

The KINDEX App – an Instrument for Assessment and Immediate Evaluation of Psychosocial Stressors in Pregnant Women in the Daily Practice of Gynecologists, Midwives, and in Women’s Hospitals

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Keywords

Prenatal · Screening · Psychosocial risks · App · Prevention · Early intervention

Summary

Background: The Konstanzer Index (KINDEX) is a structured interview developed to comprehensively and reliably assess psychosocial risk factors, prenatally, for a healthy development of mother and child. To meet the need for an immediate, fully automatic analysis of the data, we developed a tablet-based self-rating instrument, the KINDEX App, which can be operated by the pregnant woman herself. **Methods:** In this study, N = 956 pregnant women completed the tablet-based KINDEX App as a self-rating in gynecological practices or women’s hospitals. To assess the validity of the instrument, we compared the prevalences of psychosocial risk factors of this sample with representative samples and calculated Cronbach’s alpha. In addition, the acceptance of the instrument was recorded in pregnant women, gynecologists, and midwives. **Results:** The prevalence rates of our survey correspond to the prevalence rates in comparable samples. Therefore, the external validity of the App seems to be good. The number of missing answers was remarkably low (< 6%), indicating that the acceptance of the instrument is high. The internal consistency of the App was acceptable ($\alpha = 0.68$). **Conclusions:** The KINDEX App is a convenient and valid screening instrument for the assessment of psychosocial risk factors during pregnancy and, thus, an important tool for prevention and early intervention, facilitating a successful mother-child relationship and a healthy child development.

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Schlüsselwörter

Pränatal · Screening · Psychosoziale Risikofaktoren · App · Prävention · Frühe Intervention

Zusammenfassung

Hintergrund: Der Konstanzer Index (KINDEX) ist ein strukturiertes Interview, das entwickelt wurde, um bereits pränatal zuverlässig und umfassend Risiken für eine beeinträchtigte psychische Entwicklung des Kindes und der Mutter zu erfassen. Um eine unmittelbare automatisierte Auswertung zu ermöglichen, haben wir das Instrument in Form einer Tablet-gestützten Anwendung (KINDEX-App) weiterentwickelt, die die schwangere Frau eigenständig bedienen kann. **Methoden:** In dieser Studie kam die KINDEX-App in gynäkologischen Praxen und in Frauenkliniken bei insgesamt N = 956 schwangeren Frauen als Selbstbeurteilungsinstrument zum Einsatz. Zur Bestimmung der Validität des Instruments wurden Vergleiche der Prävalenzen der erhobenen psychosozialen Belastungen mit repräsentativen Studien vorgenommen und Cronbachs alpha wurde berechnet. Des Weiteren wurde die Akzeptanz des Instruments sowohl bei den schwangeren Frauen als auch bei Gynäkologinnen und Hebammen erhoben. **Ergebnisse:** Die Prävalenzzahlen aus unserer Erhebung entsprechen weitgehend anderen Befunden, die in vergleichbaren Kollektiven erhoben wurden, wodurch die externe Validität der App angenommen werden kann. Die Anzahl fehlender Werte war äußerst gering (< 6%) und lässt den Schluss auf eine gute Akzeptanz zu. Die interne Konsistenz der App lag im akzeptablen Bereich ($\alpha = 0,68$). **Schlussfolgerung:** Die KINDEX-App ist ein praktikables und valides Screening-Instrument zur Erfassung psychosozialer Belastungsfaktoren bereits während der Schwangerschaft und bildet damit eine gute Basis für die Prävention und frühe Intervention, sodass eine gelingende Mutter-Kind-Bindung und eine gesunde kindliche Entwicklung gefördert werden können.

Theoretical Background

Recent research has increasingly shown that the psychological development of both child and mother is crucially and sometimes irreversibly set in early childhood or even before birth [Bergman et al., 2010; Hsiao and Patterson, 2012; Teicher et al., 2003].

The development of the brain begins in the first months after conception and progresses rapidly, especially in the first 2 years of life [Knickmeyer et al., 2008; Seress, 2001]. During this period, the brain is particularly vulnerable to psychosocial risk factors, which may show up later in the form of mental and physical impairments [Bock et al., 2015; Laucht et al., 2000; Shapiro et al., 2013]. The research shows that the focus must not be limited to the phase after birth, because excessive psychosocial stress on the mother in the prenatal period can have a negative impact on the birth process, as well as negative neonatal and postnatal consequences for the child and the mother. The lasting consequences up to the postnatal phase can affect the mother-child relationship, as well as the child's emotional, social, and neuropsychological development [Bergman et al., 2010; Field et al., 2006; Kim and Jung, 2012; Talge et al., 2007; Teicher et al., 2003].

In Germany, the series of well-known screening check-ups was developed to ensure that mother and child are physically healthy throughout the pregnancy and birth. These measures have so far been limited, however, to the medical-physical risks to the pregnant woman and the fetus [Bundesanzeiger, 2015]. Now, however, it can be empirically demonstrated that psychosocial factors have a potentially negative impact on the development of the child and the mother and thus can cause long-term impairment of mentally healthy development [Plant et al., 2012; Radtke et al., 2011].

But so far there have been only a few studies reporting on the development, evaluation, and implementation of prenatal screening instruments for psychosocial risk factors during pregnancy, as well as on prevention and intervention programs based upon them [Austin et al., 2013; Carroll, 2005; Harrison and Sidebottom, 2008; Karatas et al., 2009]. Our research shows that in German-speaking countries, until the development of the Konstanzer Index (KINDEX) [Schauer and Ruf-Leuschner, in preparation; Ruf-Leuschner and Schauer, in preparation], there was no standardized, scientifically validated screening tool that could be used during pregnancy to detect psychosocial risk factors for the healthy development of mother and child. The KINDEX was developed based on a comprehensive literature review of the effects of psychosocial risk factors during pregnancy, and was based on the results of studies of prenatal screening tools in other countries. In its original form, the KINDEX is a short, fully standardized interview that can be used by gynecologists, midwives, and staff of counseling centers in prenatal care. Based on comprehensive literature research [e.g., Bollini et al., 2009; Carroll, 2005; Glazier et al., 2004; Heilig, 2014; Laucht et al., 2000; Lyons-Ruth and Block, 1996; Magura and Laudet, 1996], the KINDEX assesses the following prenatal risk factors: young age (≤ 21 years); migrant background of mother and/or father; single parent / not living together; financial problems; physical symptoms, medical complications, medical risk factors; complicated prenatal bonding; current stress; traumatic ex-

periences during childhood (mother; family violence); intimate partner violence; substance abuse by mother and/or father; mother's (prior) mental illness. Empirical validations of the KINDEX interviews were conducted in Germany [Ruf-Leuschner and Schauer, in preparation], Greece [Spyridou et al., 2015], Spain [Spyridou et al., 2014], and Peru [Spyridou et al., 2016].

