Association between acculturation and childhood vaccination coverage in migrant populations: a population based study from a rural region in Bavaria, Germany

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Summary

Objectives: The aim of our analysis was to investigate the association between acculturation and the vaccination coverage among pre-school children.

Methods: We performed a study of vaccination status for measles-mumps-rubella and hepatitis B among pre-school children, during mandatory school entry examinations, in a district of Bavaria, Germany, in 2004 and 2005 (N = 2,043). Prior to the examinations, parents were asked to fill out a self-administered questionnaire assessing socio-demographic information, including variables related to migration background (response rate 73 %, N = 1,481). We used Categorical Principal Component Analysis (CATPCA) to create an acculturation index and assessed the association between the acculturation and vaccination status for both vaccines.

Results: We found no difference in vaccination status with the measles-mumps-rubella vaccine in relation to acculturation. The coverage with at least three doses of hepatitis B vaccine was similar among migrants and in the indigenous population, but the risk of incomplete (1 or 2 doses) versus full vaccination was higher (OR = 2.74, 95 %CI 1.34–5.61) and the risk of lacking vaccination lower (OR = 0.30, 95 %CI 0.12–0.77) among less acculturated migrants compared to the indigenous population.

Conclusions: For multi-dose vaccines lower acculturation was associated with incomplete vaccination, but the partial protection in this group was higher compared to indigenous population.

Lower vaccination status among children with migration background as compared to the native population has been observed both in developed and developing countries[1]. This can be caused by recent movement from an area or country with a lower vaccination coverage into an area with a higher coverage[2, 3], delayed or incomplete registration by medical authorities in the new country[4] or by maintaining health behaviours and beliefs from the country of origin[5]. In Germany, lower vaccination coverage was observed among children of parents with non-German citizenship (as defined in the passport) in a study performed in 1994 in Munich[6] or 2002 in Hannover[7]. However, citizenship may not be the best source to determine migration background, especially in the case of children. In contrast to the concept of migration background, acculturation is a process of cultural adaptation resulting from interaction with the culture of the host country; it describes the phenomenon of migration beyond the dichotomous migration status.

The understanding of acculturation sometimes includes measures of health outcomes among individuals who are more or less acculturated[5, 8]. In particular, attitudes or behaviors are sometimes the investigated health outcomes: whereby acculturation is considered achieved when the migrant and native population of the host country show no differences. In another understanding, acculturation is seen as an independent factor affecting health outcomes[9, 10]. In this paper, we are using the second interpretation.

Frequently, single variables such as country of birth, length of stay in the host country, and spoken language have been proposed as assessments of acculturation[9]. Here, we use a composite measure of acculturation based on language use, being born in the host country, citizenship of the child, and age of the parents at migration. The aim of our analysis was to in-

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vestigate the association between acculturation index, created using a novel method, and the vaccination coverage among pre-school children in a population based study in a region of Bavaria, Germany.

Methods

Sample and questionnaire

We performed a study of vaccination status among pre-school children during examinations at school entry in a district of Bavaria in 2004 and 2005. The district has a population of approximately 80,000 and approximately 1,000 children are examined each year. Examinations at school entry are mandatory and thus, using this setting allowed us to obtain a regionally representative sample with almost complete participation of the investigated age group. The examinations are generally performed between 5 and 6 years of age. Information about vaccination status according to the recommendations of the responsible regulating body STIKO (German Standing Committee on Vaccination) was obtained from the children's health cards, which were available for 93 % of the examined children. The recommendations include vaccines against diphtheria-tetanus-pertussis (DTP), polio, measles-mumps-rubella (MMR), hepatitis B, *Haemophilus influenzae* type B (Hib) and *tick-borne encephalitis* (TBE) in selected regions (STIKO 2004) We restricted our analysis to the two vaccines with the lowest coverage: MMR and hepatitis B (the coverage for remaining vaccines was very high 97–99 % and did not allow an analysis). The information about vaccination status was recorded routinely for all children during the medical examination. Additionally for the purpose of this study, parents were asked to fill a self-administered questionnaire. The questionnaire was provided in German and Turkish; no attempts were made to include parents with insufficient knowledge of either German or Turkish languages, but based on the observations from the team performing the examinations, most parents with migration backgrounds had sufficient language skills to complete the questionnaire. The questionnaire assessed demographic characteristics, including variables assessing migration background, family's background characteristics (parents' educational level, parents' employment) and economic status. In the routine records from the examinations information for 2,043 children was collected from whom 96 % provided health cards with information about their vaccinations status. The additional questionnaire was completed for 1,481 children, resulting in a response rate of 72.5 %. Informed consent was obtained from the parents prior to distributing the questionnaire.

