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2019

HACETTEPE UNIVERSITY

INSTITUTE OF POPULATION STUDIES

RE-CALCULATION AND COMPARISON OF SAMPLE WEIGHTS OF THE TURKEY DEMOGRAPHIC AND HEALTH SURVEYS

IRMAK YILDIZ

Department of Social Research Methodology

Master's Thesis

Ankara

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This is to certify that we have read and examined this thesis and in our opinion it fulfills the requirements in scope and quality of a thesis for the degree of Master of Arts in Social Research Methodology.

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RE-CALCULATION AND COMPARISON OF SAMPLE WEIGHTS OF THE TURKEY DEMOGRAPHIC AND HEALTH SURVEYS

by Irmak Yıldız

Submission date: 11-Jul-2019 02:31PM (UTC+0300)
Submission ID: 1150991396
File name: (367.01K)
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ACKNOWLEDGEMENTS

I would like to express my sincere gratitude to my supervisor Assist. Prof. Dr. Tuğba ADALI for her guidance, attention, encouragement, positiveness and patience. She answered my daily questions very kindly and quickly in any time even during her holiday.

I would like to thank Prof. Dr. A. Sinan TÜRKYILMAZ for his valuable inputs and ideas at the thesis proposal stage. I would also like to acknowledge his and Prof. Dr. Özlem İLK DAĞ’s constructive criticism at the thesis defense, which have led to improvements in the final version of my thesis.

I am grateful to all staff from Hacettepe University Institute of Population Studies. They were very helpful and supported me during the archive studies.

I would like to give my special thanks to my family for their unconditional support, endless love and being understanding. They believe in me in all time of my life and this is priceless for me.

ABSTRACT

Sample surveys are widely used methods to collect data all over the world and they have been widely conducted on the issues of population growth, demography and health since the last century. Within this framework, the Demographic and Health Survey (DHS) has been organized in more than 90 countries and nationwide population surveys in Turkey under this program has been implemented by Hacettepe University Institute of Population Studies since 1993.

In the DHS Program, the calculation of sampling weights has been changed over time and the reason of this methodological change has not been evaluated. This thesis aims to examine the changes in the weighting approach of each Turkey Demographic and Health Survey, to observe the effects of weight calculation approach changes on the basic selected indicators, to use the same weighting approach across different surveys when comparing the survey results and to make a contribution to the literature about comparing two weighting approaches in a Demographic and Health Survey program framework.

In this thesis, the new sampling weights were obtained and added to the corresponding data sets to produce some statistical tables for selected variables and compared with the current results. There was no pattern observed among surveys in terms of differences in point estimates. Although the widths of confidence intervals were higher in cluster level weights approach, it was possible to ignore these effects because their values were very small. Moreover, the ratio of coefficient of variation and design effect were increased by the cluster level weighting. The cluster level approach gave us higher sampling variances.

Key Words: Sample weights, reweighting, sample surveys, Demographic and Health Survey, design effect

ÖZET

Örneklem araştırmaları, tüm dünyada veri toplamak için yaygın olarak kullanılan yöntemlerdir ve geçtiğimiz yüzyıldan beri, nüfus artışı, demografi ve sağlıkla ilgili konularda yaygın olarak uygulanmaktadır. Bu çerçevede, Nüfus ve Sağlık Araştırması, doksandan fazla ülkede düzenlenmekte ve bu program kapsamında Türkiye genelindeki nüfus araştırmaları, 1993 yılından bu yana Hacettepe Üniversitesi Nüfus Etütleri Enstitüsü tarafından uygulanmaktadır.

Nüfus ve Sağlık Araştırması kapsamında, örneklem ağırlıklarının hesaplanması zaman içinde değişmiş ve bu metodolojik değişimin nedeni açıklanmamıştır. Bu tez, her bir Türkiye Nüfus ve Sağlık Araştırması'nın ağırlıklandırma yaklaşımındaki değişiklikleri incelemeyi, ağırlık hesaplama yaklaşımı değişikliklerinin seçilmiş temel göstergeler üzerindeki etkilerini gözlemlemeyi, araştırma sonuçlarını karşılaştırırken aynı ağırlıklandırma yaklaşımını kullanmayı ve iki ağırlıklandırma yaklaşımının Nüfus ve Sağlık Araştırması programı çerçevesinde karşılaştırılmasıyla ilgili literatüre katkıda bulunmayı amaçlamaktadır.

Bu tez kapsamında, yeni örneklem ağırlıkları elde edilmiş ve seçilen değişkenler için bazı istatistiksel tablolar üretmek ve bunları mevcut sonuçlarla karşılaştırmak için uygun veri setlerine eklenmiştir. Anketler arasında nokta tahminlerine göre bir örüntü gözlenmemiştir. Küme seviyesi ağırlık yaklaşımında güven aralığı genişlikleri daha yüksek olmasına rağmen, değerleri çok küçük olduğu için bu etkileri göz ardı etmek mümkün olmuştur. Ayrıca, varyasyon katsayısı ve desen etkisi oranı küme düzeyi ağırlıklandırmayla artmıştır. Küme seviyesi yaklaşımı bize daha yüksek örneklem varyansları vermiştir.

Anahtar kelimeler: Örneklem ağırlıkları, yeniden ağırlıklandırma, örneklem anketleri, Nüfus ve Sağlık Araştırması, desen etkisi

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ABBREVIATIONS

ABPRS	Address Based Population Registration System
AIS	AIDS Indicator Surveys
cv	Coefficient of Variation
CI	Confidence Interval
CPS	Contraceptive Prevalence Survey
DHS	Demographic and Health Survey
DEFT	Design Effect
dw	Design Weight
EDHS	Egypt Demographic Health Survey
EPSEM	Equal Probability of Selection Method
EM	Ever-married
HUIPS	Hacettepe University Institute of Population Studies
HH	Household
ISI	International Statistical Institute
MIS	Malaria Indicators Surveys
MICS	Multiple Indicators Cluster Survey
NM	Never-married
NUTS	Nomenclature of Territorial Units for Statistics
PSU	Primary Sampling Unit
PPS	Probability Proportional to Size
RR	Response Rate
sw	Sampling Weight
SAM	Service Availability Module

SRS	Simple Random Sampling
se	Standard Error
SIS	State Institute of Statistics
SS	Structure Schedules
TUBITAK	The Scientific and Technological Research Council of Turkey
TDHS	Turkey Demographic and Health Survey
TURKSTAT	Turkey Statistical Institute
VIGITEL	Telephone Survey System for Monitoring Risk and Protection Factors for Chronic Illness
WFS	World Fertility Survey

CHAPTER 1. INTRODUCTION

Sample surveys are widely used methods to collect data all over the world. For example, the attitudes and beliefs of population about the current social and political issues are measured by media surveys and the results are used nearly everyday newspapers and magazines. Customer preferences, needs, expectations and experiences for extensive range of products, such as foods, clothes, automobiles, are also investigated for consumer market and manufacturers pay attention to the outcomes to regulate current products or generate new products. In a similar way, labor force participation, incomes and expenditures, public health etc. are researched scientifically to monitor and develop new strategies by social scientists, health professionals, policy makers and administrators (Heeringa, West and Berglund, 2010).

The history of the sample survey usage goes back to more than a century. Arthur Young, who was a gentleman farmer, conducted the very first sample survey between 1768 and 1770 to collect data on rural economy by touring whole England from north to east (Young, 1769, 1770a, 1771a; Gazley 1973 as cited in Brunt, 2001). He covered 413 farms and collected data on nearly 400 variables. Young's Tours showed that if the whole population (i.e. census) data were not available, gathering data and detailed information about each object would be possible. A few years later, some social investigators took Young's approach as a good example to adapt to their own research techniques. In 1795, David Davies wanted to research the state of poverty. He sent a postal survey to his fellow ministers of Church of England and requested that they provided detailed information about poor families in their parishes. 34 parishes returned to his postal survey but this approach was criticized as being unrepresentative because only self-selected ones responded. After this self-selection problem was defined, Eden (1797) conducted a new study to define poverty and sent a researcher to gather data in 16 parishes. It was seen that Eden's data did not suffer as big a sample selection bias as Young's one in the presence of interviewers. Although these two social studies proved that the research question related data collection was possible, sample surveys were forgotten for a while due to increasing tendency of the use of census material and encouraging the use of same statistical tools and comparable data for population statistics. For these reasons, sample surveys were discovered again during the late 19th century (Brunt, 2001).

Even though the early applications of sample surveys methodology existed in the 19th century, the theoretical background and guidance was absent or too little (Hansen, 1987). Anders Nicolai Kiaer, the founder and director of the Bureau of Statistics in Norway, was the pioneer of the representative survey method in social research and official statistics. His paper in 1895 began again the development of modern survey sampling theory and methods. He conducted a sample survey about retirement and sickness insurance throughout Norway by using stratified purposive sampling. He developed his method and gave details in his papers 1895, 1897 and 1901 (as cited in Bethlehem, 2009). His approach became a debatable issue by other statisticians, but Arthur Bowley supported Kiaer's method and emphasized also random sampling application. Then, The International Statistical Institute reported that two sample selection methods were accepted: 1) The Kiaer's representative method, depended on purposive sample selection, 2) The Bowley's method, based on random sample selection with equal probabilities (Bethlehem, 2009). Bowley (1926) also stressed that nonresponse may cause problems and this was needed to be taken into consideration (Hansen, 1987).

In the 1920s, R. A. Fisher at the Rothamsted Experimental Station, the oldest agricultural research center, emphasized randomization, replication and local control (stratification) which leaded to a remarkable development in statistical theory and practice. Yates and other researchers made important contributions to his theory in mid 1930s. Moreover, multistage sampling and variance estimates were also introduced in those years (Hansen, 1987).

The concept of probability sampling, confidence interval and optimum allocation were defined in Jerzy Neyman's famous paper in 1934. He also compared the purposive selection and random sampling and criticized the purposive selection methods (Hansen, 1987).

Survey sampling methods were rapidly changing with the remarkable contributions from the late 1930s. Cohran used variance analyses and regression estimation in 1939 and 1942 respectively. Multistage samples approach of Hansen and Hurwitz was published in 1943. W. G. Madow and L. H. Madow used systematic sampling in 1944. Mahalanobis introduced a philosophy of statistical engineering and a program of interpenetrating samples in 1946. In the same year, Sukhatme mentioned the control of nonsampling errors (Hansen, 1987; Bethlehem 2009).

On the other hand, the development in household sample survey field increasingly continued at the national level. Statistics Netherlands conducted a sample survey by using random selection in 1941 for the first time. Then, numerous surveys such as budget survey, income survey, agricultural production survey, expenditure survey were carried out by this institution (Bethlehem, 2009). In the United States, Bureau of the Census conducted Enumerative Check Census to estimate unemployment on a nationwide basis in 1937. After the Great Depression period, the statistical needs focused on employment and the Labor Force Survey, now known as the Current Population Survey, was designed (Hansen, 1987).

In 1947, the United Nations Statistical Commission set up the Sub-commission on Statistical Sampling in order to help national statistical institutes to improve their statistics and then the Sub-commission published its first paper, named "The Preparation of Sampling Survey Reports". This valuable document was one of the earliest international guidelines which included some suggestions about preparation of sampling survey (Bethlehem, 2009).

Sample surveys took shape by the result of so many valuable experiences and studies of researchers at the universities, institutions and organizations, as mentioned above. In the recent times, the finite natural resources and the increasing trend in population growth have an effect on the kind of surveys. For these reasons, sample surveys are also used commonly to provide data about estimating population growth, demography and health issues.

Bjerve (1973), the president of the International Statistical Institute (ISI) from 1971 to 1975, emphasized that the highest population growth occurred in less developed countries and if it continued at the same rate, the total population of these countries would be doubled in every 20-30 years. It was argued that if this situation could not be controlled, the number of poor people could increase in those countries. Also, Bjerve underlined that the United Nations published population growth projection results were suggesting that the world population would become 6.5 billion in 2000. Thus, the problems in environment, resources, standard of living will be inevitable. Then, ISI launched the World Fertility Survey (WFS). It was the first nationally representative and internationally comparable sample surveys on fertility in many countries, especially less developed ones. The WFS was carried out from 1971 to 1984 in 62 developing and developed countries and it was a major effort to improve demographic data collection and analysis. An international group of experts expressed that the WFS filled the gap in the knowledge of human fertility at scientific world (ISI, 1973; Gille, 1985).

In the 1970s, contraceptive usage started to decrease the probability of an unwanted pregnancy and the number of children in families. In order to understand how the pattern of family planning and fertility were affected by the usage and nonusage of contraception, the Contraceptive Prevalence Survey (CPS) was carried out in over 20 countries (Lewis, 1983).

According to Anderson and Cleland (1984), these two major demographic survey programs were both similar to and different from each other. Both surveys contained information about fertility, contraceptive use and attitudes to fertility. But, while the WFS aimed to collect fertility data with its determinants and other demographic variables, also to raise the availability of conducting demographic surveys in participant countries and to provide comparable cross-sectional data, the main objective of the CPS provided information for policy makers in order to evaluate population policies and family planning programs.

Numerous sample surveys followed these two pioneer demographic surveys: Demographic and Health Survey (DHS), AIDS Indicator Surveys (AIS), Malaria Indicators Surveys (MIS), Multiple Indicators Cluster Survey (MICS) and so on. DHS which is the most common and popular survey, has been organized in more than 90 countries since 1984. The aim of this project is to provide the detailed information about population, health and nutrition (The DHS Program web page, n.d.).

Parallel to the developments in the sample survey area, its analysis has also been studied by many researchers: Kish (1965, 1990, 1992), DuMouchel and Duncan (1983), Kalton (1983), Sharot (1986) and Potter (1988, 1990). According to Kalton (1983), a broad range of statistical techniques were needed to analyze survey data, where the use of sample weights and the calculation of sampling errors were the two important topics in this regard. Many survey reports and guidelines often mentioned weighting, and their explanation were sometimes given in their appendices (Kish, 1990). Sample weights assigned some elements in a sample greater relative importance than others to compensate for unequal selection probabilities, to adjust for non-response, and to match sample distributions to known population distribution (poststratification) (Kalton, 1983).

Hacettepe University Institute of Population Studies (HUIPS) was founded in Turkey to provide academic graduate program in population field and to provide demographic information and data by implementing nationwide population surveys in 1967. The Institute started conducting quinquennial sample surveys with the first one being the 1968 Survey on Family Structure and Population Problems in Turkey. In 1978, the Turkish Fertility Survey was carried out within the scope of the WFS program and then HUIPS started to implement a DHS program in Turkey since 1993. National and international organizations have been cooperating those surveys. 2013 Turkey Demographic and Health Survey (TDHS) is the last reported survey (Hacettepe University Institute of Population Studies [HUIPS] web page, n.d.).

DHS includes some standards such as in sample design, in questionnaire design and in weighting procedure in order to obtain comparable data and information in participating countries. However, the changes in those standards are possible as time goes by. These changes can be seen when DHS manuals and TDHS reports are examined. For example, while the sampling weights were calculated at the strata level in the DHS III Sampling Manual (1996), the cluster level weighting approach was defined in DHS Sampling and Household Listing Manual (2012). In a similar way, while the estimation domains were used for calculating the sampling weights of the TDHS-1993; TDHS-1998 and later ones had strata level weighting and TDHS-2013 had cluster level weighting approach. The reason of this methodological change has not been evaluated and there are no studies found about the effect of this new approach on estimates. So, it is thought that assessing this change will be an important contribution of this thesis.

In the light of these explanations, the main focuses of this thesis are to analyze the changes in the weighting approach of each TDHS, to observe the effects of weight calculation approach changes on the basic selected indicators, to use the same weighting approach across different surveys when comparing the survey results and to make a contribution the literature about the comparing two weighting approaches in a DHS program framework. The cluster level weighting approach of the TDHS-2013 will be applied to the prior four surveys, and also the strata level weight calculation will be applied to the TDHS-2013 and the TDHS-1993. Thus, each survey will have two different sampling weights (except for TDHS-1993, which will have three).

The research questions of this thesis are:

1) Do sampling weights differ with respect to cluster level or strata level calculation approach?

2) How does the changes in sampling weight affect the basic indicators, in terms of point estimates and standard errors?

Up to now, the aims and research questions of this thesis are given and this chapter will continue with the literature review part. The literature review (Chapter 2) begins with sample selection and estimation process. Then, some examples and explanations about the comparison of surveys are reviewed. In Chapter 3, detailed information about the data and methods of this thesis are given. The new sampling weights are calculated for each TDHS. Then, the descriptive statistics of the new sampling weights and the results of basic selected indicators in terms of them are given in Chapter 4. In Chapter 5, the findings are interpreted and discussed within the conceptual framework. Finally, Chapter 6 includes the conclusion and recommendations.

CHAPTER 2. CONCEPTUAL FRAMEWORK AND LITERATURE REVIEW

2.1. Sample Selection Process

Surveys are not conducted to the whole population due to time, cost and detailed information considerations. For this reason, sample surveys are conducted to a subset of the population and the results of the sample surveys are used to make inferences about the population. In this case, it is not possible to know the exact population parameter because each different sample from same population gives different result. Therefore, sample design is the most important thing in applying sample surveys and making inferences about population.

According to Kish (1965), selection and estimation process are two significant aspects of sample design. There are mainly two kinds of sample selection methods: probability and non-probability sampling. While each unit has a known and non-zero probability to be selected in probability sampling, these criteria are not satisfied in non-probability sampling. Thus, the researchers make some assumptions and then chose some typical respondents according to their assumptions in non-probability selection. Haphazard selection, expert choice, quota sampling, sampling in moving populations and snowball sampling are the main examples of the non-probability sample selection methods. However, there are five main techniques of probability sampling methods: simple random sampling (SRS), cluster sampling, stratified sampling, systematic selection, multi-stage selection; and often combinations of these methods are used.

Simple random sampling is the starting point of probability sampling methods. Each element in the population is equally likely to be selected to the sample in equal probability of selection method (epsem). Although epsem is easy to apply and leads to self-weighting samples, it is not preferred in sample surveys due to high cost in implementation and difficulties in checking. After some modifications are applied to this technique, other sample selection methods can be observed (Kish, 1965).

In cluster sampling, groups, i.e. clusters, of elements are selected. Clusters are defined usually based on geographic or spatial characteristic of the population to decrease survey costs such as travel, accommodation and training. Blocks, dwellings, classes and time periods may be clusters and they may have an equal or unequal size (Kish, 1965).

In stratified sampling, population is split into mutually exclusive subgroups (strata). Geographical variables (regions, type of residence etc.) or non-geographical variables (ages, socio-economic status etc.) can be defined as strata in surveys. If one stratum exists, the design becomes SRS. The aim is creating homogeneity within strata and heterogeneity between strata. Thus, not only representativeness of sample increases but also total sampling variance decreases (Kish, 1965).

If every k^{th} sampling unit are selected in sequences from lists, this selection method is called systematic sampling. W. G. Madow and L. H. Madow introduced this technique in 1944. It is easy to implement. Sample is separated into intervals of width I, which is the ratio of N (number population elements) to n (number sample elements). A starting point r is selected randomly from this interval and the process begins with selection of the first element. Then, the following selections go on as r+I, r+2I, r+3I... etc. (Kish, 1965).

Multistage sampling includes more than one stage of probability sampling. It is used commonly in sample surveys, especially household (HH) surveys. The sampling unit at the first step selection is called the Primary Sampling Unit (PSU), at the second step selection it is called the Secondary Sampling Unit and so on. In most cases, population is divided into clusters at the primary stage and then households are selected at the secondary stage. Thus, there are mainly two advantages: creating representative samples and reducing travel and time costs. However, if the number of stages increase, it causes rising sampling errors and complexity in making inferences (Kish, 1965).

DHS surveys with more than 25 years experience has showed that two-stage sample design is easy to apply and provides good quality (ICF International, 2012). Each of Turkey Demographic and Health Survey has multistage and stratified cluster sampling selection approach (HUIPS, 1994; 1999; 2004; 2009; 2014), which will all be explained in detail in Section 3.1.

2.2. Estimation Process

Kish (1965) emphasized two significant aspects of sample design: selection and estimation process. In the previous part, the information about the basic selection methods were given. This section explains estimation process.

Two types of error affect the estimates obtained from sample surveys: sampling errors and non-sampling errors. The types and magnitudes of such errors are important to measure and evaluate data quality. Non-sampling errors include specification, frame, nonresponse, processing and measurement errors. These types of errors are such as errors in definition or classification, errors in questionnaire design, response bias, editing/coding/programming errors, sample selection errors, outdated lists etc. Non-sampling errors are inevitable. On the other side, sampling errors cover sampling variance and estimation bias. The former one can be measured statistically and estimated from the result of survey but the latter one cannot be calculated directly because the exact value of estimated statistics is not known (Yıldız, 2011; HUIPS, 1994; 1999; 2004; 2009; 2014).

The estimated mean of sample ($\bar{y}$) and sampling variance under SRS are:

$$\bar{y} = \frac{\sum_{i=1}^{n} y_i}{n} \tag{2.1.}$$

$$var(\bar{y}) = (1 - \frac{n}{N}) \frac{\sum_{i=1}^{n} (y_i - \bar{y})^2}{n * (n-1)} \tag{2.2.}$$

where y_i is the element of sample, n is sample size, and is N is population size. The standard error (se) measures the sampling error and it is square root of the sampling variance.

$$se(\bar{y}) = \sqrt{var(\bar{y})} \tag{2.3.}$$

The term $(1 - \frac{n}{N})$ is called the finite population correction and is generally assumed to be equal to 1 in practice, whenever the sampling fraction $\frac{n}{N}$ is less than 0.05. Then, the variance formula for SRS becomes:

$$var(\bar{y}) = \frac{\sum_{i=1}^{n} (y_i - \bar{y})^2}{n * (n-1)} \tag{2.4.}$$

After getting the standard error, the confidence interval (CI) of variables are constructed to inference. For example, at the 95% confidence interval for the sample mean is:

$$\bar{y} \mp 2 * se(\bar{y}) \tag{2.5.}$$

where 2 is the rounded value of the t-distribution at %95 confidence level for a large sample (1.96). In some cases, the relative error of estimate is easier to interpret instead of the absolute measure of variation, because it is a unit free, standardized indicator of precision. The relative error (coefficient of variance of the mean, denoted by cv) is calculated as:

$$cv(\bar{y}) = \frac{se(\bar{y})}{\bar{y}} \quad (2.6.)$$

Then, the relative variance of the mean is:

$$cv^2(\bar{y}) = \frac{var(\bar{y})}{\bar{y}^2} \quad (2.7.)$$

Thus, the comparison of the variability is easy and meaningful when it is used (Kish, 1965).

If simple random sampling is used, the above statistics are calculated in a straightforward way and the inferences about population is easy. But, if the sample design becomes complex by multi-stage selection or mix usage of sampling techniques like stratified-cluster sampling, getting inferences about whole population becomes difficult because researcher has complex sample survey in this case (ICF International, 2012). In a weighted, stratified-cluster sampling, any proportion or mean turns into a ratio mean which has sum of weights at the denominator and is thus a random variable. So, the sampling variances, in turn standard errors and confidence intervals of statistics from complex sample surveys are not calculated like simple random sampling.