Evaluations of the KINDEX interviews in the various countries repeatedly mentioned the practitioner's financial limitations as well as problems in evaluations conducted by midwives and gynecologists who are not psychologically trained: In everyday practice, the specialist medical staff lacks not only the resources to conduct the interviews, but also the time to evaluate the results of the standardized instrument. These limitations prompted us to develop a self-assessment for pregnant women and also to provide an automatic, computer-aided analysis of the answers for the gynecologists and midwives, with detailed further recommendations.

In this paper, we introduce the tablet-based KINDEX App. Pregnant women, independently using a tablet computer, can now fill out this screening questionnaire as a self-report at the gynecologist's or midwife's office, as well as during check-ups at women's hospitals. Then the gynecologist or midwife is given access to an automatic analysis of the data recorded, which combines the present psychosocial risk factors with background information to display associated risks of later mental developmental impairment and to give practical instructions. It is no longer necessary to manually export the information to a statistical program in order to give feedback to the pregnant woman and offer appropriate support services. Thus, there is no longer any time lag between the assessment of the patient's stressors and the offer of appropriate assistance. Support can be offered and put into effect immediately. Moreover the encrypted, automatic export to statistical programs for more sophisticated analysis and to answer research questions that go beyond the individual case is available for research purposes.

After the validity of the KINDEX interviews was satisfactorily established [Ruf-Leuschner and Schauer, in preparation; Spyridou et al., 2014, 2015, 2016], the question was whether the tablet-based self-assessment questionnaire would be applicable in the daily practice of gynecologists and midwives. The objective of the present work is such validation, as well as ascertaining the acceptance of the KINDEX App for assessing prenatal risk factors for healthy child development, by a sample of pregnant women.

The aim of our study was threefold:

- First, we want to determine whether the assessment of prenatal risk factors using the KINDEX App is valid. In the present work, the external validity was to be checked by comparing the data collected with prevalence figures in the specialized literature.
- Second, we want to direct our attention to the acceptance by the users (pregnant women). We operationalize this by analysis of the number of missing values. Are pregnant women more willing to answer questions in a tablet-based survey? We also conducted a short, application-oriented interview with the gynecologists and midwives.
- Third, we check whether the KINDEX App has sufficient internal consistency compared to the interview.

Table 1. Overview of the risk factors of the KINDEX, the definition of risk (dichotomization), and the number of items in the KINDEX App

Risk factors	Definition of risk	Number of items in the KINDEX sum score
I) Young age	Age 21 or younger	1
II) Migrant background	Migrant background of mother and/or father	2
III) Single parent/not living together	Living without the child's father	1
IV) Financial problems	Worried about financial problems; living index ≤ 0.5 (rooms/persons)	2
V) Physical symptoms, medical complications, medical risk factors	Physical symptoms, complications during pregnancy, medical risk factors	3
VI) Complicated prenatal bonding	Unplanned pregnancy; very worried (both mother and father; on a scale from 0 to 10, in the range of 7 to 10 (top quartile)); very little happiness (both mother and father, on a scale from 0 to 10, in the range of 0 to 3 (bottom quartile))	5
VII) Very high perceived stress	PSS-4 sum score ≥ 12 out of a maximum of 16 (top quartile)	1
VIII) Traumatic experiences during childhood	Physical violence; sexual violence	2
IX) Intimate partner violence	Increasing number of disputes; vociferous fights in the past 8 weeks; fights including physical violence in the last 8 weeks; physical violence in a past relationship	4
X) Problematic substance use by mother and/or father	Nicotine, alcohol, medicines and drugs by mother-to-be and father-to-be	5
XI) (Prior) psychological problems	Ever had a psychiatric diagnosis; ever outpatient therapy or search for counseling; ever psychotropic drugs; ever inpatient therapy	4

^aData about pregnant women and medications or drugs could not be included in the sum score and the calculation of Cronbach's alpha because standard pregnancy medications were taken and no differentiation was made.

Methodology

Procedure

A total of 956 pregnant women used the KINDEX App during standard care with their gynecologists and midwives. All surveys with the KINDEX App took place in the District of Konstanz, between April 2012 and October 2014. 809 surveys (84.6%) were conducted in gynecologists' and midwives' outpatient practices, and 147 (15.4%) at women's hospitals. The gynecologists and midwives who participated in the study were asked not to make any preliminary selection, but either to offer participation in the KINDEX App project to all pregnant women who come into the practice or hospital, or, if this was not possible for time reasons, to proceed with a predetermined representative sample. The gynecologists and midwives were also instructed to give the KINDEX App to the pregnant women as a self-report questionnaire and not to conduct the KINDEX as an interview.

The KINDEX project was reviewed and approved by the Ethics Committee of the University of Konstanz.

Research Instrument – the KINDEX App

The development of the KINDEX App relied on the KINDEX, an interview questionnaire based on current literature concerning prenatal risk factors for healthy child development. The KINDEX in its original version contains 26 questions (some with sub-questions) that pertain to 11 different risk factors; see table 1. A detailed description of the KINDEX may be found in Schauer and Ruf-Leuschner [in preparation]; the KINDEX interview can be downloaded from www.babyforum-landkreis-konstanz.de. Calculations of the internal consistency of the German-speaking instrument yielded a Cronbach's alpha of 0.74 [Schauer and Ruf-Leuschner, in preparation]. For the original version of the interview questionnaire, a sum score can include up to 30 items. Cut-off values for severity of the existing stressor are not provided, because this is a multidimensional instrument. It takes between 20 and 40 min to complete the ques-

tionnaire in the interview version, depending on the stress felt by the pregnant woman. The KINDEX interview version was validated cross-sectionally and longitudinally in Germany, Spain, Greece, and Peru [Ruf-Leuschner and Schauer, in preparation; Spyridou et al., 2014, 2015, 2016].

The KINDEX App has 2 sections: the first comprises the questions to be answered by the pregnant woman, and the second is password protected and only accessible to the gynecologist or midwife.

After opening the App, the user makes a choice between 'questionnaire' and 'administration area doctor/midwife'. After entering an individual, anonymous code for each pregnant woman in the 'Start questionnaire' area, the survey for the woman can begin. She can only fill out her own questionnaire and of course cannot access the questionnaires or records of other women. Then comes an explanation of the content of the questionnaire and of the participation in the KINDEX App project. It is explained to the woman that she can fill out the questionnaire herself, that the answers will be seen by her gynecologist/midwife, and that, if problems are identified, she will receive support services from her practitioner. Here, the woman must explicitly agree to participate. All the questions about a risk factor are displayed on a single page on the tablet screen. If the woman does not answer a question, a further question appears on the tablet, asking whether the question should be skipped. Only after positive confirmation is the next page displayed, with questions on the next risk factor. It is not possible to return to the previous page. It takes between 15 and 20 min to fill out the whole questionnaire.

