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DO DIFFERENT RESPONDENT SELECTION METHODS PRODUCE DIFFERENT SURVEY ESTIMATES? A SIMULATION OF WITHIN-HOUSEHOLD SELECTION METHODS FOR 2013 TURKEY DHS*

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Abstract

Respondent selection procedures are utilized to choose a particular respondent in surveys. In the 2013 Turkey Demographic and Health Survey (2013 Turkey DHS), all women who meet the eligibility criteria were interviewed according to standard regulations of the International DHS Program. Simulating the application of different methods, this study mainly asks “How would main indicators produced in 2013 Turkey DHS differ with the implementation of various respondent choice strategies?”. The selection procedures include two probabilistic methods, two quasi-probabilistic methods, and four non-probabilistic methods. This study advanced that although interviewing all eligible women in 2013 Turkey DHS appears to be reasonable, providing estimates that are close to survey results, is also conceivable through the execution of selection methods. When the mean of total deviations is considered with their confidence intervals, probabilistic and quasi-probabilistic selection techniques have produced much better estimates with minimal deviations from the confidence intervals of the population values.

Keywords: *Respondent selection, Kish method, Probabilistic methods, Simulation study, Household survey, Turkey DHS.*

FARKLI CEVAPLAYICI SEÇİM YÖNTEMLERİ FARKLI ARAŞTIRMA TAHMİNLERİ ÜRETİR Mİ? 2013 TNSA İÇİN CEVAPLAYICI SEÇİM YÖNTEMLERİNİN BİR SİMÜLASYONU

Öz

Cevaplayıcı seçim yöntemleri hanehalkı araştırmalarında görüşülmesi gereken cevaplayıcıyı seçmek için kullanılmaktadır. 2013 Türkiye Nüfus ve Sağlık Araştırması (2013 TNSA)’da, Uluslararası DHS Programı standartlarına göre görüşmeye uygun olan tüm kadınlar ile görüşülmüştür. Bu çalışma cevaplayıcı seçim yöntemlerinin simüle edilmesiyle, temel olarak “2013 TNSA’da üretilen temel göstergeler farklı cevaplayıcı seçim yöntemlerinin uygulanmasıyla nasıl değişirdi?” sorusunu sormaktadır. Cevaplayıcı seçim yöntemleri iki olasılıklı, iki yarı-olasılıklı ve dört olasılıklı olmayan yöntemi kapsamaktadır. Çalışmanın sonuçları, 2013 TNSA’da tüm kadınlarla görüşme yapılmasının uygun olduğunu, ancak farklı cevaplayıcı seçim yöntemlerinin uygulanmasıyla da araştırma sonuçlarına yakın tahminler üretilebileceğini göstermektedir. Seçilen değişkenler için ortalama sapma büyükleri güven aralıkları ile beraber düşünüldüğünde, olasılıklı ve yarı-olasılıklı seçim yöntemlerinin nüfus değerlerinin güven aralıklarından göz ardı edilebilir sapmalar ile daha iyi tahminler ürettiği görülmektedir**.**

Anahtar kelimeler: *Cevaplayıcı seçimi, Kish yöntemi, Olasılıklı yöntemler, Simülasyon çalışması, Hanehalkı araştırması, TNSA.*

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1.INTRODUCTION

Household surveys that are conducted around the world embrace different methodological strategies while choosing respondents for the individual interview. Certain surveys employ the way of selection among eligible respondents whilst in a portion of those, all eligible respondents in a household are interviewed. In some cases, the worldwide associations proposed interviewing just a single respondent in a household to avoid any harm in sensitive surveys (WHO, 2001). Respondent selection procedures could contrast with which mode is utilized to gather information and the structure of the sample frame. Overall, telephone studies and mail surveys follow non-probabilistic or quasi-probabilistic selection methods rather than probabilistic strategies which are widely used in face-to-face surveys (Oldendick et al., 1988; Gaziano, 2005). As of late, there is an interest in developing selection methods by modification of existing procedures and detecting errors while practicing the methods (Binson and Catania, 2000; Nemeth, 2002; Rizzo et al., 2004; Olson and Smyth, 2013).

Reducing the respondent burden and interview length, expanding efficiency through the probabilistic techniques, diminishing within-unit coverage error and refusals are among the motivations behind utilizing within-household selection procedures (O'Rourke and Blair, 1983; Oldendick et al., 1988; Lavrakas et al., 2000; Battaglia et al., 2008). From the total survey error viewpoint, debates about the respondent selection techniques are made inside the setting of measurement and nonresponse errors. Intriguing investigations have focused on refusals, drop-out rates, and demographic representation under the comparison of various selection procedures (Oldendick et al., 1988, Binson and Catania, 2000; Gaziano, 2005; Battaglia et al., 2008). Overall, the fundamental reason behind the respondent selection is to acquire a representative sample and produce valid estimates which are near population value.

Turkey Demographic and Health Surveys (Turkey DHSs) are nationally representative household surveys carried out every five years starting around 1993. In Turkey DHSs, eligible women were interviewed relying upon their marital status once the household interview was completed. For the years 1993, 2003, and 2008; eligible women who have ever married were interviewed. For the years 1998, 2013, and ultimately 2018; all eligible women no matter their marital status was interviewed (HUIPS, 1994; 1999; 2004; 2009; 2014; 2019).

There are also various household surveys in Turkey that employ any respondent selection technique. In the latest Research on Domestic Violence against Women in Turkey (2014), an individual interview was completed with the selected women aged between 15 and 59 (GDSW and HUIPS, 2015). The Kish (1949) method was employed for the selection in case of more than one eligible woman in the household. Similarly, the individual interviews in Turkey Migration and Internally Displaced Persons Survey (HUIPS, 2006) were conducted with a man and a woman who are selected using the Kish table. Additionally, migration surveys conducted in recent years adopted a selection method that includes recording eligible respondents (aged 18-59) from oldest to youngest and the selection of a man and a woman using the Kish selection procedure (PMM and HUIPS, 2017; PMM and HUIPS, 2017).

