

Social Determinants of Swimming Ability among Children and Adolescents in Germany. Results of KiGGS Wave 1

Soziale Determinanten der Schwimmfähigkeit von Kindern und Jugendlichen in Deutschland. Ergebnisse aus KiGGS Welle 1

Summary

- **Background:** Swimming is a leisure activity with great potential for promoting health and development. This article examines the proportion of children and adolescents in Germany who are unable to swim, taking into account age, gender, socioeconomic status (SES) and migration background.
- **Methods:** Data were obtained from the first follow-up of the German Health Interview and Examination Survey for Children and Adolescents (KiGGS Wave 1), conducted by the Robert Koch Institute (RKI) from 2009 to 2012. Information regarding the swimming ability of 5- to 17-year-olds (n=9,750) was collected by telephone interviews. The SES index is a composite measure of parents' education, occupational status and income. Migration background refers to country of birth and nationality of both parents and child.
- **Results:** In total, 14.5% of 5- to 17-year-olds in Germany were unable to swim. At pre- and elementary school age, prevalence was considerably higher, in adolescence much lower. Those who were able to swim acquired the ability at just over 6 years of age on average. Among children of primary school age, fewer boys than girls could swim. Girls also learned to swim 4 months earlier on average. Children and adolescents from low-SES families were more likely to be unable to swim than their peers with a high SES (OR=5.95; 95% CI=3.74-9.47). A two-sided migration background (both parents, or the child and one parent, immigrated) was also associated with an elevated odds of being unable to swim (OR=2.39; 95% CI=1.63-3.50).
- **Conclusions:** The KiGGS data show that a substantial proportion of children and adolescents in Germany are unable to swim. Initiatives promoting swimming ability should focus on socially disadvantaged children and adolescents and those with a two-sided migration background.

KEY WORDS:

Swimming Ability, Drowning, Socioeconomic Status, Migration Background, Health Inequalities

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It is important to be able to swim in order to move confidently and without fear in water. In the worst case scenario, people who cannot swim well enough, or cannot swim at all, are at risk of drowning (3, 4). However, the importance of being able to swim is not limited solely to the prevention of drowning accidents, especially since a large proportion of such accidents are not caused by a lack of swimming ability

Zusammenfassung

- **Hintergrund:** Schwimmen ist eine Freizeitaktivität mit großem gesundheits- und entwicklungsförderndem Potenzial. Der Beitrag untersucht, wie hoch der Anteil der Kinder und Jugendlichen in Deutschland ist, die nicht schwimmen können, und welche Rolle Alter, Geschlecht, Sozialstatus und Migrationshintergrund dabei spielen.
- **Methodik:** In der vom Robert Koch-Institut (RKI) durchgeführten ersten Folgebefragung der Studie zur Gesundheit von Kindern und Jugendlichen in Deutschland (KiGGS Welle 1, 2009-2012) wurden per Telefonsurvey Selbst- und Elternangaben zur Schwimmfähigkeit von 5- bis 17-Jährigen erhoben (n=9 750). Der Sozialstatus wird anhand von Bildung, Beruf und Einkommen der Eltern ermittelt. Der Migrationshintergrund wird über Informationen zum Geburtsland und zur Staatsangehörigkeit des Kindes und der Eltern bestimmt.
- **Ergebnisse:** 14,5% der 5- bis 17-jährigen Kinder und Jugendlichen in Deutschland können nicht schwimmen. Im Vor- und Grundschulalter liegt der entsprechende Anteil höher, im Jugendalter deutlich niedriger. Diejenigen, die schwimmen können, haben die Schwimmfähigkeit im Schnitt mit knapp 6 Jahren erlangt. Im Grundschulalter können weniger Jungen schwimmen als Mädchen, zudem lernen Mädchen rund 4 Monate früher schwimmen. Kinder und Jugendliche mit niedrigem Sozialstatus können seltener schwimmen als Gleichaltrige mit hohem Sozialstatus (OR=5,95; 95%-KI=3,74-9,47). Heranwachsende mit beidseitigem Migrationshintergrund sind häufiger Nichtschwimmer als Gleichaltrige ohne Migrationshintergrund (OR=2,39; 95%-KI=1,63-3,50).
- **Schlussfolgerungen:** Die KiGGS-Daten zeigen, dass ein erheblicher Anteil der Kinder und Jugendlichen in Deutschland nicht schwimmen kann. Initiativen zur Förderung der Schwimmfähigkeit sollten ein besonderes Augenmerk auf Heranwachsende aus sozial benachteiligten Familien und jene mit beidseitigem Migrationshintergrund richten.

