Print ISSN: 2288-4637 / Online ISSN 2288-4645
doi:10.13106/jafeb.2021.vol8.no12.0391

Exploring the Health Production Model in Vietnam*

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Received: September 22, 2020 Revised: November 07, 2021 Accepted: November 15, 2021

Abstract

One of the sustainable development goals is to promote good health and well-being for all people. Child health is a top priority since their health issues can have a detrimental impact on human capital development, which is a critical input for the growth model. This paper applies the health production model to explore the determinants that influence the health of children under the age of five. The results of a survey of 203 households in Ho Chi Minh City, Vietnam, were examined. Child health is measured using anthropometric indicators such as weight-for-age, height-for-age, and weight-for-height (ZWFH). Three separate multinomial logistic models are regressed to examine the drivers of child health as proxied by *z*-score weight for age, *z*-score height for age, and *z*-score weight for height. The significance of input variables relating to a child's attributes, household, and environment was validated by the findings. The inclusion of overweight besides under-nourished indexes is novel because it reflects the current trend of child over-nutrition. The findings of the study highlight the importance of a wide range of initiatives to enhance child health. Moreover, the genetic effect is found to be crowded out by environmental and household factors. The finding verifies that despite their parents' moderate height, the future generation of Vietnamese can achieve the desired height.

Keywords: Health Production Model, Multinomial Logistic Models, Well-Being, Vietnam

JEL Classification Code: L29, L74, O18

1. Introduction

Children's care and protection receive a lot of attention because children are the country's future. Their health is particularly essential since it is linked to the development of adult human capital, which in turn is linked to the national economy. More than one-third of all children under the age of five have experienced nutritional medical problems such as stunting, wasting, being underweight, or overweight (Keeley et al., 2019). Both malnutrition and obesity are long-term community causes of non-communicable diseases such as hypertension, diabetes, and cardiovascular disease (Giao et al., 2019). The consequences are low labor productivity and medical burdens on the economy, which challenge the sustainable development goals to which Vietnam has committed. In Vietnam, children's nutrition problems, particularly overweight and obesity, are on the rise. When interviewing 2677 children aged three to six years old in Vietnam over a three-year period, Do et al. (2017) discovered that the rate of overweight has grown to 16.7% from 9.1%. (2013, 2014, and 2016). Using survey data from 768 children aged 12 to 24 months in Ho Chi Minh City, Giao et al. (2019) found that malnutrition and obesity affect 8.2% and 10.7%, respectively, of the overall child population.

Previous studies on this topic in underdeveloped nations have focussed on undernutrition while ignoring overnutrition. The latter has grown in popularity around the world and, like the former, creates major health problems. Vietnam is no different. This study adds to the body of knowledge by quantifying the factors that influence child health outcomes through the presentation of three scenarios: undernutrition, normal nutrition, and overnutrition. Furthermore, the outcomes of the study show that

***Acknowledgements:**
This research is funded by Ho Chi Minh City Open University under the grant number T2020.05.1.

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environmental and household factors have a "crowding out effect" on genetics, which supports the government's aim to improve Vietnamese children's stature despite the parents' moderate heights. Finally, the adverse impact of factors under technology-based theory has implied the requirement of balanced remedies to promote child health.

This paper is structured into five sections. The next section is literature reviews with theoretical backgrounds and frameworks for the child health production model. Research methodology is then presented with the empirical model, data sampling, and analyzing technique. The research findings are outlined and discussed in section 4 before concluding section 5.

