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Web-based questionnaires to assess perinatal outcome proved to be valid

Marleen M.H.J. van Gelder^{a,b,*}, Saskia Vorstenbosch^c, Lineke Derks^a, Bernke te Winkel^c,
Eugène P. van Puijenbroek^{c,d}, Nel Roeleveld^{a,e}

^aDepartment for Health Evidence, Radboud Institute for Health Sciences, Radboud University Medical Center, P.O. Box 9101, Nijmegen 6500 HB, The Netherlands

^bRadboud REshape Innovation Center, Radboud University Medical Center, P.O. Box 9101, Nijmegen 6500 HB, The Netherlands

^cNetherlands Pharmacovigilance Centre Lareb, Goudsbloemvallei 7, 's-Hertogenbosch 5237 MH, The Netherlands

^dPharmacoTherapy, -Epidemiology and -Economics, Groningen Research Institute of Pharmacy, University of Groningen, Antonius Deusinglaan 1, Groningen 9713 AV, The Netherlands

^eDepartment of Paediatrics, Radboudumc Amalia Children's Hospital, Radboud University Medical Center, P.O. Box 9101, Nijmegen 6500 HB, The Netherlands

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Abstract

Objectives: The objective of this study was to validate a Web-based questionnaire completed by the mother to assess perinatal outcome used in a prospective cohort study.

Study Design and Setting: For 882 women with an estimated date of delivery between February 2012 and February 2015 who participated in the PRiGnancy and Infant DEvelopment (PRIDE) Study, we compared data on pregnancy outcome, including mode of delivery, plurality, gestational age, birth weight and length, head circumference, birth defects, and infant sex, from Web-based questionnaires administered to the mothers 2 months after delivery with data from obstetric records. For continuous variables, we calculated intraclass correlation coefficients (ICCs) with 95% confidence intervals (CIs), whereas sensitivity and specificity were determined for categorical variables.

Results: We observed only very small differences between the two methods of data collection for gestational age (ICC, 0.91; 95% CI, 0.90–0.92), birth weight (ICC, 0.96; 95% CI, 0.95–0.96), birth length (ICC, 0.90; 95% CI, 0.87–0.92), and head circumference (ICC, 0.88; 95% CI, 0.80–0.93). Agreement between the Web-based questionnaire and obstetric records was high as well, with sensitivity ranging between 0.86 (termination of pregnancy) and 1.00 (four outcomes) and specificity between 0.96 (term birth) and 1.00 (nine outcomes).

Conclusion: Our study provides evidence that Web-based questionnaires could be considered as a valid complementary or alternative method of data collection. © 2017 Elsevier Inc. All rights reserved.

Keywords: Questionnaires; Medical records; Validation studies; Pregnancy; Internet; PRIDE Study

1. Introduction

Studies in many fields of epidemiology use data on perinatal outcome, including birth weight, gestational age, and infant sex. Maternal self-report is considered a cost-effective and efficient method to collect this information

in large-scale epidemiologic studies [1]. The accuracy of maternal recall of perinatal outcome has been assessed in previous studies using paper-based questionnaires [1–11] or interviews [12–19]. In general, mothers recalled their infants' gestational age and birth weight very well compared with medical records or birth certificates, with correlation coefficients ≥ 0.85 even years after delivery. Hence, many studies concluded that paper-based questionnaires and interviews are a valid source of information on perinatal outcome for epidemiologic studies.

However, Web-based questionnaires are gaining popularity: for some large-scale studies, such as the Pregnancy Study Online [20], the Nutrinet-Santé Study [21], and the Contraceptive Use, Pregnancy Intention, and Decisions Study [22], recruitment and data collection already take place through

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Conflict of Interest: None.

* Corresponding author. Tel.: +31-24-3666126; fax: +31-24-3613505.

E-mail address: Marleen.vanGelder@radboudumc.nl (M.M.H.J. van Gelder).