SCHLÜSSELWÖRTER:

Schwimmfähigkeit, Ertrinken, Sozialstatus, Migrationshintergrund, gesundheitliche Ungleichheit

but by other reasons (23, 43). Swimming is regarded as one of the most popular sports by both sexes (31, 39). In 2015, according to the German Olympic Sports Confederation (DOSB), approx. 320,000 children and adolescents up to the age of 18 were members of a swimming club, and just under 280,000 were in the German Life Saving Society (DLRG) (9). Furthermore, swimming is a leisure activity with great

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health- and development-promoting potential, which can also be used in the context of prevention, therapy and rehabilitation (7, 16, 35). Swimming strengthens the muscles, improves endurance and trains important motor and coordination skills. The risk of injury caused by overstraining or inappropriate mechanical stress is relatively small. In addition, regular swimming has a positive influence on children with chronic diseases such as asthma (2) and autism spectrum disorder (32). Since it is easy on the joints, it is also recommended for promoting movement in patients with juvenile idiopathic arthritis (27) or obesity (15).

From the point of view of sports education, swimming allows special sensory, environmental and movement experiences in and under water, such as diving, gliding or floating (43). Children who cannot swim have no or only limited access to such experiential places as indoor and outdoor swimming pools or natural lakes (23, 36). Being able to swim is a cultural achievement; it is also essential for participating in water-related forms of exercise and for practising sports like water polo, rowing or sailing. In view of the numerous positive effects on their development, children should learn to swim as early in life as possible. According to the federal association 'More Safety For Children', four to five is an ideal age for participation in a beginner's swimming course (6).

The media regularly report that the percentage of children and adolescents who can either not swim at all or not swim confidently has increased markedly over the last few years. The fact is, however, that the empirical data on the swimming ability of children and adolescents in Germany are inadequate. Apart from two telephone surveys that were commissioned by the DLRG in 2004 and 2010 (12, 13), the DSB SPRINT study (11), the World Vision Study 2007 and 2010 (28, 29), and some regional studies, e.g. in North Rhine-Westphalia (23, 43) and Saxony (33, 34), there is currently no verifiable information with which to reliably determine the percentage of non-swimmers among children and adolescents. These studies are not directly

comparable either, because, on the one hand, the proportion of children and adolescents who cannot swim varies greatly depending on the age group observed. Even small differences in the age composition of samples can greatly influence the percentage of non-swimmers (33). On the other hand, the heterogeneity of the measuring procedures used represents a problem because there is no uniform definition of swimming ability (43). According to Stemper and Kels (43), at least three different procedures for operationalizing swimming ability are possible, all of which have advantages and disadvantages: 1. ,Assessment': subjective information provided by children or adolescents or external assessments by parents or teachers; 2. ,Acquisition': swimming badges such as the German Youth Swimming Badge in Bronze; 3. ,Fulfilment': practical verification by means of standardized test assignments. The choice of method for determining a person's swimming ability and the number of possible categories (e.g. an additional distinction between confident and not-so-confident swimmers) are just as decisive for estimating prevalence as the age group studied.

