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Determinants of Child Malnutrition: A Structural Modeling Approach for Pakistan

ABSTRACT

The study aims to determine the inter consistency between determinant of child malnutrition in Pakistan using structural equation model. For analysis the socio-economic data pertaining to 3476 children under five years of age is taken from Pakistan Demographic and Health survey 2012-13. The determinants of child malnutrition are interrelated and complex. The structural equation model shows that maternal (variables pertaining to mother of child) factors are both directly and indirectly affecting child malnutrition. Maternal factors affects through biological (variables pertaining to child) factors and then biological factors affect malnutrition status of the children. So biological factors are playing a mediating role in child malnutrition outcomes in the present study. Whereas Environmental (variables pertaining to the surrounding conditions in which child lives) factors can affect behavioral (variables pertaining to the quality and type of care child received) factors and then behavior affect child malnutrition outcomes. But environmental factors are not directly affecting child malnutrition.

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1. INTRODUCTION

Child malnutrition is one of the striking global health issues which cause millions of deaths and disabilities in children under five. Chronic malnutrition is one of the major causes of morbidity and mortality among preschool children. It causes illness in most of the children and block their ability to reach their full intellectual and productive potential (Ismail & Suffla, 2013). Ethically and legally provision of good health care and nutrition to children is an investment in human capital formation. When a child will be healthy, he will grow to become a productive and energetic individual. Thus it is important to invest in early child health to build a strong and productive labor force (Fidler, 2000).

Pakistan is an agrarian economy where 64 percent of the population lives in rural areas and economic growth and development is mainly dependent on agricultural sector outcomes. 21 percent of the country's gross domestic product is due to agriculture sector contribution (PDHS, 2013). However children generally have a better nutritional status living in urban than rural setup of Pakistan. Similarly Pakistan's National Nutrition Survey (2011) identifies overall 43.7% children under five were stunted[1]. Report further claims that in rural areas the stunting in children was 46 percent and it was 36.9 percent in urban areas. Wasting rate[2] was 15.1 percent of which 12.7 percent was in urban areas and 16.1 percent in rural areas. About 31.5 percent of the children were underweight[3] out of that 33.3 percent were in rural areas. Astonishingly Malnutrition rate was higher in rural areas then urban areas despite of the fact that rural economy is predominantly agrarian. Pakistan and other similar countries such as India and Bangladesh have even higher rates of child malnutrition than countries of sub Saharan Africa. Whereas the first three years of a child are the building phase of a whole life and all the interventions should be concentrated to the child (Mehrotra, 2004) but as it is evident that our child population is stunted, significant portion are classified as wasted and underweight.

The causes of child malnutrition are well documented. Child health does not solely depend on the economic factors but there are other environmental (variables pertaining to the surrounding conditions in which child lives) and biological (variables pertaining to child) factors which influence the child health outcomes. Causes of child malnutrition are interrelated, diverse in nature, multispectral and involve many aspects of life. Contribution of individual, house household and community level predictors are important for the policy makers to design targeted interventions. There are studies [Cheah et al. (2010), Shehzad (2006), Jesmin et al.(2011), Rayhan and Khan (2006), Jayawardena (2014)] which have considered socio-economic factors such as parents occupation, education of family members and other social and economic conditions of the families etc.to be significant in explaining the differences in Child Malnutrition status.

Whereas a number of studies have focused on the Biological factors such as Fakir (2011), Thornton (1999), Mansuri (2006). These include gender bias in nutrition for children, insufficient food availability especially in developing countries and availability of livestock with the household etc. While there are studies which considered Environmental Variables to be more significant such as Kandala et al. (2011) Singh et al. (2011) Garcia and Alderman (1989) and Arif et al. (2012). Environmental variables such as mother education, poverty, exposure to diseases, inefficient health care system, geographic differences and ecological zones are considered to be significant in explaining differences for Child Malnutrition.

There are also few studies which focuses on the Maternal (variables pertaining to mother of child) Factors as determinants of the Child nutrition outcomes [Harpham et al. (2005), Miglioli et al. (2015), Masibo and Makoka (2012), Babtunde et al. (2011), Baber et al. (2010), Mahgoub et al. (2006), Borgen (2010), Black et al. (2008) and Bhavsar et al. (2012)]. These studies proposed that maternal characteristics such

[1] Stunted growth is when a child fails to meet the expected height or weight for their age. Malnutrition is one of the major causes.