What is new?**Key findings**

- Validity of a Web-based questionnaire to assess perinatal outcome 2 months after the estimated date of delivery was excellent with only few discrepancies between maternal self-report and obstetric record.
- Compared with paper-based questionnaires and interviews, the Web-based questionnaire seemed to perform better for most outcomes studied, including gestational age and birth weight.
- Maternal characteristics did not systematically influence disagreement between the Web-based questionnaire and the reference standard, except for parity with slightly lower agreement among primiparae.

What this adds to what was known?

- This is the first large-scale study on the validity of data on perinatal outcome collected with Web-based questionnaires.

What is the implication and what should change now?

- As the validity of data from Web-based questionnaires appear to be of similar or higher validity compared with paper-based questionnaires and interviews, they should be considered as an alternative or complementary method of data collection in epidemiologic studies.

the Internet. For various reasons, including elimination of data entry errors, validation checks, but also possibly faster reading and carelessness [23,24], data on the validity of the traditional modes of data collection cannot simply be extrapolated to Web-based questionnaires.

As no studies evaluating the accuracy of data on perinatal outcome collected through Web-based questionnaires are currently available, we validated such a questionnaire administered to the mothers 2 months after the estimated date of delivery in a prospective cohort study. In addition, we assessed whether maternal characteristics influenced disagreement between the Web-based questionnaire and the reference standard.

2. Methods

2.1. Study population

This validation study was embedded in the PRenancy and Infant DEvelopment (PRIDE) Study, an ongoing

prospective cohort study that aims to identify factors that affect the health of the mother or her child at any point in time during or after pregnancy. Participating midwives and gynecologists in the Netherlands invited pregnant women aged ≥ 18 years to participate in the PRIDE Study just before or during their first prenatal care visit (usually gestational weeks 8–12). They were asked to complete Web-based questionnaires (at baseline; in gestational weeks 17 and 34; and 2 and 6 months after the estimated date of delivery) and give consent for medical and obstetric record review at baseline. The prenatal questionnaires included questions on demographic characteristics, obstetric history, maternal health, lifestyle factors, and occupational exposures, whereas the postpartum questionnaires focused on pregnancy outcome and infant health. Although 99% of Dutch women aged 25–45 years have access to the Internet and 96% reported daily use [25], paper-based questionnaires were available for women who could not or did not want to participate online. The methods of the PRIDE Study were described in detail elsewhere [26]. For the current study, all women with an estimated date of delivery between February 2012 and February 2015 ($n = 1,738$) were selected, but women who completed paper-based questionnaires ($n = 11$) were excluded. The PRIDE Study was approved by the Regional Committee on Research Involving Human Subjects.

2.2. Main variables

We obtained data on perinatal outcome, including pregnancy outcome, plurality (i.e., the number of infants born out of the pregnancy), date and mode of delivery, infant sex, birth weight, birth length, head circumference, and the reported presence of birth defects, from the first postpartum questionnaire. For women with a miscarriage/stillbirth, termination of pregnancy, or preterm birth before the 34 weeks questionnaire, perinatal outcome was assessed through a modified questionnaire following the event. Furthermore, the estimated date of delivery was derived from the baseline and/or second prenatal questionnaire.

Using a single standardized case report form, two medically trained abstracters collected all data on perinatal outcome from individual obstetric records. These computerized records are completed by midwives and gynecologists as part of the routine prenatal and perinatal care process, irrespective of participation in the PRIDE Study. For the variables of interest, standardized fields are present in the obstetric records.

2.3. Other variables

Maternal characteristics included age, country of birth, level of education, household income, prepregnancy body mass index, gravidity, and parity. These data were all available from the prenatal PRIDE Study questionnaires.

