Factors for Preterm Births in Germany – An Analysis of Representative German Data (KiGGS)

Einflussfaktoren auf die Frühgeburt in Deutschland – Analyse der für Deutschland repräsentativen KiGGS-Daten

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Abstract

Introduction: Preterm birth is a global scourge, the leading cause of perinatal mortality and morbidity. This study set out to identify the principal risk factors for preterm birth, based on the German Health Interview and Examination Survey for Children and Adolescents (KiGGS). A range of possible factors influencing preterm birth were selected for inclusion in the questionnaire, covering factors such as gender, national origin, immigrant background, demography, living standard, family structure, parental education and vocational training.
Methods: All data were taken from the aforementioned KiGGS survey conducted between 2003 and 2006. A total of 17 641 children and adolescents (8656 girls and 8985 boys) drawn from 167 German towns and municipalities deemed to be representative of the Federal Republic of Germany were included in the study. Gestational age at birth was available for 14 234 datasets. The questionnaire included questions from the following areas as possible factors influencing preterm birth: gender, national origins, immigrant background, demography, living standard, family structure, parental education and vocational training.
Results: The preterm birth rate was 11.6%, higher than that of other national statistical evaluations. Around 57.4% of multiple pregnancies and 10% of singleton pregnancies resulted in preterm delivery. Multiple pregnancy was found to be the most important risk factor (OR 13.116). With regard to national origins and immigration background, mothers from Turkey, the Middle East, and North Africa had a higher incidence of preterm birth. Preterm birth was more prevalent in cities and large towns than in small towns and villages.
Conclusion: Risk factors associated with preterm birth were identified. These should help with the early identification of pregnant women at risk.

Zusammenfassung

Einleitung: Die Frühgeburt ist die Hauptursache für perinatale Mortalität und Morbidität und ein weltweites Problem. Das Ziel dieser Studie war, die Hauptrisikofaktoren für eine Frühgeburt aus dem Kinder- und Jugendgesundheits-Survey (KiGGS) zu identifizieren. Als mögliche Einflussfaktoren auf die Frühgeburt wurden im Fragenkatalog Fragen aus den Bereichen Geschlecht, Herkunft, Migrationshintergrund, Demografie, Lebensumstände, Familienstrukturen, Schul- und Berufsausbildung der Eltern ausgewählt.
Methoden: Datengrundlage war der KiGGS-Survey, der in den Jahren 2003 bis 2006 durchgeführt wurde. Insgesamt nahmen an der Studie 17 641 Kinder und Jugendliche (8656 Mädchen und 8985 Jungen) aus 167 für die Bundesrepublik repräsentativen Städten und Gemeinden teil. Das Gestationsalter bei der Geburt war in 14 234 Datensätzen vorhanden. Als mögliche Einflussfaktoren auf die Frühgeburt wurden im Fragenkatalog Fragen aus den Bereichen Geschlecht, Herkunft, Migrationshintergrund, Demografie, Lebensumstände, Familienstrukturen, Schul- und Berufsausbildung der Eltern ausgewertet.
Ergebnisse: Die Frühgeburtsrate betrug 11,6% und lag damit höher als in anderen nationalen Statistiken. 57,4% der Mehrlingsschwangerschaften und 10% der Einlingsschwangerschaften werden als Frühgeburt geboren. Mehrlingsschwangerschaft war der wichtigste Risikofaktor (OR 13,116). Hinsichtlich der Herkunft und des Migrationshintergrunds waren Mütter aus der Türkei, aus Mittelost und Nordafrika am häufigsten von einer Frühgeburt betroffen. Die Frühgeburt hat eine höhere Inzidenz in Großstädten gegenüber Kleinstädten und Dörfern.
Zusammenfassung: Risikofaktoren, die mit einer Frühgeburt assoziiert waren, wurden identifiziert. Diese sollen helfen, Risikoschwangere rechtzeitig zu identifizieren. Die Frühgeburtsrate

The preterm birth rate in our survey was higher than that found in other national statistical evaluations based on process data. More than half of all multiple pregnancies ended in preterm birth.

aus unserem Survey ist höher als die anderer nationaler Statistiken, die jedoch auf Prozessdaten basieren. Mehr als die Hälfte aller Mehrlingsschwangerschaften endet als Frühgeburt.