Variables used in analysis

Vaccination status was originally coded by the number of vaccine doses received by the child: from 0 to 3 for MMR and from 0 to 5 for hepatitis B. According to the vaccination schedule, children of this age should have received a single MMR dose and three doses of hepatitis B vaccine.

The following socio-demographic information was available for the analysis: gender of the child, parental education, number of children in the family and whether the child was living in a single parent home. The education variable originally had 4 different categories which were collapsed into two: lower education (no education and primary education) and higher education (secondary education and university education; in 7 % of the families at least one of the parents had a university education). To take the correlation between levels of education of both parents into account, a new joint variable was created: both parents with lower education, one parent with higher and the other with lower education, and both parents with higher education. Children with single parent were classified according to the education category of the single parent. The number of children in the household was collapsed into three categories: household with one child, two children and more than two children. Income is considered sensitive information in Germany in general and particularly in Bavaria. In order to avoid missing responses, information on economic status was obtained in terms of satisfaction with one's economic situation and the amount of housing space per person, which was calculated from the total household space and the number of people living there. This was then subdivided into two categories: lowest quartile versus other. The satisfaction with the economic situation was measured by a single item with a 7 point Likert type scale (very unsatisfied, unsatisfied, rather unsatisfied, neutral, rather satisfied, satisfied, very satisfied) and recoded into two categories: not satisfied (first three categories) and other.

Information about migration background of the children was assessed by several variables: country of birth of the child and parents, child's citizenship, parents' age at immigration to Germany (for parents born in foreign country), child's native language and language spoken by the child with the parent and peers (all variables are listed in Table 2). When any of the variables indicated a difference to indigenous population, the child was defined as having migration background. Since childhood vaccination is ultimately a parental decision, the variables are oriented towards the assessment of the parents' acculturation (jointly as a family) rather than for the children themselves.

Statistical analysis

Assessment of acculturation was restricted to the subsample of children with migration background as defined above. The

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indigenous German population was excluded from this analysis since these subjects had the same values for all variables. To create the acculturation index, Categorical Principal Components Analysis (CATPCA) was used. CATPCA is a non-parametric version of factor analysis suitable for analysis of categorical (ordinal) variables, it has been recommended for combining information from several variables into a joint index, for example measuring socio-economic status[11–13].

In contrast to a simple additive index or classical principal component analysis, which are based on means across groups of cases, CATPCA is based on proportions in the respective categories of the variables[11]. Optimal scores are created in order to obtain the highest correlation with the original variable values for each subject and to indicate the position of the respondent on the latent construct[13]. Mean score of the whole sample is set at zero and the individual scores indicate the position of the respondent, either below or above the mean. Since all variables used for creation of the index were coded with the lowest category indicating no difference to indigenous population, low (negative) score values indicate high acculturation and high (positive) values indicate low acculturation.

Following recommendations by Vyas[3], first, a two component solution was assumed. Since the analysis provided little evidence for two-dimensionality in the latent concept of acculturation, a single component solution was applied. The distribution of the acculturation index was visualised by standard kernel density plot. A cut-off point for distinguishing between a high and low acculturation group was set at the mean score in the sample i.e. at zero. Cross-tabulation of variables and multiple logistic regression analysis was used to investigate variables independently associated with not being vaccinated by either hepatitis B or MMR vaccine. For hepatitis B the outcome variable was recoded in three categories: full (at least three doses received), incomplete (1–2 doses) or lacking vaccination and multinomial logistic regression model with the reference group "full vaccination" was used. Significance level was defined at p ≤ 0.05. Data analysis was conducted using the statistical program SPSS 12 for Windows.

