Family Size and Child Nutritional Status in Pakistan

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CERTIFICATE

This is to certify that this thesis entitled: **"Family Size and Child Nutritional Status in Pakistan"** submitted by Ms. Filza Ayaz is accepted in its present form by the Department of Economics & Econometrics, Pakistan Institute of Development Economics (PIDE), Islamabad as satisfying the requirements for partial fulfillment of the degree of **Master of Philosophy in Econometrics**.

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ABSTRACT

Child health is found to have an impact on the socioeconomic outcomes in adult life. Deteriorating child health has been a major concern particularly in developing economies. A great body of literature exists on the determinants of child health; among these, family size is a very important factor which has not been studied much in the light of child nutritional status. The dilution hypothesis suggests that an increase in family size will distribute parental resources unequally among the children with younger kids getting less time and resources. Therefore, this variable is believed to have a negative effect on child nutritional status. However, there are some arguments that the assumption of a fixed and narrow flow of resources from parents underpinning the theory may not always hold. This paper empirically explores the effect of family size on child nutritional status using the Pakistan Demographic and Health Survey 2017-18 data. Child health is measured by three indicators namely HAZ (height-for-age Z score), WHZ (weight-for-height Z score), and WAZ (weight-for-age Z score). For this analysis and to address the issue of endogeneity, the instrumental variable approach is used. Consequently, family size has been instrumented with the gender of the first child (girl). The results suggest that an increase in family size by one child reduces children's HAZ by 0.205 standard deviation and increases the probability of stunting by 4.4%. The impact on WHZ and WAZ are found to be insignificant. Overall, these results indicate that, while family size may not affect children's nutritional status in the short-run, it definitely has deteriorating impact in the long-run.

Key words: Family size, stunting, wasting, underweight

CONTENTS

LIST OF ABBREVIATIONS

HAZ	Height for age Z score
WHZ	Weight for height Z score
WAZ	Weight for age Z score
2SLS	Two stage least squares
NNS	National Nutrition Survey
PDHS	Pakistan Demographic Health Survey
PACT	Planning, Access, Care, Treatment

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Chapter 1

1. INTRODUCTION

1.1 BACKGROUND

Child health is very imperative as is it the basis of a healthy and prosperous life. Good health enables children to grow, learn, develop and contribute to the society and economy whereas poor health shackles future outcomes. Children with poor health are more likely to face health problems in their adulthood and due to this they perform worse in education, income, employment and occupational choices even if controlled for other factors (Case, 2005) and (Currie, 2009). Researchers have ardently explored the factors that affect the child health but related research is still very limited.

In Pakistan, undernourishment is a great concern, as the prevalence of stunting, wasting and being underweight is quite high in children. As per the Pakistan Demographic and Health Survey (2017-18), 38% of children in Pakistan are stunted with 17% being severely stunted. This figure increases to 48% for children aged 24-35 months. Besides this, the number of children who are wasted is also quite high in Pakistan i.e. 15% for children less than 1 year of age. Furthermore, 23% of all children under 5 years of age are wasted and 8% severely wasted. This situation gets even worse when considering the case of newborn children as 57% children are small at birth i.e. stunted, and 41% weigh less and are underweight. Children who are stunted are also likely to be wasted and this rate is 20% but this is not the only case as 35% of children having large size at birth are stunted, while 21% are underweight. Similarly, the figures in the National Nutrition Survey (2019) show that 4 out of every 10 children under five years are stunted, while 17.7% are wasted. Another challenging figure in Pakistan according to the NNS, (2019) is that 21.1% adolescent boys and 11.8% adolescent girls are underweight.

The above mentioned statistics from the national survey reports portray a very distressing situation of child health in Pakistan, calling for the need to examine the underlying factors responsible for this situation. There are a few factors which are considered to have a significant effect on children's health outcomes. Amongst these factors, family size is believed to be a very significant one. It is believed that children growing up in large families are less likely to receive attention, time, care and financial support from parents. Hence, these children face physical and mental health problems. This calls for a major need to address these issues by exploring the reasons behind them as previously done by Mahgoub et al (2005), Lundborg et al. (2013) and Zewdie & Abebaw (2013).The importance of early life health for an individual's success in later life is well-studied. According to the quality-quantity model, parents in large families face high investment costs for investing in their children's health. This implies that if family size increases, it negatively effects the child's well-being (Becker & Lewis, 1973; Mogstad & Wiswall, 2016). There have been theories including the hygiene hypothesis, dilution hypothesis and various biological arguments which provide plausible explanations about the effect of family size on children's health outcomes (Lundborg et al., 2015; Keyser & Rossem, 2017).

The dilution hypothesis states that in large family size, there is a high cost of investment and care of children. Hence, there is a possibility of unequal distribution of resources among children and concentration of these resources to the first child (Horton, 1988). Generally, this hypothesis states that parents have finite resources and the increase in number of children dilutes these resources (Blake, 1981; Downey, 2001). This suggests that there is a tradeoff between the quality of children i.e., human capital and the number of children which is also explained in the quantity-quality model by Becker & Lewis, (1973), and Becker & Tomes (1976).

According to the hygiene hypothesis, as more children are born in a household, they are more vulnerable to face health problems like infectious diseases. This is also supported by the biological arguments which suggest that with time and age, the mother's health deteriorates and unhealthy mothers produce more unhealthy children (Horton, 1998). Besides this, some researchers including Mogstad &Wiswall (2016) argue about the vagueness of the effects of this variable on child health outcomes. According to Desai (1995) and Bras et al. (2010), the assumption that there is a finite supply of resources from parents is wrong. The reason for this is that these resources may change over time due to development or by provision of subsidies or facilities by government, resulting in a positive effect on child health. This notion is also supported by other researchers like Spencer (2003), Bambra et al. (2009) and Wang (2014). Whereas this argument cannot be tested in our analysis because we do not have the time series data for the indicators under consideration in this analysis. Moreover, other household and parents related factors like household income and education of parents might also have a significant effect on child health. Therefore, these variables have been also included as independent variables in our analysis.

1.2 OBJECTIVE OF STUDY

The main objective of this study is to analyze the effect of family size on the nutritional status of the children. In particular, we explore the impact of increasing family size on children's short-term and long-term health outcomes.