[2] Wasting, or low weight for height, is a strong predictor of mortality among children under five. Again malnutrition is the major cause.

[3] An underweight person is a person whose body weight is considered too low to be healthy.

as mother height, education, BMI[4], common mental disorder, households headed by mothers etc. all significantly explain the differences in the Child Malnutrition status.

Lastly a group of studies also proposed Behavioral (variables pertaining to the quality and type of care child received) factors to be more influential than others [(such as Arif (2004), Smith et al. (2004) Saito et al. (1997)]. Behavioral variable including breast feeding practices, parental and maternal care, quality of complementary nurturing, immunization and occupation have significant relationship with the child malnutrition outcomes.

To summarize, studies have considered different determinants of malnutrition under various categories i.e. maternal factors, biological factors, environmental factors and behavioral factors etc. This shows that all these factors are important in explaining the malnutrition condition. However these variables are latent[5] in nature and require indicative variables either for reflection or formation. Secondly from the literature review it appears that isolated view of determinants of malnutrition has been considered whereas the comprehensive identification with causal links would have been a better approach. Considering the above discussion above and the nature of these latent determinants we have used a structural equation model approach for better understanding of relationship nature and significance.

This paper aims to explore the role of biological, behavioral, environmental, community, maternal and demographic variables as determining factors of the Child Malnutrition. Further the study also explores their inter relationships for Pakistan. This approach provides both the direct determinants and the mediating variables for better understanding and designing effective health intervention policy and programs.

The layout of the paper is that after the introduction a section of Methodology and Data is provided, followed by analysis and results interpretation and finally conclusion is provided.

2. METHODOLOGY AND DATA

We have used the Pakistan Demographic and Health Survey[6] (PDHS) 2012-2013. PDHS data collects information from household about a large number of important questions such as health care utilization, social and economic characteristics etc. In the present study the data is selected for married women of the age bracket 15-49 and children having age of less than five years. This resulted in inclusion of 11763 women and 3975 children identified from the survey data. This was 33.6 percent of the total sample. Majority of the children in sample under study belong to rural areas (57.7 percent) of Pakistan and Punjab is having a largest proportion i.e. 28 percent of children under five and then Sindh have 21 percent of children under five in the data. More than half of female with age 15-49 years are uneducated and 99 percent were married. 80 percent of the sampled women are housewives. Around 23.4 percent children under five are living in the poorest and 20 percent in the poorer households.

[4] Body mass index is a value derived from the mass and height of a person. The BMI is defined as the body mass divided by the square of the body height, and is universally expressed in units of kg/m², resulting from mass in kilograms and height in meters.

[5] A latent variable is a variable that cannot be observed. The presence of latent variables, however, can be detected by their effects on variables that are observable.

[6] PDHS 2012-13 is the third survey conducted under the supervision of global demographic and health survey program. The first two rounds were conducted in 1990-1991 and 2006-2007. The main objective of the survey is to estimate the reliable statistics of family planning, fertility, mother and child health, gender based violence and the knowledge about HIV/AIDS

Table 1: Sample profile

Category	Variables	Number	Percentage
Population	Adult women 15-49	11763	100
	Children under five	3467	33.6
Gender of child	Male	1728	49.8
	Female	1739	50.1
Region	Rural	6793	57.7
	Urban	4970	42.3
Province	Punjab	3266	27.8
	Sindh	2523	21.4
	KPK	2270	19.3
	Baluchistan	1902	16.2
	Gilgit Baltistan	1093	9.3
	Islamabad	709	6.0
Age of child	0-5	382	3.2
	6-8	203	1.7
	9-11	197	1.7
	12-17	407	3.5
	18-23	295	2.5
	24-35	830	7.1
	26-47	821	7.0
	48-59	822	7.0
Education of mother	No education	6722	57.1
	Primary	1687	14.3
	Secondary	2077	17.7
	Higher	1277	10.9
Marital Status	Yes	11161	99.1
	No	102	.9
Work status	Currently working	2233	19.0
	Not working	9483	80.6
Wealth Index	Poorest	2758	23.4
	Poorer	2359	20.1
	Middle	2270	19.3
	Richer	2196	18.7
	Richest	2180	18.5
Family planning	Yes	4287	36.4
	No	7476	63.6
Vaccination	Yes	6911	58.8
	No	1246	10.6
HAZ* (stunting)	Not stunted	1696	19.2
	Severely stunted	798	6.8
WAZ* (underweight)	Moderately stunted	577	4.9
	Not underweight	2261	19.2
	Severely underweight	276	2.3
	Moderately underweight	534	4.5
WHZ* (wasted)	Not wasted	2754	23.4
	Severely wasted	102	.9
	Moderately wasted	215	1.8