In the 'Administrative area doctor/midwife', the gynecologist or midwife can display the number of potential stressors that the pregnant woman is subjected to. Then, a specific analysis can be displayed for each individual stressor in the survey. In addition, specific proposals are made to the gynecologist/midwife for dealing with each individual issue. Also, the button 'See questionnaire' displays the complete questionnaire with the woman's responses.

For better case management, the gynecologist/midwife can highlight in an overview whether she has already seen the values entered by a client, whether

Table 2. Overview of the frequency of the risk factors (I–XI) and individual stressors, as well as sum scores of the KINDEX and the number of missing values

	N	Missing values, N; %	M	SD	Percent	Population	Source
I. Young age	946	10; 1%	32	4.95 (Min = 17, Max = 46)	3.0	2.7%	European Health Report [WHO, 2010] ^a
II. Migrant background (of mother and/or father)	947	9; 0.9%			29.0	26.7%; 26%	Statistisches Bundesamt [2012] ^b ; Statistisches Landesamt Baden-Württemberg [2012] ^b
Migrant background – mother	950	6; 0.6%			18.9		
Migrant background – father	946	10; 1%			19.9		
III. Single parent/not living together	952	4; 0.4%			5.9	5.4%	Statistisches Landesamt Baden-Württemberg [2013] ^b
IV. Financial problems	891	65; 6.8%			27.6	21.1%	Statistisches Bundesamt [2014] ^b
Financial difficulties	927	29; 3.0%			25.6		
Small living area	903	53; 5.5%			1.7		
V. Physical symptoms, medical complications, medical risk factors	939	17; 1.8%			67.5	71%	Reincke and Werdan [2011] ^a
Pregnancy complications	932	24; 2.5%			27.5		
Physical symptoms and malaise	944	12; 1.3%			49.8		
Medical risk factors	934	22; 2.3%			25.7	29.6%; 8.2%	Blissing et al. [2008] ^a ; Spiegler et al. [2013] ^a
VI. Complicated prenatal bonding	939	17; 1.8%			46.1		
Unplanned pregnancy	935	21; 2.2%			30.2	13%	Sedgh et al. [2014] ^a ; Stöckl et al. [2012] ^a ; Wellings et al. [2013] ^a
Very little happiness – mother	940	16; 1.7%	9.38	1.59 (Min = 0, Max = 10)	1.8		
Very worried – mother	940	16; 1.7%	3.25	2.98 (Min = 0, Max = 10)	16.6		
Very little happiness – father	940	16; 1.7%	9.06	2.07 (Min = 0, Max = 10)	3.7		
Very worried – father	940	16; 1.7%	3.00	3.03 (Min = 0, Max = 10)	16.1		
VII. Very high perceived stress (PSS-4)	933	23; 2.4%	3.85	3.02 (Min = 0, Max = 10)	0.8	21%	Sable and Wilkinson [2000] ^a ; Woods et al. [2010] ^a
VIII. Traumatic experiences during childhood	920	36; 3.8%			17.8		
Physical abuse – childhood	924	32; 3.3%			14.5	23%	European Report on Preventing Child Maltreatment [WHO, 2013] ^a
Sexual abuse – childhood	923	33; 3.5%			5.2	9.6%	European Report on Preventing Child Maltreatment [WHO, 2013] ^a
IX. Intimate partner violence	920	36; 3.8%			28.7	25.4%	WHO [2013] ^a
Increase in conflicts in the relationship	923	33; 3.5%			12.8		
Vociferous arguments in the relationship	920	36; 3.8%			17.8		
Physical violent conflicts in the relationship	921	35; 3.7%			1.0		
Ever experienced violence in a relationship	920	36; 3.8%			8.6		
X. Problematic substance use by mother and/or father	922	34; 3.6%			48.6		
Nicotine – mother	925	31; 3.2%			6.8	8.5%	European Perinatal Health Report [WHO, 2010] ^a
Alcohol – mother	925	31; 3.2%			2.1	4%	Bergmann et al. [2006] ^a
Nicotine – father	921	35; 3.7% in			27.4	29%	Statistisches Bundesamt [2013] ^b ; Wickström [2007] ^a
Alcohol – father	919	37; 3.9%			28.8	41.6%	Hapke et al. [2013] ^b
Drugs – father	920	36; 3.8%			1.2	6.6%	Pabst et al. [2010] ^b

Tab. 2. Continue next page

Tab. 2. Continue

	N	Missing values, N; %	M	SD	Percent	Population	Source
XI. (Prior) psychological problems	903	54; 5.5%			32.6		
Mental illness – diagnosed	915	41; 4.3%			15.6	37%	Wittchen and Hoyer [2006] ^b
Psychotropic drugs	919	37; 3.9%			10.6	5.5%	Fritze [2011] ^b
Psychotherapy or counseling	911	45; 4.7%			30.7		
Psychiatric/psychosomatic hospital	916	40; 4.2%			6.0		
KINDEX sum score for all stressors (Max 30)			4.3	3.06 (Min = 0, Max = 18)			
KINDEX sum score for all risk factors (Max 11)			3.0	1.81 (Min = 0, Max = 10)			

^aPregnancy specific comparison sample.

^bComparison sample general population.

M = mean; SD = standard deviation; Min = minimum; Max = maximum.

she has already discussed the results and suggestions with a particular woman, and whether the practitioner would like a follow-up meeting or consultation with the woman.

The operation of the App on the tablet computer is designed to be user-friendly and intuitive.

Acceptance Questionnaire for the KINDEX App

At the beginning of the project, an interview was conducted with gynecologists and midwives to assess their acceptance of the KINDEX App. The following areas were assessed with a mostly ordinal response format: general satisfaction with the application (1 very dissatisfied – 4 very satisfied), general satisfaction with the evaluation texts (1 very dissatisfied – 4 very satisfied), assessment of the length of the evaluation texts (1 much too short – 5 much too long), assessment of the general usefulness of the KINDEX App (1 not helpful at all – 4 very helpful), assessment of the time spent by the gynecologist/midwife (1 very low – 4 very high), assessment of one's own willingness to use the App (1 very low – 4 very high), assessment of the willingness of the pregnant woman to use the KINDEX App (1 very low – 4 very high), one's own willingness to invest in an iPad for using the KINDEX App (1 very low – 4 very high); whether participation in the KINDEX App project was offered to all pregnant women or whether a selection was made on the basis of certain criteria); optimization suggestions regarding the evaluation texts/content structure/layout; preference of a paper questionnaire rather than the App version; assessment of the value of translations of the KINDEX App; further comments and feedback.