Results

Description of the total sample

In the total sample (Table 1, first column) the proportion of male children was slightly higher than female children. In around one third of the families both parents had secondary or higher education, in one third both parents had either primary or no education and in one third one of the parents had the lower and the other the higher education. Less than 10%

were single parent families, mostly with single mothers. Most of the children had one or more siblings. Less than 2% of the children were born abroad but in 12% of families both parents and additionally in 5% one parent was born abroad. About half of the respondents (parents) with migration background were born in the former Soviet Union; the same was true for their partners with migration background. Next largest groups were respondents born in Turkey and Poland (both 13%); the same was true for their partners (15% in Turkey and 10% in Poland). In the subgroup with both parents born outside of Germany, in 43.8% both were born in the former Soviet Union.

Acculturation and socio-demographic characteristics of migrants and the indigenous population

The distribution of the acculturation index is shown in Figure 1. Slightly more cases fell on the side of higher acculturation (shown as the left end of the x-axis in Fig. 1). The distribution of the acculturation index had a single peak which indicated a continuum within the migrant population (note, the indication of bimodality should be seen only as small fluctuation). Of children of parents born in the former Soviet Union, 67% belonged to the low acculturation group.

For nearly all children identified as having migration background, at least one of the parents was born in the foreign country; thus our sample consisted mainly of children being second generation migrants. Both acculturation groups displayed distinct characteristics (Table 2). For half of the children in the high acculturation group, they only differed from indigenous German population in having a parent born in a foreign country. In the other half, they differed in their speaking a foreign native language.

The low acculturation group was more heterogeneous in relation to variables indicating their difference from the indigenous German population. However, for nearly all of the children in the low acculturation group, a non-German native language of the child was reported. Additionally, in nearly all cases in this group, both parents were born in a foreign country. Thus, the low acculturation group could have been identified by their foreign native language and any of the other variables indicating migration background, presented in Table 2 (apart from parents' country of birth not being Germany). The high acculturation group could have been identified either by having only one parent born in a foreign country or by the child having a foreign native language but no of the other migration background characteristics from Table 2.

In terms of socio-demographic characteristics presented in Table 1, significant differences between families with migration background and the native population existed only for the size of living space per person, number of children and

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Table 1. Characteristics of the children and their families (%) (Pre-school children in a district of Bavaria, 2004–2005).

Characteristics	Total sample n = 1,481	Indigenous population n = 1,203	More acculturated migrants n = 143	Less acculturated migrants n = 122
Gender of the child				
Male	53.2	53.9	49.7	53.3
Female	46.8	46.1	50.3	46.7
Education of the parents				
Lower for both	39.6	39.8	37.2	40.3
Higher of one parent	30.5	31.6	28.5	21.8
Higher for both	29.9	28.6	34.3	37.8
Bringing up the child				
Alone	7.3	7.2	5.6	9.9
Together with partner	92.7	92.8	94.4	90.1
Size of living room per person (square meter)				
Lowest quartile (<= 34.25 sq.m)	25.2	19.5	39.7	63.9
Other (> 34.25 sq.m)	74.8	80.5	60.3	36.1
Satisfaction with financial situation				
Unsatisfied	15.0	12.9	18.1	33.1
Other	85.0	87.1	81.9	66.9
Number of children in a household				
1	17.0	15.5	23.8	23.0
2	57.7	59.2	54.5	46.7
≥ 3	25.3	25.3	21.7	30.3
Child's country of birth				
Germany	97.8	100	98.6	86.1
Other	1.3	0	1.4	13.9
Parents country of birth				
Both born Germany	82.7	100	4.6	0.9
One of the parents born in Germany	5.4	0	50.0	8.0
Both born outside of Germany	11.9	0	45.4	91.1

satisfaction with the economic situation. Families with migration background had less living space per person (chi-square p-value <0.001), more children (p-value = 0.01) and were less satisfied with their economic situation (p-value <0.001). Difference in education was not significant.