*HAZ is the height for age z-score and it measures the stunting condition or chronic malnutrition, *WAZ is the weight for age z-score and it measures the underweight condition or chronic malnutrition, *WHZ is the weight for height z-score and it measures the wasted condition or chronic malnutrition

Among 15-49 years age bracket women; 63.9 percent are not using family planning and 10 percent of the children are not vaccinated. 26 percent children under five are stunted, 7 percent are underweight and 3 percent are wasted. Table 1 provides other details of the sample used in the study.

The study uses latent variable based approach, because the variables used in the study are not directly observed. Often analysis is devoid of such discussion owing to non-measurability of these, but these are reflected in indicators (Reflective Models). Thus are important policy variables. These indicators become the policy variables which can be influenced and through the latent variable affects the outcome variable (in our case Malnutrition). Secondly the paper uses the Hendry Methodology (Julia, Neil & David, 2005) where general to specific model is developed. In our case also focuses on the determinants, hence focusing on just one variable may be misleading.

The study has used the following variables to find determinants of malnutrition in children under five: All these variables are either latent in nature or having more than one possible indicator.

1. Biological Factors; which includes age of the child, whether child is twin, birth interval and the size of the child at birth.
2. Maternal factors; which are mother's marital status, mother's height, weight, mother's age at first birth, mother's education and occupation.
3. Behavioral factors; includes breast feeding, place of delivery, mother's family planning, vaccination of the child and antenatal visits.
4. Environmental factors; these are type of toilet facility, source of drinking water, wealth index household having cars, motor bike, and other transport facilities, household housing type, presence of lady health worker (LHW), household size and children under five.
5. Community factors; includes type of place of residence, region.

The study uses Structural equation model-covariance based (SEM-CB) approach, which comprises of two components, a measurement model and a structural model. The measurement model relates observed responses to latent variables and some time to observed covariates. The structural model then specifies the relation between latent variables and regression of latent variables on observed variables (Skrondal & Hesketh, 2005).

In this study observed variables are age, gender child weight, mother's height and weight etc. and the latent variables are the ones which cannot be observed directly, but they are reflected in some others variable, like biological variables; which are the reflection of the variables age, child is twin, birth interval, child weight at birth. Similarly behavioral aspect is reflective of mother's family planning, child's vaccination, antenatal visits during pregnancy, breast feeding and place of delivery. SEM is then divided into four groups, path analysis, confirmative factor analysis, structural regression model and a latent growth model. Here we will use confirmatory factor analysis and structural regression models only.

The unit of analysis will be children under five years of age. Malnutrition is calculated using the WHO's (World Health Organization) criteria specified as i. Weight for age (WAZ), ii. height for age (HAZ) and iii. weight for height (WHZ). Children with z-scores ranging from -6 to 5 will be used in WAZ analysis. A child is considered malnourished if his or her z-score is more than two standard deviations below the reference population.

$$WAZ = (\frac{W_i - W_r}{SD})$$

This formula calculates the difference between the weight of a child (W_i) and the median weight from the reference population (Wr), divided by the standard deviation of the weight of the same group of children (SD).

HAZ is the height for age z-score and it measures the stunting condition or chronic malnutrition. Children with z-scores ranging from -6 to 6 will be included in this analysis. WHZ is the weight for height z-score. It calculates the current nutrition condition. For WHZ analysis includes children ranging from -5 to 5 z-scores.