In addition to these statistics, the design effect (DEFF) can be calculated for comparison between complex survey and simple random sample survey in terms of statistical efficiency. If the results of sample survey approach the simple random sampling's results, DEFF converges to 1. If stratification is used and then variance decreases for this reason, DEFF is smaller than 1. If the DEFF value is bigger than 1 by clustering, it means that the less statistically efficient design are obtained due to rising in the sampling error (Kish, 1965). The definition of DEFF varies in the literature and this sometimes causes confusion. But, in this thesis, DEFT refers to the ratio of standard errors, i.e. the square root of DEFF (ICF International, 2012; Lê and Verma, 1997):

$$DEFT = \frac{se_{Complex}}{se_{SRS}} \tag{2.8.}$$

In order to make inference from complex sample surveys, some specific methods should be applied for variance estimation. The most popular methods are: Taylor Linearization and Jackknife Repeated Replication. In DHS, while the first one is used to get the variance estimation of mean and proportion estimates, the latter one is used to obtain the variances of fertility and mortality rates which are more complex statistics than mean and proportions (ICF International, 2012). The details of sampling error estimation in complex samples by using different methods and software were discussed in Yıldız's master thesis (2011).

There is a widely used assumption for variance estimation in complex samples; called the ultimate cluster approach. This approach assumes that the sample selection is done in a single stage, clusters are selected directly at this single stage, and all units in clusters are interviewed. Thanks to this approach, the calculations become easy (Heeringa et al., 2010).

In this thesis, sampling errors and other statistics will be calculated for selected variables by SPSS program which is used Taylor linearization method, and the outputs will be given in the Results chapter.

2.3. Literature Review

The main concern of this thesis is weighting and this issue has been discussed from different point of views in this section. First of all, the concept of weight was described and discussed by many researchers.

Why, when and how to weight survey data were examined in Kish's papers (1990, 1992). He described seven main sources of weights (disproportionate sampling fractions, inequalities in sample frames, nonresponse, statistical adjustments, combining samples, adjustments to match controls and adjustments for nonprobability) and thought that these sources had different effects on survey. Therefore, different strategies were necessary to deal with these effects. He determined four different weight procedures and also he mentioned three reasons against weighting: 1) complications in estimation, 2) increased sampling variances and 3) lower mean square errors.

Kish (1990) stated that self-weighted samples were mostly preferred due to advantages of simplicity, decreasing variances and robustness. But, in practice, it was not preferred because it caused high survey costs (Kish, 1965). Therefore, instead of SRS, stratification is used to get good spread and efficiency, and clustering is included to reduce costs. In addition to these, weighting is usually necessary to balance the disproportionate allocation of sample among strata. These features affect the accuracy and precision of estimators (Kish, 1965).

In 2003, Kalton and Flores-Cervantes reviewed the weighting methods in their "Weighting Method" paper. Cell weighting, raking, linear weighting, generalised regression weighting, logistic regression weighting, mixture of cell weighting and methods for constraining weight adjustment were discussed. In order to illustrate the application of complex weighting adjustment for large-scale surveys, the U. S. Department of Agriculture's 1987-1988 Nationwide Food Consumption Survey and the Survey of Income and Program Participation were mentioned. The authors underlined that trimming can reduce the loss of precision caused by weighting, and that complex weighting adjustments that are mentioned are highly dependent on the availability of auxiliary information, and the choice of such information is also crucial.

A recent paper about why weights are useful when statistical analyses are conducted on complex sample survey was Lavallée and Beaumont's article (2015). They described the three weighting steps (design weight, nonresponse adjustment and poststratification) and examined the usage of weights in tobacco survey. To get good estimates of parameters, they concluded that weights should be used for statistical analyses of complex sample surveys.

In addition to studies on sample weights in general, there is some literature focusing on the question of whether or not weighted and unweighted results differ, and to discuss whether weight is essential or not. In this framework, while weight was found useful and necessary in some articles, some articles suggested that sometimes there was no difference between weighted or unweighted estimates. Furthermore, for some cases, the results indicated that unweighted analysis is preferable.

Korn and Graubard (1995) presented four examples to show the differences between weighted and unweighted estimators and their effects. The 1988 National Maternal and Infant Health Survey was the main data source. It is known that while unweighted estimators give biased results, weighted estimators give unbiased results for population estimators. In the light of this information, they found that weighted and unweighted means could be quite different.

Little, Lewitzky, Heeringa, Lepkowski and Kessler (1997) studied the weighting adjustment of the National Comorbidity Survey (1990-1992). They compared the estimates, standard errors and root mean squared errors of prevalence (1) not using any weights, (2) weighted without poststratification or trimming, (3) using poststratified weights with no trimming and (4) the final weight with postsratification and trimming for 14 variables so that they could discuss the effects of these adjustments, comparing the bias reduced by weighting to variance increased by these procedures. They discussed that although unweighted estimates were not off by a large extent in this particular survey, the last weighting procedure should be preferred because it did not increase variance significantly and it makes more sense theoretically.

A comparative study using sample weights in multiple regression analyses of stratified samples was made by DuMouchel and Duncan (1983). Four different regression models were defined: 1) the simple linear homoscedastic model, 2) the mixture model, 3) the omitted-predictor model and 4) the general nonlinear model. Unweighted and weighted estimates of the least squares estimator of the regression coefficient of Y on X (β), standard errors and t ratios were examined for a subset data from the Panel Study of Income Dynamics. In conclusion, they preferred the unweighted estimates of regression coefficient because extended models showed no differences.

The National Crime Victimization Survey is a stratified, multistage cluster and approximately self-weighted sample. Weights are used to adjust ratio estimation and to compensate for low nonresponse rate of units with certain characteristics. For these reasons, Lohr and Liu (1994) discussed the usage of weights and examined multiple logistic regressions models to investigate differences in coefficients, and they concluded that models with or without weights gave the same results. They stated that the conclusion would not generalized to other surveys and further statistical investigations were needed.

While weighted logistic regression models were used in rounds two and three of Community Tracking Study Household and Physician Surveys, in the fourth round of this survey unweighted logistic regression models were applied to compensate for nonresponse. In order to evaluate whether bias or higher variability in this survey using two different weight techniques, Grau, Potter, Williams and Diaz-Tena (2006) compared nonresponse adjustment using weighted and unweighted models. They found that the unweighted models had greater bias, but it was not significant. Also, the weighted model had slightly larger variance, yet this difference too was negligible.

There are also some studies in the literature that compare the use of different weighting approaches:

In 1996, Hermalin, Entwisle and Khadr stated that the service availability module (SAM) data in Egypt Demographic Health Survey (EDHS) did not represent the primary sampling unit, so they decided to re-weight the SAM data for rural areas. In other words, the weights were calculated at the household and individual levels, but the authors needed PSU level weights to produce PSU level statistics. The values of villages and women of reproductive age were compared with respect to the accessibility of family planning facilities measure and density. In Appendix of paper, the weights and standardized weights of selected rural PSU were tabulated. Also, the village population sizes were compared for 1988-89 EDHS and 1986 census in terms of different distributions.

The weighting procedures of the U. S. Department of Agriculture's Continuing Survey of Food Intakes by Individuals from 1994-1996 were discussed by Chu and Goldman (1997). The main focus of the paper was poststratification adjustment by raking. The authors compared the coefficient of variation of weights under alternative weighting schemes. It caused increasing in sampling variance when larger raking was observed.

Carlson and Williams (2001) compared the weighting class methods and propensity modeling for nonresponse adjustment in the Community Tracking Study Household Survey. Variables related to response rate were identified and logistic models were developed to estimate. The results of the aforementioned two weighting methods were almost equal to each other with respect to design effect and national level estimates.

The National Comorbidity Survey Replication design and field procedures were described in the paper by Kessler et al. (2004). Two weighting approaches (non-response and multiple-imputation) were used to weight the data. Each weight approach included five different weight components (a subsampling weight, within household selection probability, nonresponse, poststratification and a probability for being selected to the second part of the questionnaire). Weighted and unweighted distribution of respondents by basic characteristics were compared and biases were reduced by the use of weight. They also examined the effect of different weight components on the significance of bivariate associations. They concluded that weights should not be ignored in general, that important covariates of an independent variable may not be affected by weights, and suggested that model based approaches are used to study risk factors of a variable.

In 2006, the Telephone Survey System for Monitoring Risk and Protection Factors for Chronic Illness (VIGITEL) in Brazil set up to collect information about risk factors of health such as smoking, excessive consumption of fast food/alcohol, being overweight. Although telephone survey is more advantageous with respect to low survey cost and rapid process time than face-to-face household survey, bias can occur in this method because household without landlines are excluded from the frame and increasing trends are observed in nonresponse. For this reason, Bernal, Malta, de Araújo and Silva (2013) evaluated the effects of using poststratification weights on correction of bias in VIGITEL, and suggested that to minimize the bias in estimates, alternative weighting methods, like poststratification, is necessary.

Kolenikov (2016) considered the similarities and differences of weight adjustment steps with an illustrative example. The values of estimates weighted by four different weights: 1) non-response adjusted weights, 2) the poststratified weight,

3) raking and 4) the combination of the initial two. Then, estimated totals were compared. In conclusion, he decided that the combination of the nonresponse adjustment and poststratification caused most accurate weight due to less bias.

While weighting process has been included in many surveys, the extreme weights and their effects have also been argued to become problematic at the same time. For this reason, some authors have searched for solutions to this problem:

Potter (1989) stated that unexpected variability or extreme values in sampling weights may occur in survey practice due to sample selection process, errors in data frame and nonresponse adjustment, and they could cause inflation in sampling variances, decreasing precision. It was underlined that many private and public organizations used various trimming procedures to deal with extreme weights. Potter described two procedures: (1) minimizing the number and size of extreme weights, and (2) identifying, trimming and compensating for extreme final sampling weights. The Census Bureau was among the institutions that applied the former approach, in the Current Population Survey and the Consumer Expenditure Survey. For the latter approach, descriptive analysis and the distributions of final sampling weights were the fundamental component.

Liu, Ferraro, Wilson and Brick (2004) focused on methods of detecting extreme weights in household surveys. They reviewed the literature for existing methods, and discussed their limitations. Then, they proposed a new method to identify extreme weights and evaluated the strengths and weaknesses of the method for two random digit dial telephone surveys: the National Survey of America’s Families and the California Health Interview Survey. They believed that their method decreased the challenges regarding outlier detection and could be applied to many household surveys.

In addition to these valuable studies, some authors wanted to measure the effects of weighting and came up with some formulas to estimate this. The use of these formulas was examined by some researchers:

Weighting is used to deal with the unequal distributions of non-response and non-coverage effects (Kish, 1965). In the DHS program, two separate weights are calculated for households and individuals. While the design weight is generally described as the inverse of the product of each stage's selection probabilities, the sampling weights are obtained from adjusted design weight by non-response or other calibrations (ICF International, 2012). The details of the weight calculations will be explained in 3.2. Methodology section. So, the measure of weighting effect on estimates are mentioned in this section.

To calculate the effect of weighting on sample estimates, the below loss of weighting term, defined by Kish (1965), can be used, but this term is often nontrivial.

$$L_{we} \approx cv^2(w) = \frac{s^2(w)}{\bar{w}^2} \qquad (2.9.)$$

where

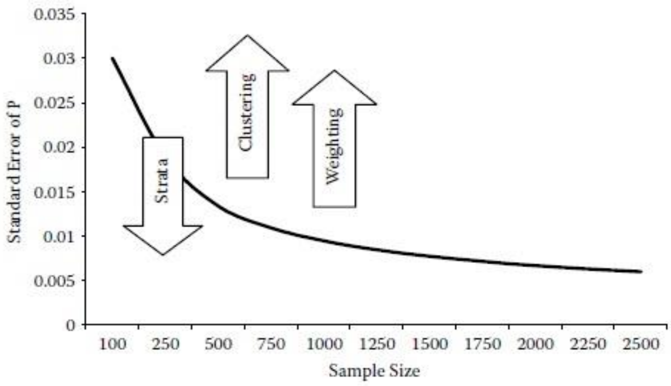
$cv^2(w)$ is the sample weight's relative variance,

$s(w)$ is the sample weight's standard deviation,

$\bar{w}$ is the mean of sample weights.

Figure 2.1. shows how the standard error of estimates are affected by stratification, clustering and weighting. At any sample size level, while stratification decreases the standard error, clustering and weighting increase it (Heeringa et al., 2010).

Figure 2. 1. The Design Effects on Standard Errors



Source: Heeringa et al., 2010

The ratio between the effect of these three variables on standard error and the standard error of SRS is compared by design effect. The notation of this term differs between the one in the previous subsection and the current one, because both have been presented according to their original sources. When sample is not self-weighted, it is expected that the DEFT value is greater than 1.

$$DEFT \approx 1 + f(G_{st} + L_{cl} + L_{we}) \tag{2.10.}$$

where

G_{st} is relative gain in precision comes from stratification,

L_{cl} is relative loss in precision due to clustering,

L_{we} is relative loss in precision due to weighting.

In order to see the gain and loss of precision in sample design, four different sample design scenarios (SRS, clustered, stratified and stratified-clustered) were examined by Heeringa and et al. (2010) (Figure 2.2.). Under the self-weighting condition, the result showed that the mean estimation of population did not change from design to design. However, when the clustered design had the highest estimated standard error and design effect, the stratified design had the lowest values for them. Moreover, it was observed that the results of stratified-clustered design fell between the values of clustered and stratified ones.

Table 2.1. The Sample Estimates Table of Four Different Sample Design

Sample Design Scenario	**Estimator**	$\bar{y}$	**se($\bar{y}$)**	**d($\bar{y}$)**	**d^2($\bar{y}$)**	**n_{eff}**
SRS	$\bar{y}_{srs}$	40.77	2.41	1.00	1.00	32
Clustered	$\bar{y}_{cl}$	40.77	3.66	1.51	2.31	13.9
Stratified	$\bar{y}_{st}$	40.77	2.04	0.85	0.72	44.4
Stratified, clustered	$\bar{y}_{st,cl}$	40.77	2.76	1.15	1.31	24.4

Source: Heeringa et al., 2010

Verma, Scott and O'Muircheartaigh (1980) examined the sample design and sampling errors of variables for the participating countries of the World Fertility Survey. They also hoped that the effect of stratification, sampling stages and cluster size on sample design features would be observed in their paper; so that later surveys would be redesigned according to this valuable assessment and useful data. They prepared rich tables for comparability. Initially, the sample design characteristics for all countries were given. Then, for some selected countries, the sampling errors were computed by using the women surveys. The comparison logic was depended on the design effect mainly. To measure the effect of unequal weighting, the below formula which was defined by Kish in 1965 was used:

$$L = \frac{\sum_{h=1}^{H} n_h \sum_{h=1}^{H} n_h w_h^2}{(\sum_{h=1}^{H} n_h w_h)^2} \qquad (2.11.)$$

where

n_h is the total number of individuals in domain h,

w_h is the weight of domain h.

In this case, the DEFT value was defined as square root of L value. Effects of weighting were calculated for three countries with respect to total sample, urban and rural areas separately.

Verma and Lê (1996) examined the sampling error and design effects of 48 national level surveys under DHS program for various variables, sub-areas and sub-classes. They also investigated the effect of sampling weight on sampling error using again Formula 2.11. In this paper, D_w^2 was used instead of L and for 10 countries departed from self-weighting, the effect of weighting on DEFT was illustrated.

According to Little and Vartivarian (2005), nonresponse weighting was used commonly to handle unit nonresponse in surveys. They noted that it is often suggested that nonresponse adjustments in sampling weights decrease bias, but increase variance. They redefined the right side of Formula 2.9. and then compared the estimates. Their findings implied that if the variables used for non-response adjustments were associated with survey variables, they could decrease variance as well as bias.

In addition to all above mentioned studies, Chin, Harding and Bill (2006), Hermes and Poulsen (2012), Tanton, Vidyattama and MnNamara (2011) and also Tanton, Williamson and Harding (2014) compared the algorithm methods of reweighting survey for small area estimations. They have not been discussed further because they are beyond the scope of this thesis.

There is no study about the comparison of weighting procedure in Turkey Demographic and Health Survey. But, sampling errors of each research for selected variables have been given in the Appendix C of each survey report (HUIPS 1994; 1999; 2004; 2009; 2014).

All in all, literature review shows that the use of weights have generally been suggested and using weight adjustment components such as nonresponse, poststratification, improve survey estimates in complex survey analysis through decreasing bias.

CHAPTER 3. METHOD

In this section, first of all, the data sets of this thesis will be introduced and then the weighting procedure of the all Turkey Demographic and Health Surveys will be explained. The main source of these subsections is Appendix B of each TDHS (HUIPS 1994; 1999; 2004; 2009; 2014). Finally, the weighting approach of this study will be given.

3.1. Data

The details of the data sets will be described in this subsection with respect to sample design and implementation, sample frame, stratification criteria, sample allocation and selection, types of questionnaire in each TDHS and the results of fieldwork. TDHS-1993, TDHS-1998, TDHS-2003, TDHS-2008 and TDHS-2013 are the data source of this thesis.

3.1.1. TDHS-1993

According to the contract between the General Directorate of Mother and Child Health and Family Planning, Ministry of Health and Macro International Inc. of Calverton, Maryland, 1993 Turkey DHS was operated by HUIPS. The major characteristics of the TDHS-1993 is that it had a weighted, multistage and stratified cluster sampling approach.

There were five regions defined in Turkey in terms of demographic, social, cultural and economic differences: West, East, North, South and Central. This definition had been used in demographic surveys since 1968 when the first large scale demographic survey was conducted. Moreover, it is divided into two areas: urban and rural. Different definitions of these areas have been used in the demographic surveys of Turkey. In the 1970s, a threshold of population size 2,000 was assigned when classifying settlements as urban or rural. Then, the size was raised 10,000 in the 1980s and 20,000 in the 1990s as well. However, the combination of the administrative status of settlements and the population size was used to create urban and rural group for some surveys. If population size in provincial centers, district centers, and other settlements is larger than 10,000, it is made part of the urban frame. Otherwise, it belonged to the rural frame. This description of urban - rural framework for the TDHS-1993 initially came from the 1985 census and the 1990 Population Census report. But, there was population growth, so populations increased after this report was published, and this situation caused the change of the status of settlements. Therefore, the final frame of the TDHS-1993 survey was shaped by the taking these differences into consideration. Exponential growth formulas were used for projection. Thereby, the urban category composed of district centers regardless of population size and all settlements with population size larger than 10,000, while the rural one consisted of all remaining settlements.

Methodologically and conceptually consistent design of previous demographic surveys is the key priority to create next TDHS. For this reason, the stratification was based on two criteria: the region and urban-rural division of Turkey. The TDHS-1993 covered all 76 provinces of Turkey in 5 regions. Moreover, the infant mortality rate estimates of each province from 1990 Population Census was used to define strata. Thus, 14 subregions were created in total (Hancıoğlu, 1991). The urban and rural criteria were also added, then the total number of strata became 28.

In this survey, 10,000 households and approximately 8,000 women interviews were aimed. In order to get powerful sampling efficiency and decrease the sampling errors, the target sample size had been allocated in stratum level for estimation domains for each TDHS. Generally, 1,000 women aged between 15 and 49 are taken as a sample for each geographical domain (Macro International Inc.,1996) to be able to obtain a good level of precision for DHS indicators. A proportional allocation had not been recommended because the stratum sizes were different than each other and it was not possible to give prediction in a small domain.

The sample selection procedure composed of three stages: Firstly, settlements were chosen systematically with probability proportional to size (PPS). Then, quarter segments were selected in urban areas which included 100 households, and villages or subdistricts were selected directly in rural areas. All selected clusters were listed to update the frames. So, listing was run in the fieldwork (Appendix B) and during this activity, segmentation (which will be explained in section 3.2.2.) was done whenever necessary. Consequently, the full address of each dwelling units were obtained from not only the 1990 Population Census, created by State Institute of Statistics (SIS), but also the listing operation. At the last stage of selection, an average of 20 households per segment were selected to represent each cluster sufficiently in overall sample.

In the fieldwork, two main questionnaires were applied: The Household Questionnaire for each household and The Individual Questionnaire for ever-married women aged between 15 and 49 in eligible households. Fieldwork proceeded between August and October 1993. The total number of households and clusters were respectively 10,631 and 500. Yet, 478 clusters could be visited due to accessibility and security problems. All in all, 8,619 households and 6,519 women interviews were completed (Table 3.1.).

Table 3.1. Design Characteristics and Sample Implementation for TDHSs

	TDHS-1993	TDHS-1998	TDHS-2003	TDHS-2008	TDHS-2013
Design Characteristics					
Number of strata	28	28	40	36	36
Number of clusters	500	480	700	634	642
Sample implementation					
Target Number of HHs	10,631	9,970	13,049	13,521	14,490
Eligible HHs	8,900	8,596	11,659	11,911	12,640
Completed HHs	8,619	8,059	10,836	10,525	11,794
HHs response rate	96.8%	93.8%	92.9%	88.4%	93.3%
Eligible Women	6,862	9,468	8,447	8,003	10,840
Completed Women	6,519	8,576	8,075	7,405	9,746
Individual response rate	95.0%	90.6%	95.6%	92.5%	89.9%

Source: (HUIPS, 1994; 1999; 2004; 2009; 2014)

3.1.2. TDHS-1998

HUIPS and the General Directorate of Mother and Child Health and Family Planning, Ministry of Health worked together in the TDHS-1998 under the agreement with Macro International Inc. of Calverton, Maryland. The financial supporters of the study were United Nations Population Fund and United States Agency for International Development.

This study and the TDHS-1993 had almost the same sample design. In the TDHS-1998, the number of provinces of Turkey increased to 80 but this situation did not lead to change in the boundary of the regions. Information about the sizes of settlements came from the temporary results of the 1997 Population Count.

In this survey, there was a slight modification to the definitions of urban and rural settlements compared to TDHS-1993. The urban framework was described by settlements with population sizes larger than 10,000 regardless of their administrative status. Thus, the rural framework composed of all other settlements outside the urban framework.

The allocation of the subregions, the total number of strata and the target sample sizes were also similar to the TDHS-1993. The primary stage of the sample selection process ended up with a list of the settlements from the 1997 Population Count. At the secondary stage, the assigned number of clusters were chosen in each settlement. SIS provided the 1995 Structure Schedules (SS) (Appendix C) for some settlements and the segmentation was applied to these settlements. Each segment included nearly 100 households. On the other hand, the remaining settlements which did not have any SS was compiled during listing activity. In the fieldwork, the whole settlements were listed if the number of households was less than 250. Otherwise, 250 households were listed and the remaining number of settlements were counted quickly. Thereby, the full addresses of dwelling units were updated when available, and were created from scratch during listing activity when absent. At the final stage, households were selected with systematic random sampling from each cluster. The cluster sizes per urban and rural segments were fixed at 25 and 15 households respectively in this survey though they had been various in TDHS-1993.

Four questionnaires for different groups existed in this survey: 1) The Household Questionnaire for total population and three individual questionnaires: 2) Ever-Married Women's Questionnaire for ever-married women in reproductive ages, 3) Never-Married Women Questionnaire for never-married women aged between 15-49 and 4) Husband Questionnaire for husbands of eligible currently married women. The data collection and processing activities were finished at the end of November 1998. Table 3.1 shows that the target number of households was 9,970 for 480 clusters. However, 476 clusters could be visited and the interviews could be completed for 8,059 households and 8,576 women.

3.1.3. TDHS-2003

TDHS-2003 was carried out by HUIPS and the General Directorate of Mother and Child Health and Family Planning, Ministry of Health. Although the previous TDHSs had financially support from the international organizations, the budget of the TDHS-2003 was from national funds for the first time.