In 2013 Turkey DHS, the eligibility criteria were being in the reproductive age period (aged between 15 and 49) and typically residing in that household or staying in the household on the night before the interview (HUIPS, 2014). Interviewing all eligible women in a household appears to be sensible because of the way that women have different individual attributes although they live in the same household. Nonetheless, a piece of the responses of women who live in the same household might be the same or similar since they share similar experiences and have similar attitudes. Besides, interviewing all eligible women in the same household could prompt increased interview length and cost as well as a high interviewer and respondent burden. As another gamble, the closeness between answers may increase on account of interviewing more than one eligible respondent in the same household (Moser and Kalton, 1971; Alves et al., 2014). Alves et al. (2014) likewise underlined the deficiency of accuracy on the survey estimates as a result of homogeneity within the households. Despite the fact that women interviews were attempted to conduct alone with women, interviewed women in the same household might be present during the other eligible women interviews. In such a manner, Clark and Steel (2007) recommended that the responses of individuals may be affected by other relatives' responses within the same households.

Existing studies which have been dedicated to investigating the effectiveness of respondent selection strategies reveal the requirement for studies that compare selection procedures as far as validity, representation,

cost, and burden. In this sense, this study centers around the current respondent selection procedures in a comparative way under the assessment of specific estimates across varying respondent selection techniques. This simulation-based study principally asks the question of "*How would main indicators in 2013 Turkey DHS differ with the execution of various respondent selection procedures?*". Given study findings, we additionally aim to discuss commonly known respondent selection strategies, particularly for household surveys that adopted interviewing all eligible respondents in the same household.

To the best of the author's knowledge, this is the first study in Turkey whose major spotlight is on the well-known respondent selection procedures for household surveys and their potential outcomes in a comparative way. In this sense, this study fills the gap in the literature through a simulation study coming from a national household survey in Turkey, given that most of the investigations on this topic were carried out in the US in an experimental view. The opportunity of using a data set from a conducted survey in such a way appears to be valuable to compare deviations of estimates produced through various selection methods. Finally, methodological assessments about within-household selection strategies regardless of the probability concern, will give a superior understanding of the current literature, particularly for surveys that use different modes of data collection in today's world.

2.LITERATURE REVIEW

There are plenty of studies that examine within-household selection procedures as well as their strengths and weaknesses, especially for the US survey settings. In other words, there exists literature on within-household selection procedures and their impact on statistics in the US surveys (Alves et al., 2014; Lavrakas, 1993; Lavrakas, 2008; Lavrakas and Bauman, 1993; Lavrakas et al., 2000; Marlar et al., 2018; Marken, 2018; Smyth et al., 2019). In later and earlier, a large portion of the examinations focuses on the Kish technique which follows the probabilistic selection procedure (Kish, 1949). Yan et al. (2015) and Kumar (2014) have featured the utilization of probabilistic methodology when selecting respondents in order to give precise statistics through a representative sample. When modes of data collection are considered, respondent choice strategies and their efficiency were generally examined for phone surveys (Binson and Catania, 2000; Marlar et al., 2018; Lavrakas et al., 2000). The Kish strategy, last and next birthday techniques, full enumeration method, oldest and youngest methods, the Troldahl-Carter-Byrant (TCB) method, and arbitrary convenience method are among the well-known selection procedures even though there are additionally alternative methods to select the specific respondent (Gaziano, 2005).

In the literature, respondent selection methods were mostly compared to the Kish technique under the assessments of refusals and drop-out rates. Additionally, the last birthday technique is likewise utilized broadly and dealt with in comparative studies (Yan et al., 2015). Oldendick et al. (1988) observed lower refusal rates while using the last birthday procedure rather than the Kish strategy albeit both techniques lead to minor differentials on demographics. Moreover, Binson and Catania (2000) put forward that the next birthday method brings about lower dropout rates contrasting both Kish and last birthday methods. Salmon and Nichols (1983) suggested that the next birthday method is a moderately proficient strategy under the comparison of TCB, male-female alternation, and no selection methods. Non-probabilistic selection techniques, for example, TCB and arbitrary convenience methods are generally used to increase cooperation with the respondent and diminish cost. Marlar et al. (2018) found the highest response rates with non-probabilistic within-household methods while the lowest accuracy rates were observed for quasi-probability birthday methods. Although they do not follow a complete random cycle, such methods attempted to approximate gender and age distributions and give a premise for modified versions of choice strategies (Gaziano, 2005).

In recent investigations, alteration or a blend of respondent selection techniques was recommended to increase efficiency rather than utilizing just a single strategy (Nemeth, 2002; Rizzo et al., 2004). A great number of household members was seen as the main challenge when using the Kish technique, particularly for third-world countries. Subsequently, simplified versions of the Kish grid were used by international associations to defeat this trouble (Elder, 2009; Kumar, 2014). Rizzo et al. (2004) fostered a blended type of Kish and recent birthday strategies. Moreover, the accuracy of respondent selection procedures was inspected through the follow-up study with mail and web modes (Olson and Smyth, 2013).

3.METHODOLOGY

3.1.Data Source

This study utilizes the 2013 Turkey DHS women data (2013 Turkey Demographic and Health Survey Data, 2014) coming from a survey already conducted by Hacettepe University Institute of Population Studies. In this survey, any respondent selection procedure was not employed within households and subsequently, all eligible women who meet the eligibility criteria were interviewed during the field (HUIPS, 2014).

This paper simulates the application of within-household selection techniques. Incorporation of all eligible women in interviewed households in 2013 Turkey DHS setting facilitates the execution of any respondent choice procedures to select a particular respondent within every household, following the goals of this simulation based study. In other words, we could be able to apply the selection techniques introduced in Section 3.2., thanks to the inclusion of all eligible women in the 2013 Turkey DHS women data set. We applied each selection strategy by selecting just a single woman from interviewed eligible women in that household.

In the primary phase of this study, 9,746 completed interviews with eligible women in 2013 Turkey DHS decreased to 7,775 originating from the fact that only one respondent was selected among all eligible respondents in each household. In this stage, for just one technique, the number of women reduced to 5,928 given the requirement for a woman who also responds to the household questionnaire. In the second phase of the study, the number of women declined to 1,682 due to consideration of households including at least two interviewed eligible women to understand core impact of selection techniques. In fact, the selections from all eligible women in the survey would be better for such type of analyses. However, adopting a purely measurement perspective, we have carried out analyses over completed interviews with eligible women due to the lack of data availability for non-respondents.