Introduction

Preterm birth (defined as birth before 37 + 0 weeks of pregnancy) is the principal cause of perinatal morbidity and mortality. Over the last two decades the preterm birth rate has remained unchanged or even risen in most countries, despite the increased understanding of possible risk factors and their pathological mechanisms [1–5].

In 2013 the preterm birth rate for Germany stood at 8.7% [6], one of the highest recorded in Europe [7]. Globally, the rate varies between 7–14%, which amounts to some 15 million babies born prematurely every year.

Approximately 75% of all cases of perinatal mortality and more than half of all cases of long-term perinatal morbidity are associated with premature delivery [8]. With an incidence of 27%, preterm delivery is the principal cause worldwide of neonatal death (occurring within the first 28 days of life), which translates into more than one million dead children every year [9]. Typical secondary complications associated with preterm birth include neonatal respiratory distress syndrome (RDS), persistent ductus arteriosus (PDA), retinopathy of prematurity (ROP), intraventricular hemorrhage (IVH), periventricular leukomalacia (PVL), and bronchopulmonary dysplasia (BPD) [10].

Preterm birth-related mortality and morbidity decreased following the introduction of antenatal corticosteroid therapy and improved neonatal intensive care. However, in addition to the abovementioned immediate perinatal outcomes, there are other consequences that severely affect the subsequent lives of affected children and their families. Typical sequelae affecting preterm born children in later life are cerebral palsy and respiratory distress syndrome, along with sensory deficits and learning difficulties [11]. In addition, the height of children born prematurely is often smaller than average in later life [12].

The reproductive phase of women who were themselves born prematurely is also affected. Thus, a low maternal birth weight (irrespective of whether this was caused by preterm birth or growth restriction) is not only a risk factor for hypertensive (including pre-eclampsia) and diabetogenic pregnancy complications [13, 14], but also for preterm birth in the next generation [15].

Improved survival rates have also affected the decisions taken by physicians when weighing up the decision to continue a pregnancy against the risks associated with preterm delivery, the consequence being an increased number of iatrogenic preterm births [16].

The causes of preterm birth can be classified as follows:

1. Premature delivery for fetal or maternal indications (e.g. pre-eclampsia, placenta previa bleeding, multiple pregnancies, or fetal growth restriction),
2. Spontaneous preterm labor without rupture of membranes, and
3. Premature rupture of membranes resulting in preterm delivery.

Some 70% of cases can be assigned to the latter two groups [17, 18], referred to here as "spontaneous preterm birth."

Complex mechanisms seem to underpin the etiology; data from previously published studies suggest that infections such as chorioamnionitis are significant cofactors, especially in early-term pregnancy [19].

Increased maternal age in pregnancy is one of the most important demographic factors underlying preterm birth. Thus a study by Schure and colleagues showed a rise in the preterm birth rate with advancing maternal age, irrespective of the number of previous live births [20].

The availability of reproductive medical techniques has also increased the number of multiple pregnancies [21]. In addition, multiple pregnancies resulting from reproductive medical treatments are more common in women of advanced maternal age [22, 23]. The preterm birth rate for multiple pregnancies stands at 40–60% [24].

Risk factors also include emotional stress and other psychological stressors. Thus it was found that a number of pregnant women suffering from posttraumatic stress disorder in the wake of the 9/11 attacks of 2001 went on to give birth prematurely (OR 2.48, 95% CI 1.05–5.84) [25].

Causal connections between the majority of these risk factors and preterm birth are, however, difficult to prove, since it has not been possible to identify these connections in randomized and controlled studies.

Since the German Health Interview and Examination Survey for Children and Adolescents (KiGGS) is a cross-sectional study, it only describes associations and prevalences. However, causes and consequences can often be plausibly assigned based on prior knowledge. A high degree of validity can be assumed if:

1. data were acquired in double-blind studies,
2. the significance level is less than $p < 0.01$,
3. dose-response relationships are present, and
4. results do not vary, even when taking cofactors into consideration.

Cross-sectional studies cannot provide proof of etiology; other study designs are required for that [26, 27].

The present study aimed to investigate the following issues:

1. Is is possible to determine preterm birth rates from the data available from the German Health Interview and Examination Survey for Children and Adolescents (KiGGS)?
2. Which children are affected by preterm birth? Is it possible to identify potential risk factors for preterm birth in Germany?

