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Descriptive Finding

How accurately do mothers recall prenatal visits and gestational age? A validation of Uruguayan survey data

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Contents

1	Introduction	1496
2	Methodology and data	1497
2.1	Data	1497
2.2	Methods	1500
3	Results	1500
4	Final remarks	1504
5	Acknowledgements	1504
	References	1505
	Appendix	1508

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Descriptive Finding

How accurately do mothers recall prenatal visits and gestational age? A validation of Uruguayan survey data

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Abstract

BACKGROUND
Many household surveys collect mothers' retrospective reports of reproductive, maternal, and child health. However, few empirical exercises assess survey measurement error in these data, based on comparisons with administrative records.

OBJECTIVE
We provide evidence on the accuracy of maternal recall regarding weeks of gestation, premature births, and the timing and number of prenatal visits.

METHODS
We compare the survey maternal recall and the vital statistics administrative records based on the 2013 Nutrition, Child Development and Health Survey (ENDIS) for Uruguay (2,963 children aged 0–3). We estimate measurement error and its determinants by using a set of probit models.

RESULTS
Mothers tend to overestimate gestational weeks and the incidence of prematurity by 0.1 weeks and 2.4 percentage points, respectively. Differences are larger regarding the timeliness and sufficiency of prenatal visits (respectively, 17.0 and 14.4 pp). Discrepancies are associated with lower educational levels, the length of the recall period (child's age) and birth order.

CONCLUSIONS
In general, our findings validate the use of survey data, although the identification of premature births and prenatal care sufficiency presents differences that could lead to errors in the evaluation of compliance with, for example, the United Nations' Sustainable

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Development Goals. Since recall accuracy is negatively associated with maternal schooling, discrepancies could be larger in relatively less developed countries.

CONTRIBUTION
The main contribution of this paper lies in the assessment of measurement error levels arising from maternal reports of gestational age and prenatal visits for a relatively short recall period in a Latin American country. Although previous studies estimate measurement errors using administrative records linked to maternal recall data, this is the only study that is based on a nationally representative survey.

1. Introduction

Gestational weeks, prematurity, and use and timing of prenatal care play a key role in monitoring reproductive, maternal, and child health. Preterm births (less than 37 gestational weeks) account for approximately 35% of neonatal deaths worldwide (Lee, Blencowe, and Lawn 2019; Liu et al. 2012) and their prevention is strongly linked to the reduction of infant mortality. Furthermore, prematurity can compromise health status in adult life, socio-emotional development, and other biological outcomes (Adegboye and Heitmann 2008). Previous research highlights the key role of prenatal care in improving mothers' and children's health and preventing morbidity and mortality, particularly during the first trimester (Moller et al. 2017; Yan 2017). Although prenatal care has increased worldwide, its coverage is far from universal.[4]

Statistical institutes have increased their efforts to build statistically representative indicators to assess the health status of mothers and children. Many countries have implemented internationally comparative surveys, such as the Demographic and Health Surveys (DHS) and the Multiple Indicator Cluster Surveys (MICS). Since administrative records are generally not available or lack socioeconomic and contextual variables, little is known about survey information measurement error levels in reproductive, maternal, and child health, particularly in developing countries.

Most studies comparing interviewee recall in household surveys and vital statistics information focus on birthweight and find a high correlation between recalled birthweight and registry data (Shenkin et al. 2017). However, the few studies on related outcomes such as gestational weeks and prenatal visits show larger measurement error levels, mainly associated with socioeconomic status (Adegboye and Heitmann 2008; Bat-Erdene et al. 2013; Jaspers et al. 2010; Shenkin et al. 2017; Tomeo et al. 1999).

[4] Prenatal care usage among pregnant women grew worldwide from 40.9% in 1990 to 58.6% in 2013, with strong heterogeneities between developed (84.8%) and developing (49.1%) countries (Moller et al. 2017).

The existing literature shows that when restricting the recall period to 12 years or less and allowing for a two-week error interval, gestational age agreements are higher than 90% (Adegboye and Heitmann 2008; Bat-Erdene et al. 2013; Jaspers et al. 2010; Sou et al. 2006). With regard to preterm births, accuracy levels are also high, even considering large recall periods (Bat-Erdene et al. [2013] and Sou et al. [2006] identify concordance levels higher than 90%). There is only one available investigation for a low-income country, Nepal, and it highlights substantial differences in the identification of premature births in the two data sources. Chang et al. (2018) pinpoint large disagreements, with the prevalence of premature births falling from 16% to 6% when using household survey information instead of clinical history data. Thus, there are no studies on this topic available for medium-income countries.