We selected means and proportions of specific demographic and socio-economic features of women, which produce key indicators in DHSs, to follow the estimates indicated by different selection procedures.

3.2.Respondent Selection Methods

The *Kish method* depends on a random process and in this technique, the interviewer records all eligible members by giving a number for each and records their personal information. Consequently, an equal chance of selection is given to each eligible member by utilizing the Kish grid (Kish, 1949), in order to guarantee unbiased selection probability for each member. In this study, the eligible women were recorded, and numbers were given for each from the oldest to the youngest. The intersection number of households and number of eligible women distinguishes a particular respondent who was given in that number. A similar approach was employed for the latest Research on Domestic Violence against Women in Turkey (GDSW and HUIPS, 2015). The *full enumeration method* begins with the generation of a random number between zero and a total number of eligible members in that household. Subsequently, the number obtained by multiplying the random number and number of eligible members in that household identifies the particular respondent whose household line number is the same (Denk et al., 2000; Srinivasan et al., 1996).

The *last and next birthday techniques* are based on the choice of a specific respondent whose birthday is the closest to the survey date (Salmon and Nichols, 1983; Yan, 2009), by ensuring an equal chance of selection resulting from births that are known as random events. In the case of the same months for survey and birth, we have assumed that this woman has celebrated her last birthday due to a lack of information on the day of birth. Conversely, these women were not selected by the next birthday method under the assumption. For both techniques, we selected a woman whose line number is the smallest when there is more than one woman who was born in the survey month.

The *oldest method* and *youngest method* depend on the selection of the youngest or oldest women according to their completed ages (Keeter and Fisher, 1997; Srinivasan et al., 1996). The *TCB method* is established by overlapping the number of household members and the number of eligible women (Troldahl and Carter, 1964; Czaja et al., 1982; Kennedy, 1993). Whenever there are two eligible women in that household, the oldest

woman was selected in households including two or four members; while the youngest woman was selected in households including three members. For three eligible women-included-households, the oldest woman was selected in households with at least four members; while the youngest woman was selected in households including three members. Finally, the oldest woman was selected in households with at least four eligible women as well as at least four household members. The *arbitrary convenience method* is based on interviews with an eligible woman who respond to the household questionnaire (Gaziano, 2005).

3.3.**Methods**

3.3.1.Analyses for Women Characteristics

Investigations for women characteristics comprise a distribution of eligible women and basic characteristics by their numbers in interviewed households. In addition, we presented the distribution of households in which women interviews were led by the same interviewer. Prior to the implementation of respondent selection procedures, the background information will give a premise for the interpretation of study findings. We introduced the households in which women interviews were conducted by the same interviewer as a proxy measure of interviewed women's presence during the other women interviews.

3.3.2.Analyses for Respondent Selection

At first, we selected a particular woman within each of eligible-woman-included households (68.5 percent among all households) according to various selection procedures. Besides, we selected a particular woman within households that included at least two eligible women (17.4 percent among all households) so that possible bias originating from only one eligible-woman-included households could be eliminated.

Within this simulation-based study, we selected women in light of eight different selection approaches described in Section 3.2., in particular *Kish grid* (Kish, 1949), *full enumeration method* (Denk et al., 2000; Srinivasan et al., 1996) (probabilistic methods), *last* and *next birthday methods* (Salmon and Nichols, 1983; Yan, 2009) (quasi-probabilistic methods), *oldest* and *youngest methods* (Keeter and Fisher, 1997; Srinivasan et al., 1996), *arbitrary convenience method* (Gaziano, 2005), and *TCB method* (Troldahl and Carter, 1964; Czaja et al., 1982; Kennedy, 1993) (non-probabilistic methods). Furthermore, we presented the percentage distribution of women selected by various selection procedures to notice the number of women selected by each of the respondent choice techniques.

Afterward, we compared the women characteristics that are determined based on just selected women across the selection strategies as well as actual 2013 Turkey DHS estimates. In the study, 2013 Turkey DHS estimates were acknowledged as population values since the nation-wide survey represents the entire country. We carried out all analyses in two stages. The first is a selection from each eligible-women-included household, and the second is a selection from no less than two eligible-women-included households to understand impact of techniques better.

Following the selection procedures, we re-calculated the means and proportions of selected variables by considering those different stages. In the calculation of new estimates in both phases, we have added a base weight factor (probability of selection) to existing weight variable. This is required as the simulations select a new sample of women in households that is different from the original sample of the survey. We could be able to treat these samples differently through this adjusted weight variable.

Toward the end, we examined the means and proportions of specific variables according to whether they fell into the confidence intervals of population estimates. Furthermore, for both phases, we re-calculated lower and upper boundaries of measurements based on different selection procedures taking potential sampling error generated by the selection into account.

During comparative investigations at the second stage as a part of the comparison, we re-calculated 2013 Turkey DHS estimates, and their certainty stretches considering at least two eligible-women-included households. At last, we determined deviations from the survey estimates for each respondent selection technique. We also calculated the mean values of the deviations for each strategy to evaluate the efficiency of selection methods.

The calculations at this stage were made as the following:

$$d_i = \frac{y_{hi}}{y_h}$$

where d_i denotes the deviation for *i-th* selection technique, y_{hi} refers to the estimate for variable h produced by i-th selection technique. The mean value of deviations, $\overline{d_\iota}$ as follows:

$$\overline{d_\iota} = \sum d_i / \sum d_h$$

where d_h is the standardized value of variable h and equivalent to 1.

For *i-th* selection technique, the mean value of the total deviations, $\overline{d_t}$, as follows:

$$\overline{d_\iota}\overline{d_t} = \overline{d_{\iota h_m}} * j/k + \overline{d_{\iota h_p}} * (1 - j/k)$$

where $\overline{d_{\iota h_m}}$ refers to the mean value of deviations for the mean of variable h_m, $\overline{d_{\iota h_p}}$ refers to the mean value of deviations for the proportion of variable h_p, j is the number of the mean of variables, and k is the all-out number of means and proportions of specific variables. All calculations here are the authors' own contributions.

We put all of these endeavors to comprehend which of the particular respondent selection procedures produce closer estimates to population values assessed from 2013 Turkey DHS. The standard errors are adjusted for the complex sample design of the survey referring to a multi-staged, stratified cluster sampling design.

