<th>RMSEA (CI)</th>
<th>SRMR</th>
<th>CFI</th>
<th>ΔCFI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Children and adolescents</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Unrestricted</td>
<td>98.714</td>
<td>12</td>
<td>0.005</td>
<td>0.053 (0.044–0.063)</td>
<td>0.037</td>
<td>0.920</td>
<td>−0.074</td>
</tr>
<tr>
<td>Restricted</td>
<td>98.714</td>
<td>12</td>
<td>0.005</td>
<td>0.062 (0.054–0.070)</td>
<td>0.037</td>
<td>0.846</td>
<td>−0.074</td>
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<tr>
<td>Female and male adolescents</td>
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<td></td>
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<td></td>
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</tr>
<tr>
<td>Unrestricted</td>
<td>67.844</td>
<td>12</td>
<td>0.005</td>
<td>0.052 (0.041–0.065)</td>
<td>0.031</td>
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<tr>
<td>Restricted</td>
<td>67.844</td>
<td>12</td>
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<td>0.054 (0.044–0.065)</td>
<td>0.031</td>
<td>0.874</td>
<td>−0.043</td>
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Paths and bi-variate correlations

<table>
<thead>
<tr>
<th>SES</th>
<th>Migration</th>
<th>R/U</th>
<th>AGE</th>
<th>PA</th>
</tr>
</thead>
<tbody>
<tr>
<td>a</td>
<td>r</td>
<td>a</td>
<td>r</td>
<td>a</td>
</tr>
<tr>
<td>Children</td>
<td>PA</td>
<td>0.17&lt;sup&gt;1&lt;/sup&gt;</td>
<td>0.18&lt;sup&gt;1&lt;/sup&gt;</td>
<td>−0.09&lt;sup&gt;2&lt;/sup&gt;</td>
</tr>
<tr>
<td>PF</td>
<td>0.47&lt;sup&gt;1&lt;/sup&gt;</td>
<td>0.48&lt;sup&gt;1&lt;/sup&gt;</td>
<td>0.074</td>
<td>0.043</td>
</tr>
<tr>
<td>Adolescents</td>
<td>PA</td>
<td>0.10&lt;sup&gt;1&lt;/sup&gt;</td>
<td>0.11&lt;sup&gt;1&lt;/sup&gt;</td>
<td>−0.02</td>
</tr>
<tr>
<td>PF</td>
<td>0.39&lt;sup&gt;1&lt;/sup&gt;</td>
<td>0.40&lt;sup&gt;1&lt;/sup&gt;</td>
<td>0.36</td>
<td>0.36</td>
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<tr>
<td>Male adolescents</td>
<td>PA</td>
<td>0.10&lt;sup&gt;2&lt;/sup&gt;</td>
<td>0.10&lt;sup&gt;2&lt;/sup&gt;</td>
<td>&lt;0.01</td>
</tr>
<tr>
<td>PF</td>
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<td>0.51&lt;sup&gt;1&lt;/sup&gt;</td>
<td>0.36</td>
<td>0.36</td>
</tr>
<tr>
<td>Female adolescents</td>
<td>PA</td>
<td>0.04</td>
<td>0.04</td>
<td>0.28&lt;sup&gt;1&lt;/sup&gt;</td>
</tr>
<tr>
<td>PF</td>
<td>0.39&lt;sup&gt;1&lt;/sup&gt;</td>
<td>0.40&lt;sup&gt;1&lt;/sup&gt;</td>
<td>0.36</td>
<td>0.36</td>
</tr>
</tbody>
</table>

a: Bollen-Stine P-value
b: 90% confidence interval
c: measurement invariance
<sup>1</sup>P < 0.001, <sup>2</sup>P < 0.01
path values; r, bivariate correlations; R/U, rural–urban differences
Key points

- There are dependencies of socio-demographic variables influencing PA as well as PF, thus indicating subpopulations in which interventions are more needed or should be more tailored towards the subpopulations’ needs.
- Younger children, immigrant children, as well as children with a lower socio-economic background are not only less physically active, but also have lower levels of PF.
- PA levels were stable from the ages of 10 to 17 and thus inter-ventional programmes should ensure adequate PA levels before the tenth year of age.

References