2.4. Statistical analyses

In all analyses, the obstetric record was considered the reference standard and only live-born singletons were included, except for pregnancy outcome and plurality. Birth weight and gestational age (calculated from the estimated and actual date of delivery) were examined as both categorical and continuous variables. For the categorical variables pregnancy outcome (live birth, miscarriage/stillbirth, termination of pregnancy), plurality (singleton, multiple), infant sex (boy, girl), gestational age [preterm (<37 weeks), term (37–41 weeks), postterm (42 weeks)], and birth weight [low birth weight (<2,500 g), normal birth weight (2,500–4,500 g), macrosomia (>4,500 g)], we calculated sensitivity and specificity with 95% confidence intervals (CIs). As the prevalence of specific birth defects was very low, these data were only inspected manually and no formal statistical analyses were conducted.

For the continuous variables (gestational age in weeks, birth weight in grams, and birth length and head circumference in centimeters), intraclass correlation coefficients (ICCs) with 95% CIs were calculated using two-way mixed effects models (single measure). Furthermore, validity was determined by calculating the proportion of women who reported these variables within predefined increments: gestational age within 1 week, birth weight within 50 g, birth length within 2 cm, and head circumference within 1 cm.

To determine whether the selected maternal characteristics influenced maternal recall, we calculated stratum-specific ICCs if the stratum contained ≥ 10 women with complete

information. IBM SPSS Statistics for Windows, version 22 (IBM Corp., Armonk, NY), was used for all statistical analyses.

3. Results

A total of 882 pregnant women with virtually complete questionnaire and obstetric record information were included in this validation study (Fig. 1). The characteristics of these women, the women for whom the obstetric record was unavailable ($n = 147$), the women who consented to obstetric record review but did not provide questionnaire information on perinatal outcome ($n = 231$), and the women with complete questionnaire information who did not give consent for obstetric record review ($n = 331$) are shown in Table 1. Differences among these groups were mainly due to missing questionnaire information. Furthermore, women with incomplete questionnaire information were less likely to be born in the Netherlands, to have a high level of education, and to deliver a live-born infant compared with women included in this validation study.

Among the women with complete information, 96.4% delivered a live-born infant, 2.8% had a miscarriage or stillbirth, and 0.8% terminated their pregnancy. For one woman, we observed a discrepancy between the questionnaire and obstetric record regarding pregnancy outcome (miscarriage vs. termination of pregnancy), but plurality was reported perfectly by our study population (Table 2). However, the questions on pregnancy outcome and plurality

Fig. 1. Sample selection. EDD, estimated date of delivery; PCP, prenatal care provider.