The aim of our study was therefore to identify high-risk pregnancies based on a knowledge of the risk factors with a view to improving prenatal care. Preventive measures can be taken early on if there are clinical indications that preterm birth is imminent.

Methods

Selection of participants and database

Our data were obtained from the German Health Interview and Examination Survey for Children and Adolescents (KiGGS) study on child and adolescent health in Germany. Commissioned by the Robert Koch Institute, the KiGGS study was conducted from 2003 to 2006, making it the first of its kind to be attempted in Germany. Certainly it was the first to compile data that were representative for the country as a whole and could be used to make

general assumptions about the health of children and adolescents between the ages of 0–17 [28–30].
Briefly, participants were chosen using a two-step procedure: the first step consisted of selecting 167 sample points deemed representative for Germany, in that they reflected the population-specific extent of urbanization and geographic distribution. To ensure that sample sizes were adequate and the data could be generalized according to place of residency (new federal states, old federal states, Berlin), the breakdown for the 167 data collection sites was as follows: 112 were in the old federal states, 50 in the new federal states, with the remaining 5 in Berlin. Then, in a second step, persons were selected from the population registers kept by the local authorities, using an age- and gender-based random sampling procedure.
For each and every data collection site, a number of children (8, 9 or 10, depending on the size of the community) were chosen for each birth cohort, resulting in (respectively) 144, 162 and 180 persons deemed suitable for study who were then asked to participate.
Auxiliary data on targeted risk factors and covariables were obtained from questionnaires sent to parents and their children. The participation rate was 66.6%, and varied only slightly between age groups and genders. Participation rates differed between immigrants and Germans, between cities and large towns (more than 100 000 inhabitants) and other data collection sites with fewer inhabitants, but also between the old and the new federal states (including Berlin). The percentage of quality-neutral data losses was comparatively low (5.3%).
With a view to securing representative findings, analyses were adjusted using a weighting factor designed to correct for deviations from the demographic structure (as on December 31, 2004) in terms of age, gender, region (Berlin, East and West Germany) and nationality.
For the background methodologies informing the KiGGS study and other particulars, readers should consult other publications [31–33].

Study population

A total of 17 641 children and adolescents (8656 girls and 8985 boys) were studied from 167 cities, towns, and villages, selected as representative for the Federal Republic of Germany. The study population comprised 14 836 children and adolescents over the age of three. There was an oversampling of participants with an immigrant background and also of participants from the new federal states.
The data for analysis were obtained from parents in the form of written statements (questionnaires); maternal data was obtained from prenatal care records (the "maternal health passport", issued to all expectant mothers in Germany documenting prenatal and natal care) and additional data was obtained from pediatric healthcare records (yellow pediatric medical checkup booklet).
Subsequent steps included physical examinations, anthropometry, and laboratory tests. Blood samples were collected from 86% of the persons studied, after first securing a positive vote from the appropriate ethics commission since it was expected that each child would benefit [34].

Statistical analysis

Statistical analysis (probability values and confidence intervals) was performed using complex sampling techniques in SPSS, Version 20 (IBM, Armonk, NY, USA, www.ibm.com). Differences between groups with probability values (p-values) of less than 0.05 or 0.01 or with non-overlapping confidence intervals of 95% were considered statistically significant.

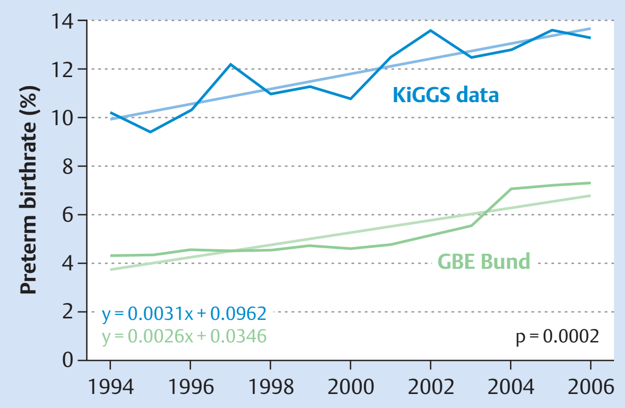

Fig. 1 Development and comparison of preterm birth rates in Germany based on data from the KiGGS survey vs. data from German Federal Health Reporting (Gesundheitsberichterstattung des Bundes, GBE Bund) in percent, with trendlines and corresponding linear equations.

