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Original Research

Objectively assessed physical activity and weight status of primary school children in Germany with and without migration backgrounds

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ABSTRACT

Objectives: Many children are insufficiently active, and children with a migration background appear to be even less active and at a higher risk of developing obesity. This study evaluated the weight status, and the frequencies and intensities of objectively assessed physical activity (PA) of children with and without a migration background.

Study design: Cross-sectional study.

Methods: PA was assessed objectively for 6 days in 273 children (aged 7.1 ± 0.6 years). In total, 74 children (27%) were classified as having a migration background. PA was grouped in light and moderate-to-vigorous (MVPA) intensities. Body mass index (BMI) percentiles (BMIPCT) were determined.

Results: Children without a migration background spent more time in MVPA compared with children with a migration background (138.2 ± 62.6 vs 121.7 ± 54.9 min, respectively; $P < 0.01$). On weekends, time in MVPA decreased significantly for all children (112.3 ± 66.0 min, $P < 0.01$), especially for children with a migration background (97.7 ± 56.7 min, $P < 0.01$). Children with a migration background displayed significantly higher BMIPCT than children without a migration background (55.7 ± 29.6 vs 44.3 ± 26.8, respectively; $P < 0.01$) and were significantly more often overweight and/or obese (13.5% vs 8.5%, respectively; $P < 0.02$).

Conclusions: Children with a migration background are less physically active and more often overweight, resulting in higher risks of developing secondary diseases. The results of this study should be considered when designing interventions to increase PA in children with a migration background.

Trial registration: German Clinical Trials Register (DRKS), DRKS-ID: DRKS00000494;

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Introduction

Although obesity rates have increased among children and adults, recent studies show signs of stagnation in the prevalence of overweight and obesity in children and adolescents in Germany.[1–3] While obesity is recognised as a worldwide epidemic,[4] when considered in combination with physical inactivity, it has become one of the leading public health challenges in recent years.[5]

Obesity in children has been associated with various physical and psychological health issues, such as cardiovascular risk factors (e.g. hypertension and type two diabetes), orthopaedic problems and decreased quality of life.[6,7] Furthermore, childhood overweight and obesity tend to persist into adolescence and adulthood.[8] Besides genetic predispositions, the main reasons for the increase of childhood obesity are behavioural, cultural and environmental factors, such as decreasing physical activity (PA), a more sedentary lifestyle and unfavourable eating habits.[9] To prevent a further spread of this epidemic, the World Health Organisation (WHO) guidelines[10] for children aged 5 years and older recommend at least 60 min of moderate-to-vigorous PA (MVPA) per day. Despite this, decreasing PA levels from early childhood into adulthood is frequently observed,[11–13] and across Europe, only 20% of children and adolescents reach the recommended 60 min of MVPA per day.[14]

Children with a migration background seem to be less physically active,[16] as well as spending more time on screen media and eating more sugary foods, which results in this population being at a higher risk of developing overweight and obesity.[17,18] It has been suggested that migration to Western countries increases the risk of overweight and obesity as a consequence of acculturation and lifestyle changes.[19] PA, although publicised worldwide, is in many countries not viewed as health enhancing or vital to a healthy lifestyle.[20] Many children (and their parents) are still unaware of the benefits of a physically active lifestyle, which results in a lack of PA especially among children with a migration background.[20]

In Germany, 21% of primary school children without a migration background are physically active less than once a week compared with 36% and 48% of boys and girls with migration backgrounds, respectively.[13] However, most of these data were assessed subjectively with their known disadvantages. There is little objective data on PA behaviours of primary school children in Germany and even less research based on objective PA assessment of children with a migration background.

However, understanding the differences in PA levels of children with migration backgrounds in Germany, as well as their influencing factors, compared with those without a migration background is vital when considering the long-term benefits PA to a healthy life. Understanding these differences will support the design and implementation of effective interventions to promote an active lifestyle in children with migration backgrounds.

Therefore, the primary aim of this study was to evaluate the frequencies and intensities of objectively assessed PA of primary school children with and without migration backgrounds in Germany. A secondary aim was to compare the body composition and weight status of children on the basis of their migration background.