Table 1. Characteristics of PRIDE Study participants by information available

Characteristic	Participants validation study (N = 882)	Obstetric record unavailable (N = 147)	Consent, but questionnaire data unavailable (N = 231)	No consent for obstetric record review (N = 331)
	n (%)	n (%)	n (%)	n (%)
Maternal age				
<25 yr	36 (4.0)	8 (5.4)	15 (6.5)	11 (3.3)
25–29 yr	291 (33.0)	64 (43.5)	87 (37.7)	114 (34.4)
30–34 yr	420 (47.6)	55 (37.4)	92 (39.8)	147 (44.4)
≥35 yr	135 (15.3)	20 (13.6)	37 (16.0)	59 (17.8)
Maternal country of birth				
The Netherlands	845 (95.8)	136 (92.5)	185 (80.1)	308 (93.1)
Other	30 (3.4)	6 (4.1)	18 (7.8)	19 (5.7)
Missing	7 (0.8)	5 (3.4)	28 (12.1)	4 (1.2)
Maternal level of education				
Low/intermediate	173 (19.6)	37 (25.2)	73 (31.6)	64 (19.3)
High	702 (79.6)	105 (71.4)	130 (56.3)	264 (79.8)
Missing	7 (0.8)	5 (3.4)	28 (12.1)	3 (0.9)
Household income				
<€2,500	103 (11.7)	21 (14.3)	31 (13.4)	48 (14.5)
€2,500–€5,000	615 (69.7)	91 (61.9)	92 (39.8)	213 (64.4)
>€5,000	85 (9.6)	6 (4.1)	6 (2.6)	20 (6.0)
Missing	79 (9.0)	29 (19.7)	102 (44.2)	50 (15.1)
Prepregnancy BMI				
Underweight (<18.5 kg/m ²)	25 (2.8)	4 (2.7)	8 (3.5)	5 (1.5)
Normal (18.5–24.9 kg/m ²)	615 (69.7)	109 (74.1)	142 (61.5)	235 (71.0)
Overweight (25.0–29.9 kg/m ²)	134 (15.2)	17 (11.6)	40 (17.3)	55 (16.6)
Obese (≥30 kg/m ²)	47 (5.3)	8 (5.4)	12 (5.2)	11 (3.3)
Missing	61 (6.9)	9 (6.1)	29 (12.6)	25 (7.6)
Gravidity				
0 previous pregnancies	408 (46.3)	78 (53.1)	102 (44.2)	144 (43.5)
≥1 previous pregnancies	471 (53.4)	69 (46.9)	125 (54.1)	186 (56.2)
Missing	3 (0.3)	0 (0.0)	4 (1.7)	1 (0.3)
Parity				
0 previous live births	505 (57.3)	101 (68.7)	130 (56.3)	180 (54.4)
≥1 previous live births	374 (42.4)	46 (31.3)	97 (42.0)	150 (45.3)
Missing	3 (0.3)	0 (0.0)	4 (1.7)	1 (0.3)
Pregnancy outcome ^a				
Live-born infant	850 (96.4)	NA	212 (91.8)	NA
Miscarriage/stillbirth	25 (2.8)	NA	16 (6.9)	NA
Termination of pregnancy	7 (0.8)	NA	3 (1.3)	NA
Pregnancy outcome ^b				
Live-born infant	835 (94.7)	104 (70.7)	NA	305 (92.1)
Miscarriage/stillbirth	26 (2.9)	2 (1.4)	NA	14 (4.2)
Termination of pregnancy	6 (0.7)	0 (0.0)	NA	3 (0.9)
Missing	15 (1.7)	41 (27.9)	NA	9 (2.7)

Abbreviations: BMI, body mass index; NA, not applicable; PRIDE, PRegnancy and Infant DEvelopment.

^a According to obstetric record.

^b According to Web-based questionnaire.

were not completed by a small part of the study population (1.7% and 2.0%, respectively). According to the obstetric records, these were all live-born singletons.

Among the 845 women with a live-born singleton, the Web-based questionnaire yielded very low levels of misclassification for mode of delivery (10 misclassified subjects), infant sex (6 misclassified subjects), gestational age (10 misclassified subjects), and birth weight (7 misclassified subjects). Consequently, sensitivity ranged between 0.90 (postterm birth) and 1.00 (low birth weight), while specificity ranged between 0.96 (term birth) and 1.00 (5 outcomes; Table 2). Birth defects were reported by 28 mothers (3.3%) in the questionnaire,

whereas 15 infants (1.8%) were diagnosed with a birth defect according to the obstetric records, 10 of which matched the maternal report. More than half of the excess birth defects reported by the mothers included relatively minor defects. The complete list of reported birth defects is shown in the Appendix Table at www.jclinepi.com.

We observed a very small difference in mean birth weight between the two methods of data collection, with mean birth weights of 3,449 g [standard deviation (SD), 531] in the questionnaire and 3,453 g (SD, 517) in the obstetric record with only a few outliers (Fig. 2). The absolute differences in the continuous variables are shown in Table 3. Gestational age matched exactly for 96.4% of