1.3 SIGNIFICANCE OF STUDY

There are various papers on child health in Pakistan but none of the previous researches has analyzed the effect of family size on child nutritional outcomes. Moreover, previous researches have only explored the socio-economic characteristics like parent's education, employment and health care or the household characteristics like the type of household, water and sanitation etc. (Iram & Butt, 2006; Shehzad, 2006; Arif & Arif, 2012; and Arif et al., 2012). Furthermore, they have also lacked in exploring the heterogeneity which exists within the households which can be a major cause of inequitable nutrition. This research aims to address these gaps particularly in the case of Pakistan. In addition to this, the paper also aims to provide evidence based information about the effects of family size on child nutritional outcomes for the purpose of policy making. It aims to provide useful insights to the government for addressing the issue of poor child nutritional status by devising efficient policies to reduce family size and by the implementation of population control measures.

1.4 ORGANIZATION OF THE STUDY

This paper has been organized such that the first chapter gives the introduction which includes background, objectives and the significance of the study. The second chapter includes the literature review followed by the explanation of data and variables in chapter 3. Chapter 4 discusses methodology and the empirical model. Chapter 5 includes the results and discussion whereas chapter 6 concludes the study.

Chapter 2

2. LITERATURE REVIEW

2.1 DETERMINANTS OF CHILD NUTRITIONAL STATUS

Many researchers have empirically explored the effect of different economic, socio-economic and demographic variables on child health outcomes. Previous researches, including Bhuiya et al. (1987) and Anwar et al. (2015), explored the effect of various demographic and socio-economic indicators on children's health outcomes. Research by Monfardini & See (2012), and Collin (2013) investigated the effect of birth order on the child outcomes due to the inequality in resource allocation. Besides this, there has been research on the effects of paternal smoking on the children's nutritional status and analysis of the nutritional differentials across various socio-economic groups (Chowdhury et al., 2010). Despite the vast literature on the determinants or factors that affect child nutritional status, the literature on the effect of family size is still limited.

2.2 EFFECT OF FAMILY SIZE ON CHILD NUTRITIONAL STATUS

The effect of family size on the child health outcomes has not been explored much, particularly in Pakistan. The previous literature provides some evidence for the dependence of children's health on family size as it negatively influences the child health outcomes. However, there is an important assumption that the children live with their parents and receive resources from them. The majority of previous researches on family size mainly analyze their effect on children's educational and employment outcomes (Booth & Kee, 2009; Ponczek & Souza, 2012; and Juhn et al., 2019). All these studies explain this relation in context with the quantity-quality model. Hence, there is a lack of research on the relationship between family size and child nutritional status particularly in Pakistan.

Hesketh et al. (2003) explored the effect of family size on morbidity, family's access to health and child nutrition in China. For this purpose they carried out a cross-sectional survey which included questions relating to anthropometry and hemoglobin measurement etc. for children aged 12 to 16 years in Zhejiang province in eastern China. In this study, Pearson's $\chi 2$ test was used to analyze the relation between family size and various demographic and health variables. Moreover, adjusted odds ratio and 95% confidence interval were calculated using logistic regression. The results of their study show that there was no considerable difference between the effect of family size on being underweight, suicide ideation and over smoking. Whereas, only children were more likely to be overweight and had experienced an illness in past year.

Delpiano (2005) used a more appropriate approach, estimating the 2SLS mode. The aim of this study was to investigate the effect of the number of children on child well-being and investment using multiple births as an indicator for the exogenous change in the family size. For this analysis the data was obtained from the 1980 US Census Five-Percent Public Use Micro Sample. The results of the 2SLS analysis showed that a change in family size causes a reallocation of resources by the parents, which is consistent with the Quantity and Quality model proposed by Becker (1965).

Hatton & Martin (2008) also examined the determinants of child health in the time period before the existence of the welfare state using the Boyd Orr cohort survey for poor families in 1937-39. This paper analyzed the tradeoff between quality, which included the health and education of children and the quantity i.e., the number of children in time of poverty in Britain. The results show that variables like birth order and family size negatively affect the heights of children whereas this is not the case for body mass index. Contrarily, the household income per capita positively affects the height of children.

Kucera & Mclntosh (2010) analyzed the effect of family size from the perspective of the dilution model. According to their study, as the family size increases, available resources for children, such as time, money and energy, decline. This decline in resources constrains the physical as well as social development of the children. The analysis for this study was done using a national sample and including an uneven number of poor households. Thus the analysis of the effects of family size on the risk of under nutrition was measured by the dietary intake for the children belonging to age group of 4-6 years. From the results it is evident that the children who belong to small families have a low risk of being undernourished as compared to children who belong to large families.

In another study Angrist et al. (2010), in the case of Israel, used multiple births and same sex of the siblings as the instruments for family size. For this analysis, the child health outcomes have been measured by three different anthropometric measures. These measures included stunting, which is low height for age; wasting, which means having low weight for height; and underweight, which measures low weight for age. From the results of this study it can be concluded that the child health characterized by stunting, wasting and underweight declined overtime although on average the household size has declined.

Lundborg et al. (2014) have also supported the quantity and quality model by Becker and researched that the family size and the health of children have an inverse relationship, though there has been a debate about the magnitude and the direction of this relation. For the analysis in the research, the dataset was taken which included all-male

Swedish birth cohorts from the time period of 1965-1978. The data was analyzed to suggest that if the family size increases due to an exogenous factor it affects the children's health. The OLS results show that as the number of children increases, each additional child exhibits a decrease in height of the child by ¼ cm. However, if birth order is used as a control, the estimate's magnitude declines and tends to be insignificant. Whereas, for estimating the family size causal effect, twin births are used as an instrument variable for family size. The results provide evidence that family size positively affects the height of the children.

Contrary to existing literature, Dasgupta & Solomon (2017) examined the effects of exogenous variations in family size on the health of the child. For this study, data from national longitudinal surveys was used to study the effect of family size on child health status by taking the variable for body weight as an indicator for health outcome. In order to address the empirical concerns due to the cross-sectional analysis child fixed effects were employed. The findings of the research suggested that there is no significant evidence for the existence of quantity-quality trade-off in terms of child health. Similarly, the results of the panel data analysis show that if a younger sibling is born in the family it decreases the probability of being obese.