Methods

Participants and data collection

Baseline data from a subsample of 273 first-grade and second-grade children (aged 7.1 ± 0.6 years [range 5.7–9.9 years], 53% male) of the so-called Baden-Württemberg study, which evaluated a large school-based health promotion programme 'Join the Healthy Boat' in south-west Germany,[22] was used. Participation in the programme was voluntary; after advertising, interested teachers contacted the programme centre, resulting in a total of 172 primary school teachers and principals at 94 schools consenting to take part. There were 3159 pupils in the participating classes, of which 1968 parents (62.3%) of pupils gave written informed consent to participate in the study. Baseline measurements of 1947 children (age range 5.4–9.9 years, 51% male) are available, from which the above-mentioned subsample was derived. Parents of the 273 children in the subsample provided a separate consent for their children to wear a multisensor device objectively assessing PA for six consecutive days; children gave their verbal assent. Further details on the Baden-Württemberg study design and protocol can be found elsewhere.[23] The study was approved by the university's ethics committee (application no. 126/10), conducted in accordance with the Declaration of Helsinki and is registered at the German Clinical Trials Register (DRKS-ID: DRKS00000494).

Of the 273 children, 74 (27%) were classified as having a migration background. A migration background was defined as having at least one parent who was born abroad or the child being spoken to in a language other than German during the first 3 years of their life (both were assessed via a parental questionnaire).

Anthropometric measurements

Children's height (cm) and body weight (kg) were assessed by trained staff using a stadiometer and calibrated electronic scales (Seca 213 and Seca 826, respectively, Seca Weighing and Measuring Systems, Hamburg, Germany). The body mass index (BMI) of children was calculated (kg/m^2) and converted to BMI percentiles (BMIPCT) based on German reference data.[24] Overweight was defined as above the 90th percentile and obesity above the 97th percentile.

Physical activity measurements

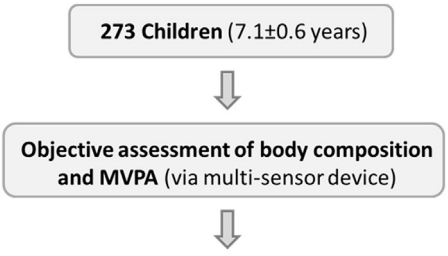
To assess the PA of children, during a school visit, trained staff fitted a multisensor device (Actiheart©, CamNtech Ltd., Cambridge, UK), which assessed uniaxial acceleration in combination with heart rate to determine PA, to the children's chests. Validity of the device in children has been established previously.[25] The recording interval was set to 15 s, and participants wore the device for six consecutive days and nights (for further details see Kettner et al.[21]). To be included in the

analyses, at least 3 days (including at least one weekend day) of valid data of more than 10 h were required. First and last recording days were excluded from the analysis to antagonise a novelty factor on the first day, whereas the last day never showed 10 h of recording.

Energy expenditure (metabolic equivalent [MET]) was predicted by Actiheart©'s captive software (Version 4.0.129), which takes into account the participant's age, height, body weight and sex, in addition to the assessed heart rate and movement counts; this was used to define their PA levels. Activity levels were classified as sleep and sedentary (<1.5 MET), light (1.5–3 MET), moderate (>3–6 MET) and vigorous (>6 MET), as well as MVPA (>3 MET).[26] To determine whether participants met the WHO PA guideline of 60 min of MVPA every day,[9] the days with valid data were extrapolated to a full week, using a ratio of 5:2 for weekdays and weekend days. Average PA times during weekdays and weekend days were calculated (see Fig. 1).

Sociodemographic data

Sociodemographic data, such as parental education level, household income and migration background, were collected using a parental questionnaire. Parental education level was determined based on the highest school education of either parent or the single parent; net household income was dichotomised above and below €1750 per month.



	Children with MB (n=74)	Children without MB (n=199)
MVPA total week (min/day) [m±sd]*	122 ± 55	138 ± 63
MVPA at weekend (min/day) [m±sd]*	98 ± 57	117 ± 69
BMIPCT [m±sd]*	55.7 ± 29.6	44.3 ± 26.8
Overweight & obesity [n(%)]*	10 (13.5)	17 (8.5)

Fig. 1 – Conceptual framework of the study including main findings for children with and without migration background (MB). MB is defined as having at least one parent who was born abroad or the child being spoken to in foreign language during the first 3 years of life. sd, standard deviation; BMIPCT, body mass index percentiles; MET, energy expenditure; MVPA, moderate-to-vigorous physical activity (>3.0 MET); overweight and obesity, BMIPCT >90%. *Significant difference between children with and without migration background ($P \leq 0.05$).