Table 2. Validity comparisons of perinatal outcome

Outcome	No. of subjects				Validity	
	TP	FP	FN	TN	Sensitivity (95% CI)	Specificity (95% CI)
Pregnancy outcome						
Live birth	835	0	0	32	1.00	1.00
Miscarriage/stillbirth	25	1	0	841	1.00	1.00 (1.00–1.00)
Termination of pregnancy	6	0	1	860	0.86 (0.60–1.00)	1.00
Plurality: singleton	830	0	0	5	1.00	1.00
Mode of delivery ^a						
Unassisted vaginal delivery	658	4	6	156	0.99 (0.98–1.00)	0.98 (0.95–1.00)
Assisted vaginal delivery	84	6	2	732	0.98 (0.94–1.00)	0.99 (0.99–1.00)
Cesarean section	72	0	2	750	0.97 (0.94–1.00)	1.00
Infant sex: boy ^a	410	1	5	401	0.99 (0.98–1.00)	1.00 (0.99–1.00)
Gestational age ^a						
Preterm birth	40	3	1	768	0.98 (0.93–1.00)	1.00 (0.99–1.00)
Term birth	753	2	8	49	0.99 (0.98–1.00)	0.96 (0.91–1.00)
Postterm birth	9	5	1	797	0.90 (0.71–1.00)	0.99 (0.99–1.00)
Birth weight ^a						
Low birth weight	30	4	0	797	1.00	1.00 (0.99–1.00)
Normal birth weight	774	1	6	50	0.99 (0.99–1.00)	0.98 (0.94–1.00)
Macrosomia	20	2	1	808	0.95 (0.86–1.00)	1.00 (0.99–1.00)

Abbreviations: CI, confidence interval; FN, false negative; FP, false positive; TN, true negative; TP, true positive.

^a Live-born singletons ($n = 845$) only.

women; discrepancies were caused by differences in the estimated date of delivery, as no mistakes were made concerning date of birth. For birth weight, birth length, and head circumference, an exact match was found for 79.2%, 81.7%, and 75.0% of women, respectively. For 96% of the women, birth weight and length matched within ± 50 g and ± 2 cm. Data on birth length were provided by 707 women (83.7%), whereas these were available in only 260 obstetric records (30.8%). For head circumference, these figures were 14.7% and 27.7%, respectively.

Table 4 shows the ICCs for gestational age, birth weight, birth length, and head circumference, overall as well as stratified by maternal characteristics. The overall

ICC ranged between 0.88 (95% CI: 0.80–0.93) for head circumference and 0.96 (95% CI: 0.95–0.96) for birth weight. We observed only minor differences in the majority of stratum-specific ICCs, with differences of ≥ 0.10 for maternal age (gestational age, birth length), maternal country of birth (birth length), maternal level of education (head circumference), and household income (gestational

Table 3. Maternal recall of gestational age, birth weight, birth length, and head circumference

Difference from obstetric record	Maternal recall <i>n</i> (%)
Gestational age ($N = 812$)	
0 wk	783 (96.4)
± 1 wk	801 (98.6)
± 2 wk	803 (98.9)
Estimated date of delivery ($N = 845$)	
0 days	758 (89.7)
± 1 day	791 (93.6)
± 2 days	812 (96.1)
± 3 days	826 (97.8)
Date of birth ($N = 812$)	
0 days	812 (100)
Birth weight ($N = 831$)	
0 g	658 (79.2)
± 50 g	794 (95.5)
± 100 g	811 (97.6)
± 150 g	812 (97.7)
± 200 g	816 (98.2)
Birth length ($N = 251$)	
0 cm	205 (81.7)
± 2 cm	242 (96.4)
± 4 cm	249 (99.2)
Head circumference ($N = 52$)	
0 cm	39 (75.0)
± 1 cm	45 (86.5)
± 2 cm	50 (96.2)

Fig. 2. Comparison of birth weight reported by mothers in a Web-based questionnaire and birth weight recorded in obstetric records ($N = 831$).