The first follow-up of the German Health Interview and Examination Survey for Children and Adolescents (KiGGS Wave 1) collected information on the swimming ability of almost 10,000 5- to 17-year-old boys and girls for the first time, in addition to extensive data on their health situation. As far as we know, this is the most comprehensive data pool to be collected on this subject in Germany. The first results have already been published as a fact sheet in the Federal Health Reporting System (38). The present study examines (1) what proportion of children and adolescents in Germany are unable to swim; (2) at what age those children and adolescents who can swim learned to do so; and (3) the extent to which the percentage of non-swimmers and the average age of learning to swim differ according to age, gender, socioeconomic status and migration background.

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Design and Sampling

KiGGS is part of the health monitoring system run by the Robert Koch Institute (RKI) and is currently carried out as a combined cross-sectional and cohort study. KiGGS aims to regularly provide prevalence data collected nationwide on the health situation of children and adolescents living in Germany, focusing on the 0-17 age group. The KiGGS baseline study (2003-2006) comprised interviews, physical examinations (incl. laboratory analyses of blood and urine samples) and tests; the follow-up survey, KiGGS Wave 1 (2009-2012) was based on surveys conducted in the form of telephone interviews. The KiGGS baseline study was a cross-sectional study with a total of 17,641 subjects aged between 0 and 17; the response rate was 66.6%. Those invited to participate were randomly drawn from population registers in a stratified random sample of 167 locations in Germany (21). The sample of KiGGS Wave 1 consisted firstly of a new cross-section sample of 0- to 6-year-olds who were again drawn at random from the population registers of the 167 original study locations. Secondly, the former participants in the KiGGS baseline study, now 6-24 years old and being continued as a closed cohort, were invited to take part in the new survey. The telephone interviews were conducted by trained study personnel at the RKI. The software product Voxco version 5.4.4.5 (Voxco Inc., Montreal QC, Canada) was used for call management and data collection. The parents of 0- to 17-year-old children and adolescents were questioned; adolescents aged 11 and over also provided information themselves. Before the study began, votes of approval had been obtained from the Ethics Commission of the Charité/University

Table 1

KIGGS WAVE 1 (2009-2012) (N=9,750)				
VARIABLE	CATEGORIES	NUMBER OF CASES (N)	UNWEIGHTED SAMPLE (%)	WEIGHTED SAMPLE (%)
Age of the Child	5-6 J	1,837	18.8	14.0
	7-10 J	2,655	27.2	29.7
	11-13 J	2,267	23.3	24.0
	14-17 J	2,991	30.7	32.3
Sex	B	4,906	50.3	51.3
	G	4,844	49.7	48.7
Socioeconomic Status	L	971	10.0	21.4
	M	5,757	59.0	59.7
	H	2,360	24.2	18.9
Migration Background	M	662	6.8	-
	-	918	9.4	17.0
	O	656	6.7	7.6
	N	8,173	83.8	75.4
Ability to Swim	M	3	0.0	-
		8,160	83.7	85.5
	N	1,283	13.2	14.5
	M	307	3.1	-

Medicine Berlin and Germany's Federal Commissioner for Data Protection; an interview was only carried out after either the subjects themselves (in the case of adults) or the persons with care and custody (in the case of minors) had been informed and had given their consent in writing. A total of 12,368 children and adolescents (6,093 girls, 6,275 boys) in the 0-17 age range relevant for the cross-sectional study took part; 4,455 of these were invited for the first time (0-6 age range: response 38.8%), and 7,913 were invited again (7-17 age range: response 72.9%). The aims, concept and design of KiGGS in general, and details of the methodology of KiGGS Wave 1, are described in detail elsewhere (19, 21, 22, 26).

Swimming Ability

Data on swimming ability are available in KiGGS Wave 1 on children and adolescents aged between 5 and 17 years ($n=9,750$) (Table 1). For children aged between 5 and 10 years a parent answered the questions, while young people aged 11 years and over were themselves interviewed. The first question asked was: „Can your child/Can you swim?“ (answer categories: „Yes“, „No“). All those who answered „Yes“ were then asked: „How old were you (was s/he) when you (s/he) learned to swim?“ The respondents were asked to state the age at which the child/adolescent was able to swim, not the age at which s/he started swimming lessons. Information was to be stated in full years.