After filling out the fields of the KINDEX App, the pregnant women were asked to answer questions on a paper instrument about the App, designed to evaluate the following areas: overall impression of the system (1 very good – 4 very bad), operation easy to understand (1 very easy – 4 very hard), application graphically appealing (1 very appealing – 4 complicated), preference of a paper questionnaire or interview (yes – no).

Sample

N = 956 pregnant women participated in the survey with the KINDEX App, with an average age of 32 years (standard deviation (SD) = 4.95; minimum (Min) = 17, maximum (Max) = 46). At the time of the survey, the women were on average in the 24th week of pregnancy (SD = 8.54; Min = 1, Max = 40). A detailed sample description can be found in table 2.

Statistical Analysis

All analyses were performed using SPSS 21. Descriptive analyses were performed to assess the frequency with which the individual risk factors in the sample are present. The results, as well as data about missing values, are listed

in table 2. Cronbach's alpha was calculated to check the internal consistency of the questionnaire. The data collected by the interviews with gynecologists and midwives on the acceptance of the KINDEX App was explored using descriptive analyses. The same approach was chosen for the pregnant women's feedback data. The results are shown in table 3.

Results

Descriptive Analyses of the KINDEX App

Table 2 shows the descriptive statistics for the individual risk factors, as well as the missing values in the sample studied. It also shows a comparison with findings from similar samples.

Of the 30 items that indicate stress (table 1), the KINDEX sum score in the present sample shows a mean of M = 4.3 (SD = 3.06; Min = 0, Max = 18; fig. 1). The KINDEX sum score computed for the 11 risk factors shows a mean of M = 3.0 (SD = 1.81; Min = 0, Max = 10; fig. 2).

The analysis of Cronbach's alpha includes 30 variables (table 1). Cronbach's alpha for the sample studied is 0.68 for the total instrument.

Descriptive Analyses of the Acceptance Questionnaire for the KINDEX App

Table 3 shows the means and standard deviations. There were n = 10 practitioners interviewed who used the KINDEX App in their work as a gynecologist (n = 8) or midwife (n = 2). Nobody refused to be interviewed. General satisfaction (M = 3.56; SD = 0.53) as well as one's own willingness to use the App (M = 2.78; SD = 0.83) and the pregnant women's willingness to fill out the App (M = 3.22; SD = 0.44) were assessed as high and very high.

In the first phase of the KINDEX App project, 68 pregnant women filled out a paper questionnaire concerning acceptance. The overall impression of the application (M = 2.40; SD = 0.52), operation (M = 2.62; SD = 0.57), and appealing graphic interface (M = 2.16, SD = 0.56) were assessed as good. Only 6 women (9%) indicated that they would have preferred a paper questionnaire.

Table 3. Overview of means, standard deviations, minimum, and maximum in the various sections of the acceptance questionnaire (gynecologists, midwives, and pregnant women)

Section	M	SD	Min	Max
Gynecologists and midwives (n = 10)				
General satisfaction with the application ^a	3.56	0.53	3	4
General satisfaction with the evaluation texts ^a	3.22	0.44	3	4
Assessment of length of the evaluation texts ^b	3.22	0.44	3	4
Assessment of usefulness of the iPad ^c	2.70	0.82	2	4
Assessment of the time spent ^d	2.50	0.85	2	4
Assessment of one's own willingness to use the App ^e	2.78	0.83	2	4
Assessment of the pregnant women's willingness to use the App ^e	3.22	0.44	3	4
Pregnant women (n = 68)				
Overall impression of the system ^e	2.40	0.52	1	3
Operation easy to understand ^f	2.62	0.57	1	3
Application graphically appealing ^g	2.16	0.56	1	3

^a1 = very dissatisfied, 2 = dissatisfied, 3 = satisfied, 4 = very satisfied.

^b1 = much too short, 2 = a little too short, 3 = just right, 4 = a little too long, 5 = much too long.

^c1 = not helpful at all, 2 = somewhat helpful, 3 = helpful, 4 = very helpful.

^d1 = very low, 2 = low, 3 = high, 4 = very high.

^e1 = very good, 2 = good, 3 = bad, 4 = very bad.

^f1 = very easy, 2 = easy, 3 = difficult, 4 = very difficult.

^g1 = very appealing, 2 = appealing, 3 = boring, 4 = complicated.

M = mean; SD = standard deviation; Min = minimum; Max = maximum.

Discussion

The present study had 3 objectives: i) examination of the external validity of the KINDEX App, ii) survey of the convenience and acceptance of the App by users (pregnant women and gynecologists/midwives), and iii) assessment of internal consistency.

Our results show that the KINDEX App is an accepted, convenient, and valid screening instrument for the assessment of psychosocial stressors during pregnancy. This is supported by the low number of missing values in each of the items, by the broadly comparable prevalence reported in the literature, by the acceptable internal consistency, as well as by positive feedback from gynecologists, midwives, and pregnant women.

External Validity

External validity was checked by comparing the data collected with the prevalence figures found in the specialized literature (table 2).

Using the KINDEX App, the prevalence of the risk factor 'Young age' (3.0%) is not different from the prevalence reported in the literature (young mothers in Germany: 2.7%) [WHO, 2010].

The risk factor 'Migrant background' shows lower prevalence in the present sample (mother: 18.9%, father: 19.9%) compared to the reported prevalence for all of Germany (26.7% of the population) [Statistisches Bundesamt, 2012]. To take into account the geographical location of our survey, we also compared our prevalence data with that of the Statistisches Landesamt Baden-Württemberg [2012]. There was also a difference here (26% of the general population). We surmise, first of all, that the further lower prevalence in the survey with the KINDEX App reflects regional differences and the heterogeneous distribution of people with migrant background in Baden-Württemberg, and secondly, that some of the mothers

with a migrant background could not be included in the project since their command of German was not adequate. For this reason, the KINDEX App has now been translated into several languages, so that in the future more women can be reached.

The risk factor 'Single parenting/not living together' (5.9%) does not differ from the reported prevalence for Baden-Württemberg (5.4%) [Statistisches Landesamt Baden-Württemberg, 2013].

For the risk factor 'Financial problems', we assessed the subjective perception of financial difficulties (25.6%) and whether there was an objectively small living area (1.7%). Overall, 27.6% of the women in our study exhibited this risk factor. The fact that we did not record socio-economic status and family income makes comparison with prevalence rates reported in the literature difficult. Our operationalization only allowed us to find approximations (e.g., in the general population, 21.1% of couples with a child feel that their housing costs are a burden) [Statistisches Bundesamt, 2014].