Table 4. Intraclass correlation coefficients (ICCs) for gestational age, birth weight, birth length, and head circumference assessed in the Web-based questionnaire compared with obstetric record information

Characteristic	Gestational age (N = 812)	Birth weight (N = 831)	Birth length (N = 251)	Head circumference (N = 52)
	ICC (95% CI)	ICC (95% CI)	ICC (95% CI)	ICC (95% CI)
Overall	0.91 (0.90–0.92)	0.96 (0.95–0.96)	0.90 (0.87–0.92)	0.88 (0.80–0.93)
Maternal age				
<25 yr	0.91 (0.81–0.96)	0.98 (0.96–0.99)	0.99 (0.93–1.00)	—
25–29 yr	0.87 (0.84–0.90)	0.93 (0.91–0.94)	0.82 (0.74–0.88)	0.94 (0.86–0.98)
30–34 yr	0.92 (0.90–0.93)	0.99 (0.99–0.99)	0.94 (0.92–0.96)	0.86 (0.71–0.93)
≥35 yr	0.99 (0.98–0.99)	0.95 (0.92–0.96)	0.92 (0.85–0.95)	—
Maternal country of birth				
The Netherlands	0.90 (0.89–0.91)	0.98 (0.98–0.98)	0.90 (0.87–0.92)	0.90 (0.83–0.94)
Other	0.99 (0.99–1.00)	1.00 (0.99–1.00)	1.00	—
Maternal level of education				
Low/intermediate	0.95 (0.93–0.96)	0.94 (0.93–0.96)	0.96 (0.93–0.98)	0.59 (0.03–0.88)
High	0.89 (0.88–0.91)	0.99 (0.99–0.99)	0.88 (0.85–0.91)	0.90 (0.82–0.94)
Household income				
<€2,500	0.99 (0.99–1.00)	0.92 (0.88–0.94)	0.88 (0.75–0.95)	—
€2,500–€5,000	0.89 (0.87–0.91)	0.96 (0.95–0.97)	0.89 (0.86–0.92)	0.87 (0.75–0.93)
>€5,000	0.89 (0.83–0.93)	0.98 (0.97–0.99)	0.89 (0.77–0.95)	—
Prepregnancy BMI				
Underweight (<18.5 kg/m ²)	0.98 (0.95–0.99)	1.00 (1.00–1.00)	—	—
Normal (18.5–24.9 kg/m ²)	0.90 (0.88–0.91)	0.96 (0.95–0.97)	0.88 (0.84–0.91)	0.92 (0.85–0.96)
Overweight (25.0–29.9 kg/m ²)	0.90 (0.86–0.93)	0.92 (0.89–0.94)	0.92 (0.85–0.96)	—
Obese (≥30 kg/m ²)	0.99 (0.98–0.99)	1.00 (1.00–1.00)	0.93 (0.77–0.98)	—
Gravidity				
0 previous pregnancies	0.89 (0.87–0.91)	0.94 (0.93–0.95)	0.85 (0.79–0.90)	0.90 (0.78–0.96)
≥1 previous pregnancies	0.93 (0.91–0.94)	0.97 (0.97–0.98)	0.94 (0.92–0.96)	0.86 (0.72–0.93)
Parity				
0 previous live births	0.89 (0.86–0.90)	0.95 (0.94–0.96)	0.86 (0.81–0.90)	0.90 (0.81–0.95)
≥1 previous live births	0.96 (0.95–0.97)	0.97 (0.96–0.98)	0.95 (0.92–0.96)	0.86 (0.70–0.94)

Abbreviation: BMI, body mass index.

age). The ICCs for gestational age, birth weight, and birth length seemed to be lower for primiparae compared to multiparae.

4. Discussion

This validation study indicated that the validity of data on perinatal outcome collected by a Web-based questionnaire 2 months after the estimated date of delivery is excellent. We observed only few differences between the questionnaire and the reference standard, without patterns systematically related to maternal characteristics, except for parity with slightly lower agreement among primiparae.

Due to differences in timing of questionnaire administration and statistical analyses, a direct comparison with the validity of the traditional modes of data collection (i.e. paper-based questionnaires and interviews) is impossible. When comparing our results for a Web-based questionnaire completed 2 months postpartum with previous studies validating traditional modes administered within 1 year after delivery, [4,5,9,12,16,17], the Web-based questionnaire seemed to perform better for most outcomes studied. For example, Poulsen et al. [16] and Pisa et al. [9] reported an exact match in gestational age for 72.2% and 85.2% of the women, respectively, compared to 96.4% in our study.