4.RESULTS

4.1.Results for Women Characteristics

The descriptive results put forward that there is at least one interviewed eligible woman in right around 68 percent of interviewed households. The major percentage belongs to households including just one interviewed eligible woman, with 51 percent among interviewed households. There are two interviewed eligible women in 13 percent of households and at least three interviewed eligible women in 4 percent of interviewed households. In other words, there are at least two eligible interviewed women in about 17 percent of all interviewed households (Table 1). Descriptive results additionally put forward that at least two women interviews were conducted by the same interviewer in 61 percent of all interviewed households (Table 1).

Table 1: Number of completed interviews with eligible women and households in 2013 Turkey DHS

Number of eligible women	**Percentage**	**Number**
0	31.5	3,710
1	51.1	6,028
2	13.0	1,537
3 or more	4.4	519
Two or more interviewed eligible-women-included households		
At least two interviews were conducted by the same interviewer	61.4	1,262
All interviews conducted by different interviewers	38.6	794
Number of completed interviews with eligible women	-	9,746
Number of eligible women	-	10,840
Number of interviewed households	-	11,794

Table 2 presents women's characteristics at various layers by a number of eligible women in interviewed households. The mean age of women was 33.2 years among households including only one eligible woman while the mean age decreased to 24.3 years among households including four and more eligible women. In the 2013 Turkey TDHS, the mean age of women was estimated as 31 years and the mean years of schooling were estimated as 7.8 years.

When fertility behaviors are considered, the mean number of children was 1.9 children among one eligible-woman-included households whilst it was 1.1 children among four and more eligible-women-included households. The survey estimate was 1.7 children among all interviewed women in 2013 Turkey DHS. The mean number of completed pregnancies was 2.3 pregnancies among households with just one eligible woman whereas it was 1.7 and 1.6 pregnancies among households with two and three eligible women, respectively. The mean number of completed pregnancies was estimated as 2.1 pregnancies in Turkey, which was the nearest estimate to households including only one eligible woman, as expected. For proportions of variables, as in the means of variables, as the number of eligible women in the households increases the values of the variables become distant from the 2013 Turkey DHS values (Table 2).

Table 2: Characteristics of women by number of eligible women

Characteristics of women (mean)	**1**	**2**	**3**	**4 and more**	**2013 Turkey DHS**	**Number**
Age	33.2	28.5	26.0	24.3	31.0	9,746
Years of schooling	7.7	8.0	7.4	8.2	7.8	9,744
Number of migration	2.6	2.6	2.4	2.4	2.6	4,998
Total number of children	1.9	1.4	1.4	1.1	1.7	9,746
Total number of living children	1.8	1.3	1.3	1.1	1.6	9,746
Total number of spontaneous abortion	1.5	1.5	1.5	1.5	1.5	1,612
Total number of induced abortion	1.5	1.6	1.4	1.5	1.5	960
Total number of stillbirth	1.2	1.2	1.0	1.3	1.2	230
Total number of completed pregnancies	2.3	1.7	1.6	1.3	2.1	9,746
Age at menarche	13.6	13.5	13.7	13.4	13.6	9,739
Age at marriage	20.9	19.3	18.3	18.2	20.4	7,063
Age at first birth	22.4	20.6	19.9	19.2	22.0	6,249
Total number of jobs	1.6	1.5	1.4	1.3	1.6	5,361
Characteristics of women (proportion)						
No education	0.11	0.11	0.18	0.14	0.12	9,746
Never married	0.10	0.51	0.61	0.72	0.28	9,746
Currently pregnant	0.06	0.02	0.02	0.03	0.04	9,746
Using any contraception	0.74	0.73	0.72	0.55	0.74	6,835
Using any modern method	0.48	0.47	0.45	0.41	0.47	6,835
Desire for more children	0.46	0.54	0.55	0.36	0.47	6,835
Number of women	5,893	2,592	930	331	9,746	-

4.2.Results for Respondent Selection Procedures

Table 3 presents the percentage of women who were selected by different selection methods in both phases. Results show that 47 percent of eligible women were selected by all selection techniques. Also, seven and five unique selection methods selected 14 percent of women and 13 percent of women, individually. Any respondent selection procedure did not select just one percent of women. Among eligible-women-included households, six procedures that are the last and next birthday methods, Kish method, full enumeration method, youngest method, and TCB method selected around 14 percent of women. Three techniques, which are the last birthday method, youngest method, and TCB method, selected almost 3 percent of women. Selections within at least two eligible-women-included households show that four methods selected about 31 percent of eligible women and three methods selected about 30 percent of women. Then again, no eligible woman was selected by all

methods. Moreover, any technique did not select around 2 percent of women (Table 3). Among at least two eligible-women-included households, the last birthday method, Kish method, youngest method, and TCB method selected 5 percent of women.

When we consider all eligible-women-included households, the mean age of women was 31.6 years among women who were selected by the last birthday method while it was 34.3 years among women who were selected by the oldest women method. In general, for the means of variables, the last birthday method and TCB method are superior to other selection techniques as far as having little deviations from the 2013 Turkey DHS estimates. Regarding with means of variables, aside from estimates from the full enumeration method, oldest and arbitrary convenience methods, any remaining estimates are inside the confidence interval of the mean of the deviation determined for 2013 Turkey DHS (Table 4).

Table 3: Distribution of women by number of different selection procedures

Number of selection methods*	**First phase**		**Second phase**	
None	0.8	78	2.3	89
1	2.1	205	6.3	243
2	4.6	448	12.2	470
3	11.1	1,082	28.5	1,098
4	12.8	1,247	31.3	1,206
5	6.1	595	16.0	616
6	1.0	97	3.2	123
7	14.3	1,394	0.2	8
8	47.3	4,610	0.0	0
Total	100.0	9,746	100.0	3,853
*Selection methods comprise all combinations of different selection procedures.				