The risk factor 'Physical symptoms, medical complications, medical risk factors' was found for 67.5% of the women in our sample. This high prevalence is mainly attributed to the subjective assessment of 'Pain, physical symptoms, malaise', which 49.8% of the women answered in the affirmative. General figures comparable to our prevalence rates are found in the literature for high-risk pregnancies, which, according to the Bavarian Quality Assurance program in 2009, amounted to 71% of all pregnancies [Reincke and Werdan, 2011].

The risk factor 'Complicated prenatal bonding' was found for a total of 46.1% of the pregnant women. A direct comparative value is not reported in the literature, according to our research. Depending on the exact way the question is posed, the prevalence rates for 'unplanned/unintended' pregnancies vary significantly [Sedgh et al., 2012: 40%; Stöckl et al., 2012: 13%; Wellings et al.,

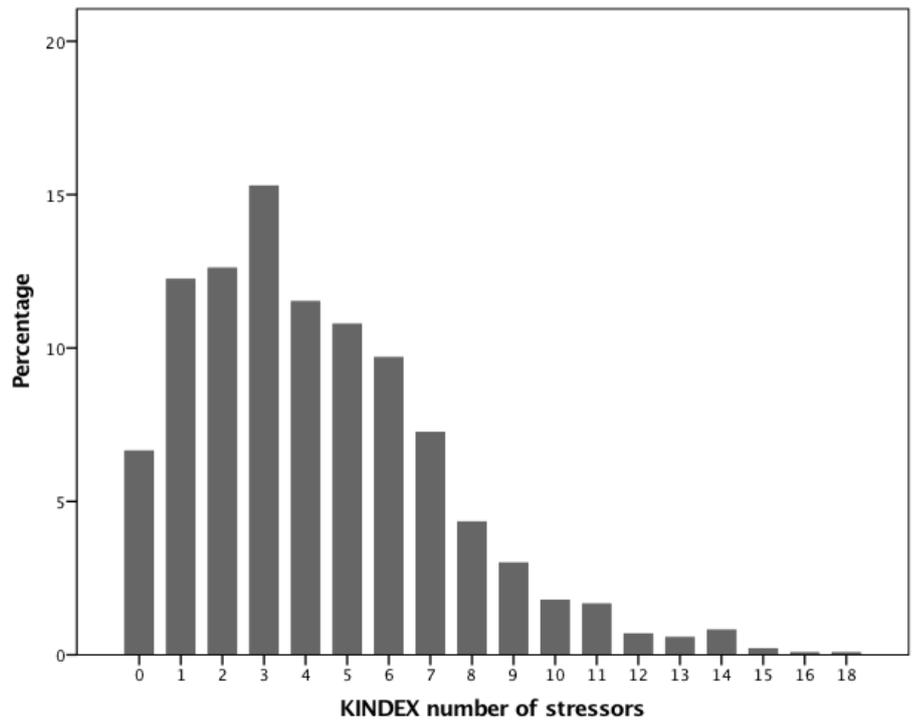


Fig. 1. Distribution of the number of stressors (0 to a maximum of 30).

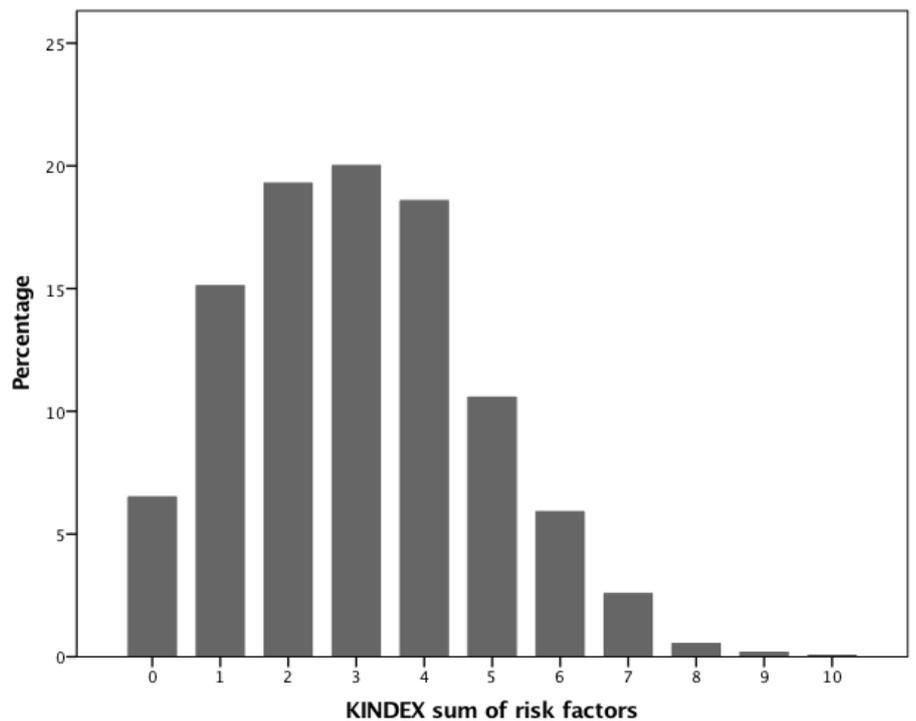


Fig. 2. Distribution of the number of risk factors (0 to a maximum of 11).

2013: 16.2%]. In our sample, 30.2% of the pregnant women reported an unplanned pregnancy. The different formulations and operationalizations of this risk factor mean that no conclusive statement can be made about external validity.

The risk factor 'Very high perceived stress' in the present sample was present in 0.8% of the women. In the study by Sable and Wilkinson [2000], mothers of live-born infants were asked retro-

spectively how often they had felt stressed during their most recent pregnancy. 21% reported that they almost always felt stressed. Wood et al. [2010] used a pregnancy-specific stress scale, and found that 6% of the pregnant women reported a high level of stress. Both studies are in strong contrast to the prevalence we detected. Various explanations are possible: For one thing, the samples differ in that the mothers in the first comparison sample were

interviewed retrospectively. Sable and Wilkinson [2000] suggest that the women whose children were born in problematic circumstances (e.g., with low birth weight), may recall their pregnancies as having been more stressful, in order to find, in retrospect, an explanation for the outcome of the pregnancy. Secondly, the risk factors were operationalized very differently in the 2 studies: with a single question in the study by Sable and Wilkinson [2000], but with a pregnancy-specific stress scale in the study by Woods et al. [2010], and with 4 questions from a standardized, but not pregnancy-specific, instrument in our survey. Furthermore, the threshold value we chose is very high. The PSS-4 (Perceived Stress Scale) records stress level with a maximum of 16 points [Cohen et al., 1983]. As the cut-off for a critical stress level, we chose the value of 12 (the highest quartile). It is conceivable that women who give a lower value also subjectively feel quite stressed. Further studies will show whether a shift in the cut-off for the KINDEX would be sensible.