2.3 EFFECT OF PARENTAL EDUCATION ON CHILD NUTRITION

Reed et al. (1996) examined the relationship between the maternal education and the nutritional status of the children. For the analysis interactive linear regression model was used and the results indicated that if mothers had less than 4 years of formal education then the relationship of maternal education with the child's weight was significantly different across various social environments. The effect of maternal education on child weight was insignificant in the lowest environment and positively significant in intermediate socio-environment. Whereas, it tends to be weakly positive in the higher socio-environment while, children belonging to mothers having higher education, tend to have a negative relationship between the two variables. The reason being that education has increased the labor force participation of women and their involvement in outdoor activities while decreasing their attention to child care.

Later, in a research Islam et al. (2003) examined the significant factors which influence the child nutritional status particularly for children under the age of six years of age. Primary data was used for the analysis and the results showed that various factors including the mother's education, income, age of child, breast feeding duration and family size were the factors which had the most significant effect on a child's nutritional status in the case of Bangladesh.

2.4 EFFECT OF WATER AND SANITATION ON CHILD NUTRITION

Baez (2008) investigated the relationship of family size with various measures related to, either the resource allocation to the children in the households or the potential consequences of these allocations for the children, particularly in the case of Colombia. The problem of exogenous variation exists in case of fertility, which is caused due to the preference of the parents to have a sex-mix among the children born. The results of this research show that the family size negatively affects the average quality of the children. This is evident from the findings that the children who belonged to large families on average had one year education less than those from small families and were less likely to go to school. Similarly in large families as the number of sibling increases, there is a high probability that children do not have access to clean drinking water and sanitation facilities.

This provides evidence that an increase in family size negatively affects the existing limited resources of the household resources. The quasi-experimental analysis shows that a similar adverse effect of family size is observed from anthropometrics data and morbidity & immunization records.

Later, Zewdie & Abebaw (2013) examined the main determinants of child undernutrition in the Kombolcha districts located in Eastern Hararghe, Ethiopia. For this purpose, cross-sectional data was collected on children under five years, by using the two-stage sampling procedure and was further analyzed by using the logit regression model. The results of this analysis revealed that 45 percent children were stunted, 28.9 percent were underweight and 11.2 percent were wasted. The study provides evidence for the existence of a strong relationship between the child nutritional status and child's age, immunization status, gender, mother's antenatal care, household size, use of latrine, source of water and morbidity.

Okeyo & Kirabira (2016) investigated in their paper the potential short-run and long-term effects of malnutrition which can be a leading factor in the increased rates of mortality among children of age five years or below. Besides this, if this problem is not addressed in the early years of child growth, it can also be a cause of low educational attainment, impaired development and low levels of economic productivity. In this study other factors have also been considered like the increasing informal settlements in urban areas in the Kisumu city located in Kenya, which have resulted in the overcrowding, pollution, insufficient supply of water supply and poor sanitary conditions. Thus, all these factors also contribute to the negative effects on the health outcomes and the nutritional status of the children in this region. In this research the correlates of the competitiveness of the household factor were used as the indicators for the nutritional status. For the purpose of analysis, a sample of 400 households was selected comprising caregivers along with the children whose age was between 6 to 59 months, and a structured questionnaire was designed. Besides this, variables of interest were included along with the techniques for anthropometric assessments. The results of the multivariate logistic regression indicated that factors like family size, parasitic infections and diet diversity score significantly affected the HAZ (height for age Z score) and WHZ (weight for height Z score).

2.5 EFFECT OF DEMOGRAPHIC VARIABLES ON CHILD NUTRITION

In a research on the determinants of nutritional status Iram & Butt (2006) explored the various environmental and socioeconomic factors which may significantly affect the nutritional status of preschool children in Pakistan. The instrumental variable approach was used and the results of this study show that various maternal and household level characteristics significantly affect the important child nutritional status. On the other hand, household size and child care practices negatively and significantly influence the child nutritional status.

Kumar & Ram (2013) researched the relationship between the household structure and child health in India. The data from the National Family Health Survey 2005–06 was analyzed and child health indicators including underweight and immunization were used as dependent variables. The results show that there is a negative and significant relation of number of siblings with the nutritional status of children and full immunization coverage even if adjusted for the socio economic and demographic variables.

In a recent paper Mmopelwa (2019) researched and analyzed how birth order and family size affect child health particularly in Botswana. Data for children aged 6-60 months was taken from the 2009/10 Botswana Core Welfare Indicator Survey and random effects model was estimated for the within and between the household variation. The results of this study show that children who have a higher birth order tend to have worse nutritional outcomes as compared to those with a lower birth order. Similarly the household size also negatively affects the child health and this variation is higher across households, which are unexplained by the variables being observed.

2.6 EFFECT OF INCOME ON CHILD NUTRITION

Engle (1993) researched on the impact of mother and fathers' income on the nutritional status of the children. For this purpose, a sample of 294 children of Guatemala, belonging to age group of 8–47 months was considered. It was also analyzed whether the incomes of the parents were pooled and that what was the relationship of income with decision-making regarding household purchases. For the analysis four different measures of income for both parents were constructed. The results showed that most of the mothers did not pool their incomes; the mothers whose income constituted a higher proportion of the overall family income had higher decision-making power. The influence of income on the nutritional status of the children was explained by using the multiple linear regression analysis, adding various control variables. Mother's share in family income was more significantly related with the nutritional status of the children whereas, father's share of income in food budget was significantly related with child health status.

In a later study, Orbeta (2005) used the household survey data to analyze the effect of family size on different family welfare dimensions in Philippines. The results of the multivariate analyses show that how family size affects various indicators including poverty incidence, vulnerability to poverty, parent's earnings and human capital investment. The results show that an increase in the number of children negatively affects the welfare of the household and these effects are regressive i.e., the negative effect is higher for poor households. However, this study did not cater for the problem of endogeneity. A similar negative relationship between the quantity which includes family size and quality which is measured by health and education of children, can be found in various studies including Rosenzweig & Wolpin, (1980), Black et al., (2005), Cáceres-Delpiano, (2006) and Li et al., (2008).