Social Determinants

In addition to examine differences in age and gender, the study also looks at the association between socioeconomic status or a possible migration background on the one hand and the swimming ability of children and adolescents on the other.

The socioeconomic status is determined on the basis of an index developed by the RKI (25). This index contains information provided by the parents on their school education and vocational training, occupational status and income. The classification into a low-, middle- or high-status group is based on a distribution-based definition of five groups with equal numbers of members (quintiles); the middle three groups (from 2nd to 4th quintile) are combined. Detailed information on the measurement of socioeconomic status in the KiGGS study has been published elsewhere (25) (Table 1).

Migration background refers to information provided on the children's own migration experience and on the country of birth and nationality of both parents. Children who have themselves immigrated from another country and at least one of whose parents was not born in Germany, or both of whose parents immigrated or do not have German nationality, are defined to have a two-sided migration background. A one-sided migration background is when children are born in Germany, but one of the parents immigrated from another country and/or does not have German nationality (37, 40, 41) (Table 1).

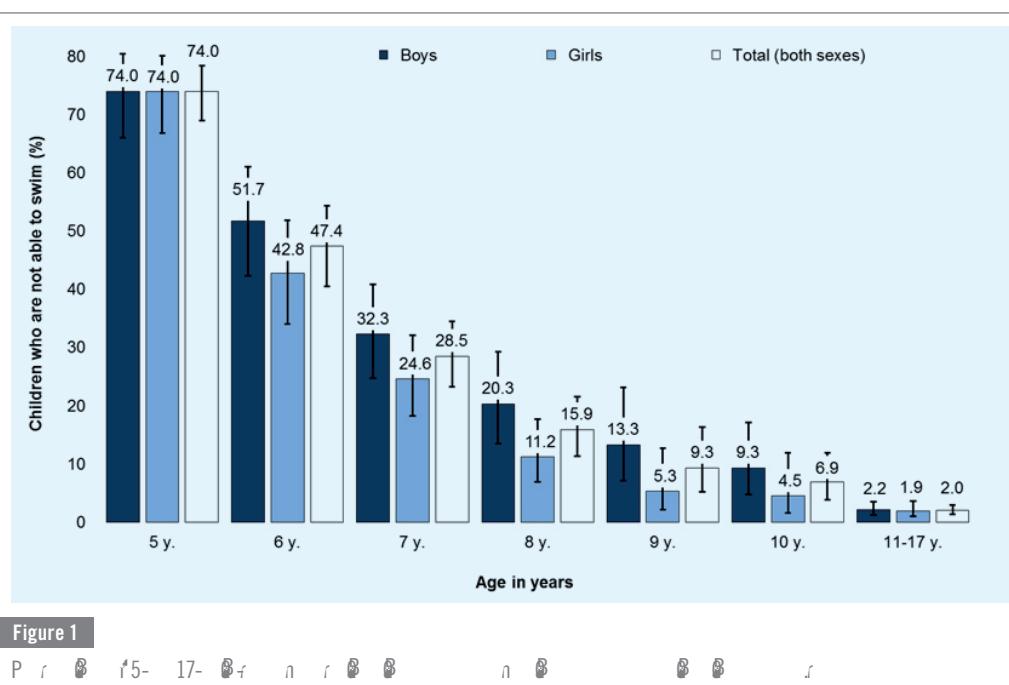


Figure 1

Statistical Analyses

All analyses were conducted with a weighting factor that corrects the sample's deviations from the population structure (figures for 31 December 2010) with regard to age, gender, region, nationality, type of municipality, and the education status of the head of the household (microcensus 2009). Furthermore, with regard to the former participants, the differences in their willingness to participate again was offset by weighting according to relevant characteristics of the KiGGS baseline study (26). Prevalences with 95% confidence intervals (95% CI) are reported, taking into account differences in age, gender, socioeconomic status and migration background. In addition, with a view to possible origin-related differences in the distribution of swimming ability, odds ratios (OR) with 95% CI are reported; these were calculated using binary logistic regressions. Odds ratios indicate the factor by which the statistical chance of being a non-swimmer is increased, e.g. in the low- and middle-status group compared to the high-status group that has been defined as the reference category. Statistical adjustments are made for any age differences and for the association between socioeconomic status and migration background.