Vaccination coverage with MMR and hepatitis B vaccine
About 93 % of the children whose parents responded to the questionnaire received one dose of MMR. While the proportion of fully vaccinated (3 doses or more) children against hepatitis B was similar across the indigenous and acculturation groups, there was a substantial difference with regard to the proportion who received no vaccine dose at all (Table 3). The coverage with any of the vaccines did not differ between children for whom the additional questionnaire was available versus the children with routine records alone.

Factors associated with vaccination coverage
Acculturation was not independently associated with not being vaccinated with MMR vaccine (Table 4). Among other factors analysed, solely education displayed an association with MMR vaccination status: lower education of either or

both of the parents was associated with a lower risk of not being vaccinated for the child.

Lower acculturation was associated with higher risk of incomplete vaccination (compared to full vaccination) but lower risk of lacking vaccination. The more acculturated group did not significantly differ with respect to both categories from the indigenous population. Higher education of both parents was associated with lacking vaccination but not with incomplete vaccination.

Discussion

We applied the concept of acculturation to analyze the association between migration background and vaccination status among pre-school children in a region of Southern Germany. Lower acculturation was associated with higher risk of incomplete vaccination, but lower risk of lacking vaccination than in the indigenous population. Higher education of the parents was a risk factor for not being vaccinated with either MMR or hepatitis B vaccine.

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Characteristics	More acculturated migrants	Less acculturated migrants
Characteristics	n = 143	n = 122
Child's country of birth		
Germany	98.6	86.1
Other	1.4	13.9
Citizenship of the child		
German	98.6	71.3
Other	1.4	28.7
Native language of the child		
German	53.8	4.1
Other	46.2	95.9
Language respondent is speaking with the child		
German	98.6	63.1
Other	1.4	36.9
Language of the child spoken with friends		
German	100	95.1
Other	0	4.9
Age of the respondent by entry in the country		
Born in Germany	27.5	5.0
<20 years	53.5	18.3
≥20 years	19.0	76.7
Age of the partner by entry in the country		
Born in Germany	30.7	1.7
< 20 years	31.4	24.2
≥ 20 years	32.1	64.2
Missing value, because single parent family	5.8	10.0

Table 2. Characteristics of the children and their families have been used to create acculturation index and to define more and less acculturated migrants (%) (Pre-school children in a district of Bavaria, 2004–2005).

Table 3. Distribution of the number of hepatitis B vaccine doses received by indigenous population and migrants (Pre-school children in a district of Bavaria, 2004–2005).

Number of doses	Indigenous population n = 1203	More acculturated migrants n = 143	Less acculturated migrants n = 122
0	13.3	8.7	4.3
1	1.5	2.9	3.4
2	2.6	2.9	9.5
3	80.9	81.9	80.2
4	1.7	2.9	2.6
5	0.1	0.7	0

Figure 1. Distribution of the acculturation index (kernel density plot, low values indicate high acculturation), pre-school children in a district of Bavaria, 2004–2005.

The majority of previous studies found that vaccination coverage was lower among children with a migration background[14, 15]. This was supported by earlier studies in Germany using citizenship as a proxy of migration background[6, 7]. The vaccination coverage has also been shown to differ for migrants from different countries or across ethnic groups[16]. In our study the vaccination coverage with at least three doses of hepatitis B vaccine (full-vaccination) was similar in children with migration background and the indigenous population. However, since a single dose of hepatitis B vaccine offers 50–60 % protection and two doses up to
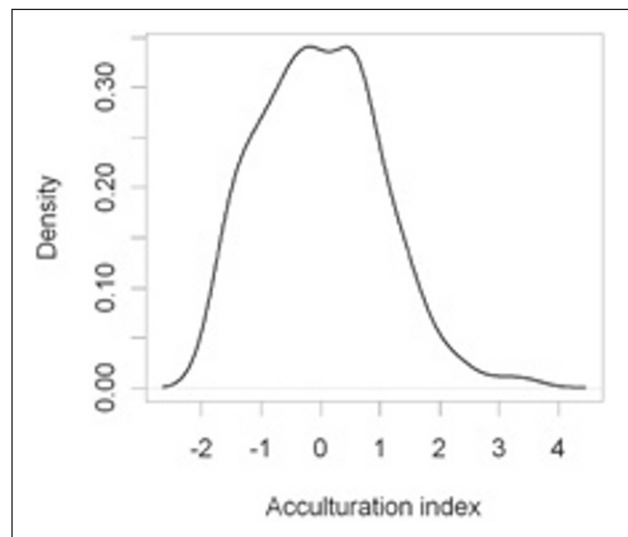
80 % protection[17], the overall protection against hepatitis B in the less acculturated subgroup was higher than in the indigenous population. This would remain undetected in an analysis restricted to full vaccination status with hepatitis B vaccine.