In terms of the risk factor 'Traumatic experiences during childhood', 14.5% reported physical and 5.2% sexual abuse. These prevalence figures are broadly comparable with those from the European Report on Preventing Child Maltreatment (physical violence: 23%, sexual assaults: 9.6%) [WHO, 2013].

The risk factor of 'Intimate partner violence' in the present sample was 28.7% of the women. This is comparable to the WHO [2013] report of the prevalence (25.4%) of self-reported physical and/or sexual violence by a current or former partner after the age of 15 in Europe. Researchers still disagree about whether the prevalence of intimate partner violence decreases during pregnancy, increases, or remains the same [Bailey, 2010]. Bailey [2010] reported in her review that the prevalence of intimate partner violence in pregnancy ranges from 1 to 20%.

Comparing the prevalence of the risk factor 'Substance abuse by mother and/or father' shows a heterogeneous pattern. 6.8% of the pregnant women using the KINDEX App reported that they smoke. This corresponds approximately to the prevalence of 8.5% in the European Perinatal Health Report [WHO, 2010]. 2.1% of the pregnant women who used the KINDEX App said they drink alcohol. This prevalence is slightly below the 4% rate of the Berlin study by Bergmann et al. [2006]. 27.4% of the pregnant women using the KINDEX App reported that their partner smoked. This is comparable to the 29% of the 2013 micro-census [Statistisches Bundesamt, 2013], but significantly lower than the 45% reported in the review by Wickström [2007]. Wickström points out that there are great geographical differences in the prevalence data. 28.8% of the pregnant women in our study report regular consumption of alcohol by their partner. This value is significantly lower than that in the study by Hapke et al. [2013], in which 41.6% of the 18- to 79-year-old men reported at-risk consumption, according to the AUDIT-C questionnaire. 1.2% of the pregnant women said that their partner uses drugs. This prevalence figure is also well below the findings of the study of Pabst et al. [2010], in which 6.6% of the 18- to 64-year-old men were reported to use drugs. Perhaps these differences can be explained by the format in which the data was compiled. While the KINDEX is a dichotomous survey, the AUDIT-C assesses consumption in a more differentiated way. The

dichotomous form of data compilation could have led to more frequent negative answers. Also, by contrast with studies that asked the men directly, in our study, the female partners were asked. Substantive explanations of the differences could also be based on the sample selection. Our survey took place in a district with a relatively high socio-economic status. This is linked to higher education, which in turn is positively correlated with more health-conscious behavior [Schmitt et al., 2008]. It could also be that the husbands of pregnant women change their consumption behavior over the short term. Women behave more health-consciously during pregnancy, and this could also encourage their partners to live in a healthier way. With regard to the item 'Medications and drug use of pregnant women', which could not be evaluated in the present study due to the lack of differentiation, reformulations should be done and explicit exclusion criteria should be established in future studies (e.g., pregnancy medications, dietary supplements).

The factor '(Prior) psychological problems' (32.6%) is composed of several items. The data on 'Psychotherapy or counseling' (30.7%) should in particular be interpreted with caution, since visits both to a doctor or psychotherapist and to a counseling center are included. In future studies with the KINDEX App, a separation among these items is stipulated, to make it easier to interpret. The prevalence of the use of psychotropic drugs (at any time) in our sample (10.6%) is significantly higher than what is reported in the literature (5.5%) [Fritz, 2011]. As far as we know, there are no comparative values for the prevalence of inpatient treatment in a psychosomatic or psychiatric hospital, irrespective of the diagnosis. The prevalence of whether one has ever been diagnosed with a mental illness in our sample is 15.6%, which is significantly less than the lifetime prevalence for any mental disorder (37%) reported in the literature [Wittchen and Hoyer, 2006]. A possible explanation here is that the women in our study were still relatively young. There are no comparative values for women under 40 years of age as far as we know. Furthermore, it could be that some women had received diagnoses in the past and therefore had also been prescribed psychotropic drugs, but that they were not informed of the diagnoses.

In summary, an optimum comparative value from the literature could not be derived for every risk factor. However, the external validity of the KINDEX App is given on the basis of comparisons with the prevalences found in the general population.

Acceptance of the App by the Users – Pregnant Women and Gynecologists/Midwives

The small number of missing values for individual Items (< 6%) speaks to the very good acceptance of the KINDEX App by the pregnant women, since they would have easily been able to skip questions or stop doing the survey. Furthermore, surveys of users of the App (pregnant women, gynecologists, midwives) showed that general satisfaction both with the KINDEX App overall and with its analysis was very high. Regarding the time spent using the App, the assessments of the gynecologists and midwives ranged from low to high. However, the time required is less than that required for the KINDEX interview format; none of the gynecolo-

gists or midwives and only a small percentage of the pregnant women would have preferred a paper version of the questionnaire [see also Brunneemann et al., in preparation]. In addition, the App offers an immediate analysis, so that no valuable time passes between the detection of the risk factors and the provision of assistance. Overall, the KINDEX App is judged positively by all participants, and both the statements of the respondents and the size of the sample, with $N = 956$ pregnant women, suggest good acceptance of the App by the gynecologists and midwives, as well as by the pregnant women.

Assessment of Internal Consistency

The internal consistency of the KINDEX App was in the acceptable range, with Cronbach's alpha of 0.68. This is comparable to the internal consistency in the studies by Spyridou et al. [2014, 2015, 2016]: $\alpha = 0.67$.

Limitations of the Present Study

The ability to interpret and generalize the present results is hampered by the limited representativeness of the sample. The survey was conducted only in the District of Konstanz, so it may be that beyond the south Baden-Württemberg area no quantitative statements are possible, and additional samples are necessary in different parts of Germany. There is also no data on the number of pregnant women who declined to participate in the survey from the beginning or who had to be excluded due to their lack of knowledge of German. With regard to the verification of external validity, comparison of prevalence rates in an optimum way was not possible for all areas due to different modes of operationalization.

Summary and Outlook

In summary, the KINDEX App is a convenient and valid screening instrument for the necessary assessment of psychosocial risk factors during pregnancy. Due to the automatic and immediate analysis that the App provides, it is a very good basis for early prevention and intervention. Successful mother-child attachment and healthy child development are the goal. The most important advantage of the instrument is that the user need not be familiar in detail with theoretical constructs and scientific literature in order to recognize risk constellations and the need for help during pregnancy. The early detection of risk factors during prenatal screening makes it possible to impart immediately to pregnant women the necessary advice and assistance tailored to that individual and thus, first of all, to promote the mental health of the mother-to-be, and

second, to safeguard the child's future development. With the KINDEX App, far more women can be reached and larger samples collected than could be done with previous instruments, due to limited time and human resources. The KINDEX App lends itself to being integrated as a routinely used instrument in prenatal care in Germany. Since the successful implementation of the German-language version of the KINDEX App, it has already been translated into several languages, so that in the future, women with migrant and refugee backgrounds can be reached even across language barriers.