Some characteristics of the sample design, such as estimation domains, some stratification variables and the sample frame of this study were the same as the TDHS-1998. However, the adaptation process of Turkey to the European Union and also the increasing number of provinces made a major difference in sampling design. In order to collect data and produce regional statistics, analyze the socio-economic status and develop policies for regions and create comparable statistics database to European Union, the State Planning Office and the State Institute of Statistics decided to implement officially a statistical classification of the member countries of the European Union, was named as "*Nomenclature of Territorial Units for Statistics*" (NUTS) in 2002. According to this classification, NUTS 3 level composed of 81 provinces, 26 regions in NUTS 2 level was created by the grouping of these provinces and 12 regional allocations were obtained in NUTS 1 level. Thus, the definition of the strata for the survey changed to cover both 5 regions and 12 regions. In order to make this possible, slight modifications were made to the 5 regions by changing the position of 6 provinces (Gaziantep, Gümüşhane, Muğla, Kahramanmaraş, Kilis, and Sivas) in the definition of classical 5 regions. Türkyılmaz and Hancıoğlu (2004) researched whether this alteration was necessary and if it had any effect on the variables or not. It was checked that these modifications did not cause any meaningful changes in regional indicators. In addition to this, the largest metropolitan cities had important effects on the design. Istanbul was divided into two parts: slum and non-slum. Besides, a huge earthquake occurred in Turkey on 17 August 1999 and the affected states were taken into consideration as separate estimation domains. As a result of all this information, the number of the strata rose from 28 to 40 in this study. This increase in the number of strata also increased the number of clusters and households.

Like the previous survey, the sample selection process had three stages and the fixed cluster size was described as 25 households per urban and 15 households per rural. Each block in urban cluster normally consisted of 100 households. But, one exception emerged from the slum and non-slum Istanbul segments. In those clusters, blocks were created from 50 households and the cluster size selected 12 households. The results of the 2000 General Population Census gave the primary information about settlements and again the SS were used for some settlements. If a settlement which had less than 250 households was selected as a segment, and did not have a structure schedule, the whole settlement was listed. If the segment was greater than size 250 and was without an SS, the first 250 ones were listed, then the remaining ones were counted to fill out the number of unlisted HH field.

The household and individual questionnaires which were very similar to the TDHS-1993, were used for data collection. Even though almost 13,000 households and 11,000 individuals interview were aimed for 700 clusters, 10,836 household questionnaire and 8,075 ever-married women's questionnaire (Table 3.1.) were successfully completed in 688 clusters.

3.1.4. TDHS-2008

TDHS–2008, the fourth survey conducted under the DHS Program, was conducted by Hacettepe University Institute of Population Studies. T. R. Ministry of Health General Directorate of Mother and Child Health and Family Planning and T. R. Prime Ministry State Planning Organization Undersecretariat were the beneficiary institutions. In addition to them, The Scientific and Technological Research Council of Turkey (TÜBİTAK) was the financial supporter.

The preparatory studies of the TDHS-2008 started in March 2007 and the sample design and implementation were similar to TDHS–2003 in general framework. The definition of urban-rural was the same as the previous survey. It was the first time that information to design the sample had not been obtained from census information, but had been rather obtained through registration data. A law regarding the establishment of the Address Based Population Registration System (ABPRS) was issued in 2006 (The Republic of Turkey Official Gazette, 2006), and was implemented in 2007, when population figures were announced based on this system for the first time (SIS, 2008). The ABPRS was based on the National Address Data Base, which is a frame containing all addresses in Turkey. The ABPRS registers each person with their citizen ID number to an address listed in the National Address Database. For designing the sample, settlement sizes were obtained through the ABPRS-2007. In TDHS-2008, segments were created based on the National Address Data Base, where occupied households were included only. These segments were created from a list of occupied households sorted by geographic proximity, and had a size of approximately 100 households each. These segments were provided for most of the clusters selected. However, segment lists could not be provided for some clusters that were of rural nature, provided the new address based system was still new.

The sample selection stages of TDHS-2008 resembled the TDHS–2003. The one-time needs of the 2003 survey were excluded from this study (such as earthquakes cities, defining slum/non-slum areas of Istanbul), then the number of strata became 36.

There were two questionnaires in the TDHS-2008: The Household Questionnaire and The Individual Questionnaire. They were applied to eligible HHs and ever-married women aged between 15-49 in the household list. A total of 10,525 HHs and 7,405 individuals interviews were completed within the 36 strata (Table

3.1.). TDHS-2008 has the lowest cluster level non-response level among the TDHSs so far because only one cluster could not be visited.

3.1.5. TDHS-2013

Hacettepe University Institute of Population Studies conducted 2013 Turkey DHS with the contributions of T. R. Ministry of Development and T. R. Ministry of Health. The financial institution of the survey was again TÜBİTAK.

The sample design, sample frame and stratification process were similar to the TDHS-2008. But, the change in both the selection process and rural cluster sizes were two main differences of this survey. The block selection from each stratum, defined as primary sampling units and was made by Turkey Statistical Institute (TURKSTAT)[1]. The blocks were address lists that were composed of dwelling unit addresses with at least one registered ID number as a usual resident in ABPRS. Therefore the number of selection stages decreased from three to two in TDHS-2013. The second phase involved the selection of households from these blocks after the listing operation had finished. The cluster sizes are different in urban and rural areas in TDHS surveys. Although the urban size (25 HHs) was the same as the previous ones, the rural size of cluster was changed to 18 HHs in 2013.

Also, the increasing rate of nonresponse was taken into consideration. So, while the target sample size were 14,496 households, the total number of clusters become 642.

The Household Questionnaire for all households and The Individual Questionnaire for all women aged between 15-49 year were used in the fieldwork

[1] The name of the State Institute of Statistics (SIS) was changed as Turkey Statistical Institute (TURKSTAT) with the new Turkish Statistical Law No. 5429 (The Republic of Turkey Official Gazette, Law No:5429, 2005).

and for 641 clusters, the response rates of households and women were calculated as 93.3 and 89.9 percent (Table 3.1.).

3.2. Selected Indicators

In this thesis, 23 variables are selected which are included in the Appendix C: Sampling Errors of each TDHS report, for whom proportions or means, standard error, confidence interval, coefficient of variation (cv) and design effect are provided. These variables will be recalculated and presented in the result chapter, with showing the differences in point estimates and precision. In Table 3.2., the variable names and their types are given. The main subpopulation of each variable depends on the identification of women (individual) questionnaire's target population and differs from survey to survey. For instance, the sampling error for "Never married" cannot be calculated for TDHS-1993, TDHS-2003 and TDHS-2008 because only the ever-married women reproductive ages were interviewed in those studies. For TDHS-2003 and TDHS-2008, the sampling error of "Currently pregnant", "Children ever born" and "Children surviving" are calculated by using all women instead of ever-married women and this situation requires additional procedures and different program usage. So, the only point estimates will be calculated for these three variables. In this case, the numerator is the target women population and the denominator is all women population, calculated by all women factors (Rutstein and Rojas, 2003). In other words, numerators were weighted by sample weight, and the denominators were weighted by the sample weight multiplied by all women factors.

Table 3.2. The Selected Indicators for Sampling Errors

Variable	Type of Estimation	TDHS-1993	TDHS-1998	TDHS-2003	TDHS-2008	TDHS-2013
Urban residence	Proportion	Ever-married women	All women	Ever-married women	Ever-married women	All women
No education	Proportion	Ever-married women	All women	Ever-married women	Ever-married women	All women
Secondary school or higher	Proportion	Ever-married women	All women	Ever-married women	Ever-married women	All women
Never married	Proportion	-	All women	-	-	All women
Currently married/in union	Proportion	Ever-married women	All women	Ever-married women	Ever-married women	All women
Currently pregnant	Proportion	Ever-married women	All women	All women	All women	All women
Children ever born	Mean	Ever-married women	All women	All women	All women	All women
Children surviving	Mean	Ever-married women	All women	All women	All women	All women
Knowing any contraceptive method	Proportion	Ever-married women	Currently married women	Currently married women	Currently married women	Currently married women
Knowing any modern contraceptive method	Proportion	Currently married women	Currently married women	Currently married women	Currently married women	Currently married women
Ever used any contraceptive method	Proportion	Currently married women	Currently married women	Currently married women	Currently married women	Currently married women
Currently using any method	Proportion	Currently married women	Currently married women	Currently married women	Currently married women	Currently married women
Currently using a modern method	Proportion	Currently married women	Currently married women	Currently married women	Currently married women	Currently married women
Currently using pill	Proportion	Currently married women	Currently married women	Currently married women	Currently married women	Currently married women
Currently using IUD	Proportion	Currently married women	Currently married women	Currently married women	Currently married women	Currently married women
Currently using condoms	Proportion	Currently married women	Currently married women	Currently married women	Currently married women	Currently married women
Currently using injectables	Proportion	Currently married women	Currently married women	Currently married women	Currently married women	Currently married women
Currently using female sterilization	Proportion	Currently married women	Currently married women	Currently married women	Currently married women	Currently married women
Currently using periodic abstinence	Proportion	Currently married women	Currently married women	Currently married women	Currently married women	Currently married women
Currently using withdrawal	Proportion	Currently married women	Currently married women	Currently married women	Currently married women	Currently married women
Want no more children	Proportion	Currently married women	Currently married women	Currently married women	Currently married women	Currently married women
Want to delay at least 2 years	Proportion	Currently married women	Currently married women	Currently married women	Currently married women	Currently married women
Ideal number of children	Mean	Ever-married women	All women	Ever-married women	Ever-married women	All women with numeric responses

3.3. Methodology

As discussed, the most basic kind of sample is a simple random sample, where each unit has an identical probability of selection. This type of sample does not require any weighting due to self-weighting, and variance estimation is straightforward. In other words, all units have a sample weight value of 1. SRS offers unbiased population estimates. On the other hand, self-weighted designs may still need sample weights. For instance, in a stratified sample design where the sample is proportionately allocated among strata; different levels of non-response in these strata make the use of weights necessary so that all strata are represented as in the population distribution.

Moreover, household surveys are often expected to provide estimates for different domains (regions, etc.), and simple random samples do not always provide enough number of cases for such analysis. In order to get good spread and control the sample size for each domain, stratification is used. Also, cluster is included in sampling process to decrease the travel cost and necessary time for data collection. So, an equal probability of selection is not feasible in this stratified cluster survey sampling. Variance increases and its estimation becomes complex. If unequal selection probabilities are not accounted for, population estimates are biased. In order to balance unequal selection probabilities and get unbiased population estimation, "weighting", is used. It also deals with the unequal distributions of non-response and non-coverage effects (Kish, 1965).

In addition to design weights that balance the effect of the unequal selection probabilities and non-response adjustments that ensure the uneven spread of nonresponse; there are some more adjustments that can be done to weights. One of them is called post-stratification. These weights are based on external data sources that provide distributions of some basic variables, such as age or sex, and adjust the sample data to resemble the population in terms of basic variables. Non-coverage adjustments are also possible but are difficult because the percentage of coverage cannot be obtained from the sample. In the DHS Program, the calculation of sampling weights has been changed over time due to the evolution of both the sample selection procedure and the computation approach. For instance, when strata weights were calculated in surveys which were used DHS III Sampling Manual (1996), cluster weights have been calculated according to DHS Sampling and Household Listing Manual since 2012.

Both changes in the DHS approach for the calculation of sampling weight, and in the sampling frame of household surveys in Turkey were reflected in the sample design and weight calculations of Turkey DHS. While the surveys prior to the TDHS-2013 were based on three-stage sample selections, the TDHS-2013 was selected with a two-stage selection approach. With the changes in the weighting scheme of DHS, the TDHS-2013 weights were computed in the cluster level, whereas the weights prior to this survey were computed in the stratum level. The main difference comes from the block and listing household sizes; while cluster level weights account for their difference, stratum level weights do not.

In this section, therefore, the weight computations in TDHSs will be examined and the weighting approaches of this thesis will be defined.

3.3.1. Weight Computations in TDHSs

It is known that Turkey DHS is not self-weighted surveys due to the fact that there is a different selection probability for each cluster. The probability of sample selection and non-response of the units are the main elements of the sampling weights in TDHSs. While the former one consists of the multi-stage selection probabilities, the latter one comes from different response behaviour of different units. For example, the response rate of the rural households are higher than their urban counterparts, highly educated individuals are less respondent than lower educated ones, never-married women are less likely respondent than ever-married women, and so on (ICF International, 2012).

The weight calculation of surveys prior to TDHS – 2013 and for TDHS – 2013 will be given separately due to the different multi-stage selection in those surveys.

3.3.1.1. The Calculation of Sampling Weights before TDHS-2013

Sample selection process was composed of three stages between TDHS–1993 and TDHS–2008. The general definition of each stage could be like this: 1) The primary sampling units were settlements in the first stage, selected systematically from a list of all settlements with PPS within each stratum. 2) Blocks or segments were selected from settlements at the second stage. In urban areas these were address lists of around 100 HHs each. In rural areas it was often a whole village. The details were given for these surveys in Section 3.1. Data. 3) With listing done after 2nd stage, the final stage included the selection of households from listed segments and villages.

The following notations are used to simplify the calculation of design weights (dw):

P_{1hi} : the first-stage sampling probability of the i^{th}cluster in the stratum h,

P_{2hij} : the second-stage sampling probability of the j^{th} segment in the i^{th} cluster of the h^{th} stratum,

P_{3hij} : the third-stage sampling probability of any household within the j^{th} segment in the i^{th} cluster of the h^{th} stratum (households were selected with equal probability within clusters),

n_h: the number of clusters to be selected from stratum h,

M_{hi}: the measure of size regarding the residing number of households in the i^{th} cluster of the h^{th} stratum,

M_h: the total number of households in the h^{th} stratum,

$$M_h = \sum_{i=1}^{h} M_{hi} \tag{3.1.}$$

M_{hij}: the measure of size of the j^{th} segment in the i^{th} cluster of the h^{th} stratum,

$M_{hij}{}'$: the measure of size of the j^{th} segment in the i^{th} cluster of the h^{th} stratum after listing activity,

m_{hij}: the number of selected households in the j^{th} segment of the i^{th} cluster in the h^{th} stratum.

The selection probability of each steps are below:

$$P_{1hi} = \frac{n_h * M_{hi}}{M_h} \tag{3.2.}$$

$$P_{2hij} = \frac{M_{hij}}{M_{hi}} \tag{3.3.}$$

$$P_{3hij} = \frac{m_{hij}}{M_{hij}{}'} \tag{3.4.}$$

The total selection probability of TDHS is obtained from the product of all stage selection probabilities:

$$P_{hij}{}^{TDHS} = P_{1hi} * P_{2hij} * P_{3hij} \tag{3.5.}$$

If each stage selection probabilities are written explicitly in Formula 3.5., $P_{hij}{}^{TDHS}$ looks like:

$$P_{hij}{}^{TDHS} = \frac{n_h * M_{hi}}{M_h} * \frac{M_{hij}}{M_{hi}} * \frac{m_{hij}}{M_{hij}{}'} \tag{3.6.}$$

M_{hi} 's at the numerator and the denominator of this formula cancel out each other. The stratum level weight calculation scheme implicitly assumes that $M_{hij}{}'$is equal to M_{hij}, because in practice, only M_{hi} and m_{hij} are used in the computation of the weights; as if $M_{hij}{}'$and M_{hij} cancel each other out. Therefore, although the final form of probability selection is written above, the overall form is as below in practice:

$$P_h{}^{TDHS} = \frac{n_h * m_h}{M_h} \tag{3.7.}$$

The inverse of the total probability of selection gives the design weight of the survey and it is the same for both household and individual in the stratum level:

$$dw_h{}^{TDHS} = \frac{1}{P_h{}^{TDHS}} = \frac{1}{\frac{n_h * m_h}{M_h}} \tag{3.8.}$$

The reason that the household and individual level design weight are the same is that there is no respondent selection within households and all eligible persons are interviewed.

Nonresponse is the second components of the weights computation in these surveys. The computation for response rate (RR) is the ideal way of the dealing with nonresponse problem. RR becomes different for cluster, household and individual level.

In order to clarify the calculation of the response rate in the strata level, the below notations are used:

RR_{ch} : the cluster level response rate in the stratum *h*,

RR_{hh} : the household level response rate in the stratum *h*,

RR_{ph} : the individual (personal) level response rate in the stratum *h*,

n_h: the number of clusters to be selected in the stratum *h*,

n_h^*: the number of clusters to be completed in the stratum h,

m_h: the number of eligible households in the stratum h,

m_h^*: the number of completed households in the stratum h,

k_h: the number of eligible individuals in the stratum h,

k_h^*: the number of completed individuals in the stratum h.

The response rates are calculated like this:

$$RR_{ch} = \frac{n_h^*}{n_h} \tag{3.9.}$$

$$RR_{hh} = \frac{m_h^*}{m_h} \tag{3.10.}$$

$$RR_{ph} = \frac{k_h^*}{k_h} \tag{3.11.}$$

Here, m_h, m_h^*, k_h and k_h^* are defined in open form:

The Household Questionnaire's result codes are: Completed (HH1), Household Present but no competent respondent at home (HH2), Household Absent (HH3), Postponed (HH4), Refused (HH5), Dwelling Vacant or address not a dwelling (HH6), Dwelling Destroyed (HH7), Dwelling Not Found (HH8), Partly Completed (HH9) and Other (HH96).

The Individual Questionnaire's result codes are: Completed (I1), Not at Home (I2), Postponed (I3), Refused (I4), Partly Completed (I5) and Other (I6).

Then, using the result codes, RR_{hh} and RR_{ph} are written as:

$$RR_{hh} = \frac{HH1}{HH1 + HH2 + HH4 + HH5 + HH8 + HH9} = \frac{{m_h}^*}{m_h} \quad (3.11.)$$

$$RR_{ph} = \frac{I1}{I1 + I2 + I3 + I4 + I5 + I6} = \frac{{k_h}^*}{k_h} \quad (3.12.)$$

All in all, the household sampling weights (sw^{HH}) and the individual level sampling weights (sw^{P}) for each stratum are the product of design weights and the inverse of the response rates:

$$sw_h^{HH} = \frac{{dw_h}^{TDHS}}{(RR_{ch} * RR_{hh})} = \frac{1}{{P_h}^{TDHS}} * \frac{1}{(RR_{ch} * RR_{hh})} \quad (3.13.)$$

$$sw_h^{P} = \frac{{dw_h}^{TDHS}}{(RR_{ch} * RR_{hh} * RR_{ph})} = \frac{1}{{P_h}^{TDHS}} * \frac{1}{(RR_{ch} * RR_{hh} * RR_{ph})} \quad (3.14.)$$

After the non-response adjustment, all weights were normalized. This means that the weights were adapted arithmetically, so that the sum of sample weights equal to the sample size.

The normalized sampling weights are given below:

$$HV005_h = sw_h^{HH} * \frac{\sum \sum {m_h}^*}{\sum_{h=1}^{H} sw_h^{HH} * {m_h}^*} \quad (3.15.)$$

$$V005_h{}^P = sw_h^P * \frac{\sum_{h=1}^{H} k_h^*}{\sum_{h=1}^{H} sw_h^p * k_h^*} \quad (3.16.)$$

3.3.1.2. The Calculation of Sampling Weights in TDHS-2013

The two major differences in the TDHS-2013's sampling weights come from sample selection process and the switch to a cluster-level weight approach. A third difference comes from the calculation of non-response adjustment, as will be explained further below. In TDHS-2013, two-stage selection process were applied due to the change in the sampling frame, and cluster level weights were computed because of the change in the DHS Program methodology. The first stage, defined as primary sampling units, was the block selection from each stratum. The selection of households from the blocks was the second stage. The details of the sample design and implementation were examined in Section 3.1. Data.

The following notations which are very similar to the previous subsection are used to simplify the calculation of design weights:

P_{1hi} : the first-stage sampling probability of the i^{th}cluster in the stratum h

P_{2hi} : the second-stage sampling probability within the i^{th} cluster of the h^{th} stratum,

n_h: the number of blocks to be selected from stratum h,

M_{hi}: the measure of size regarding the residing number of households in the i^{th} block of the h^{th} stratum,

M_h: the total number of households in the h^{th} stratum,

t_{hi}: the number of selected households in the i^{th} block of the h^{th} stratum (as fixed cluster size),

L_{hi}: the updated size of the i^{th} block of the h^{th} stratum after listing activity.

In this part, t_{hi} and L_{hi} are defined instead of m_{hij} and M_{hij}' which were desribed in the previous part respectively because DHS Sampling and Household Listing Manual has used to these latest notations since 2012.

The selection probability of each steps are below:

$$P_{1hi} = \frac{n_h * M_{hi}}{M_h} \quad (3.17.)$$

$$P_{2hi} = \frac{t_{hi}}{L_{hi}} \quad (3.18.)$$

The total selection probability of TDHS is obtained from the product of all stage selection probabilities:

$$P_{hi}{}^{TDHS} = P_{1hi} * P_{2hi} \quad (3.19.)$$

The inverse of the overall probability of selection for a household is called the design weight (or base weight) and is shown below:

$$dw_{hi}{}^{TDHS} = \frac{1}{P_{hi}{}^{TDHS}} = \frac{1}{(\frac{n_h * M_{hi}}{M_h} * \frac{t_{hi}}{L_{hi}})} \quad (3.20.)$$

In order to compensate for disproportionate nonresponse, a non-response adjustment is made to the design weight. The below notations are needed to calculate the response rate in the cluster level:

RR_{ch} : the cluster level response rate in the stratum *h*,

RR_{hh} : the household level response rate in the stratum *h*,

RR_{ph} : the individual (personal) level response rate in the stratum *h*,

n_h: the number of clusters to be selected in the stratum *h*,

$n_h{}^*$: the number of clusters to be completed in the stratum *h*,

m_{hi}: the number of eligible households in the i^{th} cluster of the h^{th} stratum,

$m_{hi}{}^*$: the number of completed households in the i^{th} cluster of the h^{th} stratum,

k_{hi}: the number of eligible individuals in the i^{th} cluster of the h^{th} stratum,

$k_{hi}{}^*$: the number of completed individuals in the i^{th} cluster of the h^{th} stratum.

According to DHS Sampling and Household Listing Manual (2012), the design weighted non-response adjustment has started to be used in both household and individual response rate calculation. In the previous manual, it was calculated with unweighted response proportions.