In the existing literature many researchers explored that when household size or family size increases, it negatively effects the child nutritional status (Delpiano, 2005; Iram & Butt, 2006; Hatton & Martin, 2008; Lundborg et al., 2014 and Mmopelwa, 2019). Contrarily, Hesketh et al., (2003) and Dasgupta & Solomon, (2017) found that family size does not affect the child health. Thus, in majority of the existing literature it is quite evident that the family size has a significant effect on the child nutritional outcomes and the most appropriate approach for the analysis of this impact is the instrumental variable approach. Though, in the existing literature on child health in Pakistan, there is lack of research on the effect of family size on child nutritional outcomes; particularly, using the instrumental variable approach.

Chapter 3

3. DATA AND VARIABLES

3.1 DATA

For this study we have used the Pakistan Demographic and Health Survey (2017-18) data which is collected by the National Institute of Population studies and is the fourth round which has been conducted in Pakistan. Moreover, this is a nationally representative survey with urban, rural breakdown and provides a data for diverse range of indicators on children, women and household level variables. The survey provides data for the four provinces i.e., Punjab, Sindh, Baluchistan and Khyber Pakhtunkhwa. Besides this, it also covers the regions including Azad Jammu & Kashmir, Gilgit Baltistan, FATA and Islamabad Capital Territory. The PDHS survey uses a stratified two-staged sample design. These strata have been created by dividing eight regions into urban and rural each i.e., 16 sampling strata. Then the two-stage sampling is used to select samples from every stratum. The second stage involved systematic sampling of households. In this survey 28 households had been selected from each of the 561 clusters. Therefore, in this survey total sample size of 16,240 households was taken out of which 12,338 were the occupied households in Pakistan and successful interviews were carried out for 11,869 households. The sample size of eligible women who were interviewed was 12,364. In addition to this 4,794 children under the age of 5 years were selected from the households sample for the anthropometric measurement.

The PDHS data set also provides data for child health variables HAZ (low height for age), WHZ (low weight for height) and WAZ (low weight for age) which are used as dependent variable in our study. These indicators, which are obtained from PDHS are computed using

World Health Organization's standards by calculating the z scores which give the standardized measure of deviation from median population reference. The values are basically obtained by taking the difference of an individual child's observations with the median population value and dividing it by the standard deviation of population. These values obtained are interpreted as the Z score value within the -2 and +2 range from median shows normal growth and if the child lies somewhere out of this range, the child is considered to be malnourished.

In Pakistan, we have joint family systems as well and it is difficult to identify whether the household has a nuclear family or a joint/ extended family system. Thus in case of a joint family system there are more members of the household which tend to constrain the resources available for investing in child health. Or on the contrary there could be more people in such households contributing for earning resources. Therefore, in this analysis total number of members in a household is used as a measure of family size which is the variable of interest.

3.2 THEORETICAL FRAMEWORK

The child nutritional status is measured by height for age, weight for height and weight for age Z scores. From the previous studies, it is observed that if more children are born and the family size increases, the resources of the family are divided among the family members. Therefore, as family size increases it negatively effects the child nutritional status. Whereas, the family size is affected by the gender of the child i.e., if the first born child is a girl the parents may continue to have more children until a son is born in the family, resulting in an increased family size.

Similarly, parent related variables are also important and may affect the child health outcomes. If the parents are more educated they may be more concerned about their children's health and have more awareness regarding the child health issues. In addition to this, higher education of parents can lead to better economic opportunities thereby, increasing investment in child health (Lindeboom et al., 2009).

Parent's age is another very important factor and the increased age is believed to result in birth defects, risk of premature birth and low birth weight (Chung, 2020). Another important factor is the marital status, if the mother is married she can provide better standard of living and health care to her children as compared to divorced or widowed mothers. Besides this, it is observed that children in female headed households are more likely to be stunted and underweight as compared to children in male headed households (Haidar & Makau, 2009). The existing research also indicates that if the child has diarrhea very frequently, it can adversely affect growth resulting in stunting; having a negative effect on child health (Checkley et al., 2008).

Water and Sanitation is also an important factor, if the families do not have access to clean drinking water and improved sanitation facilities it would result in increased child health problems like diarrhea and would negatively affect child health (World Health Organization, 2009). Moreover, if the household is located in an urban region or a well-developed area, the members of the household would have access to better health care facilities and improved living conditions. Therefore, in such households children are more likely to have a good nutritional status (Fink et al., 2014). Furthermore, if the income or wealth of the household increases, parents are more likely to invest more in their children resulting in improved child health outcomes.

3.3 VARIABLES

3.3.1 Dependent variables

Table 3.1: Dependent Variables

HAZ *height for age Z score*	Stunting *Probability of being stunted (Probability of having low height for age)*
WHZ *weight for height Z score*	Wasting *Probability of being wasted (Probability of having low weight for height)*
WAZ *weight for age Z score*	Underweight *Probability of being wasted (Probability of having low weight for age)*

HAZ: It is the height for age Z score < –2 SD of WHO Child Growth Standards median. For the construction of this variable the height for age standard deviation, according to WHO standards is taken and it is divided by 100.

WHZ: It is the weight for height Z score < –2 SD of WHO Child Growth Standards median. For the construction of this variable the weight for height standard deviation, according to WHO standards is taken and it is divided by 100.

WAZ: It is the weight for age Z score < –2 SD of WHO Child Growth Standards median. For the construction of this variable the weight for age standard deviation, according to WHO standards is taken and it is divided by 100.

Stunting: It is the probability of low height for age Z score which is below the –2 SD. For the construction of this variable the children are counted who have HAZ score below -2 standard deviation and the number of children is divided by the total number of children in the sample.

Wasting: It is the probability of low weight for height Z score which is below the –2 SD. For the construction of this variable the children are counted who have WHZ score below -2 standard deviation and the number of children below -2 standard deviation is divided by the total number of children in the sample.

Underweight: It is the probability of low weight for age Z score which is below the –2 SD. For the construction of this variable the children are counted who have WAZ score below -2 standard deviation and the number of children below -2 standard deviation is divided by the total number of children in the sample.