Table 2: Measurement Model (Confirmatory Factor Analysis)

Endogenous Variables	Structural Equation	Exogenous variables
SODW	$SODW = Env + \varepsilon_1$	Environment
TOTF	$TOTF = \alpha_1 Env + \varepsilon_2$	
LHW	$LHW = \alpha_2 Env + \varepsilon_3$	
TOPR	$TOPR = \alpha_3 Env + \varepsilon_4$	
MWM	$MWM = \alpha_4 Env + \varepsilon_5$	
MRM	$MRM = \alpha_5 Env + \varepsilon_6$	
MFM	$MFM = \alpha_6 Env + \varepsilon_7$	
WI	$WI = \alpha_7 Env + \varepsilon_8$	
MO	$MO = Mat + \varepsilon_9$	Maternal
MAFB	$MAFB = \alpha_8 Mat + \varepsilon_{10}$	
ME	$ME = \alpha_9 Mat + \varepsilon_{11}$	
RDM	$RDM = \alpha_{10} Mat + \varepsilon_{12}$	
TORP	$TORP = \alpha_{11} Mat + \varepsilon_{13}$	
CS	$CS = Bio + \varepsilon_{14}$	Biology
PBI	$PBI = \alpha_{11} Bio + \varepsilon_{15}$	
CT	$CT = \alpha_{12} Bio + \varepsilon_{16}$	
CAM	$CAM = \alpha_{13} Bio + \varepsilon_{17}$	
BW	$BW = \alpha_{14} Bio + \varepsilon_{18}$	
DOB	$DOB = Beh + \varepsilon_{19}$	Behavioral
ANV	$ANV = \alpha_{15} Beh + \varepsilon_{20}$	
MFP	$MFP = \alpha_{16} Beh + \varepsilon_{21}$	
CV	$CV = \alpha_{17} Beh + \varepsilon_{22}$	
POD	$POD = \alpha_{18} Beh + \varepsilon_{23}$	

Table 2 presents a set of 23 structural equations from the measurement portion of the model. Measurement portion of the model is the part which links each of the indicator variables with designated latent constraints. Source of drinking water (SODW), type of toilet facility (TOTF), presence of Lady Health Worker (LHW), type of place of residence(TOPR), wealth index(WI), housing type which include main roof material, main floor material, main wall material are endogenous variables and the exogenous variable is environmental factors, which is reflector for all the endogenous variables. Error term is represented by 'ε'. Maternal factors are mother's occupation; education, mother's age at first birth (MAFB) and mother relationship with husband (MRH) are endogenous variables for maternal aspects as exogenous variables. For behavior as an exogenous variable we have taken duration of breast feeding (DOB), child vaccination (CV), antenatal care visits during pregnancy (ANV), family planning (MFP), and place of delivery (POD).

The structural portion consists of 3 structural equations and each structural portion specifies the casual structure among the latent constraints. Table 3 contains all the structural equation and their associated endogenous (dependent) variables and exogenous (independent) variables. Child malnutrition depends on biological, behavior maternal and environmental factors here and then Behavior depends on Environmental factors and Biological variables depend on maternal factors.

Table 3: Structural Regression Model

Endogenous variable	Structure equation	Exogenous variable
MN	$MN = \alpha_1 Bio + \alpha_2 Beh + \alpha_3 Mat + \alpha_4 Env + D_1$	Biology, Behavior, Maternal
Beh	$Beh = \beta_1 Env + D_2$	Environmental
Bio	$Bio = \gamma_1 Mat + D_3$	Maternal

3. RESULTS AND DISCUSSION

This section discusses the results obtained from Structural equation modeling presented above, which is generally categorized as a two-stage modeling process. As we have different numbers of indicator[7]for each variable so at first stage we applied confirmatory factor analysis as a measurement model approach to specify the reflection of biological, maternal, behavioral and environmental variables in terms of their relevant items or indicators. Once the measurement model has been estimated and tested then in second stage structural regression model is applied by linking the latent variables through a series of recursive and non-recursive relationships. Which not only enable us to explore the determinants of child malnutrition but also simultaneously find the direct and indirect effects of variables like behavioral and biological aspects on the child malnutrition outcome. Finally, in order to assess the mediating role of variables we decompose the total effect of maternal factors as well as environmental factor into direct and indirect effects.