Moreover, no available studies assess survey measurement error in prenatal visits, while a single study (Tomeo et al. 1999) for the United States, based on a 57-year timespan, validates information on the timing of prenatal care usage: only 34% of survey respondents reported this information correctly.

As regards previous evidence, the main contribution of this paper lies in assessing measurement error levels arising from maternal reports on gestational age and prenatal visits for a relatively short recall period. The Uruguayan case provides useful evidence regarding medium- and high-income developing countries, as it is a high human development country, with an infant mortality rate of around 6.5‰ and a low-birthweight incidence of around 7.5% (MSP 2019; UNDP 2019). Furthermore, to the best of our knowledge this is the only study that links a nationally representative survey to administrative information in a Latin American country.

2. Methodology and data

2.1 Data

Our empirical exercise is based on a rich database that combines medical record information with survey data reported by mothers. For research purposes, the national statistical office (*Instituto Nacional de Estadística*, INE) links vital statistics microdata to data from the Survey on Nutrition, Child Development and Health (*Encuesta de Nutrición, Desarrollo Infantil y Salud*, ENDIS), a nationally representative sample of children aged 0 to 3. ENDIS is a longitudinal survey that follows up the full set of urban households that were included in INE's official household survey (*Encuesta Continua de Hogares*, ECH) between February 2012 and December 2013 (INE 2018).[5]

[5] Urban areas account for 85% of the Uruguayan population.

This study is based on the first ENDIS wave (N = 2,665 households and 3,077 children). Fieldwork was carried out between October 2013 and February 2014. The survey questionnaire gathered information on birthweight, prenatal visits (gestational week at which care started and number of visits), and gestational age. The interviewers trasnscribed birthweight from each child's health card. Additionally, ENDIS collected the unique personal identification number (*cedula de identidad*) of survey respondents and children. This information allowed INE to casewise link the ENDIS database to vital statistics data (*Certificado de Nacido Vivo*, CNV).

The wording of the survey questions of interest in this study mostly resembles the items included in clinical histories (gestational length, prematurity, prenatal care). However, as regards the week of the first prenatal control, the survey question allows for responses not entirely compatible with the health system gestational length categories (i.e., the first category is 1 to 3 weeks, a period that might be prior to conception). This is not a severe drawback since the outcome of interest is the trimester in which prenatal visits started.

The CNV is completed by the health staff at the time of birth based on information from mothers' medical history and intregates vital statistics compiled by the Ministry of Public Health. It includes information on birth and delivery place, the sociodemographic characteristics of mothers and fathers, and data on pregnancy, childbirth, and the newborn. Given the low omission rate (4%) and the quality of the information collected (Cabella and Peri 2005), we consider the CNV to be the reference ('correct' information) in terms of the dimensions analyzed in this study. The CNV registers considered include births that occurred between 2009 and 2014.[6]

ENDIS respondents were the principal carers of the children, with 96.6% being their mothers. Of these cases, 90% were merged with the CNV.[7] This led to the loss of 307 ENDIS cases, which probably correspond to reporting or fieldwork registration errors concerning the identification number of the mother or child. We estimated a probit model on the probability of merging that does not show socioeconomic biases. Linkage is negatively associated with child's age, living in Montevideo, and being a firstborn (Table A-1).

[6] The total number of births registered in CNVs in the period is 285,416.

[7] Seventy-five linked observations (13%) lacked CNV information on the number of prenatal visits. Residence in Montevideo and child's age were the only variables associated with the lack of data in the registry (Table A-1). In terms of the timing of prenatal visits, 97 linked cases lack CNV information. Again, living in Montevideo and the child's age decrease the probability of missing information (Table A-1).

Table 1: Number of valid cases in ENDIS and CNV (Number and %)

	Gestational age		Number of prenatal visits		Timing of prenatal visits	
	N	%	N	%	N	%
Total ENDIS sample	3,077	100.0%	3,077	100.0%	3,077	100.0%
ENDIS interviews conducted with mothers	2,963	96.3%	2,963	96.3%	2,963	96.3%
Not linked to CNV	307	10.0%	307	10.0%	307	10.0%
Linked cases with missing data in CNV	0	0.0%	75	2.4%	97	3.2%
Linked cases with non-missing CNV information	2,656	86.3%	2,581	83.9%	2,559	83.2%
Valid cases in both data sources	2,641	85.9%	2,564	83.3%	2,545	82.7%
Missing cases in ENDIS	15	0.5%	17	0.5%	14	0.5%