3.3.2 Independent Variables

Table 3.2: Variable of Interest

Variable of Interest
Family Size (FShd) *Number of members in the family which includes the number of household members who are usual residents of a household.*

Table 3.3: Child, parent and household covariates

Child Covariates	
Variables	**Explanation**
Gender of first born child (FG_{hd})	*A dummy variable used for the gender of the child i.e. first born child is a girl (1=yes, 0=otherwise)*
Age of Child ($Cage_{hd}$)	*Age of child in months for all the children whose anthropometric measures were taken.*
Diarrhea (Dhr_{hd})	*If the child had diarrhea, either in past twenty four hours or within past two weeks.*
Parent Covariates	
Mother's Age ($Mage_{hd}$)	*Current age of mother in completed years, who belongs to household h and is living in district d*
Mother's Marital Status ($MStat_{hd}$)	*Mother's current marital status, who belongs to household h and is living in district d*
Mother's Education ($Medu_{hd}$)	*Level of education of the mother who belongs to household h and is living in district d*
Father's Age ($Fage_{hd}$)	*Current age of father in completed years, who belongs to household h and is living in district d*
Father's Education ($Fedu_{hd}$)	*Level of education of the father who belongs to household h and is living in district d*

Household Covariates	
Gender of Head of HH ($HHhead_{hd}$)	*Gender of head of the household*
Drinking water ($Water_{hd}$)	*The time to get to the water facility, from which the water is used for drinking by the members of household h in district d*
Household sanitation facility ($Sanitation_{hd}$)	*Type of sanitation facility used by the members of household h in district d*
Type of place of Residence ($Restype_{hd}$)	*Type of place of residence of the household, either urban area residence or rural area residence*
District (D)	*District of the household h in which it is located*
Region (R)	*Region of the household h in which it is located*
Wealth ($Wealth_{hd}$)	*Wealth status of the household h in district d*

Chapter 4

4. METHODOLOGY

The problem of endogeneity arises because many factors like fertility, income, migration, autonomy and mortality etc are believed to have an effect on the household size which are further determined by many other underlying factors (Hoddinott & Mekasha, 2017). To cater for this problem the instrumental variable approach has been used in the literature for family size (De Haan, 2010; Dasgupta& Solomon, 2018). Whereas, in some papers the household fixed-effect model has been used (Horton, 1988). Thus, in this paper we also use the instrumental approach using gender of the first child as an instrument for family size.

The effect of family size on children's nutritional outcomes is estimated using the following ordinary least squares (OLS) model:

$$Y_{chd} = \beta_0 + \beta_1 FS_{hd} + \beta_2 X_{chd} + \beta_3 Z_{mhd} + \beta_4 \theta_{hhd} + \mu \qquad \text{Eq. (1)}$$

Where Y_{chd} is the nutritional status of the child c, belonging to household h and living in district d; which is represented by height for age, weight for age and weight for height Z scores in separate regressions respectively. The Z scores are calculated by taking difference of individual child's observations from the median value of the population and then dividing it by the population standard deviation. If the Z score values are within the -2 and +2 range from median, it shows normal growth and if the Z score lies out of this range, the child is considered as malnourished. In addition to this, three more regressions are run in which Ychd represents probability of being stunted, probability of being wasted and probability of being underweight respectively.

The variable FS_{hd} includes the total members of the household h in district d whereas, the vector X_{chd} represents the child related covariates in household h and district d. Moreover, Z_{mhd} is used for parent's characteristics in household h and district d. Furthermore, the vector Θ_{hhd} is used to represent household covariates (sex of head of household, family size, source of water etc.) and $\mu$is an error term. Whereas, the effect of quality and quantity tradeoff is captured by the negative coefficient of β1.

4.1 ENDOGENEITY AND INSTRUMENTAL VARIABLE APPROACH

Though there is a causal effect of the family size on the quality of children, if the family size is being determined exogenously. In simultaneous analysis of family size and the investment in child health, the β1 faces a problem of endogeneity. This problem arises if an independent variable and the error term are correlated either due to omitted variable or reverse causality. In case of endogeneity β1 does not efficiently capture the causal effect of family size on child health. This effect might be either upward bias or downward bias depending on the cause of the endogeneity. For instance, in Pakistan, the households belonging to higher wealth quintiles may plan to have less children and prioritize the quality of children by investing more in their health and education. This would result in an upward bias in the quantity and quality trade off. Contrarily, the parents who are very committed may plan to have more children and would also invest more to improve the quality of their children, causing a downward bias. So, to address this problem the instrumental variable approach has been used and the two-stage least squares model was estimated for the purpose of capturing the exogenous variation which exists in the family size. For this purpose a variable needs to be identified which affects the family size but is not related with the error term in the above equation. Therefore, the variable gender of the first child born FG was used as an instrument and the 2SLS model was estimated. The reason for using this variable as an instrument is that, if the first born child is a girl the parents may continue to have more children unless a son is born.

4.2 VALIDITY OF THE INSTRUMENT

The validity of using gender of the first child as an instrument of family size can be tested from various conditions and arguments. The first condition for using the gender of the child as an instrument is that the family size should be significantly correlated with the gender of the first child born.

$$\boldsymbol{Corr(FG_{hd},\ FS_{hd}) \neq 0}$$

The gender of the child matters in Pakistan because the sons carry the family legacy and they are considered to be the bread earners and financial support for their families, the reason being that girls are married and become part of other families. Besides this, another factor that contributes to the son preference is the prevalence of gender inequality in our society. The male children have higher chances of entering the labor force and securing highly paid jobs. Moreover, especially in rural areas sons are preferred as they inherit the agricultural land and assets. Furthermore, another reason for this preference is that sons are believed to be more likely to participate in the agricultural activities and work on the land. Therefore, if the first child is a girl then there is very high probability that the parents continue to have children until a male child is born.

The second condition for using gender of the first child born as an instrument for family size is that it is uncorrelated with the nutritional outcome of children besides being correlated through family size.

$$\boldsymbol{Corr(FG_{hd}, Y_{chd}) = 0}$$

This condition is also satisfied because the gender of the child born is random as it is determined by the nature. Hence, it is not correlated with the child nutritional status. Though this instrument may not be very efficient if there is parental control over the births depending upon the gender of the child e.g. in case of sex selective abortions by knowing the gender of the child to be born through ultrasound. In such cases the gender of the child does not remain random. In Pakistan abortions are illegal and due to this there is no proper record or data available. Therefore, we cannot be confident about the exact rate of abortions but according to (PDHS 2012-13) which is a nationally representative survey, almost 2 percent of pregnancies resulted in an abortion. Thus, the rate of abortions being carried out illegally is not very high either. Moreover, out of this percentage, the rate of sex selective abortions will be further low because abortions also take place because of other reasons.