The sensitivity of preterm birth (0.98 in the present study) ranged between 0.88 and 0.95 in previous studies [4,16]. Birth weight was reported within 100 g by 92% of the women in the study by Tate et al. [17] vs. 97.6% in our study; for low birth weight (sensitivity 1.00) reported sensitivity was 0.97 using a paper-based questionnaire [4]. However, cesarean section seemed to be reported slightly less accurate in the present study compared to Bat-Erdene et al. [4] (sensitivity 0.97 and 1.00, respectively), but this was based on only two misclassified subjects.

Results from previous studies on the influence of maternal characteristics on recall of pregnancy outcome are inconsistent [12–14,16,17,27–30]. We only observed primiparous women to have worse recall of the continuous outcomes compared to multiparous women, which is in accordance with some other studies [12,28], whereas others reported no effect of parity on recall [4,13,30] or even the opposite [9,16,17]. No systematic influence on recall was observed for all other maternal characteristics studied. As differential measurement errors may have unpredictable biasing effects on exposure–outcome associations, however, a deeper understanding of the mechanisms driving these differences in recall may inform sensitivity analyses.

Preferably, data on perinatal outcome should be collected by the same method for all study subjects. In

practice, however, this is often not feasible due to participants with missing responses or follow-up questionnaires, no consent to obtain obstetric records, or unavailability of these records. In addition, one could debate which data source should be used if both self-reported and record data are available. Due to the high level of agreement between the Web-based questionnaire and obstetric records for perinatal outcome, these data may be analyzed interchangeably, yielding the largest possible study population with complete data possible. However, sensitivity analyses may again be indicated to test this assumption. The only exception to the above may be the presence of birth defects, as obstetric records include defects diagnosed within 7 days after birth only, which may lead to large discrepancies between obstetric and maternal reports.

The relatively large sample size of the current study is one of its strengths, although formal validity comparisons for rare perinatal outcomes, such as birth defects, were impossible. By directly requesting obstetric records from prenatal care providers using personal identifiers, linkage errors were excluded. However, data from obstetric records may not represent the true values for all subjects due to inaccurate registration by the prenatal care provider, although this is unlikely due to quality control checks, or errors during data extraction. The PRIDE Study has a relatively low response rate, and participants represent a mostly highly educated population, potentially limiting the generalizability of our results. Reassuringly, we did not observe substantial systematic differences in ICC between the women with low/intermediate and high levels of education. Furthermore, due to the high Internet access rates in combination with the availability of paper-based questionnaires, selective participation caused by the method of data collection is unlikely. Finally, data were incomplete for a substantial part of the study population due to not giving consent for obstetric record review (27%), unavailability of records (12%), or not completing the questionnaire on perinatal outcome (21%). The latter was mainly caused by technological challenges in the start-up period of the PRIDE Study but is comparable to the follow-up rates in other Web-based studies [20,31]. We do not expect bias in the validity comparisons due to selection in the study population based on consent for obstetric record review because all main variables were collected prospectively and no major differences in maternal characteristics were observed between women who gave consent and women who did not give consent for record review. Based on other studies in perinatal epidemiology, bias in exposure–outcome associations is not likely either [32,33].

5. Conclusion

The results of this study show that the validity of data from a Web-based questionnaire administered 2 months after the estimated date of delivery to assess perinatal outcome, including pregnancy outcome, gestational age,

and birth weight, was similar or higher compared to data collected using traditional modes of data collection. Therefore, Web-based questionnaires should be considered as a valid complementary or alternative method of data collection in epidemiologic studies.

Supplementary Data

Supplementary data related to this article can be found at <http://dx.doi.org/10.1016/j.jclinepi.2017.07.004>.

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