3.1. Measurement model

We have four factors here; Environmental, maternal, behavioral and biological. Each factor is reflected with a list of indicators. Environmental factors are indicated with toilet facility, source of drinking water, wealth index, household housing type, presence of LHW, household size and children under five. Biological Factors are size of child at birth, birth interval, and whether child is twin, then the Maternal factors as mother's height and weight, mother's age at first birth, mother's education and occupation. Behavioral factors include breast feeding, place of delivery, mother's family planning, vaccination of the child and antenatal visits.

The first step in measurement model is identification, which refers to the idea that confirmatory factor analysis solution is possible if the numbers of free parameters are less than number of information in variance covariance input matrix. In our case the model is over identified with 292 degree of freedom, which fulfills the necessary condition of identification. The over identified model means that there are less number of parameters to be estimated than there is known information. For fulfillment of sufficient condition each latent variable is scaled, with the path coefficient for one observed variable being set to "1" for each latent variable.

The analysis of covariance structures is based on the implicit assumption that indicators are measured as deviations from their means (i.e., all indicator means equal zero).Factor loadings estimate the direct effect of factors on indicators and are interpreted as regression coefficients. For model evaluation, we judged the estimated parameters on their statistical significance and substantive sense. Those indicators which are statistically insignificant are removed from the measurement model. Loadings of each factor are interpreted as regression coefficients in measurement model. Results of these coefficients are presented in table 4 below after which the detailed discussions of factor loadings of different factors involved in the study are presented.

[7] Discussed in earlier section

Table 4: Regression Weights: (Default model)

			Ent	Mrt	Bio	Bev
SODW	<---	Envt	1			
TOTF	<---	Envt	1.13*			
LHW	<---	Envt	-0.14*			
TOPR	<---	Envt	0.63*			
MWM	<---	Envt	1.51*			
MRM	<---	Envt	1.34*			
MFM	<---	Envt	1.50*			
WI	<---	Envt	-2.62*			
MO	<---	MAT		1		
MAFB	<---	MAT		-2.5*		
RDM	<---	MAT		3.0*		
TORP	<---	MAT		-0.6*		
ME	<---	MAT		-12*		
CS	<---	Bio			1	
SOC	<---	Bio			0.48*	
BW	<---	Bio			-873	
PBI	<---	Bio			0.58*	
CT	<---	Bio			0.04*	
CAM	<---	Bio			-1.3*	
DOB1	<---	Beh				1
POD	<---	Beh				.03*
ANV	<---	Beh				-1.3*
MFP	<---	Beh				3.8*
CV	<---	Beh				-0.1*

3.1.1. Environmental Factors

Here in the study the matrix was generated using *Pearson's r* to determine the correlation coefficient of each item. There exists a colinearity between the item having the highest value i.e. r=0.78 for environmental aspects and then maternal aspects having a value of r=0.65. Here environment is a construct using source of drinking water (SODW), type of toilet facility (TOTF), presence of Lady Health Worker (LHW) in the area, Main wall material (MWM), Main floor material (MFM), main roof material (MRM) and wealth index (WI). The CFA result shows that all the factors for environmental aspect are significant and all the constructs for environment have loading near 1 and only wealth index has factor loading 2 and the sign is negative.

3.1.2. Maternal factors

The construct for maternal factors are mother relationship with husband, mother's decision making, mother's occupation, mother age at first birth and mother's education. The CFA analysis shows that Mother's age at first birth is significant and has 2 loadings and mother's education has 12. The negative sign shows that as the age of mothers increases it has very significant effects on children in terms of children care, knowledge and experience of child bearing. Mother's education is also an important factor for maternal factors. The results are consistent with the studies Islam (1994) and Priyanka (2014).

3.1.3. Behavioral factors

For behavioral aspects we have duration of breast feeding (DOB), place of delivery (POD), antenatal care (NAC), mother's family planning (FP) and vaccination (VC). The results for behavioral factors is significant and positive for place of delivery and negative but significant for antenatal visits during pregnancy and child vaccination, the highest loading for behavior aspects antenatal visits during pregnancy. There is a direct relation between behavioral factors and malnutrition as also found by Kathelen and Sunil (2009) who studied effects of behavior on child malnutrition.