Therefore, there are very few statistics of sex-selective abortions in Pakistan. Zaidi & Morgan (2016) used Pakistan demographic & health survey three rounds data and it can be observed that there is a very high son preference which is evident by fertility decisions and the contraceptive use. The results show that couples continue to have children until a son is born or to have more than one male child. These results do not provide evidence that there has been any increase in the sex ratios at birth, which is taken as an indicator of the sex selective abortion. Therefore, couples in Pakistan continue to have children to fulfill their desire for sons, although this is at the cost of large family size and low investment in children particularly daughters (Hussain et al., 2000; Ali, 2009). Similarly, research by Sathar et al (2015) shows that in comparison to the results of PDHS (2006), there has been a significant decline in the sex ratios at birth in the PDHS (2013), although it might be due to better reporting. Hence all these studies provide sufficient evidence for the gender of the first born child to be random and exogenously determined.

4.3 THE EXCLUSION RESTRICTION

In case of validity of this instrument, the exclusion restriction also needs to be satisfied by the biological argument. According to biological argument, as family size increases i.e., as number of children born increases, the mother's health deteriorates. Therefore, it may lead to birth of more unhealthy children. It means this variable has a significant effect on child health and has been omitted in the model. Whereas, in our analysis we instrument the family size with the gender of the first child born so the exclusion restriction is being satisfied.

4.4 THE TWO STAGE LEAST SQUARES MODEL

The two stage lease squares model is used for the analysis of the effect of family size on child nutrition.

The equation for the two stage least squares model is below:

$$FS_{hd} = \alpha_0 + \alpha_1 FG_{hd} + \alpha_2 X_{chd} + \alpha_3 Z_{mhd} + \alpha_4 \theta_{hhd} + \mu \qquad \text{Eq. (2)}$$

$$Y_{chd} = \gamma_0 + \gamma_1 \widehat{FS}_{hd} + \gamma_2 X_{chd} + \gamma_3 Z_{mhd} + \gamma_4 \theta_{hhd} + \mu \qquad \text{Eq. (3)}$$

In this model, the Equation (2) shows the first-stage regression. In the first stage regression, the family size (the dependent variable) is regressed on the instrument variable which is the gender of the first child born i.e., a female child and other covariates. Whereas the Equation (3) shows the model for second-stage regression.

In the second stage regression, we have regressed the indicator for the child nutritional status on the predicted family size variable which is taken from the previous equation that is equation 2. In this research we have further used two models. In model 1, there are no control variables used for both first stage and second stage regressions. Contrarily, in the second model, various child, parent and household related control variables are used for both first stage and second stage regressions.

Chapter 5

5. RESULTS

5.1 DESCRIPTIVE STATISTICS

Table 1: Descriptive Statistics

VARIABLE	OBS.	MEAN	STD. DEV.	MIN.	MAX.
FS	4098	9.246	4.864	1	39
FG	4098	0.285	0.451	0	1
FAGE	4046	34.015	7.530	17	81
MAGE	4098	29.097	6.059	15	49
CAGE	4098	29.325	17.362	0	59
HAZ	4098	-1.557	1.672	-5.99	5.81
WHZ	4098	-0.243	1.288	-4.94	4.99
WAZ	4098	-1.081	1.258	-5.9	3.9
STUNTED	4098	0.385	0.486	0	1
WASTED	4098	0.080	0.271	0	1
UNDERWEIGHT	4098	0.221	0.415	0	1

Note: The Cage (age of the child) is given in months. The variable stunted shows the probability of being stunted, wasted is the probability of wasted and underweight is the probability of being underweight.

The table 1 shows the descriptive statistics of the variables of interest including nutritional indicators, age, family size and gender of first born child. According to the results, the average value of HAZ score shows that children in sample are on average 1.5 standard deviations below the median of population. Similarly, the WHZ score shows that the children in sample are 0.2 standard deviations below the median value of the reference population. Whereas the WAZ score indicates that the children included in sample are 1.0 standard deviation below the median value of the reference population.

Similarly the mean values of stunted, wasted and underweight show that the probability of being stunted among children in Pakistan is 38% and probability of being wasted in 8%. Similarly there is also a high probability of being underweight which is 22%.

5.2 TWO STAGE LEAST SQUARES REGRESSION

The results of the 2SLS regression are reported in the tables 2 to 7 for different nutritional indicators of children, using various child, parent and household controls. In model 1 of each table first stage and second stage regressions are done without using any control variables. Whereas, in the model 2 of each table, the results of both the first stage and second stage regressions are reported after using control variables.

In table 2 model 1, in the first stage regression family size is regressed on the gender of the first born child which shows that there is a statistically significant positive relation between the instrument variable i.e., the gender of the first child born and the family size. The coefficient is positive and statistically significant indicating that when the first born child is a girl, the family size increases. Whereas in the second stage regressing HAZ on predicted family size a negative and insignificant variable is obtained, which shows that some important variables have been omitted. Thus in model 2 control variables are added and family size is regressed on gender of the first child born i.e., a girl in the first stage. Again in the first stage a positive and significant coefficient is obtained. Therefore, in the second stage HAZ (height for age Z score) is regressed on predicted family size while controlling for various factors. The results show that if family size increases by 1 member, HAZ (height for age Z score) decreases by 0.205 standard deviation.

Table 2: Impact of family size on HAZ

Panel A: First Stage (Dependent Variable = Family Size)		
Variable	Model 1	Model 2
	0.518***	0.764***
Gender of first born (girl=1)	(0.168)	(0.170)
Observations	4,098	4037
F-Statistics	9.50***	22.21***
Adjusted R2	0.002	0.099
Panel B: Second Stage (Dependent Variable =HAZ)		
Family Size	-0.019	-0.205***
	(0.111)	(0.074)
Observations	4,098	4037
Adjusted R2	0.000	0.168
Child Controls	NO	YES
Parental Controls	NO	YES
Household Controls	NO	YES

Note:* p<0.01, ** p<0.05, * p<0.1. Standard errors are displayed in the parentheses. The child controls include child age, gender, and whether the child has diarrhea. Parental controls include mother age, father age, mother education, father education and marital status of mother. The household controls are type of place of residence, time to get to the water source, sex of the household head, wealth, region and type of toilet facility.