2. Literature Review

A child is defined as a person under the age of eighteen (Berntsson & Ringsberg, 2014; Pais & Bissell, 2006). However, depending on the research goal, studies on children are divided into different age groups. The most crucial phase to be chosen for this research's objectives is early childhood, specifically children under the age of five. For example, public health officials are concerned about the health of children under the age of five (Berntsson & Ringsberg, 2014). In fact, a child's brain develops at the fastest rate during the first two years of his or her life. Because a well-developed brain is not only genetically but also nutritionally predetermined, adequate and good quality nutrition during this age of childhood will contribute to an improvement in learning ability and a higher probability of success in school and life (Engle & Huffman, 2010). Second, in many countries around the world, including Vietnam, the majority of reported statistical indicators of children's health are in this age range. As a result, obtaining reference data will be possible by selecting children in this age group for the study. Finally, the growth pattern of children in this age range reveals their important life milestones. Therefore, the research will be valuable to policymakers as they plan the best intervention to enhance child health.

Child health is defined as the extent to which an individual or group of children can (i) develop and fulfill their full potential; (ii) satisfy their own needs; and (iii) develop the capacity for them to interact well with their social, physical, and biological environments (Group & de Onis, 2006). Child health metrics can include mortality rates, morbidity rates, and anthropometric index (Armstrong et al., 2003; Hammer et al., 2006). In cases of nutritional health, the anthropometric index is preferable (Armstrong & Reilly, 2003). Anthropometric indicators are based on physical body measurements with many indicators such as mid-upper arm circumference; weight-for-age, weight-for-height, and height-for-age; skin-folds, body mass index, head circumference, etc. However, this section only discusses the most common health measurement used for modeling child health production that is height for age *z*-score, weight for age *z*-score, and weight for height *z*-score (Le & Nguyen, 2020).

Household production theory is at the core of a human capital approach that underpins the development of health-related models. A household is viewed not only as a consumer but also as a producer of products and services (Becker, 1965). Under the constraints of money, time, and technology, it is believed that the household optimizes the utility derived from the basic commodities it produces. Grossman (1972) presented a model of health demand based on a family production framework in which health is defined as durable capital stock. Individuals are supposed to get utility from the output produced by health capital as well as from the consumption of other commodities. The following ideas from health production theory were adapted to the utility function structure of the household:

$$U = U(C, H_i; X_h, X_e) \quad (1)$$

The utility function is supposed to be maximized under the constraints of the health production function and budget, with the household selecting a combination of other goods (C) and child health (H) as inputs. It is assumed that the utility function is quasi-concave. Equation (1) shows that a household's welfare depends on the consumption of other goods (C) and child health (H_i). Observed parameters such as household characteristics (X_h) and environmental factors influence relative preferences among commodities (X_e). The following is the expected child health production function:

$$H_i = f(X_i, X_c, X_h, X_e) \quad (2)$$

Child health output depends on inputs including child characteristics, environmental factors, household health, and nutritional inputs.

A Household's choice to maximize its utility function is limited by the budget constraint (I_h). The function related to child health production, which we are interested in for this study, is represented by the reduced-form equation below.

$$H_i = f(X_i, X_h, I_h, X_e) \quad (3)$$

Equation (3) shows that child characteristics (X_i) is one of the determinants of child health. They include all of the child attributes such as gender and the genetic factors endowed with child health. Kennedy et al. (2020) identified gender as one of the health determinants, as well as the possibility for health concerns for girls and women in some cultures such as China, Vietnam, and India, due to the preference for sons. As a result, boys receive preferential treatment from their parents. However, the boys suffer from over nutrition as a result of this. This is supported by Do et al. (2017),

who discovered the dominance of boys' obesity in a panel data analysis of 3–6 years old children in Vietnam over a three-year period (2013, 2014, and 2016).

Genetic attributes indeed play a key role in determining child height, an important indicator of child health. According to Temneanu et al. (2016), genetic susceptibility is one of the obesity drivers. However, genetic determinants are difficult to observe, and the capacity of the model to include unobserved child health endowment can lead to skewed results. Based on research on under 2-year-old child growth, Garza et al. (2013) recommend that parental height be used as a proxy for genetic inheritance. To capture the child's health endowment, the literature review suggested that parental heights must be included in the study. Non-genetic variables are just as important as genetic inheritance. Children can only reach their potential health if other non-genetic factors (e.g. *r* environment, caring practice, nutrient intakes, etc.) are favorable. It is derived from equation (3) that household and nutritional inputs determine child health through the effects of household characteristics (X_h) and environmental characteristics (X_e) under the nutrition-based and technology-based theory.