3.1.4. Biological factors

Biological aspects are the child's characteristics. This includes size of child, birth weight, preceding birth interval, child is twin or not and child age in months. The result shows significant and positive relation. Only size of child and child age in months show negative sign. Size of child at birth effect can be small but it changes very quickly and child age in months is also a continuous variable.

3.2. Structural Regression Analysis

After the measurement model the analysis described in this section is the second stage of structural equation modeling. This next stage of SEM models is structural regression model (SRM) in which we did testing of SRM with the measurement model proven in first stage but with different form of SRM. The diagrammatic representation of SR model is presented in Figure 1 and estimates are presented in Table 4.

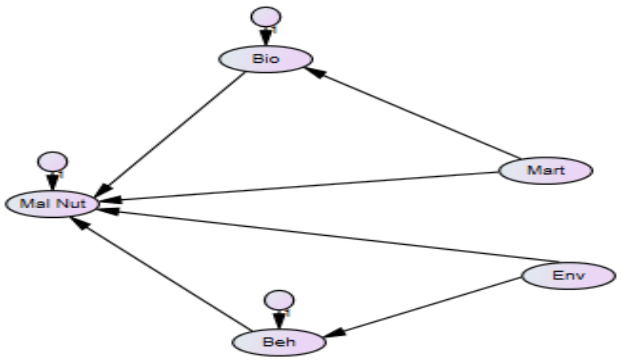

Fig 1: Structural Equation model

From figure 3.1 above we can see that three equations are estimated simultaneously. Here we have total five variables which are described in the following equations

$$MN = \alpha_1 Bio + \alpha_2 Mart + \alpha_3 Beh + \alpha_4 Env + \varepsilon_1 \ldots\ldots(1)$$

$$Bio = \beta_1 Mart + \varepsilon_2 \ldots\ldots(2)$$

$$Beh = \gamma_1 Env + \varepsilon_3 \ldots\ldots(3)$$

The first equation is the direct effect of Biological, Maternal, Behavioral and Environmental factor on Malnutrition. The results show that there is positive and significant relationship between child malnutrition and biological factors. Maternal factors are also significant but with negative sign, as maternal factors are related to mothers but they are affecting the child. From the first equation environmental factors is positively related to child malnutrition but there is no significant relation between child malnutrition and environmental factors. There are changes in the construct of environmental factors and the result contradicts the study of Cheah et al. (2010). Behavior of a child under five also depends on the mother and people living in the households. So there is negative relationship, but maternal factors are significantly affecting child malnutrition.

As we can see from the diagram i.e. figure 1 that Biological factor are mediators[8] between the maternal factor and malnutrition. This states that the maternal factors not only directly affect the malnutrition but also indirectly affects the malnutrition and this indirect effect is through the biological factors. Similarly the Behavioral factors are mediators between Environmental factors and malnutrition, which explains that environmental factor, not only directly affects the malnutrition but also indirectly affects through Behavioral factors.

Now for testing these hypotheses we estimated Equation (1), Equation (2) and Equation (3) simultaneously. Where, equation (2) explains the effect of maternal factor on biological factors and the effect of environmental factors on behavioral factors. While equation '3' explains the direct effect of environmental, biological, maternal and behavioral factors on malnutrition.

The estimated Standardized structural regression model is estimated by method of maximum likelihood and results of above proposed model are presented in Table 5. The first model which explains the direct effect of all independent variables indicate that both biological and maternal factors significantly affects the malnutrition but the role of environmental factors and behavioral factors is insignificant.

Table 5: Structural Equation Model

Variables	Equation 1: Malnutrition	Equation 2: Behavior	Equation 3: Biological
Env	0.406 (0.336)	0.065 (0.019)	
Bio	0.596 (****)		
Beh	-0.715 (0.17)		
Mart	-8.86 (****)		-1.543 (****)
CMIN/d.f. = 3.60, AGFI = 0.71, RMR = 0.076			
*p-value are in parenthesis			

But when the second model in which the behavioral factor plays mediating role between environmental factors and malnutrition is estimated it showed that environmental factors significantly affects malnutrition. This result indicates that environmental factor affects the behavior of the people, and then their behavior affects the malnutrition. So the environmental factors through behavioral factors are important determinant of the malnutrition, but direct role of environmental factors is statistically insignificant.