In order to take into account both the weighting and the correlation of the participants within a municipality, confidence intervals and p-values were calculated using procedures for complex samples. Group differences were checked for significance according to Rao-Scott using the chi-square test for complex samples corrected via the F distribution. Differences are regarded as statistically significant if the confidence intervals do not overlap or if the probability of error (p) takes on a value smaller than 0.05. The software product IBM SPSS Statistics Version 20 was used.

According to the data from KiGGS Wave 1, 14.5% of 5- to 17-year-old children and adolescents in Germany cannot swim. Overall the percentage of non-swimmers among boys at 16.1% was slightly higher than among girls at 12.9%. While no significant differences between boys and girls emerge among the 5-year-olds or among the 11- to 17-year-olds, the gender differences in

to swim at a little over 6 years old. On average, girls learn about 4 months earlier than boys. Here, too, stratified analyses according to socioeconomic status and migration background point to pronounced origin-related differences (Table 3). Children and adolescents with a high socioeconomic status learn to swim 1.5 years earlier than those from the low status group and six months before those from the middle group. Children and adolescents with a two-sided migration background learn to swim around 1.5 years later than those without a migration background. Children and adolescents with a one-sided migration background and those without a migration background learn to swim at just under the age of 6 years. The differences according to socioeconomic status and migration background can be seen in both boys and girls and remain statistically significant under multivariate analysis. If 17-year-old swimmers are analysed separately, the average age at which they were able to swim is approx. 6 years and 7 months; more than 90% of the boys and over 95% of the girls stated that they learned to swim at the age of 10 years at the latest.

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the 6- to 10-year-old age group are clearly pronounced to the detriment of the boys (24.9% vs. 17.3%, $p < 0.001$; total: 21.2%). As can be seen from Figure 1, the percentage of non-swimmers among the 5- to 11-year-olds declines successively with increasing age. While about three quarters of the children cannot (yet) swim at the age of 5 years, the figures for 7-year-olds is approx. a third for boys and a quarter for girls; the percentage of non-swimmers among the 10-year-olds is below 10%. According to their own statements, almost all the 11- to 17-year-olds can swim; here, the proportion of boys and girls who cannot swim is only around 2%.

The size of the proportion of non-swimmers depends to a large extent on the social origins of the children and adolescents. As shown in Table 2, there is a pronounced social gradient: the higher the socioeconomic status, the lower the proportion of children and adolescents who cannot swim. This applies to boys and girls alike. Children and adolescents with a two-sided migration background are also more frequently non-swimmers than their peers without a migration background. Differences between the two groups were found in both sexes. However, there are no significant differences between children and adolescents with a one-sided migration background and their peers without a migration background. Marked differences are also revealed by multivariate analysis, which statistically controls for age differences and the association between socioeconomic status and migration background. According to this, the statistical chance of being a non-swimmer is higher by a factor of 6 among children and adolescents with a low socioeconomic status than for their peers with a high socioeconomic status; the odds ratio for children and adolescents in the middle status group is 1.9:1.0. Children and adolescents with a two-sided migration background are 2.4 times more likely to be unable to swim than those without a migration background. Although the percentage of non-swimmers is comparatively low among adolescents aged 11 to 17 years, those with a low socioeconomic status or with a two-sided migration background are also most frequently unable to swim.

When the analysis is focused only on children and adolescents who can swim, it is revealed that on average they learned

The results from KiGGS Wave 1 show that 14.5% of children and adolescents aged between 5 to 17 years cannot swim. If only children of primary school age (6-10) are examined, the percentage of non-swimmers stands at 21.2%. This is also the age group in which the most marked gender differences can be seen. While around one in six girls cannot (yet) swim, this applies to one in four boys. This could be connected with age- and gender-specific differences in motor development (e.g. coordination skills).