Table 3: Impact of family size on probability of stunting

Panel A: First Stage (Dependent Variable = Family Size)		
Variable	Model 1	Model 2
	0.5183***	0.764***
Gender of first born (girl=1)	(0.168)	(0.169)
Observations	4,098	4037
F-Statistics	9.50***	22.21***
Adjusted R2	0.002	0.099
Panel B: Second Stage (Dependent Variable =Probability of Stunting)		
Family Size	-0.005	0.044**
	(0.032)	(0.022)
Observations	4,098	4037
Adjusted R2	-0.000	0.119
Child Controls	NO	YES
Parental Controls	NO	YES
Household Controls	NO	YES

Note:* ** p<0.01, ** p<0.05, * p<0.1. Standard errors are displayed in the parentheses. The child controls include child age, gender, and whether the child has diarrhea. Parental controls include mother age, father age, mother education, father education and marital status of mother. The household controls are type of place of residence, time to get to the water source, sex of the household head, wealth, region and type of toilet facility

Similarly in the table 3, results are reported for two stage least squares regression for both the models, model 1 without controls and model 2 with control variables. In the first stage again the family size is regressed on the instrument variable and we get statistically significant coefficients. Whereas in the second stage probability of being stunted is regressed on predicted family size. The results for model 1 show that the coefficient is negative and statistically insignificant, whereas in model 2 the coefficient obtained is statistically significant. Thus, the results can be interpreted that an increase in family size by 1 member increases the probability of being stunted by 4.4 percent.

One of the main reasons of this is that stunting is a long term deficiency and therefore the effect of a change in the family size is efficiently captured by this long term nutritional deficiency. Besides this, a temporary fluctuation in income and resources does not instantly effect the height of the children.

Table 4: Impact of family size on WHZ

Variable	Model 1	Model 2
Panel A: First Stage (Dependent Variable = Family Size)		
Gender of first born (girl=1)	0.518***	0.764***
	(0.168)	(0.169)
Observations	4,098	4037
F-Statistics	9.50***	22.21***
Adjusted R2	0.002	0.099
Panel B: Second Stage (Dependent Variable =WHZ)		
Family Size	0.102	0.078
	(0.086)	(0.061)
Observations	4,098	4037
Adjusted R2	0.000	0.029
Child Controls	NO	YES
Parental Controls	NO	YES
Household Controls	NO	YES

Note:*** p<0.01, ** p<0.05, * p<0.1. Standard errors are displayed in the parentheses. The child controls include child age, gender, and whether the child has diarrhea. Parental controls include mother age, father age, mother education, father education and marital status of mother. The household controls are type of place of residence, time to get to the water source, sex of the household head, wealth, region and type of toilet facility

Table 5: Impact of family size on probability of wasting

Panel A: First Stage (Dependent Variable = Family Size)		
Variable	Model 1	Model 2
Gender of first born (girl=1)	0.518***	0.764***
	(0.168)	(0.169)
Observations	4,098	4037
F-Statistics	9.50***	22.21***
Adjusted R2	0.002	0.099
Panel B: Second Stage (Dependent Variable =Probability of Wasting)		
Family Size	0.001	-0.0005
	(0.018)	(0.013)
Observations	4,098	4037
Adjusted R2	-0.000	0.020
Child Controls	NO	YES
Parental Controls	NO	YES
Household Controls	NO	YES

Note:*** p<0.01, ** p<0.05, * p<0.1. Standard errors are displayed in the parentheses. The child controls include child age, gender, and whether the child has diarrhea. Parental controls include mother age, father age, mother education, father education and marital status of mother. The household controls are type of place of residence, time to get to the water source, sex of the household head, wealth, region and type of toilet facility

Table 4 shows the results of two stage least squares regressions of WHZ (weight for height Z score). The coefficients of the first stage are statistically significant. Whereas, the coefficients of the second stage regressions in both models, model 1 and model 2 are not statistically significant. The results can be interpreted as that if the family size increases by 1 person, the WHZ (weight for height Z score) increases by 0.078 standard deviation. As per this research family includes the parents and their children thus, the added family member is the new born child and is a dependent member of the family.

Similarly, the results of probability of being wasted is reported in table 5. The coefficients of first stage regressions show a positive and statistically significant relation between family size and instrument variable in both models.

Whereas, the results of second stage regression of model 1 show that there is a positive yet insignificant effect of predicted family size on the probability of being wasted, if we regress without using controls variables. Contrarily, the second stage regression results of model 2 after adding control variables in the model, show that there is an inverse relation between the predicted family size and the probability of being wasted. Thus, it can be interpreted that if the family size increases by 1 family member, the probability of being wasted decreases by 0.05 percent.

The reason for this insignificant effect of family size on wasting may be because a temporary or short term increase in the resources may also improve the diet of the children and increase their weight. Another reason is that the child might have lower height and correspondingly a low weight, in such a case child would not be considered as wasted. Though, in reality the child has lower height and lower weight than what it should be. This could be another reason why family size does not significantly affect wasting, and is also not considered a reliable measure of undernourishment.