Source: Authors' analysis of ENDIS and CNV microdata

Table 2: Sociodemographic characteristics, descriptive statistics, linked data

Variable	Average
Maternal education	
Primary schooling	20.2%
Lower secondary school	31.4%
Higher secondary school	25.6%
University	22.9%
% Male	52.0%
% born in Montevideo	41.0%
Birth order	
Not first born	51.7%
First born	39.4%
Unknown birth order	8.9%
Average child's age	1.35
Average maternal age	28.29

Note: In 8.9% of the weighted cases in which mothers responded, it cannot be clearly identified whether the reference child is her first son/daughter. This is due to several reasons: a) mothers have children who do not live in the same household (5.9%) and thus their age is unknown; b) they had a child who died and it is not known whether he/she was born before or after the birth of the reference child (2.7%); and c) problems of merging ENDIS with ECH at the individual level (1.0%).
Source: Authors' analysis of ENDIS and CNV microdata.

ENDIS collected information on prenatal care categorized into five groups (0; 1–3; 4–5; 6–8; and 9 visits or more) and in ten groups for the week in which visits started (timing). For the sake of comparison, we replicated the same categories in the CNV. We considered that the number of controls was adequate if the mother attended at least one control per month. Due to the wording of the ENDIS question, we were able to identify the total number of controls and only the category "9 or more" was considered sufficient. As regards timing, prenatal care was considered timely if the first visit took place before the 15th week.

To assess socioeconomic and demographic variability, we considered maternal education, region of residence (Montevideo or rest of the country), sex and age of the child (i.e., the recall period), and whether the child was a firstborn.

2.2 Methods

Assuming that administrative records contain the ‘true data’, after removing those observations not included in the sampling frame (such as homeless individuals and those not living in private households), discrepancies between survey and vital statistic measures result from sampling and non-sampling survey errors. Following Groves and Lyberg (2010) and Meyer and Mittag (2019), total survey error (ε_{TSE}) can be decomposed into:

$$\varepsilon_{TSE=}\varepsilon_{REP} + \varepsilon_{INR} + \varepsilon_{ME}$$

where ε_{REP} is representation error, ε_{INR} is item nonresponse, and ε_{ME} is measurement error. The latter two terms jointly account for non-sampling error. Since many statistical offices impute missing values, in general ε_{INR} can be defined as the weighted difference between imputed survey responses and the actual values in adminstrative records. However, INE does not impute missing values in our outcomes of interest. Altogether, 11% of cases lack information on gestational age and 14% on the number and timing of prenatal visits.[8]

In turn, ε_{ME}, which is the focus of this article, results from the weighted difference in the non-missing linked observations (Boudreaux et al. 2009; Davern et al. 2009; Davern, Meyer, and Mittag 2019; Meyer and Mittag 2019).

Thus, ε_{ME} results from the weighted difference between ENDIS and CNV data for the subset of linked observations (non-missing data). It is noteworthy that this is a lower bound, since other respondents might provide more inaccurate answers.

Finally, we study the determinants of ε_{ME} by estimating a set of probit models aimed at singling out the main covariates associated with accurate maternal recall.

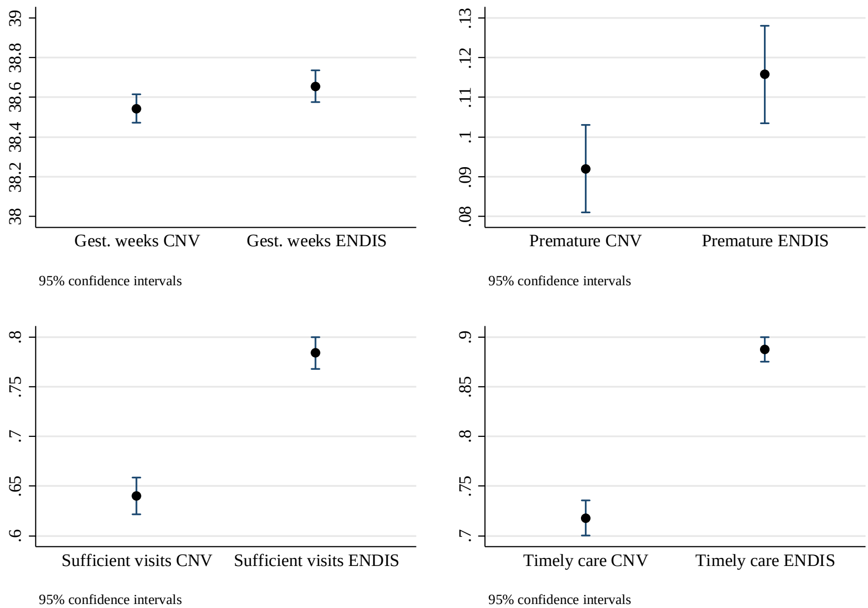
3. Results

Both ENDIS and CNV indicate high levels of timely prenatal care in Uruguay, while the incidence of prematurity is similar to that of developed countries (9.2 to 11.6%).