The prevalence rates reported by other German studies on the swimming ability of children and adolescents cannot be directly compared with the KiGGS results due to methodological differences, as outlined above. This is the result of varying definitions of swimming ability and, sometimes, differences in age groups (5, 38, 43). A 2004 survey of parents commissioned by the DLRG puts the percentage of school-age children up to the age of 18 who can swim at 66.1% (12). According to a more up-to-date DLRG study conducted in 2010, 74% of the 6- to 10-year-old primary school pupils have the Seahorse young swimmer's badge (13). However, if the youth swimmer's badge (at least bronze; former name: Freischwimmer) is used as the criterion for swimming ability, only half of the 10-year-old children can be called confident swimmers at the time they leave primary school. In the 2010 World Vision Study, 6- to 11-year-olds were asked personally whether they could swim – approx. 13% said „No“ (29). As in the KiGGS study, the proportion of children who themselves say that they cannot swim is higher among boys (16%) than girls (9%) of primary school age.

Empirical examinations of swimming ability in the form of practical tests have been implemented in two regional studies (23, 33, 34). In the MOBAQ study (MOBAQ stands for basic motor qualifications) carried out in North Rhine-Westphalia in 2005/2006, the pupils, whose average age was 11, were given five different tasks, e.g., 25 metres swimming' or ,dive from the starting block' (23). Only 30% of all the children managed to meet all requirements. 28% of the children must be categorized as

approx. 93% of the pupils passed both tests in the 2003/2004 school year, only about 66% passed in the 2012/2013 school year. It should be noted here, however, that the school swimming centre under examination only taught third-year pupils in the earlier period, while this was changed to only second-year children, i.e. on average younger children, as from 2007/2008. A clear trend towards more non-swimmers cannot, therefore, be deduced from this distorted sample, especially since the number of children who cannot swim remained relatively stable after swimming lessons were given earlier (33, 34).

One of the main results of our study is that children and adolescents from socially disadvantaged families are less often able to swim than their peers from more privileged families. In this way, a trend that can be observed on land is being continued in water. As shown by results from the KiGGS study that have already been published, children and adolescents with a high socioeconomic status not only do more sports in general in their leisure time than peers with a low socioeconomic status, they are also more frequently members of a sports club (24, 30). Other studies from Germany also show a strong association between social origin and the ability to swim (1, 23, 29, 43). While the percentage of non-swimmers among children from the ‚upper class‘ was only 3% according to the 2010 World Vision Study, the figure for the ‚middle class‘ was 15%, and for the ‚lower class‘ it was as high as 28% (29). Differences in the ability to swim are also shown when the kind of secondary school attended is taken into consideration, something which in Germany is still very much determined by social origin. According to the MOBAQ study, the proportion of 11-year-olds with no experience of swimming is considerably higher at secondary general schools (Hauptschulen) and comprehensive schools (Gesamtschulen) (16% and 11% respectively) than at grammar schools (Gymnasien), where the figure is 3% (23). Analyses of survey data from Aachen also suggest evidence of a social gradient: year 5 pupils (Fünftklässler) at grammar schools not only regard themselves as strong, confident swimmers much more frequently than pupils at intermediate (Realschulen) and secondary general schools (86%, 77%, 73%), they also have the bronze swimming badge more frequently (76%, 56%, 34%) (43).