The design weighted response rates are calculated as:

$$RR_{ch} = \frac{{n_h}^*}{n_h} \tag{3.21.}$$

$$RR_{hh} = \frac{\sum {dw_h}^{TDHS} * {m_{hi}}^*}{\sum {dw_h}^{TDHS} * m_{hi}} \tag{3.22.}$$

$$RR_{ph} = \frac{\sum {dw_h}^{TDHS} * {k_{hi}}^*}{\sum {dw_h}^{TDHS} * k_{hi}} \tag{3.23.}$$

TDHS-2013 was the first time that the non-response adjustments as part of sampling weight computations had been done separately for ever-married (EM) and never-married (NM) women due to the different response rates between these groups. Never-married women are generally more educated and employed than ever-married women and for this reason, ever-married women are more being at home than never-married ones. Therefore, the notations of the individual response rates are written like this:

$$ {RR_{ph}}^{EM} = \frac{\sum {dw_h}^{TDHS} * {k_{hi}}^{EM*}}{\sum {dw_h}^{TDHS} * {k_{hi}}^{EM}} \tag{3.24.}$$

$$ {RR_{ph}}^{NM} = \frac{\sum {dw_h}^{TDHS} * {k_{hi}}^{NM*}}{\sum {dw_h}^{TDHS} * {k_{hi}}^{NM}} \tag{3.25.}$$

Then, the household sampling weights (sw^{HH}) and the personal sampling weights (sw^{P}) for each cluster are calculated as the product of design weights and the inverse of the response rates:

$$sw_{hi}^{HH} = \frac{{dw_{hi}}^{TDHS}}{(RR_{ch} * RR_{hh})} \tag{3.26.}$$

$$sw_{hi}^{EM} = \frac{{dw_{hi}}^{TDHS}}{(RR_{ch} * RR_{hh} * {RR_{ph}}^{EM})} \tag{3.27.}$$

$$sw_{hi}^{NM} = \frac{{dw_{hi}}^{TDHS}}{(RR_{ch} * RR_{hh} * {RR_{ph}}^{NM})} \tag{3.28.}$$

Moreover, the normalization of the sampling weights were applied to TDHS-2013. So, the normalized sampling weights are given below:

$$HV005_{hi} = sw_{hi}^{HH} * \frac{\sum\sum {m_{hi}}^{*}}{\sum sw_{hi}^{HH} * {m_{hi}}^{*}} \tag{3.29.}$$

$${V005_{hi}}^{EM} = sw_{hi}^{EM} * \frac{\sum\sum {k_{hi}}^{EM*} + {k_{hi}}^{NM*}}{\sum\sum sw_{hi}^{EM} * {k_{hi}}^{EM*} + \sum\sum sw_{hi}^{NM} * {k_{hi}}^{NM*}} \tag{3.30.}$$

$${V005_{hi}}^{NM} = sw_{hi}^{NM} * \frac{\sum\sum {k_{hi}}^{EM*} + {k_{hi}}^{NM*}}{\sum\sum sw_{hi}^{EM} * {k_{hi}}^{EM*} + \sum\sum sw_{hi}^{NM} * {k_{hi}}^{NM*}} \tag{3.31.}$$

The mismatched regional distribution between the interviewed women and the ABPRS-2013 figures of the women population caused one additional step to calculate the weights of the TDHS-2013. The adjusted women sampling weight was formulized like this:

$$V005_{hi}{}^{new} = V005_{hi} * (\frac{P_{region}}{\sum P_{region}} * \frac{\sum\sum V005_{region}}{\sum V005_{region}}) \qquad (3.32.)$$

where P_{region} is the total number of women aged 15-49 in a region and $\sum V005_{region}$ is the weighted sum of the total number of women in any region.

3.3.2. Weighting Approaches in This Thesis

Within the scope of this thesis, the weighting approach of the TDHS-2013 will be applied to the prior four surveys and also the strata level weight calculation will be used to the TDHS-2013 and the TDHS-1993. Thus, each survey will have two different sampling weights, except TDHS-1993 has three.

In order to re-calculate the sampling weights, each components of the weight calculation formulas which were described in depth, are needed to be known. Although Appendix B of each reports includes some of these necessary information such as the number of strata, the settlement sizes, the selected number of clusters, cluster sizes etc., listing results especially are not available in these reports. Because of this reason, the results of the listing activity for the TDHS-2008 and the TDHS-2013 were taken from HUIPS as digital format. But, in order to get the listing results for the other three surveys, the listing forms were needed to be examined and recorded in the HUIPS Archive. In order to enter the HUIPS Archive and to look folders of the fields results for listed, unlisted households sizes and block sizes, permission was taken and making archive studies were approved by the Hacettepe University Ethics Commission (Appendix C). The archive studies were completed in 10 days and full time work was made nearly each day. Approximately 1,421 listing and block size papers were examined and 1,328 papers were also not reachable totally. For the missing information, some assumptions were done and they will be given in the following pages. Moreover, the data sets of each survey which were included the interview results were requested from HUIPS and DHS. Table 3.3. summarizes the necessary information and the sources of these information.

Table 3.3. The Sources of The Components of Weight Calculation Formulas for TDHSs

	TDHS-1993	**TDHS-1998**	**TDHS-2003**	**TDHS-2008**	**TDHS-2013**
$\boldsymbol{n_h}$	Table B.3.	Table B.3.1.	Table B.5.1.	Table B.4.1. / HUIPS as digital format	HUIPS as digital format
$\boldsymbol{M_{hi}}$	HUIPS Archive + Assumptions	HUIPS Archive + Assumptions	HUIPS Archive + Assumptions	HUIPS as digital format	HUIPS as digital format
$\boldsymbol{M_h}$	Table B.3. + Assumptions	Table B.3.1.	Table B.5.1.	Table B.4.1. / HUIPS as digital format	HUIPS as digital format
$\boldsymbol{n_h}^*$	Table B.3. + HUIPS TDHS Data Set Archive	Table B.3.1. + HUIPS TDHS Data Set Archive	Table B.5.1. + HUIPS TDHS Data Set Archive	Table B.4.1. / HUIPS as digital format	HUIPS as digital format
$\boldsymbol{m_h}$	HUIPS TDHS Data Set Archive	HUIPS TDHS Data Set Archive	HUIPS TDHS Data Set Archive	HUIPS as digital format	HUIPS as digital format
$\boldsymbol{m_h}^*$	HUIPS TDHS Data Set Archive	HUIPS TDHS Data Set Archive	HUIPS TDHS Data Set Archive	HUIPS as digital format	HUIPS as digital format
$\boldsymbol{k_h}$	HUIPS TDHS Data Set Archive	HUIPS TDHS Data Set Archive	HUIPS TDHS Data Set Archive	HUIPS as digital format	HUIPS as digital format
$\boldsymbol{k_h}^*$	HUIPS TDHS Data Set Archive	HUIPS TDHS Data Set Archive	HUIPS TDHS Data Set Archive	HUIPS as digital format	HUIPS as digital format
$\boldsymbol{t_{hi}}$	Appendix B	Appendix B	Appendix B	Appendix B / HUIPS as digital format	Appendix B / HUIPS as digital format
$\boldsymbol{L_{hi}, UL_{hi}}$	HUIPS Archive + Assumptions	HUIPS Archive + Assumptions	HUIPS Archive + Assumptions	HUIPS as digital format	HUIPS as digital format

Two methods will be defined in this section. Method 1 will represent the strata level re-calculation and Method 2 will describe the cluster level re-calculation.

3.3.2.1. Method 1: Strata Level

While whole necessary information for TDHS-2013 were taken from HUIPS as digital format, some of the listing forms and segment sizes of the TDHS-1993 were not reachable in the HUIPS Archive. So, some assumptions were necessary for filling these gaps.

The below items were assumed for the TDHS-1993:

1) If the number of listed households is known in urban areas but the block size does not exist, the block sizes are assumed to be 100 HHs.

2) If the number of listed households is known in rural areas but the block sizes do not exist, the block size will be assumed to be equal to the number of listed HHs.

3) If the number of listed households and the block size do not exist in urban areas, the block sizes will be assumed to be 100 HHs and the number of listed households will be equal to this number.

4) If the number of listed households and the block size do not exist in rural areas, the total number of households in each settlements are estimated for the block size by the ratio of the population of settlement to the mean number of de jure HH members in each cluster. Then, the number of listed households is assumed to be equal to the block size.

5) If the mean number of de jure members is zero and because of this reason, the estimation of total number of households in settlements cannot be calculated, the mean number of de jure members in specific region will be used to estimate total number of households in these settlements. This situation was observed in only one cluster in TDHS-1993.

6) If the number of listed households is 250 and the number of unlisted households is known but the block size does not exist, the block size is assumed to be equal to their sum.

7) The number of total household size for each stratum is used for weight calculation. But, at Table B.3., in the original weight calculations of TDHS-1993; only 5-region’s population size were given and the mean number of household size was noted as 5. This does not reflect reality because the mean number of household

varies not only from region to region but also from urban to rural. For example, the average household size is lowest in west region and highest in east region. Also, it is lower in urban areas than rural areas. So, the estimation procedure is applied to obtain the real stratum sizes at the household level for both subregions and their urban/rural divisions. Initially, the percentage of urban-rural residence for each 5-region and 14 specific subregions are obtained from data set. Secondly, the 5-region population sizes are divided into specific subregions size by the percentage of subregions and then the total subregions are also separated by the percent of the type of residence. Finally, the estimated household size for each stratum is obtained from the ratio of the estimated population size to the mean number of de jure members of each type of residence, which was obtained from the data set.

3.3.2.2. Method 2: Cluster Level

While again whole necessary information for TDHS-2008 were taken from HUIPS as digital format, some of the listing forms and segment sizes of the other three surveys were not reachable in the HUIPS Archive. As mentioned above, the same assumptions were used to fill these gaps whenever necessary and some additional assumptions were identified:

1) In the second phase sample selection process of TDHS-1993 and TDHS-1998, some selection probabilities of blocks are bigger than 1 due to estimated household and block size assumptions. For this reason, new assumption is required to regulate them. If the block size is bigger than the estimated household size of stratum, the estimated household size of stratum is assumed to be equal to the block size.

2) When the listing block size is smaller than the selected household numbers in TDHS-1993, the probability of the third phase sample selection is higher than 1

and again it is not possible. So, the selected household numbers are equalized to the listing block size.

Moreover, in the second phase of sample selection process, the requirement of an additional step emerged when the selected block area was too large to be listed. In this case, listers selected and list a segment of such a block. According to the Listing Manual (2013) or each report's Appendix B, up to 250 households are listed by the listing team and the remaining number of households were recorded as "The Number of Unlisted HHs" on the Household Listing Form. That is, segmentation is necessary when the listed block size is bigger than or equal to 250 and it is applied like this:

If unlisted block size (UL_{hi}) was made available by listers as suggested above, it was used to calculate the total listed block size in the segmentation formulas. Otherwise, the block size was taken the same as the total listed block size. The segmentation formula is calculated as:

$$segm = \frac{L_{hi}}{TL_{hi}} \tag{3.33.}$$

where L_{hi} is the updated size of the i^{th} block of the h^{th} stratum after listing activity and TL_{hi} is the total listed block size.

Thus, the adjusted probability of the second stage becomes:

$$adj\ P_{2hi} = P_{2hi} * segm = \frac{L_{hi}}{TL_{hi}} * \frac{t_{hi}}{L_{hi}} \tag{3.34.}$$

CHAPTER 4. RESULTS

The new sampling weights which were obtained through Method 1 (strata level) and Method 2 (cluster level) were added to the corresponding data sets as explained in the previous section. In this section, descriptive statistics and some statistical tables of the selected indicators were produced and compared with their current sampling weights by using SPSS statistical package program.

4.1. Weights

There are two different final weights for each study: households weight and women weights. Since this thesis employs variables from the women's data set, only individual level weights are summarized here for all five surveys. Tables through 4.1. to 4.5. summarize cluster level weights by stratum, because cluster level weights are difficult to present. A summary table of descriptive statistics of different sampling weights for each survey is given separately at Table 4.6.

The mean values of cluster level weights seem to be different from stratum ones because there is some variation in cluster level weights by stratum. If the mean values of two sampling weights are compared, the maximum change is observed in West 1 subregion for TDHS-1993, in Central 2 subregion for TDHS-1998 and TDHS-2003, in West 4 subregion for TDHS-2008 and in Central 3 subregion of TDHS-2013 and these changes occurred in urban areas for all survey. Thus, it is said that the cluster level weights become quite different if the case is urban area in West and Central subregion. This could denote higher mobility in these areas, meaning there is usually bigger difference in the size of the block as provided by TURKSTAT, and the size of the block after the listing operation.

Table 4.1. Comparative Table of Cluster and Stratum Level Weights, TDHS-1993

			Type of weight				
			TDHS-1993	Stratum level	Cluster level		
Sub-region	**Stratum number**	**Type of place of residence**	**Mean**	**Mean**	**Minimum**	**Mean**	**Maximum**
West 1	1	Urban	1.240	1.376	0.610	1.532	2.838
	2	Rural	1.240	0.973	0.878	0.878	0.878
West 2	3	Urban	1.240	1.260	0.898	1.238	1.546
	4	Rural	1.240	1.324	1.195	1.195	1.195
West 3	5	Urban	1.240	1.580	1.113	1.492	1.955
	6	Rural	1.240	1.713	1.546	1.546	1.546
South 1	7	Urban	0.771	0.918	0.829	0.829	0.829
	8	Rural	0.771	0.882	0.796	0.796	0.796
South 2	9	Urban	0.771	0.796	0.230	0.851	1.357
	10	Rural	0.771	0.566	0.511	0.511	0.511
Central 1	11	Urban	1.023	1.030	0.564	0.966	1.313
	12	Rural	1.023	0.940	0.848	0.848	0.848
Central 2	13	Urban	1.023	1.245	0.831	1.304	1.706
	14	Rural	1.023	0.930	0.839	0.839	0.839
Central 3	15	Urban	1.047	1.169	0.491	1.306	2.204
	16	Rural	1.023	0.816	0.736	0.736	0.736
North 1	17	Urban	0.609	0.539	0.426	0.622	1.132
	18	Rural	0.609	0.661	0.596	0.596	0.596
North 2	19	Urban	0.609	0.606	0.328	0.649	0.914
	20	Rural	0.609	0.404	0.365	0.365	0.365
East 1	21	Urban	1.157	1.047	0.557	0.964	1.548
	22	Rural	2.070	0.292	0.263	0.268	0.309
East 2	23	Urban	1.169	0.778	0.143	0.604	0.679
	24	Rural	2.111	0.363	0.328	0.328	0.328
East 3	25	Urban	0.974	1.218	0.688	1.165	1.736
	26	Rural	1.035	0.440	0.396	0.448	1.131
East 4	27	Urban	0.974	1.300	1.174	1.396	1.550
	28	Rural	0.974	0.436	0.393	0.393	0.393

Table 4.2. Comparative Table of Cluster and Stratum Level Weights, TDHS-1998

			Type of weight			
			Stratum level	Cluster level		
Sub-region	**Stratum number**	**Type of place of residence**	**Mean**	**Minimum**	**Mean**	**Maximum**
West 1	1	Urban	2.048	1.248	2.088	3.856
	2	Rural	0.326	0.314	0.324	0.355
West 2	3	Urban	1.370	1.311	1.360	1.539
	4	Rural	1.364	1.328	1.354	1.455
West 3	5	Urban	1.469	1.432	1.458	1.545
	6	Rural	1.720	1.640	1.708	1.888
South 1	7	Urban	0.681	0.668	0.676	0.700
	8	Rural	1.392	1.349	1.382	1.475
South 2	9	Urban	0.711	0.685	0.706	0.763
	10	Rural	0.656	0.643	0.652	0.666
Central 1	11	Urban	0.618	0.606	0.614	0.643
	12	Rural	1.772	1.721	1.760	1.895
Central 2	13	Urban	0.976	0.606	0.895	1.440
	14	Rural	1.546	1.360	1.757	3.782
Central 3	15	Urban	1.338	0.787	1.303	2.078
	16	Rural	0.984	0.703	0.949	1.092
North 1	17	Urban	0.354	0.340	0.351	0.380
	18	Rural	0.826	0.791	0.820	0.893
North 2	19	Urban	0.413	0.404	0.410	0.427
	20	Rural	0.864	0.844	0.858	0.864
East 1	21	Urban	0.604	0.344	0.587	0.863
	22	Rural	1.040	0.548	1.186	3.521
East 2	23	Urban	0.521	0.413	0.483	0.582
	24	Rural	1.234	1.172	1.222	1.262
East 3	25	Urban	0.772	0.426	0.777	1.104
	26	Rural	1.096	0.971	1.085	1.137
East 4	27	Urban	0.698	0.577	0.793	0.976
	28	Rural	1.373	1.333	1.534	2.064

Table 4.3. Comparative Table of Cluster and Stratum Level Weights, TDHS-2003

			Type of weight			
			Stratumlevel	**Cluster level**		
Sub-region	**Stratum number**	**Type of place of residence**	**Mean**	**Minimum**	**Mean**	**Maximum**
West 1	1	Urban	1.076	0.452	0.902	1.654
	2	Urban	1.660	0.761	1.471	3.435
	3	Urban	0.273	0.014	0.018	0.022
West 2	4	Rural	0.962	0.186	0.594	1.269
	5	Urban	0.802	0.418	0.794	1.378
	6	Rural	1.150	0.975	1.356	1.822
West 3	7	Urban	1.547	1.186	1.615	2.101
	8	Urban	3.584	3.165	3.571	4.211
	9	Rural	2.305	0.655	2.650	7.040
Central 1	10	Urban	1.058	0.847	1.107	1.345
	11	Rural	2.740	2.475	2.982	4.373
West 4	12	Urban	0.840	0.551	0.856	1.000
	13	Urban	1.043	0.805	0.932	1.076
	14	Rural	1.841	1.962	2.320	2.581
	15	Urban	3.259	2.227	2.646	3.389
	16	Rural	1.855	0.655	2.271	2.921
Central 2	17	Urban	1.408	1.085	1.323	1.446
	18	Rural	0.796	0.051	0.706	1.140
	19	Urban	0.377	0.328	0.616	1.453
	20	Rural	1.036	0.857	1.237	1.723
Central 3	21	Urban	1.723	1.920	1.920	1.920
	22	Urban	2.169	1.819	2.293	2.532
	23	Rural	1.131	0.888	1.213	1.535
South 1	24	Urban	0.533	0.365	0.527	1.093
	25	Urban	1.029	0.575	1.109	2.963
	26	Rural	1.086	0.656	1.148	3.836
Central 4	27	Urban	0.823	0.455	0.719	1.530
	28	Rural	1.186	0.690	1.244	2.405
North 1	29	Urban	0.547	0.364	0.536	0.763
	30	Rural	1.002	0.642	1.115	3.037
Central 5	31	Urban	0.850	0.581	0.718	0.832
	32	Rural	1.659	0.328	1.648	3.838
North 2	33	Urban	0.404	0.239	0.381	0.725
	34	Rural	1.169	0.708	1.050	1.314
East 1	35	Urban	0.323	0.173	0.294	0.462
	36	Rural	0.798	0.488	1.022	1.513
East 2	37	Urban	0.596	0.332	0.542	1.247
	38	Rural	0.862	0.569	1.020	1.368
East 3	39	Urban	0.596	0.357	0.581	0.882
	40	Rural	0.566	0.139	0.617	1.483

Table 4.4. Comparative Table of Cluster and Stratum Level Weights, TDHS-2008

			Type of weight			
			Stratum level	Cluster level		
Sub-region	**Stratum number**	**Type of place of residence**	**Mean**	**Minimum**	**Mean**	**Maximum**
West 1	1	Urban	2.910	2.110	2.960	4.340
	2	Rural	0.700	0.120	0.540	1.010
West 2	3	Urban	0.660	0.540	0.680	0.870
	4	Rural	1.090	0.100	0.940	1.360
West 3	5	Urban	1.530	1.180	1.600	2.220
	6	Urban	2.380	1.840	2.420	2.830
	7	Rural	2.010	0.490	1.880	4.270
Central 1	8	Urban	1.880	1.870	2.070	2.280
	9	Rural	2.280	1.990	2.190	2.290
West 4	10	Urban	0.860	0.700	0.890	1.080
	11	Urban	1.590	1.400	1.570	1.770
	12	Rural	1.390	1.060	1.370	1.680
Central 2	13	Urban	1.410	1.320	1.660	2.760
	14	Rural	1.770	1.330	1.630	2.620
Central 3	15	Urban	2.000	1.030	1.940	2.530
	16	Urban	0.600	0.570	0.630	0.790
	17	Urban	1.870	1.470	1.780	2.030
	18	Rural	0.750	0.280	0.680	1.080
South 1	19	Urban	0.630	0.500	0.650	0.750
	20	Urban	1.040	0.760	1.040	1.560
	21	Rural	0.840	0.130	0.740	1.140
Central 4	22	Urban	0.640	0.560	0.680	0.810
	23	Rural	0.840	0.620	0.810	1.660
North 1	24	Urban	0.450	0.300	0.460	0.540
	25	Rural	1.000	0.360	0.840	1.700
Central 5	26	Urban	0.890	0.790	0.960	1.210
	27	Rural	1.410	0.700	1.400	2.490
North 2	28	Urban	0.360	0.220	0.400	0.560
	29	Rural	0.950	0.300	0.840	3.330
East 1	30	Urban	0.250	0.140	0.230	0.290
	31	Rural	0.470	0.090	0.410	0.970
East 2	32	Urban	0.460	0.310	0.450	0.530
	33	Rural	0.650	0.200	0.660	1.960
East 3	34	Urban	0.450	0.430	0.500	0.620
	35	Urban	0.940	0.650	1.030	1.440
	36	Rural	0.550	0.220	0.500	1.050

Table 4.5. Comparative Table of Cluster and Stratum Level Weights, TDHS-2013

			Type of weight			
			Strata level	**Cluster level**		
Sub-region	**Stratum number**	**Type of place of residence**	**Mean**	**Minimum**	**Mean**	**Maximum**
West 1	1	Urban	2.369	1.451	2.378	3.904
	2	Rural	0.363	0.059	0.261	0.476
West 2	3	Urban	0.598	0.556	0.702	1.052
	4	Rural	0.762	0.522	0.862	1.238
West 3	5	Urban	1.843	1.611	1.991	2.442
	6	Urban	1.874	1.325	1.989	2.682
	7	Rural	1.521	1.181	1.475	1.946
Central 1	8	Urban	1.955	1.710	2.083	2.328
	9	Rural	2.021	1.518	1.754	2.312
West 4	10	Urban	1.290	1.065	1.331	1.925
	11	Urban	1.971	1.547	2.058	2.556
	12	Rural	0.970	0.550	0.962	1.287
Central 2	13	Urban	1.343	0.977	1.267	1.630
	14	Rural	0.871	0.677	0.996	1.057
Central 3	15	Urban	1.962	1.853	2.360	3.599
	16	Urban	0.584	0.528	0.618	1.050
	17	Urban	1.815	1.839	2.158	2.553
	18	Rural	0.610	0.263	0.621	1.000
South 1	19	Urban	0.737	0.639	0.756	0.936
	20	Urban	1.210	0.493	1.210	2.232
	21	Rural	0.691	0.229	0.625	0.905
Central 4	22	Urban	0.756	0.351	0.714	1.139
	23	Rural	0.743	0.191	0.557	0.832
North 1	24	Urban	0.505	0.285	0.466	0.625
	25	Rural	0.946	0.712	0.879	1.141
Central 5	26	Urban	0.956	0.686	0.989	1.432
	27	Rural	1.392	0.955	1.156	1.449
North 2	28	Urban	0.291	0.100	0.263	0.452
	29	Rural	0.679	0.389	0.661	2.050
East 1	30	Urban	0.316	0.180	0.274	0.429
	31	Rural	0.520	0.340	0.460	0.771
East 2	32	Urban	0.597	0.420	0.561	0.924
	33	Rural	0.705	0.366	0.673	1.091
East 3	34	Urban	0.646	0.469	0.642	0.886
	35	Urban	1.333	0.734	1.261	2.236
	36	Rural	0.655	0.326	0.597	0.860

Before proceeding with a comparison of different weight approaches, unweighted point estimates were compared to provide a general idea of how much sample weights affect them. These unweighted estimates are provided in Appendix D. Accordingly, it can be seen that unweighted estimates are usually quite different from weighted ones, meaning unweighted estimates in TDHS may provide biased estimates of population indicators. It was seen that unweighted and weighted estimates were not very different for the following variables: "Knowing any contraceptive method" and "Knowing any modern contraceptive method"; which have proportions very close to 1 (above 0.98 for both variables in all surveys). The differences were larger for some other variables such as "Currently married/in union", "Children surviving" and "Ideal number of children". Also, lower differences were observed for "Ever used any contraceptive method", "Currently using any method", "Currently using a modern method", "Currently using pill" and "Currently using IUD".