According to the nutrition-based theory, increased food consumption due to material prosperity improves health outcomes. Dewey and Begum (2011) provided evidence of the long-term impact of widespread nutritional supplement testing during the early years of children's lives in Guatemala. This effect continues in adulthood as well as later generation development. However, it is not sufficient because child health is improved through the provision of both energy and health care practices. Furthermore, while higher income can reduce hunger, it does not always imply a higher or healthier calorie intake. In fact, if other factors (e.g., caring practices, medical services, hygienic conditions, etc.) are not addressed, food alone will not make children less vulnerable to infectious diseases. Hence, income should be considered while assessing better sanitation, health care services, and improving the health behavior of child caregivers to improve child health.

The technology-based theory emphasizes the role of government in public health intervention in fighting infectious diseases. The necessity of community hygiene and basic health care is emphasized. In practice, the wealthy can enhance their children's health by paying for necessary medical care, but they also require community-level initiatives to foster a healthy environment. For example, in the event of communicable diseases such as SARS, avian flu, or Covid in the community, it is beyond the control of the household. Therefore, the literature review suggests using community-related explanatory variables as a determinant of child health, such as basic health care (e.g. immunization, low birth weight prevention, etc.) and environmental sanitation (e.g. availability of public piped water, garbage removal services, etc.).

In addition to hygienic conditions, many developing countries' action plans to promote child health include vaccination and low birth weight prevention. As a result, it's important to incorporate these factors in the Vietnamese child health model to ensure that their impacts on child health are consistent. Given the availability of food and health services, the cultural behavioral theory explains the variation in health outcomes since health improvement greatly depends on how people properly use resources (e.g. food, health services). In the case of children's health, caregivers' health knowledge and habits are critical because children under the age of five rely entirely on their decisions regarding medical treatment. Mothers are typically the primary caregivers for children, particularly in Vietnam. As a result, it is implied that maternal health knowledge and caring practice are the most important predictors of child health. Maternal health knowledge provides the foundation for healthy behavior that benefits children's health. Formal education can help you gain health knowledge, but general education is also vital since it improves your ability to process and evaluate information. As a result, it is more likely to engage in health-seeking behavior.

3. Research Methodology

Child health is measured by three anthropometric indexes using an anthro survey analyzer developed by WHO based on the compulsory inputs of weight, height, age, and gender of the children under five years of age. The *z*-score indicators are assessed as summarized in Table 1. Therefore, multinomial logistic models with three options: stunting, normal nutrition, and overweight are investigated in the regression model (Table 1).

It was assumed that some households had more than one under-five child, but they may not have volunteered for the survey. As a result, the survey's first target is 200 houses with children under the age of five, with the goal of obtaining at least 108 observations for this study. To achieve "representative criteria," a multi-staged sampling design and probability sampling approach were used. The sample was selected in three stages: districts, wards, and households. The model proposed in Table 2 was based on a review of theories, empirical data, and contextual justification relating to child health determinants.

The data set after screening includes a total of 203 children under five years old in Ho Chi Minh City who qualify for the analysis. The proportion of male and female children in the sample are relatively balanced with 55%

Table 1: Summary of *z*-Score indicators (Group & de Onis, 2006)

Indicators	Definitions
Stunting	Height-for-age < –2SD
Wasting	Weight -for -height < –2SD
Overweight	Weight-for-height > +2SD
Underweight	Weight-for-age < –2SD

and 45% respectively. The majority of households have two children (42.5%) followed by one-child households (41.7%). The percentage of households with 3 children is low, accounting for 15.8%. Over 20% of children do not currently live with their father (21%) and mother (22.5%). The percentage of interviewees who are not direct caregivers is 30.8 percent. The age of the parents ranges from 20 to 45. 42.86% of the children have poor nutritional health, of which the proportion of children with *Z*-score > +2 (overweight) is 26.7%.