To start with, datasets where the gestation age at delivery was known were identified and the preterm births were selected. Questions focusing on possible factors influencing preterm birth such as gender, nationality, immigrant background, demography, living standards, family structure, parental education and vocational training, parental occupational status, and household income were chosen; the responses were analyzed using bi- or multivariate statistical correlation analysis.
Stratified prevalences were determined and the probabilities for differences between groups were calculated using chi² test for nominal data and Kendall's tau b correlation coefficient for ordinal data.
The risk factors for preterm birth were determined using multivariable logistic regression, and odds ratios (OR) and 95% confidence intervals (95% CI) were specified. Linear regression equations were used to show changes in birth rates over time.

Results

▼

A total of 17 641 children and adolescents (8656 girls and 8985 boys) were studied from 167 cities, towns, and villages, chosen as representative for Germany. Gestational age at birth was known for 14 234 datasets. ► **Table 1** shows the key data on risk factors for preterm birth. The datasets were analyzed using bi- or multivariate statistical correlation analysis. Because of the complexity, correlations and associations are listed according to the specific issue.

Preterm birth rate

With regard to the preterm birth rate, 11.6% of births occurred before the 38th week of gestation (< 37 + 0 GW).
In the annual birth cohorts (1985–2006), figures ranged between 8 and 14.9%. The gender distribution for preterm births was 12% (for boys) and 11.1% (for girls) (p = 0.047).
57.4% of multiple births and 10% of singleton births were premature. Over time, the preterm birth rate showed a clear upward trend (► **Fig. 1**).

Table 1 Logistic regression for risks underlying preterm birth. OR (Odds Ratio), 95 % CI (95 % confidence interval), p-value (significance). Significant results are indicated in bold.

Risk factor*	OR**	95 % CI**		p-value
		lower	upper	
Pregnancy factors				
Multiple pregnancy	**13.116**	**10.896**	**15.790**	**0.000**
No information	1.012	0.526	1.944	0.972
Boys	**1.117**	**1.010**	**1.234**	**0.030**
Maternal factors				
Nullipara	**1.470**	**1.322**	**1.634**	**0.000**
Maternal age				**0.023**
▸ 20–29	0.983	0.750	1.287	0.898
▸ 30–39	1.182	0.891	1.567	0.247
▸ 40 and above	1.212	0.745	1.971	0.440
▸ No information	0.775	0.323	1.860	0.568
Maternal height (per10 cm)	**0.804**	**0.746**	**0.867**	**0.000**
Maternal BMI				**0.002**
▸ < 19 kg/m²	**1.315**	**1.057**	**1.637**	**0.014**
▸ 24–< 26 kg/m²	0.879	0.759	1.018	0.085
▸ 26–< 28 kg/m²	0.952	0.798	1.135	0.581
▸ 28–< 30 kg/m²	**0.764**	**0.613**	**0.951**	**0.016**
▸ 30–< 35 kg/m²	**0.799**	**0.654**	**0.977**	**0.029**
▸ ≥ 35 kg/m²	1.109	0.865	1.421	0.415
▸ No information	0.742	0.401	1.370	0.340
Social factors				
Social status				**0.000**
▸ middle	**0.805**	**0.713**	**0.910**	**0.001**
▸ high	**0.701**	**0.606**	**0.812**	**0.000**
New federal states	**1.168**	**1.021**	**1.335**	**0.024**
Urban area				**0.008**
▸ small town	**1.239**	**1.056**	**1.453**	**0.009**
▸ midsize town	**1.315**	**1.123**	**1.541**	**0.001**
▸ large town or city	**1.202**	**1.019**	**1.419**	**0.029**
National origins of mother				**0.011**
▸ Europe/North America/Australia	1.112	0.943	1.310	0.206
▸ Turkey/Near East/Middle East/North Africa	**1.501**	**1.207**	**1.867**	**0.000**
▸ Sub-Saharan Africa	1.292	0.510	3.272	0.589
▸ Latin America	1.262	0.584	2.726	0.554
▸ Asia	1.479	0.996	2.197	0.053
▸ No information	1.006	0.580	1.746	0.982
Constant	3.966			0.030

* Reference categories are not listed, e.g. singleton birth, girl, multipara (child with older siblings), country, old federal states, rural area, low social status, Germany, under 20 years of age, 19–< 24 kg/m².