Even if the earliest possible intervention should be a priority objective, and thus the prenatal detection of psycho-social risk factors is important for a healthy child and maternal development, not all women can be reached during pregnancy. We have therefore developed a KINDEX App for postpartum use. This App is being used in women's hospitals and allows psychosocial risks to be evaluated even before the mother and child are released from the hospital, and for appropriate support to be initiated [Brunneemann et al., in preparation]. A web platform based on the KINDEX App was developed (www.mykind.info) to make sure that such help is not only available through the health-care system. Here, the pregnant woman can fill out a slightly modified form of the KINDEX, independently of gynecologists or midwives. She then immediately receives practical advice, understandable to the layman, on how to positively affect the stressors she experiences during her pregnancy, and where she can find help and support. Using this platform or the App, she can fill out the KINDEX at regular intervals during the pregnancy and receive graphically illustrated evaluations of how she is coping with her stressors.

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References

- Austin MP, Colton J, Priest S, Reilly N, Hadzi-Pavlovic D: The antenatal risk questionnaire (ANRQ): acceptability and use for psychosocial risk assessment in the maternity setting. *Women Birth* 2013;26:17–25.
- Bailey BA: Partner violence during pregnancy: prevalence, effects, screening, and management. *Int J Womens Health* 2010;2:183–197.
- Bergmann K, Sarkar P, Glover V, O'Connor T: Maternal prenatal cortisol and infant cognitive development: moderation by infant-mother attachment. *Biol Psychiatry* 2010;67:1026–1032.