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Table 4 Factors associated with not being vaccinated with MMR and hepatitis B vaccine in the studied sample (Pre-school children in a district of Bavaria, 2004–2005)

Characteristics	MMR vaccine n = 1,426		Hepatitis B vaccine n = 1,425		
	% not vaccinated[a]	OR (95 % CI) for not being vaccinated[b]	% with lacking or incomplete vaccination	OR (95 % CI) for incomplete vaccination[b, c]	OR (95 % CI) for lacking Vaccination[b, c]
Acculturation status					
Indigenous population	6.9	1	13.3	1	1
More acculturated migrants	7.3	0.97 (0.44–2.04)	8.8	1.01 (0.42–2.46)	0.60 (0.31–1.15)
Less acculturated migrants	6.8	0.90 (0.38–2.10)	4.3	2.74 (1.34–5.61)	0.30 (0.12–0.77)
Gender of the child					
Male	7.2	1	12.8	1	1
Female	6.5	0.92 (0.60–1.42)	11.1	0.79 (0.48–1.30)	1.16 (0.83–1.63)
Education of the parents					
Lower for both	6.0	0.69 (0.41–1.15)	8.8	0.80 (0.44–1.43)	0.44 (0.29–0.68)
Higher of one parent	5.2	0.57 (0.32–0.99)	12.6	0.55 (0.28–1.10)	0.65 (0.44–0.98)
Higher for both	8.7	1	15.9	1	1
Bringing up the child					
Single parent	6.7	1.13 (0.47–2.71)	14.4	0.87 (0.31–2.39)	1.67 (0.87–3.19)
Both parents	7.0	1	12.0	1	1
Size of apartment per person					
Lowest quartile (<= 34.25 m²)	7.1	0.79 (0.44–1.39)	11.7	0.84 (0.43–1.63)	1.03 (0.66–1.59)
Other (> 34.25 m²)	7.0	1	12.5	1	1
Satisfaction with financial situation					
Unsatisfied	8.6	1.29 (0.69–2.42)	11.5	1.59 (0.82–3.07)	1.12 (0.66–1.88)
Other	6.8	1	12.2	1	1
Number of children in the household					
1	5.7	1	9.8	1	1
2	6.3	1.11 (0.59–2.13)	11.1	0.82 (0.35–1.88)	1.63 (0.92–2.89)
≥ 3	9.1	1.82 (0.88–3.77)	15.9	0.95 (0.49–1.82)	1.07 (0.65–1.77)

[a] % not vaccinated equals (1-vaccination coverage)
[b] adjusted for all other variables in the table
[c] multinomial logistic regression with three categories: full (at least three doses received – reference group), incomplete (1–2 doses) or lacking vaccination

There are several possible explanations why the fraction who received any vaccination with hepatitis B was higher among children from the less acculturated group. Given the organization of health insurance in Germany, with mandatory coverage for all residents and free treatment, it is unlikely that differential access to medical care could explain this difference. Since most of the children with migration background were born in Germany, their vaccination status was not directly related to different vaccination programs in other countries. One possible explanation was that children whose parents were born in countries of the former Eastern block benefited from the positive attitudes of the parents towards vaccination since the vaccination programs were well accepted in their countries of origin. Furthermore, since most countries of origin for migrants living in Germany have a higher prevalence of hepatitis B than Germany, parents with migration background might

be more aware of the risks associated with this infection and therefore more likely to comply with vaccination. At the same time, medical staff might advocate more strongly for vaccination in children with migration background. None of these potential explanations would apply to MMR, which might explain why migration background was not associated with a higher coverage for this vaccine. Interestingly, the advantage of the less acculturated migrants disappeared when at least three doses of hepatitis B vaccine were required. This might indicate that compliance with further vaccination among this group is lower or at least not better than in the indigenous population.