Statistical analyses

All statistical analyses were performed using SPSS Statistics 25 (SPSS Inc., Chicago, IL) with a significance level set to $\alpha < 0.05$. Descriptive statistics for continuous variables are displayed as mean values and standard deviations. Categorial variables are described with absolute and relative frequencies. Group differences between means were analysed with paired and independent *t*-tests, and the Chi-squared test was used to analyse group differences with categorical variables. Linear regression models with stepwise variable selection were used to examine differences in different PA levels of children with and without migration backgrounds on weekends and weekdays, adjusting for sex, age and BMIPCT.

Results

Sample characteristics

The mean age of the 273 first-grade and second-grade children was 7.1 ± 0.6 years; 53% of them were male, and just over one-quarter of participants (27%) were classified as having a migration background. Participant's anthropometric and socio-economic characteristics are shown in Table 1. No group differences were found for age, height and body weight; however, children with a migration background displayed significantly higher BMIPCT than children without a migration background (55.7 ± 29.6 vs 44.3 ± 26.8, respectively; $P \leq 0.01$) and were significantly more overweight and/or obese (13.5% vs 8.5%, respectively; $P \leq 0.02$). Children without a migration background were significantly more often from families with a household income of above €1750 per month (84.4% vs 68.9%, $P \leq 0.01$) and were significantly more likely to have parents with a high school degree (38.9% vs 25.4%; $P \leq 0.04$). Thus, household income and parental education were initially controlled for in each analysis but showed no effect, which resulted in neglecting them for the final regression models.

Light physical activity

Children spent a daily total of 495 ± 72 min (equating to 8.25 h) in light PA (≤3 MET; see Table 2). A significant difference in time in light PA could be observed on weekends compared with weekdays (474 ± 80 and 503 ± 78 min, respectively; $P < 0.01$). There was no difference between children with and without migration backgrounds in time spent in light PA.

Moderate and moderate-to-vigorous physical activity

As shown in Table 2, there was a significant difference between children with and without migration backgrounds in time spent in moderate PA as well as in MVPA (Fig. 2) but not vigorous PA in total ($T = -2.14$, $P < 0.03$ and $T = -2.11$, $P < 0.04$, respectively); however, during weekends children with migration backgrounds spent significantly less time in both intensities than children without migration backgrounds ($T = -2.59$, $P < 0.01$ and $T = -2.46$, $P < 0.02$, respectively). This difference stayed significant, even if adjusting for sex, age and

Table 1 – Descriptive characteristics of the study participants.

Characteristic	Total sample (n = 273)	Children with MB[a] (n = 74)	Children without MB[a] (n = 199)	T value	P-value
Sex (male) [n (%)]	128 (46.9)	29 (39.2)	99 (49.7)	−1.57	0.119
Age (years) [m ± SD]	7.1 ± 0.6	7.2 ± 0.7	7.1 ± 0.6	−1.02	0.307
Height (cm) [m ± SD]	123.8 ± 6.0	123.5 ± 6.7	123.9 ± 5.8	0.55	0.584
Weight (kg) [m ± SD]	24.6 ± 4.9	25.5 ± 5.6	24.3 ± 4.5	−1.62	0.109
BMIPCT [m ± SD]	47.4 ± 28.0	55.7 ± 29.6	44.3 ± 26.8	−2.90	0.004[f]
Weight status					
Overweight[b] [n (%)]	17 (6.2)	6 (8.1)	11 (5.5)	−1.21	0.019[f]
Obese[c] [n (%)]	10 (3.7)	4 (5.4)	6 (3.0)	−0.92	0.067
High household income[d] [n (%)]	219 (80.2)	51 (68.9)	168 (84.4)	2.51	0.014[f]
High family education level[e] [n (%)]	92 (35.4)	17 (25.4)	75 (38.9)	2.11	0.037[f]

BMIPCT, body mass index percentiles; M, mean; MB, migration background; SD, standard deviation.
[a] Migration background is defined as having at least one parent who was born abroad or the child being spoken to in foreign language during the first 3 years of life.
[b] Overweight = BMIPCT >90–97%.
[c] Obese = BMIPCT >97%.
[d] High household income = net household income of more than €1750/month.
[e] High family education level = at least one parent has a high school degree.
[f] Significant difference between children with and without migration background ($P \leq 0.05$).

Table 2 – Time (in rounded min) spent in different physical activity intensities and percentage of children meeting physical activity guidelines.

