1 *Original Article*

Heterogeneous Analysis of Women Empowerment and Child Malnutrition: A Secondary Analysis of Pakistan Demographic and Health Survey.

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8   **Abstract: Background:** The development of the economy of a certain nation or region is
9 significantly influenced by the health status of the children. Malnutrition is considered to be one of
10 the major contributors to the deteriorating health status of children with different maternal factors
11 playing a predictive role in it. Literature indicates that women's empowerment affects child nutri-
12 tion and health status in several pathways. Therefore, the present paper has been set up to study the
13 relationship between child malnutrition and three key aspects of women's empowerment. **Meth-**
14 **ods:** This study conducts a heterogeneous analysis of child malnutrition and women empowerment
15 in Pakistan using the data from the last two rounds of the Pakistan Demographic and Health Survey
16 (PDHS 2012-13, PDHS 2017-18). Child malnutrition is indicated by stunting, wasting, and un-
17 derweight. While for measuring women empowerment, three areas of women's empowerment:
18 Decision-making, social independence and attitude towards violence were used. Data was analyzed
19 using linear probability model in SPSS. **Results:** The results suggest that children of mothers with
20 less than eight years of schooling, compared to those children whose mothers had greater than or
21 equal to 8 years of education, are more likely to be stunted (p-values<0.01), underweight
22 (p-values<0.05), and wasted (p-values<0.10). Similarly, the decision-making variable is highly and
23 significantly associated with stunted (p-value<0.01), wasted (p-value<0.01), and being under-
24 weight (p-value<0.10) in both rural and urban areas. **Conclusions:** While some variability exists
25 across maternal education, residence, and socioeconomic status, there is a need for tailored poli-
26 cies. The overarching conclusion emphasizes empowering women, particularly in decision-making
27 roles, regardless of educational, residential, or socioeconomic backgrounds.

30 **1. Introduction**

31   The development of the economy of a certain nation or region is significantly influenced by
32 the nutritional and health status of young children living there. Moreover, it strongly correlates
33 with achieving the Sustainable Development Goals (SDGs), particularly Goal 2, 3 and 5 that fo-
34 cuses on the eradication of hunger, promotion of health and well-being and achievement of gender
35 equality respectively. The nutritional and health status of the children not only acts as an essential
36 catalyst for the development of the country but also manifests as an outcome of development
37 (Hoddinott, 2016). Although it is widely acknowledged that spending on education is essential for
38 increasing labor productivity and accumulating human capital, Hoddinott (2016) asserts that in-
39 vesting in child nutrition is as critical. According to evidence from the underdeveloped world
40 (Hoddinott, 2016; Hoddinott et al., 2008; Stein et al., 2010), child malnutrition negatively impacts
41 adult life in the form of cognitive impairment, short height, reduced productivity, and lower income
42 that signifies the importance of investing in child nutrition. Similarly, malnutrition is one of the
43 significant causes of child mortality, and evidence shows that more than half of malnourished
44 children are from the poor world UNICEF, 2020).

45   Literature shows that women's education is one of the aspects of maternal empowerment that
46 also affects the child's nutritional status (Smith & Haddad, 2000). Other aspects of maternal em-
47 powerment include a woman's attitude towards abuse at home, her use of healthcare, and her de-
48 cision-making over the spending of the household (Deutsch & Silber, 2019). The consequences of
49 various facets of women's empowerment on children's nutritional markers differ (Malapit & Qui-
50 sumbing, 2015). Women empowerment may affect child nutrition and health status in several
51 pathways; nevertheless, four of these are extensively articulated in the economics literature, e.g.

(Cornwall, 2016; Doan & Bisharat, 1990; Engle et al., 1999; Handa, 1996; Santoso et al., 2019). These potential channels include access to household resources, household resource allocation for child nutrition, women's say in time allocation, and decision-making power in matters related to household members. Decision-making power or controlling household resources enables women to increase their welfare and devote more resources to their children's health care (Duflo, 2012; Santoso et al., 2019). Some welfare programs like cash transfers target the female population for the efficient outcomes of such programs (De Brauw et al., 2014; Duflo, 2012; Durr-e-Nayab & Farooq, 2014; Roy et al., 2015; Van den Bold et al., 2013). However, if a woman is not empowered in a household and all the money she receives is taken by her partner, then such programs would have no or negligible impact on the household's welfare (Duflo, 2012).