Considering the proportions of variables, the proportion of never married women was 0.28 among women who were selected by the youngest method, which is the same as the proportion of never married women in Turkey. Overall, each selection method provided close estimates to one another and 2013 Turkey DHS estimates. Besides, the estimates produced through selection methods mostly fall into confidence intervals of 2013 Turkey DHS estimates. Considering the mean of deviations for proportions of variables, the youngest method, Kish method, next birthday method, and TCB method have quite small deviations from mean deviations of 2013 Turkey DHS. At the point when mean of absolute deviations are taken into account, Kish strategy, last birthday method, next birthday method, and full enumeration method has produced the best estimates with a negligible deviation from the confidence interval of the 2013 Turkey DHS estimates (Table 4).

We carried out the second stage of the simulations considering the execution of selection within at least two eligible-women-included households with the comparison of 2013 Turkey DHS estimates from both eligible and at least two eligible-women-included households. For means of variables, the full enumeration method, next birthday method and arbitrary convenience method are better than other techniques comparing 2013 Turkey DHS estimates and their confidence intervals. For proportions of variables, compared to 2013 Turkey DHS estimates from any eligible women, full enumeration methods gave better estimates to means of variables while the oldest method delivered better estimates. Overall, the next birthday method and Kish method produced the estimates with a negligible deviation from the confidence interval of the 2013 Turkey DHS estimates (Table 5).

Comparing to the newly calculated point and interval estimations from at least two eligible-women-included households in 2013 Turkey DHS with the estimates determined in view of various selection strategies, mean of total deviations introduced that Kish method, next birthday method, full enumeration method, and last birthday method are superior to other non-probabilistic selection techniques (Table 5).

For both phases, error intervals that are estimated for selected variables are given by the analysis phase (Figure 1). These figures show the small deviations from the TDHS estimates especially for probabilistic and quasi-probabilistic selection techniques.

Table 4: Characteristics of women by respondent selection methods in the first phase and mean of the deviations from 2013 Turkey DHS

Variables	Last birthday	Next birthday	Kish	Full enumeration	Oldest	Youngest	TCB	Arbitrary convenience	2013 Turkey DHS	2013 Turkey DHS confidence intervals	
										Lower	Upper
Mean of variables											
Age of women	32,3	32,7	32,6	33,1	33,7	31,5	31,8	33,5	31.0	30.8	31.2
Years of schooling	7,8	7,7	7,7	7,6	7,5	7,9	7,9	7,5	7.8	7.7	7.8
Number of migration	2,6	2,6	2,6	2,6	2,6	2,6	2,6	2,6	2.6	2.6	2.6
Total number of children	1,8	1,8	1,8	1,9	2,0	1,7	1,7	2,0	1.7	1.6	1.7
Number of living children	1,7	1,8	1,7	1,8	1,9	1,6	1,6	1,9	1.6	1.6	1.6
Number of spontaneous abortion	1,5	1,5	1,5	1,5	1,5	1,5	1,5	1,5	1.5	1.4	1.5
Number of induced abortion	1,5	1,5	1,5	1,5	1,5	1,5	1,5	1,4	1.5	1.4	1.6
Number of stillbirths	1,2	1,2	1,2	1,2	1,2	1,2	1,2	1,2	1.2	1.1	1.3
Number of completed pregnancies	2,2	2,3	2,3	2,3	2,5	2,1	2,1	2,5	2.1	2.0	2.1
Age at menarche	13,6	13,6	13,6	13,7	13,7	13,6	13,6	13,7	13.6	13.5	13.7
Age at first marriage	20,8	20,7	20,8	20,7	20,7	20,8	20,8	20,7	20.4	20.3	20.5
Age at first birth	22,3	22,3	22,3	22,2	22,2	22,4	22,4	22,2	22.0	21.9	22.1
Number of jobs	1,6	1,6	1,6	1,6	1,6	1,6	1,6	1,6	1.6	1.6	1.6
Mean of the deviations	**1.02**	**1.03**	**1.03**	**1.04**	**1.05**	**1.01**	**1.01**	**1.05**	**1.00**	**0.98**	**1.02**
Proportion of variables											
No education	0.110	0.116	0.114	0.118	0.124	0.105	0.106	0.114	0.120	0.108	0.132
Never married	0.163	0.148	0.153	0.133	0.105	0.195	0.186	0.088	0.275	0.264	0.287
Currently pregnant	0.053	0.054	0.054	0.054	0.054	0.053	0.054	0.059	0.044	0.039	0.049
Using any contraception	0.595	0.605	0.603	0.617	0.638	0.570	0.576	0.662	0.735	0.720	0.749
Using any modern method	0.385	0.393	0.391	0.401	0.415	0.370	0.374	0.436	0.474	0.458	0.491
Desire for more children	0.447	0.434	0.437	0.419	0.394	0.475	0.468	0.387	0.474	0.459	0.488
Mean of the deviations	**0.88**	**0.88**	**0.88**	**0.88**	**0.87**	**0.89**	**0.89**	**0.87**	**1.00**	**0.94**	**1.06**
Mean of total deviations	**0.98**	**0.98**	**0.98**	**0.99**	**0.99**	**0.97**	**0.97**	**0.99**	**1.00**	**0.97**	**1.03**
Number of women*	7,775	7,775	7,775	7,775	7,775	7,775	7,775	5,928	9,746	-	-

*Number of women as a result of respondent selection vary between 7,571 and 7,726; and 5,903 depending on the missings on selected variables.

Table 5: Characteristics of women by respondent selection methods in the second phase and mean of the deviations from 2013 Turkey DHS