Table 2: Variables Description in the Model

No	Variables	Description & Measurement	Justification for their Inclusion in the Model
Dependent Variables			
1	Zheight	Child height for age in Z-score	Anthropometric method
2	Zweight	Child weight for age in Z-score	
3	ZWFH	Child weight for height in Z-score	
Independent Variables			
4	Childnos	Number of children in the family	To examine the impact of household characteristics on child health
5	Hhsizes	Household sizes	
6	Religion	Mother's religion, 1 if having a religion, 0 if otherwise	
7	Caregiver	1 if the child has his/her caregiver, 0 if otherwise	To capture the explanation of different health outcomes based on cultural behavioral theory
8	Sex	Child's gender: 1 if female; 0 if otherwise	To examine whether there is a gender bias treatment at the research places
9	Birthweight	Child weight at birth as a proxy for basic health care based on the public health intervention theory, measured in kilograms	It reflects the effect of maternal health prevention program launched by the government, which is a predictor of child health outcome
10	Mheight	Mother's height in centimeters	To capture the genetic endowment of child health because taller parents tend to have taller children
11	Fheight	Father's height in centimeters	
12	Flive	Biologic father lives in the house with the child	To capture the well-being impact on the child health
13	Mlive	Biologic mother lives in the house with the child	
14	Mbirthage	Mother age in years	To capture implications of the technology-based theory
15	Prenatal	Mother self-evaluation on the prenatal care, Likert 1(less) – 5 (much)	
16	Vaccine	Mother self-evaluation on the child's vaccination, Likert 1(less)-5(much)	
17	Nutrition	Mother self-evaluation on the nutritional level, Likert 1(less)-5(much)	To capture the implication of material well-being theory
18	Nutriknowledge	Mother self-evaluation on the nutrition knowledge, Likert 1(less)-5(much)	This converts to healthy practices
19	Sanitation	Mother self-evaluation on the household sanitation, Likert 1(less)-5(much)	Sanitation obviously influences child health. For instance, poor sanitation can cause diarrhea, worms, and other infectious diseases

Table 3: Child Health Model Regression

Independent Variables	*Z*-score Height for Age (< –2SD)	*Z*-score Weight for Age (< –2SD)	*Z*-score Weight for Height (< –2SD)	*Z*-score Weight for Height (> +2SD)
HHsizes				−1.346(***) (0.517)
ChildNo.	2.466 (**) (1.149)	−2.353(*) (1.350)	−	
Religion	1.746 (**) (0.789)	4.019(*) (2.434)	−	
Female				−4.802(***) (1.394)
Mheight				−0.258(***) (0.081)
Caregiver	−4.053(***) (1.152)	−	−	−4.081(***) (1.359)
Birthweight	−1.469(*) (0.873)	−	−4.751(***) (1.739)	
Mlive	3.542(***) (1.380)	−4.854(***) (1.735)	−2.817(*) 1.672	8.684(***) (2.119)
Mbirthage	−0.253(**) (0.083)	−0.222(*) (0.126)	0.240(*) (0.141)	0.163(**) (0.084)
Nutrition				−5.290(***) (1.633)
Nutriknowledge	3.976 (***) (1.200)		−4.871(***) (2.047)	
Vaccine	−3.729(***) (1.055)		5.303(***) (1.885)	−9.853(***) (2.718)
Prenatal			5.335(***) (1.822)	5.199(***) (1.579)
Sanitation			−4.856(***) (1.616)	8.749(***) (2.727)
	LR $chi^2(32)$ = 144.43 Prob > chi^2 = 0.0000 Pseudo R^2 = 0.4294 N = 203	LR $chi^2(32)$ = 173.78 Prob > chi^2 = 0.0000 Pseudo R^2 = 0.5641 N = 203	LR $chi^2(32)$ = 201.98 Prob > chi^2 = 0.0000 Pseudo R^2 = 0.5091 N = 203	

Note: Standard errors are in parentheses. *p < 0.1, **p < 0.05, ***p < 0.01.