As seen in Table 4.6., the mean values of cluster and strata level weights for all surveys are 1 due to the normalization process. For all surveys, it can be observed that the minimum values are lower and the maximum values are higher for cluster level weights compared to stratum level weights. Moreover, standard deviations are always higher for cluster level weights. While the maximum differences are observed in TDHS-2003, the minimum differences occurred in TDHS-2008 for standard deviation values.

The relative variance of the cluster level weights ($cv^2(w)$) is higher than the strata level in all surveys. This means that the effective sample size goes up in the cluster level weighted one. For example, while the sample size for the cluster level weighted TDHS-1993 is 20.1 % larger than the SRS sample size, for strata level weighted TDHS-1993, it is only 13.2 % bigger than the sample size of SRS.

All in all, the variability in cluster level weight are higher than the strata level weight because the extreme values for minimum and maximum are observed in cluster level. This causes the larger standard deviation.

Table 4.6. Descriptive Statistics of Different Sampling Weights

	Type of weight	N	Minimum	Maximum	Mean	Std. Deviation	$cv^2(w)$
TDHS-1993	Cluster level	6,519	0.143	2.838	1.000	0.449	0.201
	Stratum level	6,519	0.292	1.713	1.000	0.363	0.132
TDHS-1998	Cluster level	8,576	0.314	3.856	1.000	0.550	0.303
	Stratum level	8,576	0.326	2.048	1.000	0.495	0.245
TDHS-2003	Cluster level	8,075	0.014	7.040	1.000	0.680	0.463
	Stratum level	8,075	0.273	3.584	1.000	0.579	0.335
TDHS-2008	Cluster level	7,405	0.087	4.271	1.000	0.760	0.577
	Stratum level	7,405	0.248	2.911	1.000	0.713	0.509
TDHS-2013	Cluster level	9,746	0.059	3.904	1.000	0.691	0.478
	Stratum level	9,746	0.285	2.730	1.000	0.623	0.388

4.2. Selected Indicators

In order to show the differences in point estimates and precision, the selected 23 variables are re-calculated and presented here. Five tables for each study at the national level are given and each table includes cluster and strata level results in row with respect to selected variables.

4.2.1. TDHS-1993

1993 national sample results with respect to different level weight calculation for selected variables are given at Table 4.7. As defined in the previous chapter, the proportions or means of variables are selected statistics in this thesis. The difference in estimates in this table are defined as subtracting cluster level from strata level. It changes between -0.032 and 0.027. While the minimum difference is observed in "Children ever born" variable, the maximum one is seen in "Urban residence" variable. Original point estimates of TDHS-1993 provide relatively different estimates than both stratum level and cluster level weights, as will be discussed in the next chapter.

The standard errors seem to be equal to each other and the confidence interval is computed by adding and subtracting twice standard error to the sample estimate. For all variables, except "Urban residence", "Children ever born" and "Children surviving", the lower and upper confidence limits of cluster level estimation are very similar to the strata level. In the meantime, for "Urban residence" variable, the lower and upper confidence limits of cluster level estimation is nearly 0.03 higher than the strata level estimation, it is nearly 0.02 and 0.03 lower than strata level for "Children surviving", and "Children ever born" variables respectively. Although there are some differences in lower and upper confidence limits, the width of confidence limits seem to be similar to each other. The highest difference of interval comparison is seen in again "Ideal number of children" variable.

The coefficient of variation for nearly all cluster level estimates, except "Currently using injectables", are slightly different from the strata level ones. But, for "Knowing any contraceptive method" and "Ideal number of children" variables, the values of the ratio of cv are 0.976 and 1.152 in the same order. These numbers also reflect the minimum and maximum change in this statistic respectively.

The difference of the cluster level and strata level design effect for "Urban residence", "Secondary school or higher" and "Ideal number of children" variables equals to 0.14 and bigger than this value. The smallest value of the difference of the cluster level and strata level design effect (-0.038) is observed for "Currently using periodic abstinence" variable.

Table 4.7. Selected Statistics by Different Weight Calculation Approaches, TDHS-1993

Variables	Type of weight	Estimate	Standard Error	95% Confidence Interval		Coefficient of Variation	Design Effect	Square Root Design Effect	Unweighted Count	Difference in estimate (Cluster level - Strata level)	Ratio of CV (Cluster level/Strata level)
				Lower	Upper						
		(1)	(2)	(3)		(4)	(5)	(6)	(7)	(8)	(9)
Urban residence	Cluster level	0.735	0.010	0.715	0.754	0.014	3.411	1.847	6,519	0.027	1.016
	Stratum level	0.708	0.010	0.689	0.726	0.014	2.888	1.699	6,519		
	TDHS-1993	0.641	0.010	0.622	0.660	0.015	2.676	1.636	6,519		
No education	Cluster level	0.234	0.009	0.217	0.251	0.037	2.688	1.640	6,519	-0.006	1.022
	Stratum level	0.240	0.009	0.223	0.257	0.036	2.661	1.631	6,519		
	TDHS-1993	0.271	0.010	0.252	0.290	0.036	3.074	1.753	6,519		
Secondary school or higher	Cluster level	0.200	0.009	0.182	0.219	0.046	3.487	1.867	6,519	0.009	1.053
	Stratum level	0.191	0.008	0.175	0.208	0.044	2.973	1.724	6,519		
	TDHS-1993	0.175	0.008	0.160	0.191	0.045	2.768	1.664	6,519		
Never married*	Cluster level										
	Stratum level										
	TDHS-1993										
Currently married/in union	Cluster level	0.959	0.003	0.953	0.965	0.003	1.502	1.225	6,519	-0.001	1.009
	Stratum level	0.960	0.003	0.954	0.966	0.003	1.512	1.230	6,519		
	TDHS-1993	0.962	0.003	0.956	0.967	0.003	1.332	1.154	6,519		

Table 4.7. Selected Statistics by Different Weight Calculation Approaches, TDHS-1993 (Continued)

Variables	Type of weight	Estimate	Standard Error	95% Confidence Interval		Coefficient of Variation	Design Effect	Square Root Design Effect	Unweighted Count	Difference in estimate (Cluster level - Strata level)	Ratio of CV (Cluster level/Strata level)
				Lower	Upper						
		(1)	(2)	(3)		(4)	(5)	(6)	(7)	(8)	(9)
Currently pregnant	Cluster level	0.069	0.003	0.063	0.077	0.050	1.219	1.104	6,519	0.000	1.007
	Stratum level	0.070	0.003	0.063	0.077	0.050	1.206	1.098	6,519		
	TDHS-1993	0.076	0.004	0.069	0.083	0.047	1.186	1.089	6,519		
Children ever born	Cluster level	2.842	0.035	2.773	2.911	0.012	1.729	1.315	6,519	-0.032	1.012
	Stratum level	2.874	0.035	2.806	2.943	0.012	1.685	1.298	6,519		
	TDHS-1993	3.041	0.044	2.956	3.127	0.014	2.225	1.492	6,519		
Children surviving	Cluster level	2.522	0.029	2.465	2.580	0.012	1.828	1.352	6,519	-0.024	1.013
	Stratum level	2.546	0.029	2.489	2.604	0.011	1.778	1.334	6,519		
	TDHS-1993	2.671	0.034	2.604	2.737	0.013	2.075	1.440	6,519		
Knowing any contraceptive method	Cluster level	0.994	0.001	0.991	0.996	0.001	1.198	1.095	6,519	0.001	0.976
	Stratum level	0.993	0.001	0.991	0.995	0.001	1.162	1.078	6,519		
	TDHS-1993	0.991	0.002	0.987	0.994	0.002	1.674	1.294	6,519		
Knowing any modern contraceptive method	Cluster level	0.989	0.002	0.986	0.992	0.002	1.436	1.198	6,273	0.000	1.063
	Stratum level	0.989	0.001	0.986	0.992	0.001	1.220	1.105	6,273		
	TDHS-1993	0.986	0.002	0.982	0.989	0.002	1.521	1.233	6,273		

Table 4.7. Selected Statistics by Different Weight Calculation Approaches, TDHS-1993 (Continued)

Variables	Type of weight	Estimate	Standard Error	95% Confidence Interval		Coefficient of Variation	Design Effect	Square Root Design Effect	Unweighted Count	Difference in estimate (Cluster level - Strata level)	Ratio of CV (Cluster level/Strata level)
				Lower	Upper						
		(1)	(2)	(3)		(4)	(5)	(6)	(7)	(8)	(9)
Ever used any contraceptive method	Cluster level	0.831	0.007	0.818	0.844	0.008	1.902	1.379	6,273	0.002	1.043
	Stratum level	0.829	0.006	0.816	0.841	0.008	1.721	1.312	6,273		
	TDHS-1993	0.802	0.008	0.787	0.817	0.009	2.287	1.512	6,273		
Currently using any method	Cluster level	0.651	0.007	0.637	0.664	0.011	1.357	1.165	6,273	0.000	0.992
	Stratum level	0.650	0.007	0.636	0.664	0.011	1.378	1.174	6,273		
	TDHS-1993	0.626	0.008	0.610	0.642	0.013	1.772	1.331	6,273		
Currently using a modern method	Cluster level	0.361	0.007	0.346	0.375	0.020	1.416	1.190	6,273	0.003	0.996
	Stratum level	0.357	0.007	0.343	0.372	0.020	1.408	1.187	6,273		
	TDHS-1993	0.345	0.007	0.331	0.360	0.021	1.489	1.220	6,273		
Currently using pill	Cluster level	0.050	0.004	0.043	0.057	0.074	1.785	1.336	6,273	0.000	0.986
	Stratum level	0.050	0.004	0.043	0.058	0.075	1.853	1.361	6,273		
	TDHS-1993	0.049	0.004	0.043	0.057	0.071	1.646	1.283	6,273		
Currently using IUD	Cluster level	0.196	0.006	0.184	0.209	0.032	1.550	1.245	6,273	0.003	1.000
	Stratum level	0.193	0.006	0.181	0.205	0.032	1.518	1.232	6,273		
	TDHS-1993	0.188	0.006	0.176	0.201	0.034	1.662	1.289	6,273		

Table 4.7. Selected Statistics by Different Weight Calculation Approaches, TDHS-1993 (Continued)

Variables	Type of weight	Estimate	Standard Error	95% Confidence Interval		Coefficient of Variation	Design Effect	Square Root Design Effect	Unweighted Count	Difference in estimate (Cluster level - Strata level)	Ratio of CV (Cluster level/Strata level)
				Lower	Upper						
		(1)	(2)	(3)		(4)	(5)	(6)	(7)	(8)	(9)
Currently using condoms	Cluster level	0.071	0.004	0.063	0.080	0.060	1.740	1.319	6,273	0.000	1.015
	Stratum level	0.071	0.004	0.063	0.080	0.059	1.690	1.300	6,273		
	TDHS-1993	0.066	0.004	0.059	0.074	0.058	1.476	1.215	6,273		
Currently using injectables	Cluster level	0.001	0.000	0.000	0.001	0.504	0.876	0.936	6,273	0.000	1.031
	Stratum level	0.001	0.000	0.000	0.001	0.489	0.825	0.908	6,273		
	TDHS-1993	0.001	0.000	0.000	0.002	0.456	0.875	0.935	6,273		
Currently using female sterilization	Cluster level	0.030	0.002	0.026	0.034	0.075	1.062	1.030	6,273	0.000	1.040
	Stratum level	0.030	0.002	0.026	0.034	0.072	0.992	0.996	6,273		
	TDHS-1993	0.029	0.002	0.025	0.033	0.070	0.918	0.958	6,273		
Currently using periodic abstinence	Cluster level	0.011	0.002	0.008	0.015	0.169	1.896	1.377	6,273	0.000	0.979
	Stratum level	0.011	0.002	0.008	0.015	0.173	2.003	1.415	6,273		
	TDHS-1993	0.010	0.002	0.007	0.013	0.166	1.675	1.294	6,273		
Currently using withdrawal	Cluster level	0.269	0.007	0.255	0.283	0.027	1.661	1.289	6,273	-0.004	1.002
	Stratum level	0.273	0.007	0.258	0.287	0.027	1.686	1.298	6,273		
	TDHS-1993	0.262	0.007	0.247	0.277	0.028	1.789	1.337	6,273		

Table 4.7. Selected Statistics by Different Weight Calculation Approaches, TDHS-1993 (Continued)

Variables	**Type of weight**	**Estimate**	**Standard Error**	**95% Confidence Interval**		**Coefficient of Variation**	**Design Effect**	**Square Root Design Effect**	**Unweighted Count**	**Difference in estimate (Cluster level - Strata level)**	**Ratio of CV (Cluster level/Strata level)**
				Lower	**Upper**						
		(1)	**(2)**	**(3)**		**(4)**	**(5)**	**(6)**	**(7)**	**(8)**	**(9)**
Want no more children**	Cluster level	0.666	0.007	0.652	0.679	0.010	1.313	1.146	6,273	-0.002	1.018
	Stratum level	0.668	0.007	0.655	0.681	0.010	1.281	1.132	6,273		
	TDHS-1993	0.669	0.006	0.656	0.682	0.010	1.174	1.083	6,273		
Want to delay at least 2 years**	Cluster level	0.139	0.005	0.130	0.149	0.033	1.113	1.055	6,273	0.002	0.989
	Stratum level	0.137	0.005	0.128	0.146	0.033	1.117	1.057	6,273		
	TDHS-1993	0.139	0.004	0.130	0.148	0.032	1.050	1.025	6,273		
Ideal number of children	Cluster level	2.341	0.018	2.306	2.377	0.008	2.031	1.425	6,399	0.001	1.152
	Stratum level	2.340	0.016	2.309	2.371	0.007	1.561	1.249	6,399		
	TDHS-1993	2.396	0.018	2.362	2.431	0.007	1.762	1.327	6,399		

*****Not applicable due to the definition of target population of women questionnaire.

**In these variables, the statistics obtained from data set are not matched the reported ones in Appendix-C of TDHS-1993.

4.2.2. TDHS-1998

1998 national sample results with respect to different level weight calculation for selected variables are given at Table 4.8. The range of the difference in estimates is between -0.050 and 0.018. While the minimum difference is observed in “Children ever born” variable, the maximum one is seen in “Never married” variable.

The standard errors do not differ from each other. For all variables, except “Children ever born” and “Children surviving”, the lower and upper confidence limits of cluster level estimation are slightly same as the strata level. For these two variables the lower and upper confidence limits of cluster level estimation is nearly 0.05 lower than the strata level estimation. As was the case in TDHS-1993, the width of confidence limits seem to be similar to each other. The highest difference of interval comparison is seen in again “Children ever born” and “Children surviving” variables.

The coefficient of variation for most cluster level estimates are a little different from the strata level ones. But, the minimum and maximum change in the values of the ratio of cv are 0.388 and 2.736 for “Currently using periodic abstinence” and “Currently using female sterilization” variables respectively.

The difference of the cluster level and strata level design effect for four variables (“Urban residence”, “No education”, “Ever used any contraceptive method” and “Currently using a modern method”) equals 0.06 or is bigger than this value. The smallest value of the difference of the cluster level and strata level design effect (-0.030) is observed for “Currently using withdrawal” variable.

Table 4.8. Selected Statistics by Different Weight Calculation Approaches, TDHS-1998

Variables	Type of weight	Estimate	Standard Error	95% Confidence Interval		Coefficient of Variation	Design Effect	Square Root Design Effect	Unweighted Count	Difference in estimate (Cluster level - Strata level)	Ratio of CV (Cluster level/Strata level)
				Lower	Upper						
		(1)	(2)	(3)		(4)	(5)	(6)	(7)	(8)	(9)
Urban residence	Cluster level	0.662	0.017	0.627	0.694	0.026	11.299	3.361	8,576	-0.004	1.027
	Stratum level	0.665	0.017	0.631	0.697	0.025	10.885	3.299	8,576		
No education	Cluster level	0.164	0.006	0.152	0.177	0.039	2.610	1.616	8,576	-0.003	1.090
	Stratum level	0.167	0.006	0.156	0.180	0.036	2.246	1.499	8,576		
Secondary school or higher	Cluster level	0.312	0.011	0.291	0.334	0.035	4.636	2.153	8,576	0.009	1.000
	Stratum level	0.303	0.010	0.283	0.324	0.035	4.440	2.107	8,576		
Never married	Cluster level	0.295	0.006	0.283	0.307	0.021	1.524	1.235	8,576	0.018	0.995
	Stratum level	0.277	0.006	0.266	0.289	0.021	1.412	1.188	8,576		
Currently married/in union	Cluster level	0.673	0.006	0.661	0.685	0.009	1.544	1.243	8,576	-0.017	1.080
	Stratum level	0.690	0.006	0.678	0.702	0.009	1.434	1.197	8,576		
Currently pregnant	Cluster level	0.049	0.002	0.044	0.054	0.049	1.051	1.025	8,576	-0.002	1.014
	Stratum level	0.050	0.002	0.046	0.055	0.048	1.058	1.029	8,576		
Children ever born	Cluster level	1.957	0.029	1.900	2.013	0.015	1.405	1.185	8,576	-0.050	1.067
	Stratum level	2.007	0.027	1.952	2.061	0.014	1.292	1.137	8,576		

Table 4.8. Selected Statistics by Different Weight Calculation Approaches, TDHS-1998 (Continued)

Variables	Type of weight	Estimate	Standard Error	95% Confidence Interval Lower	95% Confidence Interval Upper	Coefficient of Variation	Design Effect	Square Root Design Effect	Unweighted Count	Difference in estimate (Cluster level - Strata level)	Ratio of CV (Cluster level/Strata level)
		(1)	(2)	(3)		(4)	(5)	(6)	(7)	(8)	(9)
Children surviving	Cluster level	1.757	0.023	1.711	1.802	0.013	1.253	1.119	8,576	-0.046	1.076
	Stratum level	1.802	0.022	1.759	1.846	0.012	1.136	1.066	8,576		
Knowing any contraceptive method	Cluster level	0.989	0.002	0.985	0.992	0.002	1.725	1.313	5,893	0.000	1.021
	Stratum level	0.989	0.002	0.985	0.992	0.002	1.721	1.312	5,893		
Knowing any modern contraceptive method	Cluster level	0.987	0.002	0.982	0.990	0.002	1.701	1.304	5,893	0.000	1.018
	Stratum level	0.987	0.002	0.982	0.990	0.002	1.690	1.300	5,893		
Ever used any contraceptive method	Cluster level	0.841	0.007	0.827	0.854	0.008	2.062	1.436	5,893	-0.001	1.113
	Stratum level	0.842	0.006	0.829	0.854	0.007	1.713	1.309	5,893		
Currently using any method	Cluster level	0.640	0.008	0.623	0.656	0.013	1.757	1.325	5,893	0.001	1.064
	Stratum level	0.639	0.008	0.623	0.654	0.012	1.583	1.258	5,893		
Currently using a modern method	Cluster level	0.379	0.009	0.361	0.396	0.023	1.893	1.376	5,893	0.001	1.027
	Stratum level	0.377	0.009	0.361	0.394	0.023	1.832	1.353	5,893		
Currently using pill	Cluster level	0.044	0.004	0.038	0.051	0.080	1.717	1.310	5,893	0.000	1.018
	Stratum level	0.044	0.003	0.037	0.051	0.079	1.684	1.298	5,893		

Table 4.8. Selected Statistics by Different Weight Calculation Approaches, TDHS-1998 (Continued)

Variables	Type of weight	Estimate	Standard Error	95% Confidence Interval		Coefficient of Variation	Design Effect	Square Root Design Effect	Unweighted Count	Difference in estimate (Cluster level - Strata level)	Ratio of CV (Cluster level/Strata level)
				Lower	Upper						
		(1)	(2)	(3)		(4)	(5)	(6)	(7)	(8)	(9)
Currently using IUD	Cluster level	0.198	0.007	0.184	0.213	0.036	1.869	1.367	5,893	0.000	1.030
	Stratum level	0.198	0.007	0.185	0.212	0.035	1.805	1.343	5,893		
Currently using condoms	Cluster level	0.083	0.005	0.074	0.093	0.059	1.819	1.349	5,893	0.001	1.022
	Stratum level	0.082	0.005	0.073	0.092	0.058	1.768	1.330	5,893		
Currently using injectables	Cluster level	0.005	0.001	0.003	0.007	0.208	1.176	1.085	5,893	0.000	1.029
	Stratum level	0.005	0.001	0.003	0.007	0.202	1.141	1.068	5,893		
Currently using female sterilization	Cluster level	0.042	0.003	0.036	0.049	0.076	1.491	1.221	5,893	0.000	1.003
	Stratum level	0.042	0.003	0.037	0.049	0.076	1.522	1.234	5,893		
Currently using periodic abstinence	Cluster level	0.011	0.002	0.007	0.016	0.195	2.454	1.567	5,893	0.000	0.993
	Stratum level	0.011	0.002	0.007	0.016	0.197	2.506	1.583	5,893		
Currently using withdrawal	Cluster level	0.244	0.008	0.230	0.259	0.031	1.765	1.328	5,893	0.000	0.990
	Stratum level	0.244	0.008	0.229	0.259	0.031	1.845	1.358	5,893		
Want no more children	Cluster level	0.621	0.007	0.607	0.635	0.011	1.240	1.114	5,893	0.000	1.026
	Stratum level	0.621	0.007	0.607	0.634	0.011	1.206	1.098	5,893		

Table 4.8. Selected Statistics by Different Weight Calculation Approaches, TDHS-1998 (Continued)

Variables	Type of weight	Estimate	Standard Error	95% Confidence Interval		Coefficient of Variation	Design Effect	Square Root Design Effect	Unweighted Count	Difference in estimate (Cluster level - Strata level)	Ratio of CV (Cluster level/Strata level)
				Lower	Upper						
		(1)	(2)	(3)		(4)	(5)	(6)	(7)	(8)	(9)
Want to delay at least 2 years	Cluster level	0.135	0.005	0.125	0.146	0.040	1.444	1.202	5,893	-0.001	1.016
	Stratum level	0.136	0.005	0.126	0.147	0.039	1.453	1.205	5,893		
Ideal number of children	Cluster level	2.348	0.018	2.313	2.383	0.008	2.114	1.454	8,191	-0.009	1.023
	Stratum level	2.357	0.017	2.323	2.391	0.007	2.022	1.422	8,191		

4.2.3. TDHS-2003

Table 4.9. presents the findings for TDHS-2003. The minimum and maximum values of difference in estimates are -0.028 and 0.024 and are observed in “Urban residence” and “Children ever born” variables respectively.

The standard errors by different weighting schemes are very close. For all variables, except “Urban residence”, the lower and upper confidence limits of cluster level estimation are slightly same as the strata level. For “Urban residence”, the lower and upper confidence limits of cluster level estimation is nearly 0.03 lower than the strata level estimation. Widths of confidence intervals are similar. The highest difference of interval comparison is seen in again “Urban residence” variable.