Time period/meeting recommendation	Total sample (n = 273)	Children with MB[a] (n = 74)	Children without MB[a] (n = 199)	T value	P-value
Total week (mean ± SD)					
LPA (min/day)	495 ± 72	484 ± 72	499 ± 71	1.62	0.107
MPA (min/day)	124 ± 54	115 ± 49	130 ± 55	2.03	0.043[b]
VPA (min/day)	8 ± 10	6 ± 8	8 ± 11	1.12	0.264
MVPA (min/day)	134 ± 61	122 ± 55	138 ± 63	1.99	0.048[b]
Weekend (mean ± SD)					
LPA (min/day)	474 ± 80	461 ± 78	479 ± 80	1.75	0.081
MPA (min/day)	108 ± 62	93 ± 52	113 ± 64	2.35	0.019[b]
VPA (min/day)	5 ± 8	4 ± 8	5 ± 8	0.50	0.617
MVPA (min/day)	112 ± 66	98 ± 57	117 ± 69	2.26	0.025[b]
Weekdays (mean ± SD)					
LPA (min/day)	503 ± 78	493 ± 79	507 ± 78	1.36	0.178
MPA (min/day)	134 ± 58	124 ± 55	137 ± 59	1.70	0.91
VPA (min/day)	9 ± 12	7 ± 9	9 ± 13	1.34	0.183
MVPA (min/day)	142 ± 67	131 ± 61	146 ± 68	1.65	0.100
≥60 min MVPA per day					
Meeting recommendations [n (%)]	131 (48.0)	37 (50.0)	94 (47.2)	−0.41	0.686

LPA, low physical activity (1.5–2.9 MET); MB, migration background; MET, energy expenditure; MPA, moderate physical activity (3.0–5.9 MET); MVPA, moderate-to-vigorous physical activity (>3.0 MET); SD, standard deviation; VPA, vigorous physical activity (>6.0 MET).
[a] Migration background is defined as having at least one parent who was born abroad or the child being spoken to in foreign language during the first 3 years of life.
[b] Significant difference between children with and without migration background ($P \leq 0.05$).

BMIPCT (F 36.10, $P < 0.01$ and F 40.37, $P < 0.01$, respectively; see Table 3).

Guideline achievement

Although nearly half (48.0%) of the participating children were physically active for 1 h on all days of the week, there was a tendency towards children with a migration background reaching the recommended 60 min of daily MVPA more often than their German counterparts (50.0% vs 47.2%, respectively; see Table 2); however, statistical significance could not be reached.

Weight status

Compared with children without a migration background, children with a migration background displayed significantly higher BMIPCT (55.7 ± 29.6 vs 44.3 ± 26.8, respectively; $P < 0.01$)

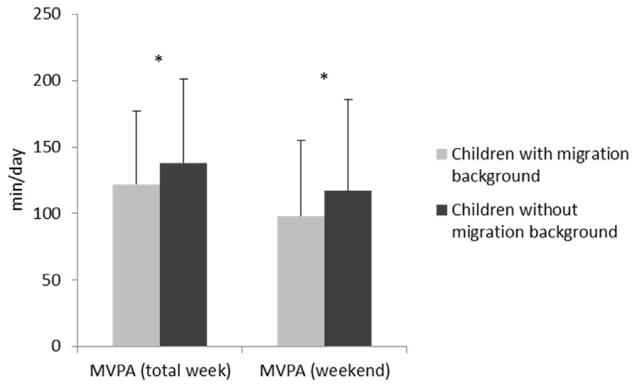


Fig. 2 – Mean moderate-to-vigorous physical activity (MVPA) levels in minutes per day during all days of the week and the weekend for children with and without migration backgrounds. Migration background is defined as having at least one parent who was born abroad or the child being spoken to in foreign language during the first 3 years of life. The bars represent the standard deviation.*Significant difference between children with and without migration background ($P \leq 0.05$).

Table 3 – Results from the final regression model for the different intensities in total.