Variables	Last birthday	Next birthday	Kish	Full enumeration	Oldest	Youngest	TCB	Arbitrary convenience	2013 Turkey DHS confidence intervals First phase			2013 Turkey DHS confidence intervals Second phase		
									2013 Turkey DHS	**Lower**	**Upper**	**2013 Turkey DHS**	**Lower**	**Upper**
Mean of variables														
Age of women	26.0	28.6	28.2	32.4	38.4	19.3	21.2	33.8	31.0	30.8	31.2	27.6	27.3	28.0
Years of schooling	8.5	7.7	7.9	7.1	5.8	9.6	9.3	7.0	7.8	7.7	7.8	7.9	7.7	8.0
Number of migration	2.6	2.5	2.5	2.6	2.6	2.5	2.6	2.5	2.6	2.6	2.6	2.5	2.5	2.6
Total number of children	1.0	1.5	1.4	2.0	2.9	0.1	0.3	2.2	1.7	1.6	1.7	1.4	1.3	1.4
Number of living children	0.9	1.4	1.3	1.9	2.7	0.1	0.3	2.1	1.6	1.6	1.6	1.3	1.2	1.4
Number of spontaneous abortion	1.4	1.5	1.5	1.5	1.5	1.3	1.3	1.5	1.5	1.4	1.5	1.5	1.4	1.6
Number of induced abortion	1.5	1.5	1.6	1.5	1.6	1.0	1.4	1.4	1.5	1.4	1.6	1.5	1.4	1.6
Number of stillbirths	1.1	1.3	1.1	1.1	1.1	3.1	1.8	1.1	1.2	1.1	1.3	1.2	1.0	1.4
Number of completed pregnancies	1.2	1.8	1.7	2.4	3.5	0.2	0.4	2.7	2.1	2.0	2.1	1.7	1.6	1.7
Age at menarche	13.6	13.5	13.5	13.7	13.8	13.3	13.5	13.5	13.6	13.5	13.7	13.6	13.4	13.7
Age at first marriage	19.4	19.1	19.2	19.0	19.0	19.9	20.0	19.1	20.4	20.3	20.5	19.1	18.9	19.2
Age at first birth	20.6	20.5	20.5	20.4	20.5	20.9	21.0	20.6	22.0	21.9	22.1	20.4	20.3	20.6
Number of jobs	1.4	1.5	1.4	1.5	1.5	1.3	1.4	1.4	1.6	1.6	1.6	1.4	1.4	1.5
Mean of the deviations (first phase)	0.88	0.96	0.94	1.02	1.15	0.84	0.81	1.05	**1.00**	**0.98**	**1.02**	-	-	-
Mean of the deviations (second phase)	0.94	1.03	1.01	1.11	1.28	0.87	0.84	1.15	-	-	-	**1.00**	**0.96**	**1.04**
Proportion of variables														
No education	0.086	0.136	0.122	0.162	0.216	0.044	0.056	0.146	0.120	0.108	0.132	0.131	0.120	0.142
Never married	0.621	0.497	0.533	0.363	0.116	0.880	0.801	0.295	0.275	0.264	0.287	0.549	0.533	0.564
Currently pregnant	0.017	0.021	0.021	0.021	0.022	0.019	0.020	0.023	0.044	0.039	0.049	0.022	0.017	0.027
Using any contraception	0.253	0.342	0.319	0.442	0.632	0.059	0.103	0.517	0.735	0.720	0.749	0.721	0.699	0.743
Using any modern method	0.159	0.226	0.203	0.292	0.419	0.037	0.068	0.346	0.474	0.458	0.491	0.466	0.441	0.491

Desire for more children	0.693	0.584	0.608	0.449	0.224	0.927	0.864	0.392	0.474	0.459	0.488	0.534	0.509	0.559
Mean of the deviations (first phase)	**0.92**	**0.93**	**0.93**	**0.88**	**0.82**	**1.02**	**0.99**	**0.85**	**1.00**	**0.94**	**1.06**	-	-	-
Mean of the deviations (second phase)	**0.76**	**0.82**	**0.81**	**0.82**	**0.84**	**0.78**	**0.79**	**0.82**	-	-	-	**1.00**	**0.92**	**1.08**
Mean of total deviations (first phase)	**0.89**	**0.95**	**0.94**	**0.98**	**1.05**	**0.90**	**0.87**	**0.98**	**1.00**	**0.97**	**1.03**	-	-	-
Mean of total deviations (second phase)	**0.88**	**0.97**	**0.95**	**1.02**	**1.14**	**0.84**	**0.83**	**1.04**	-	-	-	**1.00**	**0.95**	**1.05**
Number of women*	1,682	1,682	1,682	1,682	1,682	1,682	1,682	1,350	7,775	-	-	3,853	-	-

*Number of women as a result of respondent selection vary between 1,682 and 22; and 41 depending on the missings on selected variables.