** An OR of more than 1 indicates a higher risk; it is significant when the upper and lower 95 % CI are over 1. An OR of less than 1 indicates a lower risk. It is significant when the 95 % CI is always less than 1.

Parental nationality

The preterm birth rate was significantly higher for immigrants than non-immigrants (13.8 vs. 11.2 %, p < 0.001). German mothers had a preterm birth rate of 11 %, whereas the figures for mothers from Central Europe, Black Africa and Latin America were respectively 12.6 %, 13.6 %, and 15.3 %. Mothers from Turkey, the Near East, the Middle East and North Africa (17.3 %) and from Asia (17.2 %) (p < 0.001) were most likely to have preterm births.
11.1 % of families with a German father had a preterm birth (as opposed to 10.1 % for families with a European father and 11.6 % for the overall population). This is in contrast to the figures for fathers from Turkey, the Near East, the Middle East and North Africa (16 %), sub-Saharan Africa (16.1 %), Latin America (16.2 %) and Asia (16.3 %) (p < 0.001).
For immigrant mothers, the preterm birth rate depended on the duration of residence in Germany. For mothers who had only arrived in Germany in the year of delivery, the preterm birth rate was 12.4 %, whereas the rate for women who had resided in Germany between two and ten years increased to 14.3 % before declining again to 11.3 % (overall population: 11.6 %; p = 0.003). The paternal duration of residence was not statistically significant.

Effect of place of residency on preterm birth rate

The preterm birth rate correlated to a highly significant degree with municipal size. Whereas for rural regions the preterm birth rate was 9.5 %, the corresponding figure for small towns was 11.7 %; for midsized towns it was 12.2 %, and for large towns and cities it was 12.1 % (p = 0.001). In comparison, there was no significant difference (p = 0.301) in preterm birth rates between the new (12.1 %) and old federal states (11.4 %).

Social status and preterm birth

Social status was determined based on parental statements on
1. education and vocational training,
2. household income, and
3. occupational status.

Following Winkler and Lange [35, 36], social status was calculated as an index based on the above-listed indicators. To this end, each of the three indicators was assigned a value ranging from 1–7; these values were then added together to create a spectrum which ranged from a minimum of 3 points to a maximum of 21 points. This permitted a family's social status to be classified, with 3–8 points indicating a low status, 9–14 points a middle social status, and 15–21 points a high social status.

Occupational status for the purposes of classification was defined as the current job held or, failing that, the last job held.

Taking social status into consideration resulted in significant results. The preterm birth rate was found to be 13.5 % for low, 11.1 % for middle, and 10.5 % for high social status groups ($p < 0.001$).

Multivariable analysis of risks associated with preterm birth

When logistic regression was used to analyze the risk for preterm birth, the respective risk factors were added incrementally (**Table 1**).

Maternal age referred to age at the time of delivery; however, body mass index (BMI) only referred to BMI at the time of the survey, which may not adequately reflect the association at the time of delivery.

Multiple pregnancy was the most significant risk factor for preterm birth. The risk was, in fact, 13 times higher than for singleton pregnancies (**Table 1**).

This was followed by parity; however, the number of prior pregnancies or of older siblings was not significant, prompting the decision to take both figures together. Thus, the risk for nulliparae was found to be 1.5 times higher (**Table 1**).

Children from the new federal states had an only marginally higher risk (less than 20 %) of preterm birth (**Table 1**).

A further maternal risk factor studied was height, stratified in increments of 10 cm to simplify presentation. Mothers from towns, especially those of medium height, had a higher risk of preterm birth than mothers from rural areas. Middle and high social status reduced risk, whereas an immigrant background increased it (**Table 1**). Maternal age did not play a significant role. Risk decreased with increased maternal height and was highest for low or very high BMI (**Table 1**).

Discussion

Preterm birth is a global scourge. A rise in preterm birth rates has been observed in almost all countries all over the world. Preterm birth is the leading cause of perinatal mortality. Every year, an estimated 15 million babies are born prematurely worldwide, and more than one million children die annually from the sequelae of preterm birth [2]. In industrially more developed countries the preterm birth rate is 7.5 %; the corresponding figures for less and least developed countries are 8.8 % and 12.5 %, respectively [37].