[8] The proportion of missing data is similar to previous studies available for developed countries (Bat-Erdene et al. 2013).

Measurement error estimates for the variables of interest in this study (Figure 1) indicate that the extent of reporting inaccuracies varies in each outcome considered. The two data sources show statistically significant differences, with higher levels of prematurity and sufficient prenatal checks in ENDIS than in CNV.

Figure 1: Measurement error. Linked data with non-missing values in CNV



	Gestational weeks	Premature	Sufficient visits	Prenatal care before week 15
Measurement error	**–0.112**	**–0.024**	**–0.143**	**–0.169**
Difference	–0.113	–0.024	–0.144	–0.170
Weight of group in linked cases with valid CNV	0.994	0.994	0.993	0.995

Note: Mean-comparison tests´ p-values for all dimensions are 0.000.
Source: Authors’ analysis of ENDIS and CNV microdata

Mothers tend to overestimate gestational weeks. In fact, 26.9% declare a higher number of gestational weeks than those registered in administrative records, whereas 18.4% declare a lower number. CNV indicates a higher accumulation in the weeks associated with term births than in the weeks associated with survey recall.

Although the range of discrepancy is wide (between –14 and 21 weeks), error levels are low: 85.3% of the recalled information presents an error of one week or less, whereas 94.6% are below or equal to two weeks. The two weeks cut-off point is relevant since previous work has shown that this difference is significant from the physiological point of view (Adegboye and Heitmann 2008). These results are located at an intermediate point between findings for similar recall periods for Nepal (Chang et al. 2018), Canada (Bat-Erdene et al. 2013), and Taiwan (Sou et al. 2006).

While the CNV indicates a 9.2% incidence of prematurity, this figure rises to 11.6% in the ENDIS data. The overestimation of the incidence of premature births relative to registry information is in line with previous studies. However, observed differences are smaller than the findings for Nepal (10 percentage points in Chang et al. 2018), although higher than those reported for Canada (Bat-Erdene et al. 2013).[9]

The range of misreporting regarding prematurity is 5.5%: 1.6% of the mothers declare that the child was born at term, while CNV classifies these newborns as premature. The remaining 3.9% report to ENDIS that the child was born before week 37, whereas CNV records these cases as born full term. The latter might be the worst error in terms of yielding errors in prevalence estimates and for the use of this variable as a determinant of subsequent nutritional and other developmental outcomes.

There are substantial differences between the CNV and ENDIS in the number and timing of prenatal controls: 25.7% in regard to sufficient prenatal care and 22.4% in terms of timely uptake. In both cases, most of the discrepancies result from mothers declaring higher levels of care use – either a larger number of controls (20.0% of the total) or an earlier start (19.7% of the total). As regards the declaration of the number of controls in the ENDIS, the most remarkable difference lies in the proportion of cases in the category "9 or more controls", which exceeds CNV data by 13 percentage points.

In terms of timeliness of prenatal care, there are relevant differences between reported and registered data, with, once again, a desirability bias in ENDIS. These might partly result from the unclear wording in ENDIS questions, referred to in Section 2.

Finally, we explored the variables associated with measurement error (Table 4), undertaking probit estimations of the differences between mothers' recall and the administrative record for weeks of pregnancy (errors of 1 or 2 weeks), prematurity (total differences and error in premature declaration in the survey), sufficient number of controls, and timely uptake.

As expected, recall worsens with child's age and is better for firstborns and more-educated mothers, except for prematurity in the latter variable. With regard to the number of prenatal visits, discrepancies are more important in Montevideo and differences fall by mother's age, but at a decreasing rate.

[9] It should be noted that the recall period of the Canadian study is four months, so more adjusted results than those found in the present study are expected.