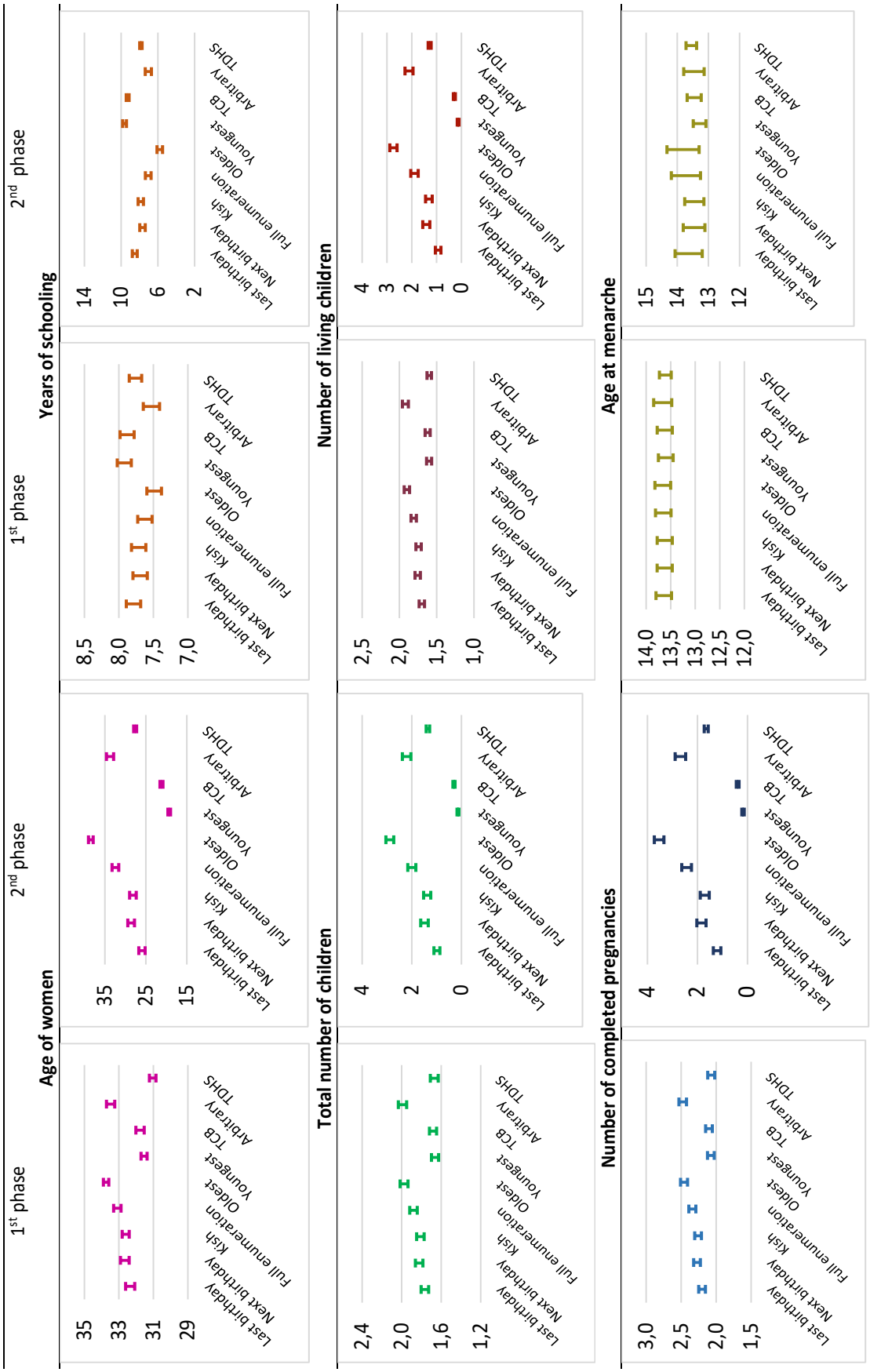

Figure 1: Error bars for selected study variables by respondent selection techniques (first and second phases)

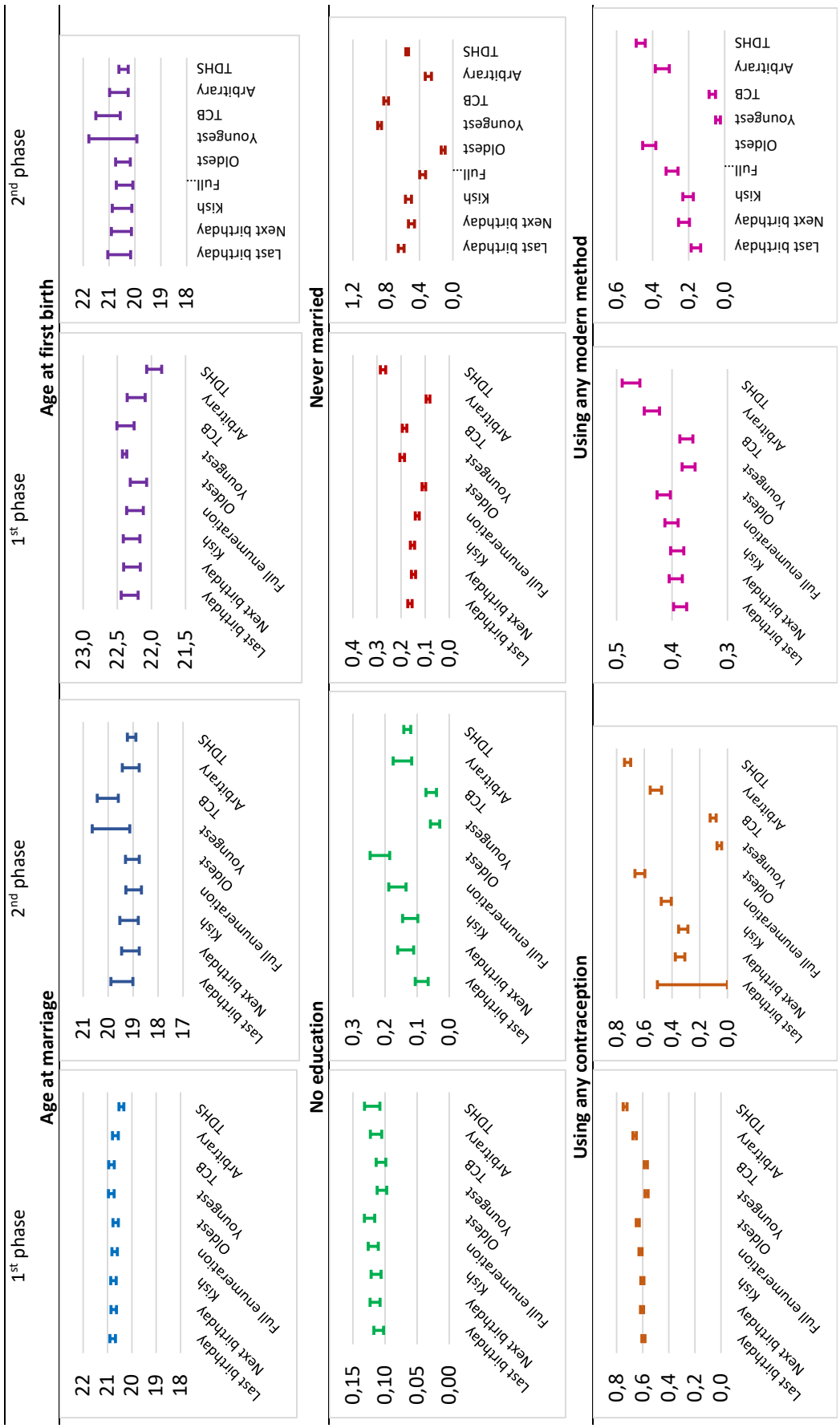

Figure 1 (continued): Error bars for selected study variables by respondent selection techniques (first and second phases)

5. DISCUSSION AND CONCLUSION

In this simulation based study under 2013 Turkey DHS, we compared eight different within-household selection techniques based on the deviations of estimates to survey statistics. We measured the efficiency of respondent selection procedures with the mean deviations of the estimates from 2013 Turkey DHS, which is the nationally representative household survey. In the second phase of the examination, we also repeated selection procedures from households including at least two eligible interviewed women. The main goal of this phase was to follow selection procedures better by avoiding identical selection originating from just a single eligible-woman-included household.