But when we look at the role of the maternal and biological factors, their role is significant directly as well as indirectly. Equation (1) which explains the direct effects shows that both maternal and biological

[8] Variable which cause intervention between two variables

factor significantly affects the malnutrition and similarly equation (3) shows that maternal factors also have significant indirect effect on malnutrition. So maternal factor has direct as well as indirect effect through biological factor on malnutrition. The effect of these variables is further decomposed into direct and indirect effect presented in section 3.3.

Now for judging the overall goodness of fit of structural regression model different criteria has been used. For testing overall goodness of fit in structural equation modeling, variety of fit indices can be used. For the important signal of how good the model fits to the data, Absolute fit indices are applied. In the list of absolute fit indices Chi square test, GFI, AGFI, RMR and SRMR are included. In the list of absolute fit indices, GFI values describe the explained portion while the RMR are residual based. So GFI values are close to 1, and RMR and SRMR close to 0 representing a good fit.

In our model chi-square value is 1054 with 292 degree of freedom. This chi-square over degree of freedom ratio (CMIN/d.f.) is about 3.60 which is insignificant represents that the model fits the data. AGFI is 0.71 which close to 1 and RMR is 0.076 which is close to 0 indicates that the model fits the data quite reasonably.

3.3. Direct and Indirect effects

As the total effect is a combination of indirect and direct effect so the total effect can be decomposed into two parts. In our case we have both direct and indirect effects of environment on malnutrition. The indirect effect of environment on malnutrition is through behavior. Similarly maternal factors have both direct as well as indirect effect on malnutrition and its indirect effect is through biological factors. The direct effect of behavior and Environment on malnutrition is (-0.715) and (0.406) respectively in standardized form. Environment also have indirect effect through behavior which can be measured as -0.715*0.065= -0.046. So the total effect of environment on malnutrition is direct effect plus indirect effect (0.406) + (-0.046) which turns out to be 0.359.

Similarly the direct effect of maternal factors and biological factors on malnutrition is -8.86 and 0.0596. Now the indirect effect of maternal factors on malnutrition is -0.919 (0.596*-1.543=-0.919). The total effect of maternal factor on malnutrition is also sum of direct plus indirect effects i.e. (-8.406) + (-0.919) = -9.325.

To conclude, its found that Environmental factors are not directly affecting child malnutrition but environmental factors first effect behavior and behavior effects child malnutrition. The total effect of environmental factors is .359 and indirect effect of maternal variables is -0.919.

4. CONCLUSION AND POLICY RECOMMENDATIONS

This section summarizes and concludes along with some policy implications based on the results and evidences. This study was an attempt to bridge the gap on the inter-related and complex determinants of child malnutrition. The first objective of the study was to find the inter-correlation among different indicators/items of the exogenous variables which affect malnutrition and their internal consistency. Our results show 45 percent children are stunted, 14 percent are underweight.

The structural equation model shows that maternal factors are directly and indirectly affecting child malnutrition. Maternal factors affect through biological factors and then biological factors affect malnutrition so Biological factor is playing a mediating role in child malnutrition. Environmental factors can affect indirectly through behavior and then behavior affect child malnutrition but environmental factors are not directly affecting child malnutrition. From these results we can infer that all variables are important in the policy context. While gauging the impact its not just the direct affect at times the variable indirectly (total effect) also affect the dependent variable (here the maternal factors). It could just be the indirect effect (partial effect, in this case the environmental variable) which requires policy intervention.

4.1. Policy implications

Based on the results obtained from the analysis, this study provides recommendations to decrease child malnutrition. Most important is to bring change in the behavior of mother. Steps should be taken to improve the hygiene of the child rather than building hospital. The specific policies and recommendations can be drawn from the discussion above.

1. Easy access to health facility should be provided in rural areas. When the access increase there will be more knowledge and awareness to mothers.
2. Special awareness sessions should be conducted by health specialist to change in the behavior of mother towards child care, food and hygiene.
3. Education must be a top priority in rural area to address food security and enhancing the child malnutrition.

4.2. Limitation of the study

The study aims to find the interrelated and complex determinants of child malnutrition. The study was best defined when done at district level. But due to data constraints the results are interpreted at province level. Second there was no data available on income and expenditures in PDHS so the study included wealth index.

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