Chorioamnionitis is an important cofactor for preterm birth. Histologically verified chorioamnionitis is found in approx. 60–80 % of the placentas of mothers who gave birth prior to the 28th week of gestation, as well as in 40–50 % of the placentas of mothers who gave birth between the 29th and 34th weeks of gestation [19].

The World Health Organization (WHO) classifies preterm births into three categories: "extremely preterm" (< 28 GW); "very preterm" (28 to < 32 GW) and "moderate to late preterm" (32 to < 37 GW).

"Late preterm infants" are the most rapidly growing subgroup of preterm births and account for more than 80 % of all preterm births (Germany 2013: 83 % [6]).

In addition to the direct consequences, preterm birth also carries an increased risk of late sequelae, such as chronic conditions and higher mortality rates in later life. Many survivors suffer from the consequences, which may include learning difficulties as well as visual and auditory impairment, for the rest of their lives. In addition to pneumonia, complications associated with preterm birth are among the primary causes of death in children under the age of five [38].

According to the figures issued for 2013 by the Institute for Applied Quality Improvement and Research in Healthcare GmbH (Institut für angewandte Qualitätsförderung und Forschung im Gesundheitswesen; AQUA), the preterm birth rate for all of Germany was 8.7 % [6].

However, this is lower than the preterm birth rate calculated from the KiGGS data, which stands at 11.6 % for the overall population. When the birth years were considered individually (e.g. 1985–2006), the preterm birth rate ranged between 8 and 14.9 %. For the period 1994–2006, it was possible to compare the data from the KiGGS survey with the preterm birth rates from the German Federal Health Reporting system (Gesundheitsberichterstattung des Bundes, GBE Bund) (**Fig. 1**). The data of the KiGGS survey differed significantly from the data supplied by GBE Bund ($p = 0.0002$). In fact, for every year of observation, the KiGGS data was approx. 2–3 times higher than the corresponding figures from GBE Bund, even though the trend lines were virtually parallel for both datasets (a rise in the KiGGS trend line of 0.0031 vs. a rise in the GBE trend line of 0.0026).

This is particularly interesting because surveys like KiGGS are recognized as offering the best method to determine prevalence due to their direct and representative acquisition of data from individuals.

A possible cause of this discrepancy could be due to the fact that, at the time, there was no systematic, structured perinatal documentation system across all of Germany, meaning that it was difficult to compare data of individual federal states [39].

Another explanation could be the quality of the process data, i.e. data relating to the care process. Non uniform documentation methods in delivery wards could have skewed data outcomes.

Comparisons of preterm birth rates from different decades should be treated with caution as it is by no means certain that the data are comparable. As survival rates for extremely premature and extremely low birthweight neonates improved, registration procedures may have changed over time.

With regard to the incidence of multiple pregnancies, earlier studies have shown that in all industrial countries multiple birth rates are trending upward, chiefly due to the introduction of reproductive medical techniques [40]. Some 40–60 % of all multiple births are premature [24]. Perinatal mortality is four times higher for twins than for singleton births; with triplets the perinatal mortality is six times higher [41]. Morbidity and mortality of twins born as a result of reproductive medical techniques do not, however, diverge from those of spontaneously conceived twins [42].

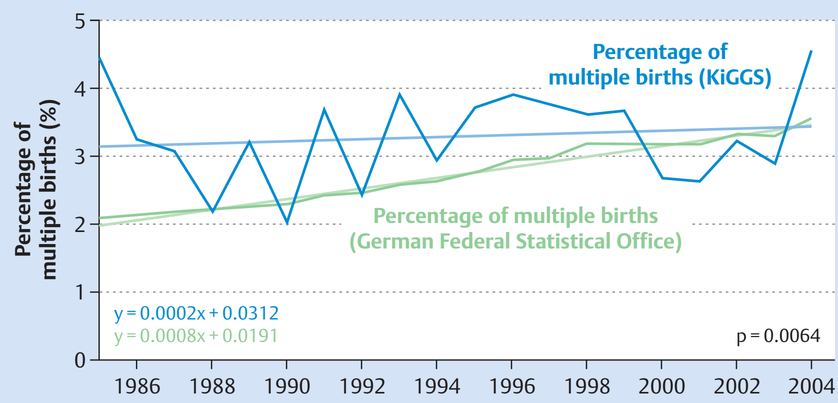

Fig. 2 Comparison of the percentage of children resulting from multiple pregnancies: the KiGGS dataset vs. the dataset of the German Federal Statistical Office (DeStatis).