Our finding that higher educational level of the parents was associated with lower vaccination status of the child was consistent with some other findings in developed countries[18]. In recent years, media reported doubts regarding safety of some

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vaccines[19–21], which affected negatively parents' attitudes and decisions regarding vaccination of their children, especially among more educated[22].

Acculturation is usually measured by an index based on a single variable or in some cases by an arbitrarily constructed composite index[9]. The advantage of using CAPTCA is that the methodology is more general. It allows flexible combination of several variables, which can measure different aspects or just improve the reliability of the measurement. CAPTCA performs automatic weighting of the variables based on distribution found in the sample, which seems theoretically more convincing than arbitrary weighting schemes used in construction of a composite index. CAPTCA also allows us to investigate potential multidimensionality of acculturation (for example use of the foreign language might be a different dimension of acculturation than the duration of stay in the new country). This was not the case in our sample, but could be relevant in others. Furthermore, CAPTCA might help to detect distinct groups among migrant population (indicated by clustering of cases with similar index values). Another study on the association between acculturation and prevalence of depressive symptoms in adolescents in California found two clearly distinct groups among migrants[23]. For the purposes of this study, where the outcome (vaccination) is decided by parents, we included some variables related to the child (the use of language) to assess the acculturation of their parents. We found that the index could be replaced by simpler questions. However, instead of making a priori assumptions, CATPCA provided empirical justification for such choice. In another setting, different variables might be more useful.

Our study had some limitations. First, although routine records existed for almost the entire population of school children, additional information from the questionnaire was obtained only for 73 % of the children. One of the reasons for non-response may be insufficient proficiency in German language – observations from the study team disagreed with this explanation, but the possibility still exists. Unfortunately, we have no socio-demographic information on non-respondents. Second, health cards which provided information about the vaccination status were not available for 4 % of children for whom the additional questionnaire was filled. The absence of health cards during the mandatory examinations could indicate a lower awareness of parents regarding their children's health status and therefore children for whom information was missing might have lower vaccination coverage. The information about economic status was obtained only by a subjective satisfaction, which might be a poor indicator of the objective economic status. Our decision not to ask directly about income was based on the expected problems with disclosure of this information. We did not assess the validity of the subjective measure we used.

The selection of variables used to assess acculturation in our study might not correctly reflect acculturation in general. For example, in using time since immigration, we did not consider that objective time might be a poor measure of individual adjustment. Also the use of foreign language in the family might reflect different attitudes, sometimes it can indicate deficiencies in the level of mastering the language of the host country, at other times parents being fluent in the language of the host country may still cultivate the native language. CATPCA is only a technical solution to combine information, but the validity of the obtained score depends on the quality of the obtained information. While we were not able to study validity of the score in our study, one possibility would be to compare it against subjective self-assessment of acculturation or instruments measuring cultural preferences[24].

Our study may not be generalizable for the whole population of children with migration background living in Germany. The region where the study was performed is predominantly rural and most migrants in Germany are living in urban areas. The studied region was also not representative in terms of economic situation for all parts of Germany, with a relatively high prosperity of Bavaria as compared to other German states.

In conclusion, we found that lower acculturation was associated with higher risk of incomplete vaccination, but lower risk of lacking vaccination, resulting in a better protection in this subgroup. This was against our initial expectations, but appears plausible given the possible explanations. As the population with migration background in our study is not likely to represent the majority of migrants (especially with respect to citizenship status), attention should be paid to the possibility that less acculturated migrants might have higher risk of incomplete vaccination. On the other hand, increasing acculturation can be associated with an increase in lacking vaccination and in a loss of the advantage resulting from higher partial protection. The positive implication is that highly acculturated migrants can be reached by programs oriented towards indigenous populations and thus, they do not require specific interventions. We illustrated the use of CATPCA to combine information about acculturation into a composite index, and we propose the use of this method for future analyses of acculturation.

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