The coefficient of variation for most cluster level estimates are a little different from the strata level ones. But, for “Knowing any modern contraceptive method” and “Urban residence” variables, the values of the ratio of cv are 1.027 and 1.553 in the same order. These numbers also reflects the minimum and maximum change in this statistic respectively.

The highest value of the difference of the cluster level and strata level design effect (0.540) is observed for “Urban residence” variable. There is not any negative value in the difference of design effect statistic. For all other variables, the difference of DEFT values fall between 0 and 0.026 interval.

Table 4.9. Selected Statistics by Different Weight Calculation Approaches, TDHS-2003

Variables	Type of weight	Estimate	Standard Error	95% Confidence Interval		Coefficient of Variation	Design Effect	Square Root Design Effect	Unweighted Count	Difference in estimate (Cluster level - Strata level)	Ratio of CV (Cluster level/Strata level)
				Lower	Upper						
		(1)	(2)	(3)		(4)	(5)	(6)	(7)	(8)	(9)
Urban residence	Cluster level	0.684	0.009	0.666	0.702	0.013	2.999	1.732	8,075	-0.028	1.553
	Stratum level	0.712	0.006	0.700	0.724	0.008	1.421	1.192	8,075		
No education	Cluster level	0.221	0.009	0.204	0.240	0.042	4.011	2.003	8,075	0.003	1.117
	Stratum level	0.218	0.008	0.202	0.235	0.037	3.157	1.777	8,075		
Secondary school or higher	Cluster level	0.242	0.009	0.224	0.262	0.039	3.947	1.987	8,075	-0.002	1.115
	Stratum level	0.245	0.009	0.228	0.262	0.035	3.215	1.793	8,075		
Never married*	Cluster level									0.000	
	Stratum level										
Currently married/in union	Cluster level	0.949	0.003	0.943	0.955	0.003	1.413	1.189	8,075	-0.001	1.071
	Stratum level	0.950	0.003	0.944	0.955	0.003	1.256	1.121	8,075		
Currently pregnant**	Cluster level	0.042							12,138	0.000	
	Stratum level	0.042							12,138		
Children ever born**	Cluster level	1.861							12,138	0.024	
	Stratum level	1.837							12,138		

Table 4.9. Selected Statistics by Different Weight Calculation Approaches, TDHS-2003 (Continued)

Variables	Type of weight	Estimate	Standard Error	95% Confidence Interval		Coefficient of Variation	Design Effect	Square Root Design Effect	Unweighted Count	Difference in estimate (Cluster level - Strata level)	Ratio of CV (Cluster level/Strata level)
				Lower	Upper						
		(1)	(2)	(3)		(4)	(5)	(6)	(7)	(8)	(9)
Children surviving**	Cluster level	1.706							12,138	0.016	
	Stratum level	1.690							12,138		
Knowing any contraceptive method	Cluster level	0.998	0.000	0.997	0.998	0.000	0.657	0.810	7,686	0.000	1.085
	Stratum level	0.998	0.000	0.997	0.998	0.000	0.572	0.756	7,686		
Knowing any modern contraceptive method	Cluster level	0.995	0.001	0.993	0.996	0.001	0.785	0.886	7,686	0.000	1.027
	Stratum level	0.995	0.001	0.994	0.996	0.001	0.769	0.877	7,686		
Ever used any contraceptive method	Cluster level	0.899	0.005	0.889	0.908	0.006	2.115	1.454	7,686	-0.001	1.136
	Stratum level	0.900	0.004	0.891	0.909	0.005	1.664	1.290	7,686		
Currently using any method	Cluster level	0.709	0.006	0.696	0.721	0.009	1.546	1.243	7,686	-0.001	1.082
	Stratum level	0.710	0.006	0.698	0.721	0.008	1.329	1.153	7,686		
Currently using a modern method	Cluster level	0.427	0.007	0.414	0.440	0.015	1.362	1.167	7,686	0.003	1.047
	Stratum level	0.425	0.006	0.412	0.437	0.015	1.229	1.108	7,686		
Currently using pill	Cluster level	0.049	0.003	0.043	0.055	0.060	1.393	1.180	7,686	0.002	1.057
	Stratum level	0.047	0.003	0.042	0.053	0.056	1.204	1.097	7,686		

Table 4.9. Selected Statistics by Different Weight Calculation Approaches, TDHS-2003 (Continued)

Variables	Type of weight	Estimate	Standard Error	95% Confidence Interval		Coefficient of Variation	Design Effect	Square Root Design Effect	Unweighted Count	Difference in estimate (Cluster level - Strata level)	Ratio of CV (Cluster level/Strata level)
				Lower	Upper						
		(1)	(2)	(3)		(4)	(5)	(6)	(7)	(8)	(9)
Currently using IUD	Cluster level	0.203	0.006	0.191	0.214	0.029	1.619	1.272	7,686	0.000	1.075
	Stratum level	0.202	0.005	0.192	0.213	0.027	1.400	1.183	7,686		
Currently using condoms	Cluster level	0.108	0.005	0.099	0.117	0.044	1.816	1.348	7,686	0.000	1.083
	Stratum level	0.108	0.004	0.099	0.117	0.041	1.548	1.244	7,686		
Currently using injectables	Cluster level	0.004	0.001	0.003	0.006	0.209	1.404	1.185	7,686	0.000	1.101
	Stratum level	0.004	0.001	0.003	0.006	0.190	1.056	1.027	7,686		
Currently using female sterilization	Cluster level	0.057	0.003	0.051	0.063	0.053	1.311	1.145	7,686	0.000	1.049
	Stratum level	0.057	0.003	0.051	0.063	0.051	1.193	1.092	7,686		
Currently using periodic abstinence	Cluster level	0.011	0.001	0.009	0.014	0.117	1.175	1.084	7,686	0.000	1.047
	Stratum level	0.011	0.001	0.009	0.014	0.112	1.086	1.042	7,686		
Currently using withdrawal	Cluster level	0.260	0.007	0.248	0.274	0.025	1.740	1.319	7,686	-0.003	1.049
	Stratum level	0.264	0.006	0.251	0.277	0.024	1.609	1.269	7,686		
Want no more children* **	Cluster level	0.602	0.009	0.584	0.620	0.015	1.445	1.202	3,894	-0.001	1.024
	Stratum level	0.604	0.009	0.586	0.621	0.015	1.385	1.177	3,894		

Table 4.9. Selected Statistics by Different Weight Calculation Approaches, TDHS-2003 (Continued)

Variables	**Type of weight**	**Estimate**	**Standard Error**	**95% Confidence Interval**		**Coefficient of Variation**	**Design Effect**	**Square Root Design Effect**	**Unweighted Count**	**Difference in estimate (Cluster level - Strata level)**	**Ratio of CV (Cluster level/Strata level)**
				Lower	**Upper**						
		(1)	**(2)**	**(3)**		**(4)**	**(5)**	**(6)**	**(7)**	**(8)**	**(9)**
Want to delay at least 2 years* **	Cluster level	0.129	0.006	0.117	0.141	0.048	1.414	1.189	3,894	0.000	1.019
	Stratum level	0.129	0.006	0.117	0.141	0.048	1.367	1.169	3,894		
Ideal number of children	Cluster level	2.511	0.021	2.469	2.553	0.008	1.557	1.248	4,029	0.002	1.042
	Stratum level	2.509	0.020	2.469	2.549	0.008	1.393	1.180	4,029		

*****Not applicable due to the definition of target population of women questionnaire.

**All women is defined the base population for these variables, indicating all-women factors are used. So, only the point estimates are calculated using SPSS program.

***In these variables, the statistics obtained from data set are not matched the reported ones in Appendix C of TDHS-2003.

4.2.4. TDHS-2008

Table 4.10. summarizes the findings for the 2008 survey. The difference in estimates ranges between -0.003 and 0.020. While the minimum difference is observed in “Urban residence” variable, the maximum one is seen in “Ideal number of children” variable.

The standard errors do not change by a great extent by different weights. For “Urban residence” and “Secondary school or higher” variables, the lower and upper confidence limits of cluster level estimation are greater than the strata level. On the other hand, for four variables (“No education”, “Currently using female sterilization”, “Currently using withdrawal” and “Ideal number of children”), the lower and upper confidence limits of cluster level estimation is smaller than the strata level estimation. The maximum change in the lower and upper confidence limits (approximately 0.02) is observed in “Urban residence” variable. Widths of confidence intervals do not change much. The highest difference of interval comparison is seen in again “Urban residence” variable.

The coefficient of variation for most cluster level estimates are nearly same as the strata level ones because the ratio of coefficient of variation close to 1. While the minimum value (0.957) is seen in “Knowing any modern contraceptive method” variable, the maximum value (1.235) is observed in “Urban residence” variable.

The difference of the cluster level and strata level design effect for “Urban residence”, “No education”, “Secondary school and higher”, “Currently married/in union”, “Currently using periodic abstinence” and “Want no more children” variables nearly equals 0.05 or bigger than this value. For only “Knowing any modern contraceptive method” variable, the value of differences in design effect estimation is -0.003.

Table 4.10. Selected Statistics by Different Weight Calculation Approaches, TDHS-2008

Variables	Type of weight	Estimate	Standard Error	95% Confidence Interval		Coefficient of Variation	Design Effect	Square Root Design Effect	Unweighted Count	Difference in estimate (Cluster level - Strata level)	Ratio of CV (Cluster level/Strata level)
				Lower	Upper						
		(1)	(2)	(3)		(4)	(5)	(6)	(7)	(8)	(9)
Urban residence	Cluster level	0.779	0.008	0.762	0.794	0.011	2.916	1.708	7,405	0.020	1.235
	Stratum level	0.758	0.006	0.745	0.771	0.009	1.706	1.306	7,405		
No education	Cluster level	0.182	0.009	0.165	0.199	0.047	3.614	1.901	7,405	-0.002	1.065
	Stratum level	0.183	0.008	0.168	0.200	0.044	3.226	1.796	7,405		
Secondary school or higher	Cluster level	0.306	0.012	0.284	0.330	0.038	4.845	2.201	7,405	0.008	1.026
	Stratum level	0.298	0.011	0.277	0.320	0.038	4.421	2.103	7,405		
Never married*	Cluster level										
	Stratum level										
Currently married/in union	Cluster level	0.945	0.004	0.936	0.952	0.004	2.295	1.515	7,405	-0.001	1.041
	Stratum level	0.945	0.004	0.937	0.952	0.004	2.141	1.463	7,405		
Currently pregnant**	Cluster level	0.042							11,184	0.002	
	Stratum level	0.039							11,184		
Children ever born**	Cluster level	1.708							11,184	0.004	
	Stratum level	1.703							11,184		

Table 4.10. Selected Statistics by Different Weight Calculation Approaches, TDHS-2008 (Continued)

Variables	Type of weight	Estimate	Standard Error	95% Confidence Interval		Coefficient of Variation	Design Effect	Square Root Design Effect	Unweighted Count	Difference in estimate (Cluster level - Strata level)	Ratio of CV (Cluster level/Strata level)
				Lower	Upper						
		(1)	(2)	(3)		(4)	(5)	(6)	(7)	(8)	(9)
Children surviving**	Cluster level	1.604							11,184	0.011	
	Stratum level	1.593							11,184		
Knowing any contraceptive method	Cluster level	0.998	0.000	0.997	0.999	0.000	0.765	0.874	7,042	0.000	0.978
	Stratum level	0.998	0.000	0.997	0.999	0.000	0.769	0.877	7,042		
Knowing any modern contraceptive method	Cluster level	0.996	0.001	0.994	0.997	0.001	1.048	1.024	7,042	0.000	0.957
	Stratum level	0.996	0.001	0.994	0.997	0.001	1.042	1.021	7,042		
Ever used any contraceptive method	Cluster level	0.914	0.004	0.906	0.922	0.004	1.472	1.213	7,042	0.001	1.009
	Stratum level	0.913	0.004	0.905	0.921	0.004	1.419	1.191	7,042		
Currently using any method	Cluster level	0.730	0.007	0.716	0.743	0.010	1.715	1.310	7,042	0.000	1.024
	Stratum level	0.730	0.007	0.716	0.743	0.009	1.641	1.281	7,042		
Currently using a modern method	Cluster level	0.461	0.007	0.447	0.476	0.016	1.562	1.250	7,042	0.002	0.996
	Stratum level	0.460	0.007	0.445	0.474	0.016	1.566	1.251	7,042		
Currently using pill	Cluster level	0.054	0.003	0.047	0.061	0.064	1.653	1.286	7,042	0.000	1.010
	Stratum level	0.053	0.003	0.047	0.061	0.064	1.608	1.268	7,042		

Table 4.10. Selected Statistics by Different Weight Calculation Approaches, TDHS-2008 (Continued)

Variables	Type of weight	Estimate	Standard Error	95% Confidence Interval		Coefficient of Variation	Design Effect	Square Root Design Effect	Unweighted Count	Difference in estimate (Cluster level - Strata level)	Ratio of CV (Cluster level/Strata level)
				Lower	Upper						
		(1)	(2)	(3)		(4)	(5)	(6)	(7)	(8)	(9)
Currently using IUD	Cluster level	0.170	0.006	0.159	0.182	0.035	1.717	1.310	7,042	0.002	1.016
	Stratum level	0.169	0.006	0.158	0.180	0.034	1.646	1.283	7,042		
Currently using condoms	Cluster level	0.145	0.006	0.133	0.158	0.043	2.210	1.487	7,042	0.002	1.017
	Stratum level	0.143	0.006	0.132	0.156	0.042	2.108	1.452	7,042		
Currently using injectables	Cluster level	0.008	0.001	0.006	0.012	0.163	1.586	1.259	7,042	0.000	1.039
	Stratum level	0.009	0.001	0.006	0.012	0.157	1.498	1.224	7,042		
Currently using female sterilization	Cluster level	0.081	0.004	0.074	0.090	0.051	1.594	1.262	7,042	-0.002	1.039
	Stratum level	0.083	0.004	0.076	0.092	0.049	1.511	1.229	7,042		
Currently using periodic abstinence	Cluster level	0.006	0.001	0.004	0.009	0.210	1.884	1.373	7,042	0.000	1.026
	Stratum level	0.006	0.001	0.004	0.009	0.205	1.687	1.299	7,042		
Currently using withdrawal	Cluster level	0.260	0.007	0.245	0.275	0.029	2.014	1.419	7,042	-0.002	1.019
	Stratum level	0.262	0.007	0.248	0.277	0.028	1.965	1.402	7,042		
Want no more children	Cluster level	0.589	0.008	0.574	0.603	0.013	1.642	1.282	7,039	0.001	1.042
	Stratum level	0.588	0.007	0.574	0.602	0.012	1.509	1.228	7,039		

Table 4.10. Selected Statistics by Different Weight Calculation Approaches, TDHS-2008 (Continued)

Variables	Type of weight	Estimate	Standard Error	95% Confidence Interval		Coefficient of Variation	Design Effect	Square Root Design Effect	Unweighted Count	Difference in estimate (Cluster level - Strata level)	Ratio of CV (Cluster level/Strata level)
				Lower	Upper						
		(1)	(2)	(3)		(4)	(5)	(6)	(7)	(8)	(9)
Want to delay at least 2 years	Cluster level	0.144	0.006	0.133	0.156	0.040	1.905	1.380	7,039	0.001	1.008
	Stratum level	0.143	0.006	0.132	0.155	0.040	1.860	1.364	7,039		
Ideal number of children	Cluster level	2.517	0.021	2.475	2.559	0.009	2.326	1.525	7,261	-0.003	1.019
	Stratum level	2.520	0.021	2.478	2.561	0.008	2.240	1.497	7,261		

*****Not applicable due to the definition of target population of women questionnaire.

**All women is defined the base population for these variables, indicating all-women factors are used. So, only the point estimates are calculated using SPSS program.

4.2.5. TDHS-2013

TDHS-2013 results with respect to different level weight calculation for selected variables are given at Table 4.11. The minimum and maximum values of the difference in estimates are -0.028 and 0.015 respectively. “Children ever born” and “Never married” variables reflects the former and latter one.

The standard errors seem to be equal each other. For 3 variables (“Urban residence”, “Secondary school or higher”, ”Currently using any method”), the lower and upper confidence limits of cluster level estimation are greater than the strata level. On the other hand, for 4 variables (“No education”, “Children ever born”, “Children surviving” and “Ideal number of children”), the lower and upper confidence limits of cluster level estimation is smaller than the strata level estimation. The maximum change in the lower and upper confidence limits (approximately -0.03) is observed in “Children ever born” variable. Although there are some differences in lower and upper confidence limits, the width of confidence limits seem to be similar each other. The highest difference of interval comparison is seen in again “Children ever born” variable.

The cluster and strata level estimates have approximately same coefficient of variation for most variables because their ratio close to 1. Yet, the ratios of “Knowing any modern contraceptive method” and “Currently using UID” variables are found 0.885 and 1.053 respectively, which also indicate the minimum and maximum values.

The difference of the cluster level and strata level design effect for “Urban residence” and “Currently using UID” variables nearly equals 0.05 or bigger than this value. For “No education” and “Knowing any modern contraceptive method” variables, the difference in DEFT estimation is -0.065.

Table 4.11. Selected Statistics by Different Weight Calculation Approaches, TDHS-2013

Variables	Type of weight	Estimate	Standard Error	95% Confidence Interval		Coefficient of Variation	Design Effect	Square Root Design Effect	Unweighted Count	Difference in estimate (Cluster level - Strata level)	Ratio of CV (Cluster level/Strata level)
				Lower	Upper						
		(1)	(2)	(3)		(4)	(5)	(6)	(7)	(8)	(9)
Urban residence	Cluster level	0.811	0.006	0.799	0.822	0.007	2.113	1.453	9,746	0.015	0.987
	Stratum level	0.796	0.006	0.785	0.807	0.007	1.974	1.405	9,746		
No education	Cluster level	0.120	0.006	0.108	0.132	0.051	3.469	1.863	9,746	-0.008	1.001
	Stratum level	0.127	0.007	0.115	0.141	0.051	3.714	1.927	9,746		
Secondary school or higher	Cluster level	0.534	0.009	0.516	0.553	0.018	3.482	1.866	9,746	0.009	1.006
	Stratum level	0.526	0.009	0.508	0.544	0.018	3.323	1.823	9,746		
Never married	Cluster level	0.275	0.006	0.264	0.287	0.021	1.631	1.277	9,746	-0.001	1.009
	Stratum level	0.277	0.006	0.265	0.288	0.021	1.614	1.270	9,746		
Currently married/in union	Cluster level	0.683	0.006	0.671	0.695	0.009	1.628	1.276	9,746	0.000	1.022
	Stratum level	0.682	0.006	0.671	0.694	0.009	1.557	1.248	9,746		
Currently pregnant	Cluster level	0.044	0.003	0.039	0.050	0.060	1.616	1.271	9,746	0.000	1.031
	Stratum level	0.045	0.003	0.040	0.050	0.058	1.536	1.239	9,746		
Children ever born	Cluster level	1.667	0.020	1.628	1.707	0.012	1.283	1.133	9,746	-0.028	0.960
	Stratum level	1.695	0.021	1.653	1.737	0.013	1.378	1.174	9,746		
Children surviving	Cluster level	1.600	0.018	1.564	1.636	0.012	1.233	1.111	9,746	-0.024	0.966
	Stratum level	1.624	0.019	1.586	1.662	0.012	1.311	1.145	9,746		

Table 4.11. Selected Statistics by Different Weight Calculation Approaches, TDHS-2013 (Continued)

Variables	Type of weight	Estimate	Standard Error	95% Confidence Interval		Coefficient of Variation	Design Effect	Square Root Design Effect	Unweighted Count	Difference in estimate (Cluster level - Strata level)	Ratio of CV (Cluster level/Strata level)
				Lower	Upper						
		(1)	(2)	(3)		(4)	(5)	(6)	(7)	(8)	(9)
Knowing any contraceptive method	Cluster level	0.998	0.001	0.997	0.999	0.001	1.123	1.060	6,835	0.000	0.979
	Stratum level	0.998	0.001	0.997	0.999	0.001	1.074	1.037	6,835		
Knowing any modern contraceptive method	Cluster level	0.997	0.001	0.995	0.998	0.001	1.154	1.074	6,835	0.000	0.885
	Stratum level	0.996	0.001	0.994	0.998	0.001	1.297	1.139	6,835		
Ever used any contraceptive method	Cluster level	0.917	0.004	0.909	0.925	0.004	1.416	1.190	6,835	0.002	0.994
	Stratum level	0.915	0.004	0.907	0.923	0.004	1.393	1.180	6,835		
Currently using any method	Cluster level	0.735	0.007	0.720	0.748	0.010	1.767	1.329	6,835	0.005	1.000
	Stratum level	0.729	0.007	0.715	0.743	0.010	1.720	1.311	6,835		
Currently using a modern method	Cluster level	0.474	0.008	0.458	0.491	0.018	1.905	1.380	6,835	0.005	1.014
	Stratum level	0.470	0.008	0.454	0.486	0.018	1.816	1.348	6,835		
Currently using pill	Cluster level	0.046	0.003	0.040	0.053	0.070	1.576	1.256	6,835	0.001	1.009
	Stratum level	0.046	0.003	0.040	0.052	0.069	1.523	1.234	6,835		
Currently using IUD	Cluster level	0.168	0.006	0.156	0.180	0.036	1.744	1.321	6,835	0.001	1.053
	Stratum level	0.167	0.006	0.156	0.178	0.034	1.563	1.250	6,835		

Table 4.11. Selected Statistics by Different Weight Calculation Approaches, TDHS-2013 (Continued)

Variables	Type of weight	Estimate	Standard Error	95% Confidence Interval		Coefficient of Variation	Design Effect	Square Root Design Effect	Unweighted Count	Difference in estimate (Cluster level - Strata level)	Ratio of CV (Cluster level/Strata level)
				Lower	Upper						
		(1)	(2)	(3)		(4)	(5)	(6)	(7)	(8)	(9)
Currently using condoms	Cluster level	0.158	0.006	0.146	0.171	0.040	2.015	1.420	6,835	0.004	1.011
	Stratum level	0.154	0.006	0.142	0.166	0.040	1.908	1.381	6,835		
Currently using injectables	Cluster level	0.006	0.001	0.004	0.008	0.167	1.084	1.041	6,835	0.000	1.014
	Stratum level	0.006	0.001	0.004	0.008	0.165	1.091	1.044	6,835		
Currently using female sterilization	Cluster level	0.094	0.004	0.086	0.103	0.045	1.406	1.186	6,835	-0.001	1.029
	Stratum level	0.095	0.004	0.087	0.104	0.044	1.344	1.159	6,835		
Currently using periodic abstinence	Cluster level	0.003	0.001	0.002	0.006	0.302	2.118	1.455	6,835	0.000	1.012
	Stratum level	0.003	0.001	0.002	0.006	0.299	2.032	1.425	6,835		
Currently using withdrawal	Cluster level	0.255	0.007	0.242	0.270	0.028	1.773	1.332	6,835	0.001	1.003
	Stratum level	0.255	0.007	0.241	0.269	0.028	1.754	1.324	6,835		
Want no more children	Cluster level	0.474	0.007	0.460	0.488	0.015	1.407	1.186	6,835	0.000	1.029
	Stratum level	0.474	0.007	0.460	0.488	0.015	1.331	1.154	6,835		
Want to delay at least 2 years	Cluster level	0.181	0.006	0.169	0.193	0.034	1.691	1.300	6,835	0.002	1.027
	Stratum level	0.179	0.006	0.168	0.191	0.033	1.583	1.258	6,835		
Ideal number of children	Cluster level	2.721	0.019	2.683	2.758	0.007	2.272	1.507	9,679	-0.013	0.996
	Stratum level	2.733	0.019	2.696	2.771	0.007	2.279	1.510	9,679		

CHAPTER 5. DISCUSSION

Analyzing the changes in the weighting approach of each TDHS, observing the effects of weight calculation approach changes on the basic selected indicators, getting a standard weighting approach when comparing the survey results and making a contribution to the literature about comparing two weighting approaches in a DHS program framework were the main purposes of this thesis. For these purposes, cluster level new sampling weights were calculated for the prior four surveys of the TDHS-2013 and the strata level new sampling weights were computed for the TDHS-1993 and TDHS-2013. After doing archival and desktop work to get the new sampling weights, the difference of cluster and strata level weights and the effects of this situation on the selected variables for women population were investigated.