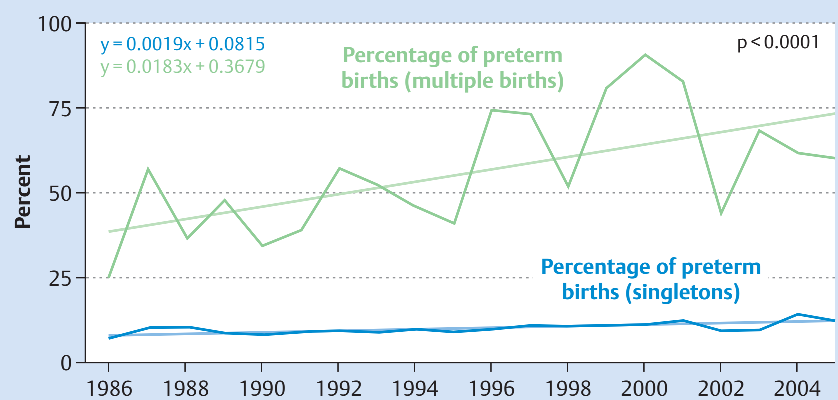

Fig. 3 Trend line for the percentages of preterm births (singletons and multiples) during the period of observation of the KiGGS survey.

According to Hellin's rule, the frequency of spontaneous multiple births is depicted by the formula $1:85^{n-1}$, with n corresponding to the number of children born. Calculated for twins, the frequency is 1 : 85 (1.2%); for triplets the figure is $1:85^2$ (= 1 : 7225; 0.014%). A higher prevalence of multiple pregnancies was also found in our analysis. In the observation period covered by the KiGGS survey, the percentage of children resulting from multiple pregnancies averaged 3.3%, exhibiting a slightly upward trend.

These results are consistent with statistical data from the German Federal Statistical Office [43]. See **Fig. 2** for a comparison of the two datasets.

A multiple pregnancy is a significant risk factor for preterm birth. Our data showed that 57.4% of multiples were born prematurely (**Fig. 3**). Trend analysis showed an almost tenfold rise over time for multiples as opposed to singletons (0.0019 vs. 0.0183).

These results are consistent with previously published data.

In their analysis of data from Berlin, Bergmann et al. noted an increase from 1.3 to 1.8% in multiple births between 1993 and 1999. This study observed an increase in the proportion of multiple births in preterm births as well as in the number of pregnancies following reproductive medical treatment [44].

Where maternal BMI is concerned, it is known that extremes of weight, i.e. obesity and very low maternal weight, are correlated with an increased risk of preterm birth. Despite the simultaneous consideration of other factors that affect BMI in the logistical model such as low socioeconomic status or ethnicity, the correlation persists [45, 46]. Both women with a BMI of $< 19\ kg/m^2$ and those with a BMI $> 35\ kg/m^2$ had an increased risk of preterm birth (OR 1.315 and 1.109 respectively).

With regard to the role played by parental origins, it could be shown that an immigrant background was a risk factor for preterm birth. Mothers from Turkey, the Near East, the Middle East, North Africa, and Asia (grouped together here due to similar risk patterns) were most commonly affected. One possible explanation might be that immigrants from countries in these parts of the world had to leave their homelands under extremely stressful conditions (political tensions, war). In a Swedish study by Liu et al., the risk of preterm birth among immigrants from countries wracked by civil war was evaluated. It was found that the risk was greatest in the first year of residency in Sweden (1.39), but declined after a period of two or three years 47].

A correlation between the duration of stay in Germany and the preterm birth rate was also evident in our own analysis (year 1: 12.4%; years 2–10: 14.3%; after 11 years: 11.3%).