Table 3: Probit estimates of marginal effects on the differences between variables captured in the two data sources, linked data

	Gest. age diff. higher than 1 week (1)	Gest. age diff. higher than two weeks (2)	Diff. in identification of a premature birth (3)	Diff. in sufficient prenatal visits (4)	Diff. in early uptake of prenatal visits (5)
Lower secondary school	–0.0893	–0.173	–0.0466	–0.210	–0.0929
	(0.0825)	(0.105)	(0.111)	(0.0757)	(0.0770)
Higher secondary school	–0.203	–0.255	–0.133	–0.282	–0.329
	(0.0895)	(0.118)	(0.122)	(0.0807)	(0.0844)
University	–0.260	–0.431	–0.0746	–0.468	–0.812
	(0.102)	(0.144)	(0.136)	(0.0919)	(0.108)
Sex of the child (Male = 1)	–0.0792	–0.138	0.0886	–0.0168	0.108
	(0.0601)	(0.0829)	(0.0821)	(0.0545)	(0.0587)
Region (Montevideo = 1)	0.0167	0.0594	–0.0237	0.143	0.00190
	(0.0629)	(0.0862)	(0.0869)	(0.0571)	(0.0622)
Child's age	0.141	0.128	0.139	0.0177	0.0999
	(0.0339)	(0.0462)	(0.0466)	(0.0304)	(0.0326)
Mother's age	0.000751	–0.0239	0.0159	–0.0217	–0.0311
	(0.0273)	(0.0343)	(0.0395)	(0.0230)	(0.0261)
Squared mother's age	–0.000229	5.97e–05	–0.000473	0.000261	5.39e–05
	(0.000467)	(0.000595)	(0.000671)	(0.000392)	(0.000447)
Firstborn	–0.152	–0.321	–0.295	–0.222	–0.513
	(0.0708)	(0.101)	(0.100)	(0.0637)	(0.0716)
Unknown birth order	0.105	0.253	0.254	0.0162	0.289
	(0.107)	(0.133)	(0.133)	(0.0984)	(0.101)
Constant	–0.859	–0.866	–1.785	–0.0319	0.225
	(0.404)	(0.504)	(0.584)	(0.343)	(0.385)
Observations	2,641	2,641	2,641	2,564	2,545

Standard errors in parentheses

Note: (1) Binary variable that takes the value 1 when the difference between the remembered and recorded data exceeds 1 week. (2) Binary variable that takes the value 1 when the difference between the remembered and recorded data exceeds 2 weeks. (3) Binary variable that takes the value 1 when the two sources of information identify the condition of prematurity differently. (4) Binary variable that takes the value 1 if the difference between the mothers' recall and recorded information on prenatal visits is 6 or more. (5) Binary variable that takes the value 1 when the information on the timing of the first prenatal visit (before week 14) is different in the two data sources.

Source: Authors' elaboration based on ENDIS and CNV microdata.

4. Final remarks

Our findings indicate that mothers' recall levels in Uruguay are high for all the variables of interest (weeks of gestation, prematurity, prenatal controls, early control uptake), yielding to low measurement error levels in most of the outcomes considered in this study. In turn, discrepancies are associated with lower maternal education levels, the length of the recall period (child's age), and birth order. By identifying low measurement error levels we validate the inclusion in survey questionnaires of items collecting information on gestational weeks and prenatal controls. However, the incidence of prematurity and timeliness of prenatal visits can be underestimated by 20%, which could lead to errors in the evaluation in compliance with Sustainable Development Goals.

Further studies for other developing countries will allow the external validity of these results to be checked. Since this study is based on relatively recent births (three years maximum), it is relevant to validate these findings for longer recall periods. As recall accuracy is negatively associated with maternal educational attainment, discrepancies could be larger in relatively less developed countries.

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Appendix

Table A-1: Marginal effects of variables associated with the probability of merging and missing data (probit model)

	Missing in CNV	Merged and missing data in number of visits	Merged and missing data in timing of visits
Lower secondary school	–0.105	0.133	0.0680
	(0.0931)	(0.155)	(0.134)
Higher secondary school	–0.00240	0.0425	–0.0735
	(0.0959)	(0.167)	(0.148)
University	0.0138	–0.00522	0.0350
	(0.107)	(0.183)	(0.157)
Sex of the child (Male = 1)	–0.0754	–0.0758	–0.133
	(0.0640)	(0.104)	(0.0941)
Region (Montevideo = 1)	0.359	0.621	0.418
	(0.0646)	(0.108)	(0.0949)
Child's age	0.212	0.112	0.134
	(0.0332)	(0.0601)	(0.0546)
Mother's age	0.0317	0.0178	0.0157
	(0.0326)	(0.0498)	(0.0423)
Squared mother's age	–0.000629	–0.000190	–0.000250
	(0.000549)	(0.000832)	(0.000713)
Firstborn	–0.196	–0.0710	–0.00748
	(0.0740)	(0.120)	(0.109)
Unknown birth order	–0.131	–0.120	0.0864
	(0.122)	(0.202)	(0.165)
Constant	–1.988	–2.732	–2.394
	(0.482)	(0.751)	(0.633)
Observations	2,963	2,656	2,656

Standard errors in parentheses.
Source: Authors' elaboration based on ENDIS and CNV microdata.