It was seen that the cluster level sampling weights have more extreme values than stratum level weights, i.e. the minimum values are lower and the maximum values are higher. This implied that there was higher variability, and the increases in the standard deviation of weights reflected this situation. For all surveys, the relative variance of the cluster level weights had higher values than the strata level weights. Thus, higher sample sizes would be needed for cluster level weight approach to obtain the same level of precision as the stratum level weight.

The basic statistics of complex survey analysis were calculated for selected 23 indicators and the results were given and interpreted separately for each survey at the national level. In this section, results from the individual surveys will be compared. In order to facilitate this, four comparison tables are prepared (Tables 5.1. through 5.4.). Tables are about the differences in point estimates, the difference in the width of confidence limits, the ratio of cv and the difference in square root design effect.

The instructions for table use are like this: the base approach is strata level approach. In other words, differences are calculated by as subtracting cluster level from strata or the ratios are computed by dividing cluster level over strata level. If the difference is bigger than zero, implying that cluster level weighted estimate is higher than stratum level weighted estimate, the font of this value is bold. If the difference is equal to zero or not applicable, there is no given value at the tables. If the difference is smaller than zero, the font color of this value is red. Also, if any value represents the maximum value or minimum value within a given survey, the background color of this value is green or pink respectively. These are done to search for potential patterns across all surveys and selected indicators.

In the light of these explanations, Table 5.1. shows the comparison table of difference in estimates. Even though the point estimates for 7 variables were usually larger with cluster level weights than strata level (the first column of the total number of variables in row is greater than or equal to 3, i.e. more than half of the surveys), the differences were negative for 6 variables, meaning higher values were observed with strata level weights (the last column of the total number of variables in row is greater than or equal to 3). The estimated proportion of “Currently using a modern method” variable increased with the cluster level approach for all surveys. A similar result was seen for the “Secondary school or higher” variable. While the proportion for this variable increased using cluster level weights, the value for “No education” variable decreased. The reason of this situation may be due to the type of the residence. In urban areas, larger weights are observed than rural areas because the listing household size is often bigger than the block size and this causes the smaller sampling fractions and in turn large weights. Also, the number of urban clusters are much higher than rural clusters. The estimates for the proportion of women who are “Currently married/in union” decreased with cluster level weights for four of the surveys. The maximum changes in point estimates were observed in “Urban residence” variable for 3 surveys. This indicator is actually one of the sample design variable and it affects the strata directly. The reason of this case may be related to the above discussion made for the education variables. While the estimated mean of

“Children ever born” variable decreased when calculated with cluster level weights, the estimated proportion of “Urban residence” increased for three surveys. For “Knowing any modern contraceptive method”, “Currently using injectables” and “Currently using periodic abstinence” variables, two weighting approaches gave the same estimated values in all surveys and the differences were zero. If each survey are compared among themselves, the effect of cluster weight are similar for TDHS-1993, TDHS-2008 and TDHS-2013 in 7 variables. That is, the estimated values for “Urban residence”, “Secondary school or higher”, “Currently using a modern method”, “Currently using UID” and “Want to delay at least 2 years” variables increased by cluster level weights approach. However, the estimate of "No education” and “Children surviving” variables decreased in cluster level. The maximum reduction in the estimated value was measured for “Children ever born” variable with -0.050.

The difference in the width of confidence limits are presented at Table 5.2. and only four variables (“No education”, “Children ever born”, “Children surviving” and “Ideal number of children”) in the TDHS-2013 had smaller width of confidence interval in cluster level approach. Moreover, most of the variables (19 variables for TDHS-1993, 14 variables for TDHS-2008 and 12 variables for TDHS-2013) had equal confidence interval width in the two approaches. But, the maximum increase in the width of confidence limits were observed in TDHS-1993 for “Ideal number of children”, in TDHS-1998 for “Children ever born” and “Children surviving” variables, in TDHS-2003 and TDHS-2008 for “Urban residence” variable and in TDHS-2013 for 6 variables. Actually, the highest values of difference in width of confidence limits (0.012 and 0.009) were for “Urban residence” and “Ideal number of children”, after cluster level approach had been applied to survey.

Table 5.3. shows the results of the ratio of coefficient of variation. In cluster level approach, the coefficient of variation for 8 variables increased in all surveys, implying lower precision of estimates. In addition to this, for at least 15 variables in each survey the coefficient of variation were bigger in cluster level than strata level.

The maximum and minimum changes were observed in TDHS-1998, when the cluster level approaches was used. In this case, while the cv for “Currently using female sterilization” variable increased by 2.736 times implying lower precision, “Currently using periodic abstinence” variable’s cv decreased by a factor of with cluster level weighting.

Finally, Table 5.4. gives the differences of the cluster level and strata level design effect. The cluster level DEFT value was higher than the strata level one for 19 variables in all surveys and for at least 16 variables in each survey; implying cluster level weighting requires higher sample sizes to reach the same level of precision as stratum level weighting. The cluster level DEFT values for “Urban residence” variable are bigger than strata level in two surveys and the difference were measured 0.540 and 0.401. On the other hand, for “No education” variable, DEFT value is 0.065 smaller in cluster than strata level approach.

To sum up, cluster level weighting tends to decrease precision in general, however, there are no additional pattern when two weighting approaches are compared. The reason for this case may be the assumptions made to complete missing information. All assumptions, except for the estimated number of households, were made to ensure that no additional uncertainty will be added. That is, the block size was assumed to be equal to the number of listed HHs or vice versa. During the weight calculation steps, these ensured that these two values cancel out in the overall selection probability: where the number of listed HHs was the denominator of the last stage selection probability and the block size was the numerator of the previous stage of selection probability (see Formula 3.6. and below explanation in section 3.3.1.1.) . Therefore, if the assumed values were known, the cluster level weights would have even higher variability and increase the design effect values more than currently observed.

Moreover, while point estimates for TDHS-1993 are nearly equal to each other in cluster level and stratum level weight approaches, they are different from the original one. The reason of this situation may be the assumptions made in the calculation of the original weight variable in this survey. As described in the survey report (HUIPS, 1994), it was assumed that the household size was taken as 5 for all regions. Moreover, response rates were assumed to be the same for urban and rural residences because they were not very different. However, in practice, the mean household differed by region (e.g. it was larger in the East than the others) and although the differences were small, rural response rates were usually higher in rural areas.

Table 5.1. Comparison Table of Difference in Estimate

Variables	Difference in estimate (Cluster level - Strata level)					Total Number of Variables in Row		
	TDHS-1993	TDHS-1998	TDHS-2003	TDHS-2008	TDHS-2013	> 0	=0	< 0
Urban residence	**0.027**	-0.004	-0.028	**0.020**	**0.015**	3	0	2
No education	-0.006	-0.003	**0.003**	-0.002	-0.008	1	0	4
Secondary school or higher	**0.009**	**0.009**	-0.002	**0.008**	**0.009**	4	0	1
Never married*		**0.018**			-0.001	1	3	1
Currently married/in union	-0.001	-0.017	-0.001	-0.001		0	1	4
Currently pregnant		-0.002		**0.002**		1	3	1
Children ever born	-0.032	-0.050	**0.024**	**0.004**	-0.028	2	0	3
Children surviving	-0.024	-0.046	**0.016**	**0.011**	-0.024	2	0	3
Knowing any contraceptive method	**0.001**					1	4	0
Knowing any modern contraceptive method						0	5	0
Ever used any contraceptive method	**0.002**	-0.001	-0.001	**0.001**	**0.002**	3	0	2
Currently using any method		**0.001**	-0.001		**0.005**	2	2	1
Currently using a modern method	**0.003**	**0.001**	**0.003**	**0.002**	**0.005**	5	0	0
Currently using pill			**0.002**		**0.001**	2	3	0

Table 5.1. Comparison Table of Difference in Estimate (Continued)

Variables		Difference in estimate (Cluster level - Strata level)					Total Number of Variables in Row		
		TDHS-1993	TDHS-1998	TDHS-2003	TDHS-2008	TDHS-2013	> 0	=0	< 0
Currently using IUD		**0.003**			**0.002**	**0.001**	3	2	0
Currently using condoms			**0.001**		**0.002**	**0.004**	3	2	0
Currently using injectables							0	5	0
Currently using female sterilization					-0.002	-0.001	0	3	2
Currently using periodic abstinence							0	5	0
Currently using withdrawal		-0.004		-0.003	-0.002	**0.001**	1	1	3
Want no more children**		-0.002		-0.001	**0.001**		1	2	2
Want to delay at least 2 years**		**0.002**	-0.001		**0.001**	**0.002**	3	1	1
Ideal number of children		**0.001**	-0.009	**0.002**	-0.003	-0.013	2	0	3
Total Number of Variables in Column	**> 0**	8	5	6	11	10			
	=0	9	9	10	7	7			
	< 0	6	9	7	5	6			

*****Not applicable for TDHS-1993, TDHS-2003 and TDHS-2008 due to the definition of target population of women questionnaire.
**In these variables, the statistics obtained from data set were not matched the reported ones in Appendix C of TDHS-1993 and TDHS-2003.

Table 5.2. Comparison Table of Difference in The Width of Confidence Limits

Variables	Difference in The Width of Confidence Limits (Cluster level - Strata Level)					Total Number of Variables in Row		
	TDHS-1993'	TDHS-1998'	TDHS-2003'	TDHS-2008'	TDHS-2013	> 0	=0	< 0
Urban residence	**0.002**	**0.001**	**0.012**	**0.007**		4	1	0
No education		**0.002**	**0.004**	**0.002**	-0.002	3	1	1
Secondary school or higher	**0.003**	**0.001**	**0.004**	**0.002**	**0.001**	5	0	0
Never married*		**0.001**				1	4	0
Currently married/in union		**0.001**	**0.001**	**0.001**	**0.001**	4	1	0
Currently pregnant**						0	5	0
Children ever born**		**0.004**			-0.005	1	3	1
Children surviving**		**0.004**			-0.004	1	3	1
Knowing any contraceptive method						0	5	0
Knowing any modern contraceptive method						0	5	0
Ever used any contraceptive method	**0.001**	**0.003**	**0.002**			3	2	0
Currently using any method		**0.001**	**0.001**	**0.001**		3	2	0
Currently using a modern method		**0.002**	**0.002**		**0.001**	3	2	0
Currently using pill			**0.001**			1	4	0

Table 5.2. Comparison Table of Difference in The Width of Confidence Limits (Continued)

Variables		Difference in The Width of Confidence Limits (Cluster level - Strata Level)					Total Number of Variables in Row		
		TDHS-1993'	TDHS-1998'	TDHS-2003'	TDHS-2008'	TDHS-2013	> 0	=0	< 0
Currently using IUD			**0.001**	**0.002**	**0.001**	**0.001**	4	1	0
Currently using condoms			**0.001**	**0.001**	**0.001**	**0.001**	4	1	0
Currently using injectables				**0.001**			1	4	0
Currently using female sterilization				**0.001**			1	4	0
Currently using periodic abstinence							0	5	0
Currently using withdrawal				**0.001**			1	4	0
Want no more children* **			**0.001**	**0.001**	**0.001**	**0.001**	4	1	0
Want to delay at least 2 years* **						**0.001**	1	4	0
Ideal number of children		**0.009**	**0.001**	**0.003**	**0.002**	-0.001	4	0	1
Total Number of Variables in Column	**> 0**	4	14	15	9	7			
	=0	19	9	8	14	12			
	< 0	0	0	0	0	4			

The minimum values of each survey are 0,000.

*****Not applicable for TDHS-1993, TDHS-2003 and TDHS-2008 due to the definition of target population of women questionnaire.

**All women is defined the base population for these variables, indicating all-women factors are used. So, only the point estimates are calculated using SPSS program. There is no calculation for TDHS-2003 and TDHS-2008.

***In these variables, the statistics obtained from data set were not matched the reported ones in Appendix C of TDHS-1993 and TDHS-2003.

Table 5.3. Comparison Table of Ratio of CV

Variables	Ratio of CV (Cluster level/Strata level)					Total Number of Variables in Row		
	TDHS-1993	TDHS-1998	TDHS-2003	TDHS-2008	TDHS-2013	> 0	=0	< 0
Urban residence	**1.016**	**1.027**	**1.553**	**1.235**	0.987	4	0	1
No education	**1.022**	**1.090**	**1.117**	**1.065**	**1.001**	5	0	0
Secondary school or higher	**1.053**	**1.000**	**1.115**	**1.026**	**1.006**	5	0	0
Never married*		0.995			**1.009**	1	3	1
Currently married/in union	**1.009**	**1.080**	**1.071**	**1.041**	**1.022**	5	0	0
Currently pregnant**	**1.007**	**1.014**			**1.031**	3	2	0
Children ever born**	**1.012**	**1.067**			0.960	2	2	1
Children surviving**	**1.013**	**1.076**			0.966	2	2	1
Knowing any contraceptive method	0.976	**1.021**	**1.085**	0.978	0.979	2	0	3
Knowing any modern contraceptive method	**1.063**	**1.018**	**1.027**	0.957	0.885	3	0	2
Ever used any contraceptive method	**1.043**	**1.113**	**1.136**	**1.009**	0.994	4	0	1
Currently using any method	0.992	**1.064**	**1.082**	**1.024**	1.000	3	0	2
Currently using a modern method	0.996	**1.027**	**1.047**	0.996	**1.014**	3	0	2
Currently using pill	0.986	**1.018**	**1.057**	**1.010**	**1.009**	4	0	1

Table 5.3. Comparison Table of Ratio of CV (Continued)

Variables		Ratio of CV (Cluster level/Strata level)					Total Number of Variables in Row		
		TDHS-1993	TDHS-1998	TDHS-2003	TDHS-2008	TDHS-2013	> 0	=0	< 0
Currently using IUD		**1.000**	**1.030**	**1.075**	**1.016**	**1.053**	5	0	0
Currently using condoms		**1.015**	**1.022**	**1.083**	**1.017**	**1.011**	5	0	0
Currently using injectables		**1.031**	**1.029**	**1.101**	**1.039**	**1.014**	5	0	0
Currently using female sterilization		**1.040**	**2.736**	**1.049**	**1.039**	**1.029**	5	0	0
Currently using periodic abstinence		0.979	0.388	**1.047**	**1.026**	**1.012**	3	0	2
Currently using withdrawal		**1.002**	0.990	**1.049**	**1.019**	**1.003**	4	0	1
Want no more children* **		**1.018**	**1.026**	**1.024**	**1.042**	**1.029**	5	0	0
Want to delay at least 2 years* **		0.989	**1.016**	**1.019**	**1.008**	**1.027**	4	0	1
Ideal number of children		**1.152**	**1.023**	**1.042**	**1.019**	0.996	4	0	1
Total Number of Variables in Column	**> 0**	16	20	19	16	15			
	=0	1	0	4	4	1			
	< 0	6	3	0	3	7			

*Not applicable for TDHS-1993, TDHS-2003 and TDHS-2008 due to the definition of target population of women questionnaire.

** All women is defined the base population for these variables, indicating all-women factors are used. So, only the point estimates are calculated using SPSS program. There is no calculation for TDHS-2003 and TDHS-2008.

***In these variables, the statistics obtained from data set were not matched the reported ones in Appendix-C of TDHS-1993 and TDHS-2003.

Table 5.4. Comparison Table of Difference in Square Root Design Effect

Variables	Difference in Square Root Design Effect (Cluster level - Strata Level)					Total Number of Variables in Row		
	TDHS-1993	TDHS-1998	TDHS-2003	TDHS-2008	TDHS-2013	> 0	=0	< 0
Urban residence	**0.148**	**0.062**	**0.540**	**0.401**	**0.049**	5	0	0
No education	**0.008**	**0.117**	**0.226**	**0.105**	-0.065	4	0	1
Secondary school or higher	**0.143**	**0.046**	**0.194**	**0.098**	**0.043**	5	0	0
Never married*		**0.046**			**0.007**	2	3	0
Currently married/in union	-0.004	**0.045**	**0.068**	**0.052**	**0.028**	4	0	1
Currently pregnant**	**0.006**	-0.004			**0.032**	2	2	1
Children ever born**	**0.017**	**0.049**			-0.041	2	2	1
Children surviving**	**0.019**	**0.054**			-0.034	2	2	1
Knowing any contraceptive method	**0.017**	**0.001**	**0.054**	-0.003	**0.023**	4	0	1
Knowing any modern contraceptive method	**0.094**	**0.004**	**0.009**	**0.003**	-0.065	4	0	1
Ever used any contraceptive method	**0.067**	**0.127**	**0.164**	**0.022**	**0.010**	5	0	0
Currently using any method	-0.009	**0.067**	**0.091**	**0.029**	**0.018**	4	0	1
Currently using a modern method	**0.003**	**0.023**	**0.058**	-0.001	**0.032**	4	0	1

Table 5.4. Comparison Table of Difference in Square Root Design Effect (Continued)

Variables		**Difference in Square Root Design Effect (Cluster level - Strata Level)** TDHS-1993	TDHS-1998	TDHS-2003	TDHS-2008	TDHS-2013	**Total Number of Variables in Row** > 0	=0	< 0
Currently using pill		-0.025	**0.013**	**0.083**	**0.018**	**0.021**	4	0	1
Currently using IUD		**0.013**	**0.024**	**0.089**	**0.027**	**0.070**	5	0	0
Currently using condoms		**0.019**	**0.019**	**0.104**	**0.035**	**0.038**	5	0	0
Currently using injectables		**0.028**	**0.016**	**0.157**	**0.035**	-0.003	4	0	1
Currently using female sterilization		**0.034**	-0.013	**0.053**	**0.033**	**0.027**	4	0	1
Currently using periodic abstinence		-0.038	-0.017	**0.042**	**0.074**	**0.030**	3	0	2
Currently using withdrawal		-0.009	-0.030	**0.051**	**0.018**	**0.007**	3	0	2
Want no more children* **		**0.014**	**0.015**	**0.025**	**0.053**	**0.033**	5	0	0
Want to delay at least 2 years* **		-0.002	-0.004	**0.020**	**0.016**	**0.042**	3	0	2
Ideal number of children		**0.176**	**0.032**	**0.068**	**0.028**	-0.002	4	0	1
Total Number of Variables in Column	**> 0**	16	18	20	18	17			
	=0	1	0	3	3	0			
	< 0	6	5	0	2	6			

*****Not applicable for TDHS-1993, TDHS-2003 and TDHS-2008 due to the definition of target population of women questionnaire.

** All women is defined the base population for these variables, indicating all-women factors are used. So, only the point estimates are calculated using SPSS program. There is no calculation for TDHS-2003 and TDHS-2008.

***In these variables, the statistics obtained from data set were not matched the reported ones in Appendix C of TDHS-1993 and TDHS-2003.

CHAPTER 6. CONCLUSION AND RECOMMENDATIONS

The aims of this thesis were to examine the changes in the weighting approach of each TDHS, to present the effects of changes on the basic selected indicators, to create consistency in weighting approach when comparing the survey results and to contribute literature about comparing different weighting approaches in a Demographic Health Survey program framework.

In the first chapter, the history of the sample surveys was given initially and it ended with the aims, research questions and scope of this thesis. Chapter 2 consisted of the conceptual framework and literature review part of this thesis. In Chapter 3, the details of the data sets were described with respect to sample design, and the implementation process and the weight computations in each TDHS were mentioned in two different parts: earlier than TDHS-2013 and in TDHS-2013. The weighting approaches of this thesis were described and the new sampling weights were calculated. The results were provided in Chapter 4. Then, the findings of the study were discussed within the conceptual framework in Chapter 5.

All in all, there was no pattern observed among surveys in terms of differences in point estimates. Yet, although the widths of confidence intervals were higher for statistics weighted by cluster level weights, it is possible to ignore these effects because they are very small. According to table of the result of the ratio of coefficient of variation, and the differences of the cluster level and strata level design effect, cluster level weights approach made a negative impact on the at least 16 variables out of 23 variables in terms of precision of estimates.

The cluster level weighting approach gives us higher sampling variances, because smaller or larger weight values were observed for each survey and the reason is the differences in blocks sizes and listing results. So, these outliers affect the inferences and it might be problematic at times. The solution of this problem may be trimming the weights, which could be recommended as a further study.

In the DHS Program, the calculation of sampling weights has been changed over time due to the evolution of both the sample selection procedure and the computation approach. But, there are no studies or publications about the advantages and disadvantages of the cluster level sampling weights approach. Moreover, additional information about why change in weight calculation is necessary and how it affects the sampling design and inferences were not also discussed in the last DHS Sampling and Household Listing Manual. For these reasons, it was believed that this thesis made a contribution to the literature because for the first time the changes in weight calculation was examined under the DHS program and also the Turkey DHS.

In the previous chapters, it was said that some listing household sizes and block sizes did not exist in the HUIPS Archive. The stratum sizes for TDHS-1993 also were not given in the survey report. So, the calculation process of new weights was challenging because many assumptions had to be developed and made. But if standard DHS recode data sets included these information (block/enumeration are sizes, listing sizes, stratum sizes, etc.), such assumptions would not be needed. Therefore, it is recommended that necessary information for weight calculation be added to DHS datasets in the future for researchers, who can thus replicate the weights found in the datasets and adjust them if needed.

Some limitations existed in this thesis and taking into consideration them for the future studies are recommended:

1) Some information for the weight calculation steps such as the number of listed and unlisted household size, the block size were not reachable and they will be actually not completed in the future time for TDHS-1993, TDHS-1998 and TDHS-2003.

2) The limited number of indicators were selected to compute for the sampling error and other statistics because too many variables existed in the survey reports and it was not possible to cover all of them in this thesis.

3) The target population of individual women questionnaire covered the reproductive ages ever-married women for three of the survey: TDHS-1993, TDHS-2003 and TDHS-2008. The other two surveys included also never-married women younger than 50-year-old. For this reason, “Never married” variable which were chosen to be examined in this thesis was not applicable for those three surveys.

4) In a similar way, although the women questionnaire of TDHS-2003 and TDHS-2008 depended on ever-married women 15-49 ages, the based population for "Currently pregnant”, “Children ever born” and “Children surviving” variables were defined for all women. The additional procedures and different program use were needed to calculate. So, except the point estimates, all other statistics could not be calculated in related tables.

5) The computations presented at the tables were made by the SPSS program which used the Taylor Linearization Method to calculate the sampling error of complex surveys. Variables that required the use of Jackknife Repeated Replications (rates and indicators that used the all women factor) were excluded from this thesis because of special software needs. A further study could include indicators such as total fertility rate and infant mortality rate through the use of special packages developed.