In this context, mention should also be made of the so-called "Latina epidemiologic paradox" also known as the "healthy migrant effect," which has been observed in almost all immigrant countries. As originally described, the paradox was that Americans of Hispanic or Latin American origin (Latinas) exhibited a rather better health profile than Americans of Caucasian origin, despite Latinas often having a lower socioeconomic status [48]. In terms of pregnancies of Mexican women, the paradox was that they were less likely to give birth to underweight babies or have preterm deliveries than Americans of non Mexican origin; the decreased risk factor was in the order of 30% [49]. This paradox was only found, however, in the first generation of immigrants. Immigrants, for one thing, arrive with certain traditions and habits that promote healthy outcomes. They may have, for example, suppor-

tive family structures to draw on in their new country, structures that play out positively in terms of reproductive health [50,51]. In the course of adapting to an unfamiliar environment, so called acculturation processes, these health-promoting habits were no longer documented for second and third generation immigrants [52].
The figures for our study show that after ten years of residence the preterm birth rate of immigrants achieved parity with that of non immigrants (11.3 vs. 11.6%). Evidently, this is a highly complex issue which is influenced by such diverse factors as country of origin, circumstances of arrival in the new country (classic immigration vs. refugees fleeing war), social status, and access to medical care.
Urban women were more likely to give birth prematurely than rural women. Our data showed, moreover, that while women of immigrant background living in larger communities were at greater risk of preterm birth, the preterm birth rate declined the longer they lived in Germany.
These results are in accordance with previously published studies. Thus, for instance, Kent et al. showed that inhabitants of urban areas are more likely to miscarry or give birth prematurely. As exemplified by Afro-American women living below the poverty line, it could be shown that urban women had a greater risk of miscarriage or preterm delivery than their rural counterparts [53].
Social status is an important cofactor in the incidence of preterm birth. Several authors reported that women of low social status are more likely to suffer preterm birth [53,54]. In a study by Straube et al., the preterm birth rate for unskilled and semiskilled working women was 7.8%, whereas the corresponding figure for women working as senior civil servants was lower (6.3%). When combined with other risk factors, the figure for the former even increased exponentially. Thus, the preterm birth rate for working women aged ≥ 40 years with more than four living births jumped from 8.2 to 13.8%; in contrast, the figure for senior civil servants in the same category was 5.6% [55].
The importance of social status is further emphasized by the fact that higher social status not only lowers the risk of preterm birth, it also reduces the incidence of cognitive and social deficits in later life among children born prematurely.
Treyvaud et al. showed, for instance, that an optimal home environment is conducive to prematurely born babies developing better cognitive and socio-emotional skills in infancy [56]. Our own results confirmed the role played by social status. The OR for a preterm birth for mothers of medium and high social status were 0.805 and 0.701, respectively.

Conclusion

In summary, the present study is the first systematic and generalizable analysis of the risk factors for preterm birth in Germany.
The preterm birth rate in the KiGGS survey was 11.6%, but when stratified according to year of birth (1985–2006), it rose up to 14.9%.
Remarkably, the preterm birth rate in the present survey was significantly higher than that of either GBE Bund or the German Federal Statistical Office, both of which are based on process data. Despite intensive efforts, it has not so far proved possible to prevent or reduce preterm birth. Neither comprehensive information on known risk factors nor the better availability of medical care during pregnancy nor the proximity of well equipped perinatal care centers nor a profusion of therapeutic approaches (tocolysis, progesterone administration, cervical cerclage) have been able to lower the preterm birth rate.
Particular attention should be focused on underweight expectant mothers, expectant mothers of low social status, and expectant mothers with an immigrant background during prenatal check-ups. Analysis of the KiGGS data showed that expectant mothers from areas of conflict have a higher risk of preterm birth, and that this pattern persists even after years of living in Germany.
Our investigation also showed that more than half of all multiple pregnancies ended in preterm birth.
Given the increasing use of reproductive medical techniques, these figures should prompt physicians to make prospective mothers aware of the increased risk of preterm birth, even when transferring only two embryos, or, more generally, to weigh up the higher risk of preterm birth against the attempts to improve reproductive medical success rates.
Plainly there is still much to do when it comes to identifying pregnant women at risk and avoiding preterm births. When there is a high probability for preterm birth, treatment in a perinatal center should be initiated.
But for this to succeed it is important that the risk factors for preterm birth are known. Our investigation has systematically analyzed and summarized the relevant factors which can help to identify pregnant women at risk early on.

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Conflict of Interest

None.

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