Table 6: Impact of family size on WAZ

Panel A: First Stage (Dependent Variable = Family Size)		
Variable	Model 1	Model 2
	0.518***	0.764***
Gender of first born (girl=1)	(0.168)	(0.169)
Observations	4,098	4037
F-Statistics	9.50***	22.21***
Adjusted R2	0.002	0.099
Panel B: Second Stage (Dependent Variable =WAZ)		
Family Size	0.040	-0.063
	(0.084)	(0.056)
Observations	4,098	4037
Adjusted R2	-0.000	0.141
Child Controls	NO	YES
Parental Controls	NO	YES
Household Controls	NO	YES

Note:*** p<0.01, ** p<0.05, * p<0.1. Standard errors are displayed in the parentheses. The child controls include child age, gender, and whether the child has diarrhea. Parental controls include mother age, father age, mother education, father education and marital status of mother. The household controls are type of place of residence, time to get to the water source, sex of the household head, wealth, region and type of toilet facility

Table 7: Impact of family size on probability of underweight

Panel A: First Stage (Dependent Variable = Family Size)		
Variable	Model 1	Model 2
	0.518***	0.764***
Gender of first born (girl=1)	(0.168)	(0.169)
Observations	4,098	4037
F-Statistics	9.50***	22.21***
Adjusted R2	0.002	0.099
Panel B: Second Stage (Dependent Variable =Probability of Underweight)		
Family Size	-0.001	0.036*
	(0.027)	(0.019)
Observations	4,098	4037
Adjusted R2	-0.000	0.079
Child Controls	NO	YES
Parental Controls	NO	YES
Household Controls	NO	YES

Note:*** p<0.01, ** p<0.05, * p<0.1. Standard errors are displayed in the parentheses. The child controls include child age, gender, and whether the child has diarrhea. Parental controls include mother age, father age, mother education, father education and marital status of mother. The household controls are type of place of residence, time to get to the water source, sex of the household head, wealth, region and type of toilet facility

In table 6, the results for instrumental variable regressions are shown for WAZ (weight for age Z score). The results of the first stage regression indicate a positive and statistically significant effect of gender of first born child on the family size. Contrarily, the results of the second stage regression of model 1 and 2 show that the coefficients are statistically insignificant. Whereas, in the second stage regression of the model 1, if we do not control for any variables there is a positive relation between predicted family size and WAZ. However, after controlling for child, parent and household covariates we get a negative coefficient of WAZ in second stage regression. This means that an increase in family size by one member results in a decrease in WAZ (weight for age Z score) by 0.063 standard deviation.

Table 7 summarizes the results of the 2 stage least squares regression estimates, for the effect of family size on the probability of being underweight. The second stage regressions of model 1 show that the coefficient of probability of being underweight is not statistically significant in the model without controls. Whereas, after adding the control variables in the model 2, the coefficient of the regression results become statistically significant. The results of the estimation of this model show that if family size increases by 1 person then the probability of being underweight increases by 3.6 percent.

The reason for this significant effect of family size on underweight may be because with the increasing age of the child the weight also changes and during this time if more children are born the parent's attention, time and resources may shift to the newborn. Thus, a change in family size significantly affects the WAZ score.

Chapter 6

6. CONCLUSION

Child nutritional status is very important not only for the future of children but also for the future of a country. The nutritional status of children affects their productivity as well as their contribution to the economy. Thus, this paper highlights the significance of child nutritional status by examining the effect of family size on stunting, wasting and underweight. The instrumental variable approach is used to estimate the effect of family size on HAZ, WHZ and WAZ Z scores as well as the probability of being stunted, wasted and probability of being underweight. In these estimations, the gender of the first child born which is a girl, has been used as an instrument for family size. Through the two stage least square estimations controlling for various child, parent and household variables, it is evident that family size adversely effects the nutritional status of children in terms of stunting and underweight.

The results of the instrumental variable regressions show that there is a significant relation between HAZ and family size. This means that an increase in family size decreases the height for age Z score thereby leading to an increase in stunting. Similarly if there is an increase in family size, it means that the children in the family are more likely to be stunted. The results are contrary in case of WHZ and probability of being wasted as an increase in family size increases the Z score which means a decline in wasting. Similarly an increase in family size also reduces the probability of being wasted.

It is evident from the estimations that in case of WAZ if the family size increases it results in a decrease in WAZ, which means more children are underweight. Similarly if family size increases, children are more likely to be underweight. Therefore it can be concluded that an increase in family size leads to a decline in the HAZ and WAZ Z scores, increasing the probability of being stunted and being underweight.

The results of this study are consistent with the research of other researchers including (Delpiano, 2005; Iram & Butt, 2006; Hatton & Martin, 2008; Lundborg et al., 2014 and Mmopelwa 2019). In these studies, the range of results of underweight (weight for age Z score) is -0.082 to -0.034 while the coefficient in this research is -0.063 and lies within this range. Similarly, the range of coefficients of stunting (height for age Z score) is -2.11 to -0.021 and the coefficient of this study is -0.205, so it lies within the range given in previous literature. Lastly, the range of coefficients of wasting (weight for height Z score) is -0.007 to 0.002, while the coefficient of this research is -0.0005 and is consistent with literature. Therefore, it is quite evident that the family size has a significant and negative effect on the child nutritional outcomes.

The population control policies of some countries are important when it comes to family size and its effect on child health. Thailand's government in 1970 launched a population program for availability of contraceptives, resulting in a decline in total fertility rate (Chao & Allen, 1984) while in China one-child policy program was initiated in 1970s by the Chinese government. California government launched a 'Family PACT Program' in 1997 for women belonging to low-income households, averting 205,000 pregnancies (Foster et al., 2006). Later, government of Iran in 1989 reinstated the national family-planning program, leading to increase in contraception use (Aghajanian & Merhyar, 1999). These strategies opted by countries show that effective implementation of the population control measures resulted in a significant decline in fertility rates and population growth. If such programs are initiated in Pakistan along with effective implementation protocols, they can significantly reduce the population growth rate and the burden on the resources.

6.1 POLICY RECOMMENDATION

The issue of large families and the effects of family size on the nutritional status of the children need to be addressed. Hence, the results of this research provide evidence that to reduce the rates of child nutritional deficiencies like stunting, wasting and underweight, a holistic approach should be opted for, targeting the reduction in family size. In Pakistan there is a dire need that efficient policies should be designed and existing policies should be evaluated in order to address the issues of rapid population growth and to end all forms of malnutrition by creating awareness among the public. The local government by partnering with private organizations should bring about some institutional change and enhance the capacity-building for the provision of quality food, basic necessities and improved living standards. Programs for family planning should be initiated, which could lead to a decline in the desired number of children or family size and alter the reproductive preferences, thereby improving the child nutritional status.

6.2 LIMITATION OF THE STUDY

This paper has considered the main factors which affect the child nutritional outcomes. One of the limitations of this study is that there was not enough data to test the potential channels through which family size affects the nutritional status of the children.

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