- Bergmann RL, Richter R, Milto C, Michel B, Dudenhausen JW: Epidemiologie des Alkoholkonsums in der Schwangerschaft; in Bergmann RL, Spohr H-L, Dudenhausen JW (Hrsg): Alkohol in der Schwangerschaft – Häufigkeit und Folgen. München, Urban & Vogel, 2006, pp 19–32.
- Blissing S, Roloff R, Rehn M, Frambach T, Dietl J: Prävalenz von Übergewicht und Adipositas bei Schwangeren an der Universitäts-Frauenklinik Würzburg und resultierende perinatale Ergebnisse – ein Vergleich zwischen 1980 und 2005. *Geburtshilfe Frauenheilkd* 2008; 68:159–164.
- Bock J, Wainstock T, Braun K, Segal M: Stress in utero: prenatal programming of brain plasticity and cognition. *Biol Psychiatry* 2015;78:315–326.
- Bollini P, Pampallona S, Wanner P, Kupelnick B: Pregnancy outcome of migrant women and integration policy: a systematic review of the international literature. *Soc Sci Med* 2009;68:452–461.
- Bundesanzeiger: Bekanntmachung eines Beschlusses des Gemeinsamen Bundesausschusses über eine Änderung der Richtlinien über die ärztliche Betreuung während der Schwangerschaft und nach der Entbindung («Mutterschafts-Richtlinien»): Änderung der Angaben im Abschnitt G – Medikamentöse Maßnahmen und Verwendung von Verband- und Heilmitteln. Berlin, Bundesministerium für Gesundheit, 2015, AT 04.05.2015 B3.
- Brunnemann N, Ruf-Leuschner M, Schauer M, Elbert T: Perinatale Erfassung psychosozialer Belastungen als Risiken für die Entwicklung über die Lebensspanne – die KINDEX peri App. In preparation.
- Carroll JC: Effectiveness of the Antenatal Psychosocial Health Assessment (ALPHA) form in detecting psychosocial concerns: a randomized controlled trial. *CMAJ* 2005;173:253–259.
- Cohen S, Kamarck T, Mermelstein R: A global measure of perceived stress. *J Health Soc Behav* 1983;24:385–396.
- Field T, Diego M, Hernandez-Reif M: Prenatal depression effects on the fetus and newborn: a review. *Infant Behav Dev* 2006;29:445–455.
- Fritze J: Psychopharmaka-Verordnungen: Ergebnisse und Kommentare zum Arzneiverordnungsreport 2011. *Psychopharmakotherapie* 2011;18:245–256.
- Glazier RH, Elgar FJ, Goel V, Holzzapfel S: Stress, social support, and emotional distress in a community sample of pregnant women. *J Psychosom Obstet Gynecol* 2004;25:247–255.
- Hapke U, Lippe E, Gaertner B: Riskanter Alkoholkonsum und Rauschtrinken unter Berücksichtigung von Verletzungen und der Inanspruchnahme alkoholspezifischer medizinischer Beratung – Ergebnisse der Studie zur Gesundheit Erwachsener in Deutschland (DEGS1). *Bundesgesundheitsblatt* 2013;809–813.
- Harrison PA, Sidebottom AC: Systematic prenatal screening for psychosocial risks. *J Health Care Poor Underserved* 2008;19:258–276.
- Heilig L: Risikokonstellationen in der frühen Kindheit. Auswirkungen biologischer und psychologischer Vulnerabilitäten sowie psychosozialer Stressoren auf kindliche Entwicklungsverläufe. *Z Erziehungswiss* 2014;17: 263–280.
- Hsiao EY, Patterson PH: Placental regulation of maternal-fetal interactions and brain development. *Dev Neurobiol* 2012;72:1317–1326.
- Karatas JC, Matthey S, Barnett B: Antenatal psychosocial assessment: how accurate are we in determining 'low-risk' status? A pilot study. *Arch Womens Ment Health* 2009;12:97–103.
- Kim HW, Jung YY: Effects of antenatal depression and antenatal characteristics of pregnant women on birth outcomes: a prospective cohort study. *J Korean Acad Nurs* 2012;42:477–485.
- Knickmeyer RC, Gouttard S, Kang C, Evans D, Wilber K, Smith JK, Hamer RM, Lin W, Gerig G, Gilmore JH: A structural MRI study of human brain development from birth to 2 years. *J Neurosci* 2008;28:12176–12182.
- Laucht M, Esser G, Schmidt MH: Längsschnittforschung zur Entwicklungsepidemiologie psychischer Störungen: Zielsetzung, Konzeption und zentrale Befunde der Mannheimer Risikokinderstudie. *Z Klin Psychol Psychother* 2000;29:246–262.
- Lyons-Ruth K, Block D: The disturbed caregiving system: relations among childhood trauma, maternal caregiving, and infant affect and attachment. *Infant Ment Health J* 1996;17:257–275.
- Magura S, Laudet AB: Parental substance abuse and child maltreatment: review and implications for intervention. *Child Youth Serv Rev* 1996;18:193–220.
- Pabst A, Piontek D, Kraus L, Müller S: Substanzkonsum und substanzbezogene Störungen. Ergebnisse des Epidemiologischen Suchtsurveys 2009. *SUCHT* 2010;56: 327–336.
- Plant DT, Barker ED, Waters CS, Pawlby S, Pariante CM: Intergenerational transmission of maltreatment and psychopathology: the role of antenatal depression. *Psychol Med* 2012;43:519–528.
- Radtke KM, Ruf M, Gunter HM, Dohrmann K, Schauer M, Meyer A, Elbert T: Transgenerational impact of intimate partner violence on methylation in the promoter of the glucocorticoid receptor. *Transl Psychiatry* 2011; 1:e21.
- Reincke M, Werdan K: Internistische Erkrankungen in der Schwangerschaft II. *Internist* 2011;52:1147–1148.
- Ruf-Leuschner M, Schauer M: Externale und prospektive Validität des KINDEX – ein Instrument zur pränatalen Erfassung von psychosozialen Risikofaktoren bei Schwangeren. In preparation.
- Sable MR, Wilkinson D: Impact of perceived stress, major life events and pregnancy attitudes on low birth weight. *Fam Plann Persp* 2000;32:288–294.
- Schauer M, Ruf-Leuschner M: KINDEX: Pränatale Erfassung psychosozialer Belastungen als Risiken für die Entwicklung über die Lebensspanne – der Konstanzer INDEX. In preparation.
- Schmitt NM, Schmitt J, Kirch W: Sozioökonomische Ungleichheiten in der Gesundheit und im Gesundheitsverhalten – aktuelle Entwicklungen in Deutschland und Europa. *Wiss Z Tech Univ Dresden* 2008;57:77–80.
- Sedgh G, Singh S, Hussain R: Intended and unintended pregnancies worldwide in 2012 and recent trends. *Stud Fam Plann* 2014;45:301–314.
- Seress L: Morphological changes of the human hippocampal formation from midgestation to early childhood; in Nelson CA, Luciana M (eds): *Handbook of Developmental Cognitive Neuroscience*. Cambridge, MIT Press, 2001, pp 45–58.
- Shapiro GD, Fraser WD, Frasch MG, Seguin JR: Psychosocial stress in pregnancy and preterm birth: associations and mechanisms. *J Perinat Med* 2013;41:631–645.
- Spiegler J, Stichtenoth G, Weichert J, König IR, Schlaud M, V D Wense A, Olbertz D, Gurth H, Schiffmann JH, Bohnhorst B, Gortner L, Herting E, Göpel W; German Neonatal Network, GNN: Pregnancy risk factors for very premature delivery: what role do hypertension, obesity and diabetes play? *Arch Gynecol Obstet* 2013; 288:57–64.
- Spyridou A, Schauer M, Ruf-Leuschner M: Prenatal screening for psychosocial risks in a high risk-population in Peru using the KINDEX interview. *BMC Pregnancy Childbirth* 2016;16:13.
- Spyridou A, Schauer M, Ruf-Leuschner M: Obstetric care providers are able to assess psychosocial risks, identify and refer high-risk pregnant women: validation of a short assessment tool – the KINDEX Greek version. *BMC Pregnancy Childbirth* 2015;15:41.
- Spyridou A, Schauer M, Ruf-Leuschner M: Obstetric care providers assessing psychological risk factors during pregnancy: validation of a short screening tool – the KINDEX Spanish version. *Child Adolesc Psychiatry Ment Health* 2014;8:1–15.
- Statistisches Bundesamt: Migrantenanteil in Deutschland 2012 nach Bundesländern. http://statistik-bw.de/BevoelkGebiet/Indikatoren/BV-BS_migranten.asp, 2012 (last accessed April, 2015).
- Statistisches Bundesamt: Mikrozensus 2013. Verteilung der Bevölkerung nach ihrem Rauchverhalten in Prozent. Wiesbaden, Statistisches Bundesamt. www.gbe-bund.de/oowa921-install/servlet/oowa/aw92/WS0100/_XWD_FORMPROC?TARGET=&PAGE=_XWD_2&OPINDEX=2&HANDLER=_XWD_CUBE.SETPGS&DATACUBE=_XWD_3_0&D.000=3735&D.003=42, 2013 (last accessed April, 2015).
- Statistisches Bundesamt: Statistisches Jahrbuch 2014. Wiesbaden, Statistisches Bundesamt, 2014.
- Statistisches Landesamt Baden-Württemberg: Leben und Arbeiten in Baden-Württemberg. Ergebnisse des Mikrozensus 2013. www.statistik.baden-wuerttemberg.de/veroeffentl/Faltblatt/803814018.pdf, 2013.
- Statistisches Landesamt Baden-Württemberg: Migrantenanteil in Deutschland 2012 nach Bundesländern. http://statistik-bw.de/BevoelkGebiet/Indikatoren/BV-BS_migranten.asp, 2012 (last accessed April, 2015).
- Stöckl H, Hertlein L, Himsl I, Delius M, Hasbargen U, Friese K, Stöckl D: Intimate partner violence and its association with pregnancy loss and pregnancy planning. *Acta Obstet Gynecol Scand* 2011;91:128–133.
- Talge NM, Neal C, Glover V: Antenatal maternal stress and long-term effects on child neurodevelopment: how and why? *J Child Psychol Psychiatry* 2007;48:245–261.
- Teicher MH, Andersen SL, Polcari A, Anderson CM, Navalta CP, Kim DM: The neurobiological consequences of early stress and childhood maltreatment. *Neurosci Biobehav Rev* 2003;27:33–44.
- Wellings K, Jones KG, Mercer CH, Tanton C, Clifton S, Datta J, et al.: The prevalence of unplanned pregnancy and associated factors in Britain: findings from the third National Survey of Sexual Attitudes and Lifestyles (NATSAL-3). *Lancet* 2013;382:1807–1816.
- WHO (World Health Organization): Intimate partner violence prevalence. <http://apps.who.int/gho/data/view.main.IPVGBDREGION?lang=en>, 2010 (last accessed Mai, 2015).
- WHO (World Health Organization): Preterm birth. www.who.int/mediacentre/factsheets/fs363/en/, 2013 (letzter Zugriff Mai 2015).
- Wickström R: Effects of nicotine during pregnancy: human and experimental evidence. *Curr Neuropharmacol* 2007;5:213–222.
- Wittchen H-U, Hoyer J: *Klinische Psychologie & Psychotherapie*. Heidelberg, Springer Medizin Verlag, 2006.
- Woods SM, Melville JL, Guo Y, Fan M-Y, Gavin A: Psychosocial stress during pregnancy. *Am J Obstet Gynecol* 2010;202:61.e1–61.e7.