Since children under five are still at home and not in school, mothers are essential to the health and development of these young children. At this point, household circumstances influence both the health of children and the empowerment of women, particularly in the first five years of life, and have a substantial impact on maternal influence on child health. It is crucial to empower women through education, decision-making control over household problems, and access to healthcare for themselves and their children (Babu et al., 2016). In the economics literature, women empowerment and maternal empowerment are interchangeably used. They are summarised as the degree of acquiring the ability to make choices about their own lives, their children, and the environment in which they live (Hossain, 2020; Kabeer, 2017; Pratley, 2016). The published literature on women empowerment and child malnutrition can be categorised into two groups. One part of the literature examined several aspects of women empowerment and demonstrated how it affects children's health and nutritional condition (Basu & Koolwal, 2005; Begin et al., 1999; Dancer & Rammohan, 2009; Merchant & Udipi, 1997; Roushdy, 2004; Shroff et al., 2009). Whereas the second part of the literature used a composite index for women empowerment and investigated its impact on child malnutrition (Bose, 2011; Brunson et al., 2009; Chakraborty & Anderson, 2011; Cunningham et al., 2015; Doan & Bisharat, 1990; Hossain, 2020; Jamal, 2018; Radebe et al., 1996).

In Pakistan, women empowerment varies across regions and significantly impacts reproductive behaviour (Mahmood, 2002). Several studies on child nutrition have been conducted in Pakistan. These studies examined the association between child malnutrition and poverty (Arif et al., 2014), determinants of child malnutrition (Mahmood, 2001), women empowerment and their reproductive choices (Ali et al., 1995), risk factors for stunting in Karachi (Fikree et al., 2000), the association between ecological and maternal factors with child malnutrition (Asif et al., 2019), socioeconomic factors and child malnutrition (Afzal, 2013), land owned by women and child's health (Rehman et al., 2019) and women's empowerment and child malnutrition (Jamal, 2018; Shafiq et al., 2019).

While utilising the data from the Pakistan Panel Household Survey (PPHS), Arif et al. (2014) found a high prevalence of child malnutrition; however, they found no association between child malnutrition and poverty and perceived food shortage. In contrast to Arif et al. (2014), Mahmood (2001) argued that poverty, unhygienic household environment, lack of health care utilisation and prenatal education are significant contributors to child growth faltering. Similarly, socioeconomic status, flush facilities, and birth interval are significant determinants of child malnutrition in Pakistan (Mahmood, 2001). Looking into how women empowerment affects reproductive decisions, Ali et al. (1995) documented a significant relationship between women's education and "Time Wanted Pregnancy" preferences with reproductive choices like child ever born. Fikree et al. (2000) investigated the potential risk factors contributing to wasting, and stunting in Karachi, Pakistan. They documented that socioeconomic status, environmental factors, and maternal characteristics like education, parity, and feeding practices contribute to child stunting and wasting. Factors like maternal education and health-seeking behaviour may also indirectly contribute to better child health outcomes.

Most of the studies mentioned above were conducted at one local level (in one city in Pakistan) and/or just investigated the impact of maternal empowerment on child nutrition at one point. Furthermore, these studies lack a heterogeneous analysis of women empowerment and child malnutrition. This study fills this gap. According to the latest PDHS (2017-18), 38 per cent of children under-5 is stunted, 23 per cent are underweight, and 7 per cent of the children are wasted. The evidence and figures from PDHS suggest that more work should be done on this critical issue. Fifty percent of the children were stunted, forty percent were underweight, and nine percent of the sampled youngsters were wasted, according to the first PDHS survey (PDHS-1990). Similarly, PDHS 2012-13 report documented that forty five percent of the children were found stunted, thirty

per cent of the children were underweight, and eleven per cent of the children were wasted. These statistics are the motivation to conduct a heterogeneous analysis of women empowerment and child malnutrition. The main objective of this study is to conduct a heterogeneous analysis of women empowerment and child malnutrition. Furthermore, this study investigates the potential channel through which women empowerment affects child malnutrition.