4. Results and Discussion

Religion and the number of children in the household have a major impact on stunting and wasting, while the size of the household has an impact on obesity. If the mother is religious, the child's health suffers. Though it is theoretically possible for religion to promote health through ethical and regulative behaviors (Chiswick & Mirtcheva, 2010). However, religious beliefs may discourage their members from using the services of doctors and hospitals, causing negative health outcomes (Karlsson, 2019). The findings of this study support the latter. It implies in religious families, children have the worst health outcomes (see Table 3).

Child gender is not statistically significant in either stunting, underweight or wasting model. The result is in line with the findings of previous studies on Vietnamese children's health by Desai (2000). Additionally, the study showed that there was little or no gender discrimination in child health treatment, thanks to the spread effects of the family planning policy introduced by the government. The majority of households have two or three children. Hence, both men and women are regarded as equal nowadays. Female children, on the other hand, are less likely to be overweight than their male counterparts. This reflects the current state of affairs in Vietnam. In wasting and underweight models, child weight at birth is statistically significant at 1% and 10%, respectively. The negative sign of this variable indicates that a high birth weight for a child helps to reduce the occurrence of wasting and being underweight, which is consistent with both theory and empirical evidence. This finding helps public health policymakers focus on prenatal care intervention programs because it is an important period for a healthy child.

It has been discovered that children who have caretakers have a better health outcome in terms of stunting and overweight. This is further supported by the fact that the "Mlive" variable, which refers to children who live with their biological parents, has a negative impact on wasting and underweight. Under the cultural behavioral theory, the findings indicate that adults use the given resources correctly. However, the reverse sign of stunting and obesity warns of the inappropriate use of material resources during childhood care and indulgence. Mother height, the variable representing the genetic endowment of child health, was statistically significant and negative at 1% in the overweight model but insignificant in the remaining models. The significant and negative coefficient of the variables in the regression result with the dependent variable "overweight" can be logically understood that taller mothers are likely to have better stature children.

However, with regard to other models, this also conveys the message that the height variation caused by environmental factors may be much greater than genetic factors. Japan's experience illustrates this argument. Even though the Japanese are thought to be genetically short statured people, government initiatives to increase their height over the last 30 years have resulted in significant improvements in the average height of the younger generation.

The inclusion of explanatory variables under technology-based theory implies hygienic conditions (sanitation), vaccination (vaccine), and maternal age at birth (Mbirthage) have shown different impacts (positive and negative) of public health intervention on child health. The increase of maternal age at birth (years) reduces stunting and wasting but increases underweight and overweight. In addition to reducing stunting and overweight, vaccinations also help improve underweight children's nutrition. Sanitation significantly reduces underweight but increases overweight. When children are overweight, the Nutrition level (Nutrition) is negative and significant at 1%.

5. Conclusion

The literature review examined the role of child characteristics, family attributes, and environmental factors in influencing child health and the role of material well-being, cultural behavior, and public health intervention theories. In some ways, this empirical study supports the theory and gives additional evidence in a specific context (Choi et al., 2013; Ngo et al., 2020; Nguyen & Bui, 2020a, 2020b; Nguyen, 2021; Nguyen & Nguyen, 2020; Nguyen et al., 2018). Vietnam is an emerging market with moderate economic growth. This growth also brings with it problems related to health care for children. The findings of this research have shown the serious problem of obesity which is the consequence of the fast-food consumption trend. Therefore, child health production models with all health indicators (stunting, wasting, underweight, overweight) are studied. The inclusion of overweight is novel because it reflects the trend of over-nutrition in the modern world and Vietnam is not an exception. The findings of the study highlight the importance of a wide range of initiatives to enhance child health. Additionally, the study has demonstrated the importance of genetics, although the impact can be mitigated by environmental factors. The finding indicates the Vietnamese children can achieve their desired heights regardless of their parents' heights.

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