The findings of the study showed that different respondent selection methods produce closer estimates with the estimates from the 2013 Turkey DHS albeit some of those are quasi-probabilistic or non-probabilistic. In this sense, Gaziano (2005) stated that non-probabilistic selection methods attempt to approximate gender and age distribution even though they don't follow a definitely random process. This finding of the study confirms the need for partial random nature during the respondent selection. The analyses carried out under the subsequent phase were in accordance with findings obtained from the first stage although the mean of the total deviations increased in that stage. In addition, we concluded that probabilistic or quasi-probabilistic respondent selection techniques produced better estimates with a negligible deviation from the confidence interval of the 2013 Turkey DHS estimates contrasted with non-probabilistic selection techniques.

Overall, the mean of total deviations that we calculated from both the first and second phase of examinations confirmed that the Kish method, next birthday method, last birthday method, and full enumeration method have the least degree of deviations in ranges between 0.97-0.99 for the first phase, 0.76-1.84 and 0.83-1.14 for first and second trials of the second phase, respectively. Non-probabilistic techniques were less effective techniques in terms of producing close estimates to 2013 Turkey DHS.

We additionally observed similar results in regards to the minor differentials on demographic characteristics in previous studies that compared the Kish method and last birthday method as well as the recent type of Kish and recent birthday methods developed by Rizzo et al. (2004) and the next birthday method (Oldendick et al., 1988; Beebe et al., 2007). The implementation of any probabilistic respondent selection techniques may also decrease the risk of women's presence during the other women interviews, since the responses of women may be influenced by other women's responses within the same household (Clark and Steel, 2007). In the 2013 Turkey DHS, at least two women interviews were conducted by the same interviewer in three of five households which include at least two eligible women. This could be accepted as a proxy measure of women's presence during the other women interviews in the same household. Still, this assumption needs further investigation using the required information about presence of others during the interviews.

All things considered, any technique does not ensure that almost all estimates will be close to survey estimates and fall into their confidence intervals. Considering the percentage distribution of households by the number of eligible women, there was just a single woman who could be selected to interview in half of the households no matter what the respondent selection technique. Consistently, all methods selected 47 percent of women. Accordingly, the information provided by the same women may result in producing close estimates within confidence intervals regardless of whether we practiced different respondent selection techniques. To overcome this limitation, we conducted the second phase of examinations by restricting the sample to households with at least two eligible women. Hence, four different strategies chose the majority of the women in that group rather than all selection methods. Overall, interviewing all eligible women in 2013 Turkey DHS, which is among standard guidelines of the International DHS Program, still seems to be sensible because of certain justifications such as population representation and giving valid estimates for all indicators even for rare events among women in Turkey. Furthermore, it appears that interviewing all eligible women is associated to include sufficient numbers of respondents to present estimates with high precision (DHS Program, 2022), even though clear evidence on why all eligible women are interviewed is lacking. On the other hand, to obtain high precision for survey estimates, interviewing only one woman in each household may require an increase in the target sample size of households, leading to a considerable cost factor.

To the best of the authors' knowledge, this is the first study in Turkey which could be considered as work to inspect respondent selection methods and measure their efficiency under the comparison of survey estimates. This is important on the grounds that such comparisons have so far commonly made for telephone and mail survey settings in the US (Lavrakas, 2008; Lavrakas et al., 2000; Smyth and Olson, 2019), as opposed to face-to-face interviewing techniques. This study simulates techniques using survey data that already collected, which appears to be acceptable due to the lack of a newly designed experimental study from the beginning of the survey. In this connection, the novelty of the study is the utilization of data from a completed survey designed in a simulation-based way for the first time in the literature to understand the extent of the deviations in the survey estimates originated from different respondent selection methods.

This study has two limitations. First, a simulation of within-household selection techniques in the subsequent phase was carried out over 17 percent of households including at least two eligible women. This may lead to a restriction to uncover the impact of selection procedures on survey estimates. Second, selected women are expected as ones who complete the survey under the assumption of the 2013 Turkey DHS response pattern. To put it more explicitly, this study is carried out over 9,746 completed interviews with eligible women rather than 10,840 eligible women who we know from the household interviews (Table 1). This is mainly due to the lack of information about eligible women who were not interviewed because of various reasons (HUIPS, 2014). As suggested by Lee et al. (2009) and Groves and Peytcheva (2008), these non-respondents in surveys may be a selective group of women, especially those living in urban areas, having a higher level of education, and being never married. Therefore, certain findings of this study, particularly mean years of schooling, mean number of children, and proportion of uneducated women, may be suffered from this situation. Therefore, this study can be accepted as a methodological investigation that adopts a purely and simply measurement perspective. Further, based on the second limitation, we recommend concentrating on such problems taking the possibility of different response behaviors and availability of data for nonrespondents into account.

Another discussion can be made over interviewer effects on respondent selection procedures. Interviewers are also known as their impact in DHS surveys. Selecting eligible women aged 15-49 appropriately and conducting interviews with only those women are among the main roles of interviewers. However, as a potential risk, interviewers may tend to mark selected women as 'not at home during visits/survey dates', not to carry out interviews. Similarly, they may tend to select women who are absent at the time of the interview to reduce their burden. The DHS literature that concentrates on some quality aspects such as age displacement of women and children, digit preference in age reporting, and incompleteness of birth dates (Macro International Inc., 1993; Institute for Resource Development, 1990) supports such risks.

In light of the study findings, the adaptation of the efficient selection techniques, especially probabilistic methods, within the households may be moved into the practice of survey execution, particularly for a part of questions that expect to gather data about predominant issues in the country. In this sense, any lacking of representation and quality originating from the selection technique ought to be avoided. Taking into account that demographic and health surveys continue to be applied in more than 90 different developing countries from different continents with very similar sampling and questionnaire designs, it is worth investigating the potential outcomes of different respondent selection procedures on the estimates for different DHS countries. Besides, this study calls for further studies that focus on measuring and assessing the efficiency of selection methods through different ways such as response quality, time efficiency, ease of fieldwork operation, cost, and burden. Yet again when new data collection modes in today's world are considered, the future examinations which account for the respondent selection methods and their appropriate implementation are acquiring importance (Dillman, 2021; Olson and Smyth, 2013).

Ethical statement

The Ethics Committee of Hacettepe University approved the 2013 Turkey DHS questionnaires after the questionnaire design was completed. At the beginning of the interview, each respondent was asked to give informed consent to participate in the survey.

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