Variable	Coefficient	95% CI	P-value
LPA total			
Migration background[a]	−0.06	−28.38 to 10.16	0.353
Age	−0.12	−26.06 to 0.29	0.055
Sex	−0.08	−28.61to 5.26	0.176
BMIPCT	−0.17	−0.74 to −0.12	0.006[b]
MPA total			
Migration background[a]	−0.15	−29.54 to −5.55	0.004[b]
Age	0.15	4.75 to 21.14	0.002[b]
Sex	−0.43	−56.22 to −35.14	0.001[b]
BMIPCT	0.32	0.42 to 0.80	0.001[b]
VPA total			
Migration background[a]	−0.07	−3.96 to 0.78	0.187
Age	0.09	−0.19 to 3.04	0.084
Sex	−0.46	−11.38 to −7.22	0.001[b]
BMIPCT	0.23	0.04 to 0.12	0.001
MVPA total			
Migration background[a]	−0.14	−32.41 to −5.86	0.005[b]
Age	0.15	5.29 to 23.44	0.002[b]
Sex	−0.45	−66.64 to −43.31	0.001[b]
BMIPCT	0.32	0.48 to 0.09	0.001[b]

BMIPCT, body mass index percentiles; CI, confidence interval; LPA, low physical activity (1.5–2.9 MET); MET, energy expenditure; MPA, moderate physical activity (3.0–5.9 MET); MVPA, moderate-to-vigorous physical activity (>3.0 MET); VPA, vigorous physical activity (>6.0 MET).

[a] Migration background is defined as having at least one parent who was born abroad or the child being spoken to in foreign language during the first 3 years of life.

[b] Significant difference between children with and without migration background ($P \leq 0.05$).

and were significantly more often overweight and/or obese (13.5% vs 8.5%, respectively; $P < 0.02$). Note that BMIPCT was controlled for in PA analyses; for total MVPA, this resulted in a change in $F = 34.91$ ($P < 0.01$).

Discussion

This study examined weight status of children and objectively assessed PA levels on the basis of their migration background. The results of this study show a negative association between migration background and daily PA in primary school children in Germany. Overall, children with a migration background displayed lower levels of moderate PA and MVPA than children without a migration background.

In this sample, group differences in light, moderate, vigorous and moderate-to-vigorous PA were examined, showing that children without a migration background spent more in moderate PA as well as in MVPA but not vigorous PA. Generally, low levels of PA in children with a migration background have previously been observed in Germany and Canada,[27–29] showing that, in particular, Turkish children (which are one of the largest immigrant groups in southern Germany) engage in very little PA.[15]

Most of the previous data were assessed subjectively, and often sports participation was used to assess PA. For instance, Lämmle et al.[30] found that children with a migration background were less physically active than German children. This fact was also supported by other studies in Europe,[15] which have found that children with migration backgrounds are less likely to engage in organised sports or to be physically active in their leisure time but not during recess at school.[31] Furthermore, it was shown that children with migration backgrounds were 4.6-times less likely to engage in sports compared with their German counterparts.[32] Conversely, in Denmark, primary school children with a migration background were less engaged in organised sports (based on self-report), but if looking at PA itself (objectively assessed), there was no difference in amount of daily PA between children with or without migration background (86 vs 83 min per day, respectively).[33] It was proposed that one reason for this was their amounts of outdoor play every day.[33]

This might also be the reason why children with a migration background in this sample reached the PA guideline of 60 min of MVPA daily more often than their German counterparts (although this was not statistically significant). Even though children with a migration background showed lower levels of moderate PA and MVPA in total, when assessing every day of the week individually, they were active more often, suggesting that German children tend to be physically active in 'bulk' compared with every day. This might suggest a greater participation in organised sports by German children because they were more active on fewer days a week, whereas children with a migration background showed less activity on more days. This may also be a result of cultural differences, especially for girls with a migration background, as they are often not allowed to participate in certain activities and are driven to school more often than German children.[32]

In addition, the potential impact of sex and age on PA behaviour must not to be neglected. Literature shows an age-related decline of PA levels, even in young children[15] and also that boys are consistently more physically active than girls.[15,23] Owing to the limited sample size, stratification by age and sex was not possible, but both factors have been controlled for in this study. The difference in PA levels

according to age and sex might also have cultural as well as situational reasons. Once at school, children tend to be significantly less physically active than before (possibly owing to prolonged periods of sitting),[15] and no matter whether children are offered structured or unstructured opportunities to be physically active, boys show higher levels of PA.[34,35]

Results of this study show that most physically active time was spent in light intensities, but there were no differences in light PA between children with and without a migration background. Recently, it has been discussed that not only MVPA would be beneficial to health but also lower intensities of PA,[36] which is why this should be also be promoted. A recent publication by Hansen et al.[37] suggests that changing as little as 10 min of sedentary time each day into either light PA or MVPA would have favourable effects on the insulin response of children and adolescents, as well as their waist circumferences.[37]