2. Materials and Methods

2.1. Data

This study utilizes the latest PDHS: PDHS 2012-13 and PDHS 2017-18. PDHS is a part of the globally collected Demographic and Health Survey (DHS) series. The DHS series collected four surveys in Pakistan, i.e. 1990-91, 2007-08, 2012-13, and 2017-18. The National Institute of Population Studies (NIPS), a leading research organization in Pakistan, collects the data. ICF and the Pakistan Bureau of Statistics (PBS) provided technical support, while the United States Agency gave financial support for International Development (USAID).

In PDHS 2012-13, 13,558 women were interviewed, while the data for the domestic violence module is taken from approximately one-third of the whole sample, i.e. 3,687. Similarly, in PDHS 2017-18, 15,068 women were interviewed overall. As I also included PDHS 2012-13 in the pooled data, 12,336 women were interviewed (excluding AJK and FATA). Furthermore, 3,322 women overall were questioned for the domestic abuse module. As discussed above, my analytical sample is pooled from the last two rounds (PDHS 2012-13 and PDHS 2017-18) and includes women for whom domestic violence module data is collected. My final analytical sample size is 4897.

2.2. Outcome Variables

The growth-altering markers in children include underweight, wasting, and stunting. Using the WHO's guidelines for child growth, stunting, underweight, and wasting were measured. Z-scores for height relative to age that fall within two standard deviations (SD) of the median of the WHO growth reference population are considered stunted. If a child's weight-for-age Z score is less than plus or minus two standard deviations below the reference population, they are considered underweight. Similarly, wasting is defined as weight-for-height Z scores less than minus two SD below the reference population. All three child growth faltering indicators are dichotomous. When the child is stunted, the stunting variable's value is 1, and when it is not, it is 0. If a child is underweight, their code is 1, and if not, it is 0. Similarly, wasting is categorized as follows: 1 if the child is wasted and 0 if they are not wasted.

2.3. Focused Variable

The main variable of interest in the present study is women's empowerment. To measure women empowerment, I follow Ewerling et al. (2021) by making a Survey-based Women emPoweERment (SWPER) index. Based on fourteen items taken from PDHS datasets, the SWPER index is calculated. The SWPER index provides a broad overview of the three aspects of women's empowerment: decision-making, social independence, and attitude toward violence. I applied the Principal Component Analysis (PCA) technique to compute the women empowerment index on the fourteen items. Before applying PCA, I re-categorize the fourteen items so that higher values indicate greater empowerment. I kept three main components out of 14 components, which combined accounted for 70% of the variation.

2.4. Control variables

Using data from PDHS datasets and the literature study, the empirical analysis uses the following control variables. The variables include child gender, age, diarrhea status, birth order, body mass index (BMI), smoking behavior, improved water facility, improved sanitary facility, and improved cooking fuel, household wealth index, the month of birth, year of birth, survey year, and the cluster of a household.

For regression analysis, the variables documented in the literature were controlled. Nevertheless, disease environment, maternal health conditions, gender empowerment, accessibility to ANC, cultural norms, and practices may influence childhood mortality. Therefore, to control these factors, cluster fixed effect with month and year of birth fixed effect and survey fixed effect was used. Children in the same cluster share many of the characteristics mentioned above. Clusters without having any variation in ANC quality do not contribute to the estimate and are thus dropped from the analysis.

Further, a heterogeneous analysis of women empowerment and child malnutrition by examining major dimensions of women empowerment was conducted using the following equation for estimation.

$$Mn_{it} = \beta_0 + \beta_1 \times swatt_i + \beta_2 \times swsoc_i + \beta_3 \times swdec_i + \beta_4 \times X_i + \delta_t + \theta_i + \varepsilon_i \quad (8)$$

Where β_1 is the impact of woman attitude to violence on malnutrition status of a child; β_2 indicates the impact of woman social independence on child malnutrition; β_3 shows the impact of decision-making on child malnutrition status; δ_t are cohort (month and year of birth and survey) fixed effects, while θ_i is the cluster fixed effect. All the regression models are estimated through linear probability model (LPM) with high-dimensional fixed effects.