REFERENCES

Anderson, J. E., & Cleland, J. G. (1984). The world fertility survey and contraceptive prevalence surveys: A comparison of substantive results. *Studies in Family Planning*, *15*(1), 1-13.

Bernal, R. T. I., Malta, D. C., de Araujo, T. S., & Silva, N. N. D. (2013). Telephone survey: post-stratification adjustments to compensate non-coverage bias in city of Rio Branco, Northern Brazil. *Revista de saude publica, 47(2),* 316-325.

Bethlehem, J. (2009). The Rise of Survey Sampling. (CBS Discussion Paper; No. 09015). *The Hague: Statistics Netherlands*.

Bjerve, P. J. (1973). *World Fertility Survey*. Presented at the 39th Session of International Statistical Institute, Vienna, Austria.

Brunt, L. (2001). The advent of the sample survey in the social sciences. *Journal of the Royal Statistical Society: Series D (The Statistician)*, *50*(2), 179-189.

Carlson, B. L., & Williams, S. (2001). A comparison of two methods to adjust weights for non-response: propensity modeling and weighting class adjustments. In Proceedings of the annual meeting of the *American Statistical Association*, 5-9.

Chin, S. F., Harding, A., & Bill, A. (2006). *Regional dimensions: preparation of 1998-99 HES for reweighting to small-area benchmark (Technical Paper 34).* NATSEM.

Chu, A., & Goldman, J. (1997). Weighting procedures for USDA's continuing survey of food intakes by individuals 1994–1996. In *Proceedings of the Section on Survey Research Methods*, *American Statistical Association*, 802-807.

DuMouchel, W. H., & Duncan, G. J. (1983). Using sample survey weights in multiple regression analyses of stratified samples. *Journal of the American Statistical Association, 78(383),* 535-543.

Gille, H. (1985). *The World Fertility Survey*. International Statistical Institute.

Grau, E., Potter, F., Williams, S., & Diaz-Tena, N. (2006). Nonresponse adjustment using logistic regression: To weight or not to weight. *American Statistical Association, Survey Research Methods Section,* 3073-3080.

Hacettepe University Institute of Population Studies (1994). *Turkish Demographic and Health Survey 1993*. Hacettepe University Institute of Population Studies, Ministry of Health General Directorate of Mother and Child Health and Family Planning and Macro International Inc., Ankara, Turkey.

Hacettepe University Institute of Population Studies (1999). *Turkish Demographic and Health Survey 1998*. Hacettepe University Institute of Population Studies, General Directorate of Mother and Child Health/Family Planning, Ministry of Health and Macro International Inc., Ankara, Turkey.

Hacettepe University Institute of Population Studies (2004). *Turkish Demographic and Health Survey 2003*. Hacettepe University Institute of Population Studies, Ministry of Health General Directorate of Mother and Child Health and Family Planning, State Planning Organization and European Union, Ankara, Turkey.

Hacettepe University Institute of Population Studies (2009). *“Turkey Demographic and Health Survey 2008”*. Hacettepe University Institute of Population Studies, T.R. Ministry of Health General Directorate of Mother and Child Health and Family Planning, T. R. Prime Ministry Undersecretary of State Planning Organization and TÜBİTAK, Ankara, Turkey.

Hacettepe University Institute of Population Studies (2014). *“2013 Turkey Demographic and Health Survey”*. Hacettepe University Institute of Population Studies, T.R. Ministry of Development and TÜBİTAK, Ankara, Turkey.

Hacettepe University Institute of Population Studies. (n.d.). History. Retrieved June 9, 2019, from http://www.hips.hacettepe.edu.tr/eng/institute.shtml

Hacettepe University Institute of Population Studies. (n.d.). Surveys. Retrieved June 9, 2019, from http://www.hips.hacettepe.edu.tr/eng/population_survey.shtml

Hancıoğlu, A. (1991). *Indirect estimation of mortality from information on the survival status of a close relative: Turkey 1970-1985* (Unpublished Doctoral Dissertation). Hacettepe University Institute of Population Studies, Ankara, Turkey.

Hansen, M. H. (1987). Some history and reminiscences on survey sampling. *Statistical Science*, *2*(2), 180-190.

Heeringa, S. G., West, B. T., & Berglund, P. A. (2010). *Applied survey data analysis*. Chapman and Hall/CRC.

Hermalin, A. I., Entwisle, B., & Khadr, Z. (1996). Reweighting DHS data to serve multiple perspectives. *Studies in family planning*, *27*(2), 88-98.

Hermes, K., & Poulsen, M. (2012). A review of current methods to generate synthetic spatial microdata using reweighting and future directions. *Computers, Environment and Urban Systems*, *36(4)*, 281-290.

International Statistical Institute. (1973). The World Fertility Survey: An International Programme of Fertility Research. *International Statistical Review/Revue Internationale de Statistique*, 303-314.

Kalton, G. (1983). *Introduction to survey sampling*. Sage Publications.

Kalton, G., & Flores-Cervantes, I. (2003). Weighting methods. *Journal of official statistics*, *19(2)*, 81.

Kessler, R. C., Berglund, P., Chiu, W. T., Demler, O., Heeringa, S., Hiripi, E., ... & Zheng, H. (2004). The US national comorbidity survey replication (NCS-R): design and field procedures. *International journal of methods in psychiatric research, 13(2)*, 69-92.

Kish, L. (1965). *Survey Sampling*. John Wiley & Sons, Inc.

Kish, L. (1990). Weighting: Why, when, and how. In *Proceedings of the Survey Research Methods*, *American Statistical Association*, 121-130.

Kish, L. (1992). Weighting for unequal Pi. *Journal of Official Statistics, 8(2),* 183.

Kolenikov, S. (2016). Post-stratification or non-response adjustment. *Survey Practice, 9(3)*. Retrieved June 9, 2019, from https://www.surveypractice.org/article/2809-post-stratification-or-non-response-adjustment

Korn, E. L., & Graubard, B. I. (1995). Examples of differing weighted and unweighted estimates from a sample survey. *The American Statistician, 49(3),* 291-295.

Lavallée, P., & Beaumont, J. F. (2015). Why We Should Put Some Weight on Weights. *Survey Methods: Insights from the Field (SMIF)*. Retrieved June 9, 2019, from https://surveyinsights.org/?p=6255

Lê, T. N., & Verma, V. K. (1997). *An analysis of sample designs and sampling errors of the Demographic and Health Surveys*. DHS Analytical Reports No.3. Calverton, Maryland: Macro International Inc.

Lewis, G. L. (1983). The Contraceptive Prevalence Survey Project: Content and Status. *Population index, 49(2),* 189-198.

Little, R. J., & Vartivarian, S. (2005). Does weighting for nonresponse increase the variance of survey means?. *Survey Methodology, 31(2),* 161.

Liu, B., Ferraro, D., Wilson, E., & Brick, J. M. (2004). Trimming extreme weights in household surveys. In *Proceedings of the Section on Survey Research Methods, American Statistical Association,* 3905-3912.

Lohr, S. L., & Liu, J. (1994). A comparison of weighted and unweighted analyses in the National Crime Victimization Survey. *Journal of Quantitative Criminology, 10(4),* 343-360.

Macro International Inc. (1996). *Sampling Manual*. DHS-III Basic Documentation No.6. Calverton, Maryland.

ICF International. (2012). *Demographic and Health Survey Sampling and Household Listing Manual*. MEASURE DHS, Calverton, Maryland, U.S.A.: ICF International.

Potter, F. (1988). Survey of procedures to control extreme sampling weights. In *Proceedings of the Section on Survey Research Methods, American Statistical Association,* 453-458.

Potter, F. J. (1990). A study of procedures to identify and trim extreme sampling weights. In *Proceedings of the Section on Survey Research Methods, American Statistical Association,* 225-230.

Rutstein, S. O., & Rojas, G. (2003). Guide to DHS statistics. *Calverton, MD: ORC Macro*.

Sharot, T. (1986). Weighting survey results. *Journal of the Market Research Society, 28(3),* 269-284.

Tanton, R., Vidyattama, Y., Nepal, B., & McNamara, J. (2011). Small area estimation using a reweighting algorithm. *Journal of the Royal Statistical Society: Series A (Statistics in Society), 174(4),* 931-951.

Tanton, R., Williamson, P., & Harding, A. (2014). Comparing two methods of reweighting a survey file to small area data. *International Journal of Microsimulation, 7(1)*, 76-99.

The Demographic and Health Survey Program. (n.d.). Who We Are. Retrieved June 9, 2019, from https://www.dhsprogram.com/Who-We-Are/About-Us.cfm

The Republic of Turkey Official Gazette. (2005). *5429 Türkiye İstatistik Kanunu.*

The Republic of Turkey Official Gazette. (2006). *5490 Nüfus Hizmetleri Kanunu.*

The State Institute of Statistics. (2008). *Adrese Dayalı Nüfus Kayıt Sistemi 2007 Nüfus Sayımı Sonuçları.* Bulletin No:9.

Türkyılmaz A. S. and Hancıoğlu A. (2004). Region Definitions in 2003 Turkey Demographic and Health Survey: Appropriateness to European Union Regional Statistics System and Effects on Sample Design. *The Turkish Journal of Population Studies, Vol. 26,* 3-14.

Verma, V., Scott, C., & O'Muircheartaigh, C. (1980). Sample designs and sampling errors for the World Fertility Survey. *Journal of the Royal Statistical Society: Series A (General)*, *143*(4), 431-463.

Verma, V., & Lê, T. (1996). An analysis of sampling errors for the demographic and health surveys. *International Statistical Review/Revue Internationale de Statistique, 64(3),* 265-294.

Yıldız, D. (2011). *Sampling Error Estimation By Using Different Methods And Software In Complex Samples.* (Master's thesis). Hacettepe University Institute of Population Studies, Ankara, Turkey.

APPENDIX

APPENDIX A. EXAMPLE OF LISTING FORM

LİSTELENEN TOPLAM HANEHALKI SAYISI			
LİSTELENMEYEN TOPLAM HANEHALKI SAYISI			

HACETTEPE ÜNİVERSİTESİ
2013 TÜRKİYE NÜFUS VE SAĞLIK ARAŞTIRMASI
HANEHALKI LİSTELEME FORMU

SAYFA 1 / __

KÜME NO				

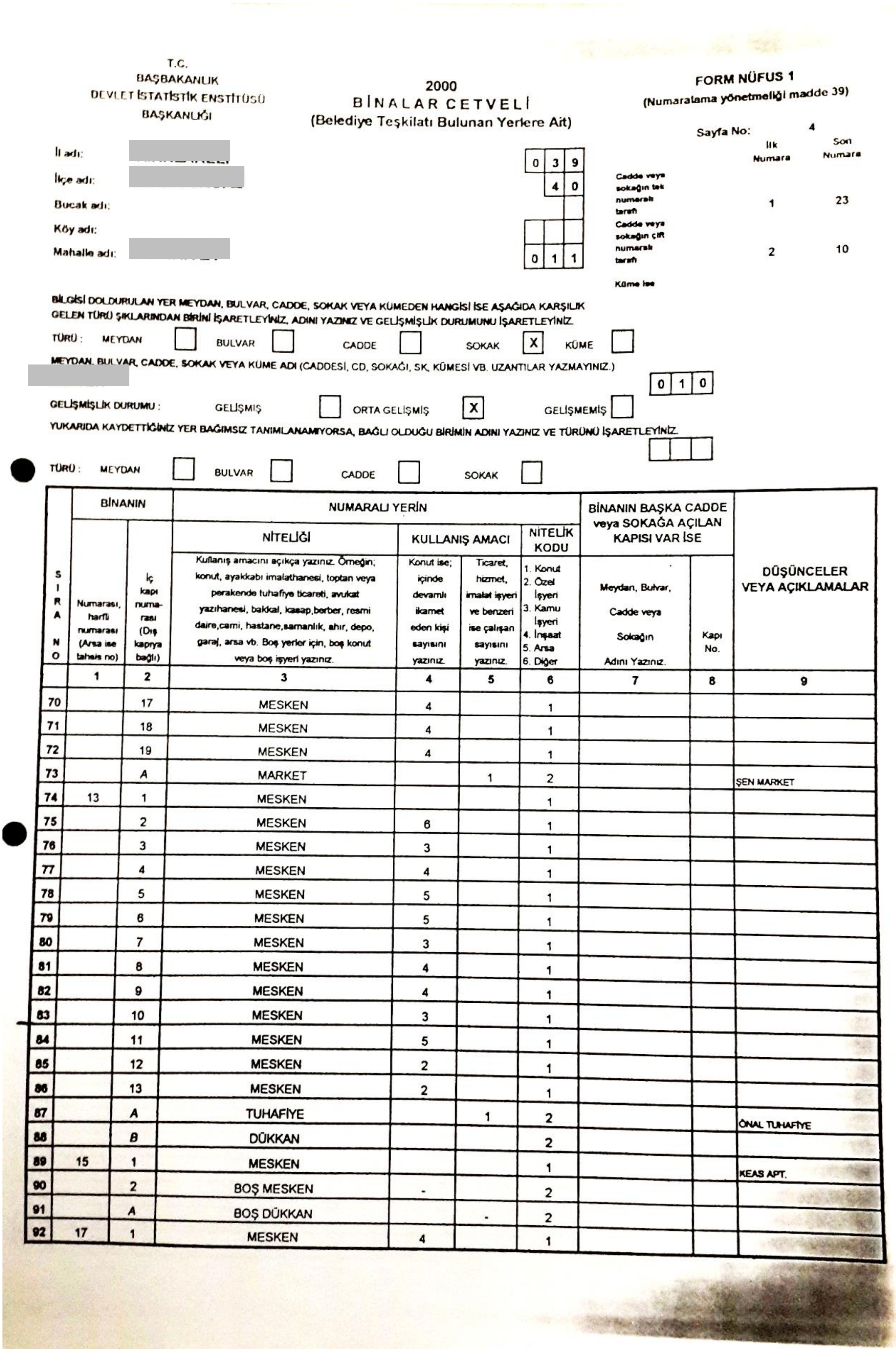
5 BÖLGE		**İL**			**BUCAK**		**HARİTACI**			**KENT / KIR (1/2)**
12 BÖLGE		**İLÇE**			**KÖY**		**LİSTELEMECİ**			**TÜİK BLOK FORMU KULLANILDI (1) KULLANILMADI (2)**

BURAYI BOŞ BIRAKINIZ		BİNA SIRA NO (1)	BİNANIN ADRESİ, TARİFİ VEYA KÖY/MAHALLE İSMİ (2)	BİNA İÇİ SIRA NO (3)	BİRİM TİPİ (4)	UYGUN KONUT? (E/H) (5)	HANEHALKI REİSİNİN ADI VE SOYADI (6)	GÖZLEMLER (SOKAK İSMİ DEĞİŞMİŞ İSE ESKİ VE YENİ İSMİ MUTLAKA BELİRTİNİZ) (7)
Seçilen HH No	Uygun HH No							

BİRİM TİPİ KODLARI

KONUT		KONUT OLMAYAN	
11 DOLU KONUT	14 YIKIK / OTURULACAK DURUMDA DEĞİL	21 TİCARİ / İŞ YERİ	30 İNŞAAT
12 ARAŞTIRMA BOYUNCA KONUTTA KİMSE YOK	15 YILIN ÇOĞUNLUĞUNDA VE ARAŞTIRMA SÜRESİNCE KULLANILAN YAZLIK / MEVSİMLİK	22 KAMU	40 ARSA
13 BOŞ KONUT	16 KISA SÜRELİ YAZLIK / MEVSİMLİK OLARAK KULLANILAN KONUT	23 DİĞER KURUMSAL	70 DİĞER

APPENDIX B. EXAMPLE OF THE STRUCTURE SCHEDULE



T.C.
BAŞBAKANLIK
DEVLET İSTATİSTİK ENSTİTÜSÜ
BAŞKANLIĞI

2000
BİNALAR CETVELİ
(Belediye Teşkilatı Bulunan Yerlere Ait)

FORM NÜFUS 1
(Numaralama yönetmeliği madde 39)

Sayfa No: 4

İl adı: [redacted] 0 3 9
İlçe adı: [redacted] 4 0
Bucak adı:
Köy adı:
Mahalle adı: [redacted] 0 1 1

	İlk Numara	Son Numara
Cadde veya sokağın tek numaralı tarafı	1	23
Cadde veya sokağın çift numaralı tarafı	2	10
Küme ise		

BİLGİSİ DOLDURULAN YER MEYDAN, BULVAR, CADDE, SOKAK VEYA KÜMEDEN HANGİSİ İSE AŞAĞIDA KARŞILIK GELEN TÜRÜ ŞIKLARINDAN BİRİNİ İŞARETLEYİNİZ, ADINI YAZINIZ VE GELİŞMİŞLİK DURUMUNU İŞARETLEYİNİZ.

TÜRÜ : MEYDAN ☐ BULVAR ☐ CADDE ☐ SOKAK ☒ KÜME ☐

MEYDAN, BULVAR, CADDE, SOKAK VEYA KÜME ADI (CADDESİ, CD, SOKAĞI, SK, KÜMESİ VB. UZANTILAR YAZMAYINIZ.)
[redacted] 0 1 0

GELİŞMİŞLİK DURUMU : GELİŞMİŞ ☐ ORTA GELİŞMİŞ ☒ GELİŞMEMİŞ ☐

YUKARIDA KAYDETTİĞİNİZ YER BAĞIMSIZ TANIMLANAMIYORSA, BAĞLI OLDUĞU BİRİMİN ADINI YAZINIZ VE TÜRÜNÜ İŞARETLEYİNİZ.

TÜRÜ : MEYDAN ☐ BULVAR ☐ CADDE ☐ SOKAK ☐

SIRA NO	BİNANIN		NUMARALI YERİN				BİNANIN BAŞKA CADDE veya SOKAĞA AÇILAN KAPISI VAR İSE		DÜŞÜNCELER VEYA AÇIKLAMALAR
			NİTELİĞİ	KULLANIŞ AMACI		NİTELİK KODU			
	Numarası, harfli numarası (Arsa ise tahsis no)	İç kapı numarası (Dış kapıya bağlı)	Kullanış amacını açıkça yazınız. Örneğin; konut, ayakkabı imalathanesi, toptan veya perakende tuhafiye ticareti, avukat yazıhanesi, bakkal, kasap, berber, resmi daire, cami, hastane, samanlık, ahır, depo, garaj, arsa vb. Boş yerler için, boş konut veya boş işyeri yazınız.	Konut ise; içinde devamlı ikamet eden kişi sayısını yazınız.	Ticaret, hizmet, imalat işyeri ve benzeri ise çalışan sayısını yazınız.	1. Konut 2. Özel İşyeri 3. Kamu İşyeri 4. İnşaat 5. Arsa 6. Diğer	Meydan, Bulvar, Cadde veya Sokağın Adını Yazınız.	Kapı No.	
	1	2	3	4	5	6	7	8	9
70		17	MESKEN	4		1			
71		18	MESKEN	4		1			
72		19	MESKEN	4		1			
73		A	MARKET		1	2			ŞEN MARKET
74	13	1	MESKEN			1			
75		2	MESKEN	6		1			
76		3	MESKEN	3		1			
77		4	MESKEN	4		1			
78		5	MESKEN	5		1			
79		6	MESKEN	5		1			
80		7	MESKEN	3		1			
81		8	MESKEN	4		1			
82		9	MESKEN	4		1			
83		10	MESKEN	3		1			
84		11	MESKEN	5		1			
85		12	MESKEN	2		1			
86		13	MESKEN	2		1			
87		A	TUHAFİYE		1	2			ÖNAL TUHAFİYE
88		B	DÜKKAN			2			
89	15	1	MESKEN			1			KEAS APT.
90		2	BOŞ MESKEN	-		2			
91		A	BOŞ DÜKKAN		-	2			
92	17	1	MESKEN	4		1			

APPENDIX C. THE APPROVAL OF HACETTEPE UNIVERSITY ETHICS COMMISSION

Tarih: 30.04.2018 18:03
Sayı: 35853172-100-E.00000019285

E.00000019285

T.C.
HACETTEPE ÜNİVERSİTESİ
Rektörlük

Sayı : 35853172-100
Konu : Etik Komisyonu Hk.

NÜFUS ETÜTLERİ ENSTİTÜSÜ MÜDÜRLÜĞÜNE

İlgi : 13.04.2018 tarih ve 225 sayılı yazınız.

Enstitümüz Sosyal Araştırma Yöntemleri Anabilim Dalı yüksek lisans programı öğrencilerinden **Irmak YILDIZ**'ın **Dr. Öğr. Üyesi Tuğba ADALI** danışmanlığında yürüttüğü **"Türkiye Nüfus ve Sağlık Araştırmalarının Örneklem Ağırlıklarının Yeniden Hesaplanması ve Karşılaştırılması"** başlıklı tez çalışması, Üniversitemiz Senatosu Etik Komisyonunun **17 Nisan 2018** tarihinde yapmış olduğu toplantıda incelenmiş olup, etik açıdan uygun bulunmuştur.

Bilgilerinizi ve gereğini rica ederim.

e-imzalıdır
Prof. Dr. Rahime Meral NOHUTCU
Rektör Yardımcısı

Evrakın elektronik imzalı suretine https://belgedogrulama.hacettepe.edu.tr adresinden 41915ea8-93d6-468f-bacd-be31b0e9a5b6 kodu ile erişebilirsiniz.
Bu belge 5070 sayılı Elektronik İmza Kanunu'na uygun olarak Güvenli Elektronik İmza ile imzalanmıştır.

Hacettepe Üniversitesi Rektörlük 06100 Sıhhiye-Ankara
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APPENDIX D. UNWEIGTED POINT ESTIMATES

Table D.1. Unweighted Point Estimates

Variables	Unweighted Estimates				
	TDHS-1993	**TDHS-1998**	**TDHS-2003**	**TDHS-2008**	**TDHS-2013**
Urban residence	0.633	0.665	0.740	0.740	0.735
No education	0.271	0.185	0.252	0.176	0.151
Secondary school or higher	0.173	0.295	0.238	0.362	0.495
Never married*		0.283			0.259
Currently married/in union	0.962	0.687	0.952	0.957	0.701
Currently pregnant**	0.074	0.052	0.000	0.000	0.048
Children ever born**	3.031	2.075	1.849	1.759	1.834
Children surviving**	2.669	1.867	1.697	1.642	1.748
Knowing any contraceptive method	0.991	0.989	0.998	0.997	0.998
Knowing any modern contraceptive method	0.987	0.987	0.996	0.995	0.996
Ever used any contraceptive method	0.811	0.831	0.888	0.895	0.906
Currently using any method	0.630	0.631	0.697	0.710	0.715
Currently using a modern method	0.344	0.373	0.406	0.446	0.452
Currently using pill	0.048	0.043	0.046	0.055	0.043
Currently using IUD	0.185	0.189	0.191	0.167	0.158
Currently using condoms	0.066	0.085	0.101	0.128	0.145
Currently using injectables	0.001	0.005	0.005	0.008	0.007
Currently using female sterilization	0.030	0.046	0.057	0.085	0.097
Currently using periodic abstinence	0.009	0.010	0.012	0.005	0.004
Currently using withdrawal	0.268	0.242	0.268	0.257	0.258
Want no more children	0.665	0.623	0.594	0.585	0.479
Want to delay at least 2 years	0.140	0.132	0.136	0.144	0.171
Ideal number of children	2.400	2.401	2.608	2.618	2.770

*****Not applicable due to the definition of target population of women questionnaire.
**All women is defined the base population for these variables.