In this current study, the weight status of children was assessed on the basis of BMI percentiles. Children with a migration background showed significantly higher BMI percentiles and had a higher prevalence of overweight and obesity compared with those children without a migration background; a fact that has been observed in various countries all over Europe[38] with numerous different explanations. One reason for this might be the heterogeneity of the group with migration backgrounds. It includes all children whose parents are born abroad or have spoken to the child in a foreign language during the first 3 years of life. In this sample alone, there were children from 21 different countries and languages, in addition to their differences in culture, background and habits. It has been suggested that the disparities could be a consequence of an interaction of cultural, genetic, socio-economic and environmental factors.[20] These include lower parental education level, lower socio-economic status, higher screen media consumption, increased energy intake and less PA.[9] Some of these results have been confirmed in the current study, namely, lower PA levels and lower socio-economic status (here substituted with household income and parental education), but sometimes without a direct link. In this study, children with a migration background more frequently came from families with less household income and a low education level; however, no association was seen in the regression analyses. This is in contrast to studies from Switzerland and the Netherlands,[9,39] which found that children with parents with low education levels had a higher prevalence of overweight and obesity—this increased if children had a migration background.[9]

However, in this sample, only a very small proportion of children were classified as overweight or obese (6.2% and 3.7%, respectively), which is considerably less than the incidence of overweight and obesity in other national samples of children below 10 years of age (e.g. 10.6% and 3.8% in boys and 12.9% and 5.6% in girls[38]). Having said this, the group of children with a migration background in the current study were shown to be 50% more overweight and 80% more obese than their German counterparts, which is alarming. These results should not be neglected when looking at potential health inequalities.

Nonetheless, there are limitations to this study, which should be considered when interpreting these findings. Although assessed objectively over a relatively long period of time, PA was calculated on the basis of energy expenditure which might have led to a misinterpretation of intensities in some children and, therefore, the total outcome. Also, recording time intervals were set to 15 s, which, at least for some activities, might have been too long to capture all of the activities, and some activities might not have been recorded adequately or not at all. Also, the use of subjective assessment methods in many studies used for comparison complicate classification of PA. Furthermore, information provided by the parents in the questionnaire is subjective, which many result in reporting bias. Additionally, owing to the voluntary participation in this study (on the school, parent and child levels), a selection bias cannot be ruled out. It should also be noted that owing to the variances in policies, PA and the achievement of PA guidelines can be different across countries and therefore only be compared caution. Moreover, because the children with a migration background in this study predominantly came from families with a lower socio-economic background (although controlled for), it cannot be ruled out that this might have affected the PA behaviour and/or weight status of children. Correspondingly, although the sample was spread over a relatively large geographical area, the results are not representative, which is also shown in the comparably low prevalence of overweight and obesity. However, strengths of this study include the objective measurement of body composition and the individual calculation of PA on the basis of objectively collected data.

Conclusions

To summarise, this study provides an objective analysis of PA in children with and without a migration background. Primary school children with a migration background often came from a lower socio-economic group, were less physically active than their German counterparts (especially at the weekend) and were more often overweight and therefore at a higher risk of related secondary diseases. These results should be considered when tailoring interventions for a healthier lifestyle aimed at children and parents with a migration background. Those interventions should include aspects such as nutrition and PA, as well as support for teachers and direct parental involvement to encourage children to be more active, eat and drink more healthily and reduce time spent on screen-based activities.[40] Interventions in the school setting would have the advantage that all children (with or without a migration background) can be reached.[41] One area for improvement could be in organised sports, where children with a migration background currently participate far less than those without a migration background.[36] Schools would therefore be an ideal place to offer such programmes, and this would also avoid financial barriers to organised sports activities for families with low incomes. To précis, a comprehensive analysis of the target group (i.e. children and families with a migration background), an intervention development and a consideration of potentially influencing factors, such as cultural barriers, are necessary to be able to reach those groups more effectively.

Author statements

Ethical approval

The study was approved and consented by the University of Ulm's ethics committee (No. 126/10), conducted in accordance with the Declaration of Helsinki and is registered at the German Clinical Trials Register (DRKS-ID: DRKS00000494).

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Competing interests

The authors declare that they have no competing interests.

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