3. Results

3.1 Heterogeneous Effects

Descriptive statistics are given in Appendix A (Table A). Three primary variables are examined to investigate the variation in children's nutritional status: socioeconomic level, place of residence, and maternal education. Tables 1, 2, and 3 exhibit the results for the varied effects of maternal education, site of residence, and socioeconomic position, respectively. The PDHS 2017-18 report shows that there exists a significant difference in child malnutrition status across mothers who had no education and those who had a high level of education. The report documented that 48% of the stunted children whose mothers had no education compared to 16% of the stunted children whose mothers had higher education levels. The document also reveals that 32% of the children were underweight in the group of mothers who had no education compared to 8% of the children underweight in the group of mothers who had high-level education. Similarly, 9% of the children wasted from the group of mothers who had no education compared to 5% of the children whose mothers had high-level education.

The heterogeneity between mothers having less than eight years of education and mothers having eight or above eight years of education was investigated. Table 1 indicates that children whose mothers had less than eight years of schooling, compared to those children whose mothers had greater than or equal to 8 years of education, are more likely to be stunted, underweight, and wasted. However, it is also important to note that irrespective of maternal education, decision-making has a significant role in child malnutrition. This result suggests that women must be empowered in decision-making in intra-household resources irrespective of their educational attainment.

Similarly, the present study also examines the heterogeneous effects across places of residence (rural/urban). Table 2 shows little heterogeneity across residences. Nevertheless, it is crucial to note that the social independence variable shows significant effects in both rural and urban areas for stunting and underweight. However, the effect is more potent in rural areas. Similarly, the decision-making variable is, again, highly significant in rural and urban areas.

Another dimension of heterogeneous effects that the present study evaluates is socioeconomic status. Table 3 presents and highlights the importance of women's decision-making power in intra-household resources, which is the crucial dimension of women's empowerment that contributes to the child's nutritional status, irrespective of socioeconomic status. The results in Tables 1, 2, and 3 have some important implications. The empowered woman in a household, specifically in decision-making power, may better allocate the household resources (financial and non-financial) in the interest of her children and the overall welfare of the household in general. It also highlights the importance of the notion that irrespective of educational attainment, residential status, and socioeconomic background, the power must be in the hands of women in the decision-making process to allocate the intra-household resources efficiently, specifically for the welfare of the children.

213 **Table 1: Women Empowerment and Child Malnutrition (Heterogeneous Effects across Education)**

VARIABLES	Stunted		Underweight		Wasted	
	<8 Years	>=8 Years	<8 Years	>=8 Years	<8 Years	>=8 Years
Attitude Towards Violence	-0.0193	-0.0282	-0.0293**	-0.0272	-0.0108	-0.0185
	(0.0120)	(0.0289)	(0.0116)	(0.0202)	(0.0079)	(0.0145)
Social Independence	-0.0980***	-0.0170	-0.0468***	0.0023	-0.0176*	-0.0206*
	(0.0149)	(0.0194)	(0.0143)	(0.0161)	(0.0094)	(0.0120)
Decision Making	-0.0878***	-0.0682***	-0.0347***	-0.0417***	-0.0121*	0.0008
	(0.0117)	(0.0207)	(0.0103)	(0.0152)	(0.0069)	(0.0112)
Observations	3,196	1,310	3,252	1,331	3,206	1,309
MOB & YOB	Yes	Yes	Yes	Yes	Yes	Yes
Cluster FE	Yes	Yes	Yes	Yes	Yes	Yes

214 **Note:** At the 1%, 5%, and 10% levels, significance is shown by *** $p<0.01$, ** $p<0.05$, and * $p<0.1$. The regression models
215 include standard controls mentioned in 2.3.4

216 **Table 2: Women Empowerment and Child Malnutrition (Heterogeneous Effect across Rural/Urban)**

VARIABLES	Stunted		Underweight		Wasted	
	Rural	Urban	Rural	Urban	Rural	Urban
Attitude Towards Violence	-0.0001	-0.0462***	-0.0160	-0.0505***	-0.0091	-0.0031
	(0.0140)	(0.0168)	(0.0129)	(0.0135)	(0.0077)	(0.0096)
Social Independence	-0.0908***	-0.0317**	-0.0380***	-0.0153	-0.0096	-0.0232***
	(0.0154)	(0.0135)	(0.0144)	(0.0117)	(0.0091)	(0.0087)
Decision Making	-0.0776***	-0.0966***	-0.0467***	-0.0345***	-0.0087	-0.0162**
	(0.0134)	(0.0155)	(0.0116)	(0.0128)	(0.0076)	(0.0080)
Observations	2,573	2,003	2,619	2,033	2,587	1,998
MOB & YOB	Yes	Yes	Yes	Yes	Yes	Yes
Cluster FE	Yes	Yes	Yes	Yes	Yes	Yes