Finally, the KiGGS results suggest that there are significantly more non-swimmers among children and adolescents with a two-sided migration background than among children and adolescents with no migration background. This finding has also been reported in previous studies (1, 23, 28). Probably the real differences are even greater because a good knowledge of German on the part of the parents was, in a way, a prerequisite for participation in the KiGGS Wave 1 telephone survey, so that certain groups of children and adolescents with a migration background are likely to be underrepresented. The Augsburg schoolentrance examinations for the 2011/2012 school year showed that almost half of the just-under-6-year-old children whose parents both said they spoke German as their mother tongue could already swim, whereas this only applied to approx. a quarter of the children with mixed family languages (1). In the MOBAQ study, the proportion of children with no experience of swimming was the highest among 11-year-olds with Muslim roots at 25% (23). Also in other countries, such as the USA or Canada, there are marked differences depending on ethnic origin, both in the dissemination of swimming ability and in statistics on drowning (14, 17, 20, 44, 46). In the USA, the societal debate on the fact that the number of African Americans and Latinos who can swim is significantly lower than among the white population is conducted under the label ‚minority swimming gap‘ (18).

Table 3

	BOYS IN YEARS	(95% CI)	GIRLS IN YEARS	(95% CI)	TOTAL IN YEARS	(95% CI)
Socioeconomic Status						
Low	7.32	(6.95-7.69)	6.83	(6.52-7.14)	7.09	(6.83-7.35)
Middle	6.15	(6.04-6.26)	5.85	(5.76-5.95)	6.00	(5.92-6.08)
High	5.65	(5.54-5.77)	5.28	(5.19-5.38)	5.47	(5.39-5.55)
Migration Background						
Two-sided	7.46	(7.13-7.80)	7.10	(6.76-7.44)	7.28	(7.03-7.53)
One-sided	5.94	(5.75-6.14)	5.94	(5.64-6.24)	5.94	(5.76-6.13)
None	6.09	(5.98-6.19)	5.70	(5.62-5.79)	5.89	(5.81-5.97)
Total	6.30	(6.19-6.40)	5.94	(5.84-6.03)	6.12	(6.04-6.19)

How Can the Differences in Swimming Ability by Socioeconomic and Migrant Status Be Explained?

Many parents teach their children how to swim themselves. In the MOBAQ study, the ‚family‘ was mentioned most frequently, ahead of ‚a course‘ or ‚school‘, as the place where children said they learned to swim (23). The prerequisite for this is, of course, that the parents themselves are confident swimmers. Since parents of children with a migration background are probably more likely to be unable to swim, this leads to a kind of ‚intergenerational inheriting‘ of non-swimmer status. Not in all countries is such a high priority given to swimming as in Germany. In some cultures it is customary only to bathe. Furthermore, some parents do not want their daughters to take part in school swimming lessons together with boys. Traditions, a sense of shame, fears and religious rules are likely to play a role here.

From a political point of view, another key result of the KiGGS study is that significantly fewer socially disadvantaged children are able to swim than their peers from socially better-off families. Cost reasons could be significant here, because admission prices for swimming pools and private swimming courses are relatively expensive. It is true that swimming courses qualify for reimbursement under the jobseekers‘ assistance scheme or income support as educational and inclusion services provided for needy children in Germany. However, the reimbursement has to be applied for, and this means that parents must know about the measures, understand how to apply for the educational package – and have the initiative to do so.

Certain developments over the last few years could also have adverse overall effects on the swimming ability of children and adolescents in Germany. One frequently cited aspect is that an increasing number of indoor and outdoor swimming pools are either being converted into so-called fun pools with limited opportunities for swimming, or closed completely because of municipal spending constraints (45). The loss of training pools and the need to travel greater distances means that many schools no longer offer the swimming lessons that are prescribed in the curriculum (5). A key result of the DSB SPRINT study was that more than 20% of schools have no access to sports facilities for swimming lessons (11). The study also criticized the poor technical qualification of teachers. Sometimes there is a lack of commitment on the part of the parents (23). The MOBAQ study revealed an impressive link: the more children notice that their family is interested in their sport and support it, the more likely they are to have learned to swim (23).

KiGGS Wave 1 is based on a nationwide population survey. By drawing a large random sample and using statistical weighting procedures, considerable e Tm451]TJET03b(i)1.1 (f-12)1.4 (d)-1.5 uh9-46.1 (i)1.4t (r)-11.o ge (a)-14nider (ot)12.i.1 (h9-4n (r)-71.1 0 Tm(Tm45.5

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