217 **Note:** At the 1%, 5%, and 10% levels, significance is shown by *** $p<0.01$, ** $p<0.05$, and * $p<0.1$. The regression models
218 include standard controls mentioned in 2.3.4

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223 **Table 3: Women Empowerment and Child Malnutrition (Heterogeneous Effects: Socioeconomic Status)**

VARIABLES	Stunted		Underweight		Wasted	
	Lower SES	Higher SES	Lower SES	Higher SES	Lower SES	Higher SES
Attitude Towards Violence	-0.0093	-0.0464***	-0.0150	-0.0546***	-0.0123	-0.0155**
	(0.0159)	(0.0149)	(0.0164)	(0.0124)	(0.0112)	(0.0076)
Social Independence	-0.1233***	-0.0399***	-0.0450**	-0.0097	-0.0145	-0.0177**
	(0.0202)	(0.0118)	(0.0202)	(0.0103)	(0.0137)	(0.0073)
Decision Making	-0.0851***	-0.0901***	-0.0521***	-0.0319***	-0.0277***	-0.0053
	(0.0157)	(0.0123)	(0.0155)	(0.0103)	(0.0103)	(0.0076)
Observations	2,027	2,497	2,073	2,525	2,046	2,486
MOB & YOB	Yes	Yes	Yes	Yes	Yes	Yes
Cluster FE	Yes	Yes	Yes	Yes	Yes	Yes

224 **Note:** At the 1%, 5%, and 10% levels, significance is shown by *** $p<0.01$, ** $p<0.05$, and * $p<0.1$. The regression models
225 include standard controls mentioned in 2.3.4

3.2 Mechanism

Women empowerment may affect a child's nutritional status in various ways. In the present study, the influence of women in intra-household decision-making channels or processes on child health and nutritional status was evaluated. The role of three major decision-making processes in a household was evaluated including 1) a healthcare decision; 2) a decision regarding household purchases; and, 3) a decision regarding women's visits to their families and relatives. The results of the estimation are shown in Table 4. I have used three different models. I control for child, maternal, and other socioeconomic characteristics in the first model. In the second model, I use the month of birth and year of birth fixed effects. While in the last model (model 3) I use cluster fixed effects. The results from Panel A show that all three decision-making processes contribute to child stunting. The likelihood of a child suffering from stunting decreases from 4 percentage points to 6 percentage points with the help of all three decision-making variables. However, the magnitude of the healthcare decision variable is a bit higher than the others. It may provide suggestive evidence that healthcare decisions in women's hands are critical to ameliorating a child's nutritional status. Similarly, in Panels B and C, I check the association between the main decision-making variable and the probability of underweight and wasted children. The decision variables have no statistical association with the probability of underweight children, whereas household purchases significantly contribute to the probability of children being wasted.

Table 4: Mechanisms: Women Empowerment and Child Malnutrition

Variables	Model 1	Model 2	Model 3
Panel A		Stunted	
Healthcare Decision	-0.0597**	-0.0642**	-0.0415
	(0.0271)	(0.0268)	(0.0309)
Purchase Decision	-0.0479**	-0.0452**	-0.0375
	(0.0229)	(0.0227)	(0.0251)
Visiting Family and Relatives	-0.0539*	-0.0590**	-0.0548*
Decision	(0.0282)	(0.0277)	(0.0311)
Panel B		Underweight	
Healthcare Decision	-0.0040	-0.0073	0.0123
	(0.0239)	(0.0239)	(0.0255)
Purchase Decision	-0.0052	-0.0037	-0.0158
	(0.0201)	(0.0201)	(0.0213)
Visiting Family and Relatives	-0.0258	-0.0289	-0.0266
Decision	(0.0247)	(0.0247)	(0.0268)
Panel C		Wasted	
Healthcare Decision	0.0119	0.0107	0.0273
	(0.0171)	(0.0171)	(0.0188)
Purchase Decision	0.0250*	0.0245*	0.0113
	(0.0140)	(0.0140)	(0.0156)
Visiting Family and Relatives	0.0260	0.0252	0.0240
Decision	(0.0188)	(0.0185)	(0.0200)
Observations	4,206	4,206	4,206
MOB & YOB FE	No	Yes	No
Cluster FE	No	No	Yes

4. Discussion

In this study, I have investigated the heterogeneous effects of women's empowerment on child malnutrition. I have checked the heterogeneity across three main dimensions: maternal education, place of residence, and socioeconomic status. I observed significant differences across these dimensions that underscore the importance of certain factors contributing to child malnutrition. I have found that children of mothers having less education are more likely to be stunted, wasted, and underweight. The literature on child malnutrition also documents that children of mothers having higher education are well-nourished compared to the children of mothers who have less or no education (Asif *et al*., 2019). It is pertinent to note that different dimensions may contribute differently to child malnutrition. I have used three main dimensions of women empowerment: social independence, attitude towards violence, and decision making. The effects of social independence variable are more potent in rural areas. Deutsch & Silber (2019) also found that the effect is significant in rural areas compared to urban areas. Similarly, the effects of decision making variable is similar across rural and urban area. These findings suggest and highlight the importance of social independence in rural areas and decision making of women irrespective of residence. I have also checked heterogeneous effects across socioeconomic status. The results suggest that irrespective of socioeconomic status, women should be empowered in social independence, attitude towards violence and decision making process in a household.

5. Conclusions

Nutrition in early stage of life has significant impacts on a country's economic growth and is directly related to Sustainable Development Goals: Eradicating Hunger, Promoting Health and Well-Being, and Achieving Gender Equality. While using the PDHS (PDHS 2012-13, 2017-18) datasets, this study examines the complex nature of women empowerment and nutritional status of their children less than five years of age. In this study, women empowerment consists of three main dimensions: attitude towards violence, social independence, and decision making. The evidence shows that as women get more empowered in a household, nutritional status of their children gets improved. The heterogeneous effects indicate that maternal education, place of residence, and their socioeconomic status are significantly correlated with child malnutrition indicators. Decision-making and social independence compared to attitude towards violence, contributing more to child malnutrition. This sheds lights on importance of women empowerment, especially empowering them in decision making process in the household. It supports the view to investigate the effectiveness of the existing laws related to women empowerment. Furthermore, it also strongly supports the viewpoint to aware people of women's rights and specifically maternal rights in household settings.

Institutional Review Board Statement: Ethical review and approval were forfeited for this study, because I have done secondary analysis of publicly available data which is available at www.dhsprogram.com. However study has followed all the ethical guidelines.

Data Availability Statement: The data I have used in this analysis is taken from the last two rounds of PDHS (PDHS 2012-13, PDHS2017-18). The PDHS data is publically available and can be found at www.dhsprogram.com

Conflicts of Interest: The author declares no conflict of interest.

Appendix A

Table A: Descriptive Statistics

Variable	Obs	Mean	Std. Dev.	Min	Max
Stunted	4816	.419	.493	0	1
Underweight	4893	.252	.434	0	1
Wasted	4822	.094	.292	0	1
Women Empowerment Index	4839	.000	1.000	-2.060	2.899
Attitude Towards Violence	4840	.000	1.000	-2.227	2.291
Social Independence	4841	.000	1.000	-3.023	3.722
Decision Making	4839	.000	1.000	-2.387	2.758
Child Gender	4897	1.489	.5	1	2
Child Age	4897	2.081	1.401	0	4
Child had Diarrhea	4897	.428	.855	0	1
Mother BMI	4881	2.447	.859	1	4
Smoking	4897	.051	.219	0	1
Improved Water	4762	.76	.427	0	1
Improved Sanitary	4763	.636	.481	0	1
Improved Cooking Fuel	4763	.421	.494	0	1
Birth Order	4897	3.589	2.383	1	15
Wealth Index	4897	2.868	1.411	1	5
Cluster	4897	234.603	143.976	1	514
Month of Birth	4897	6.848	3.403	1	12
Year of Birth	4897	2012.504	2.939	2007	2018

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