

# Child health and maternal health knowledge: evidence from Vietnam

Tuyen Thi Mong Nguyen<sup>1</sup>, Quyen Le Hoang Thuy To Nguyen<sup>2</sup>, Phong Thanh Nguyen<sup>3</sup>

<sup>1</sup>Department of Fundamental Studies, Ho Chi Minh City Open University, Ho Chi Minh City, Vietnam

<sup>2</sup>Office of Cooperation and Research Management, Ho Chi Minh City Open University, Ho Chi Minh City, Vietnam

<sup>3</sup>Professional Knowledge & Project Management Research Team (K2P), Ho Chi Minh City Open University, Ho Chi Minh City, Vietnam

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## ABSTRACT

The care and protection of children are vital because children are the future of the country. Their health links to the development of adult human capital and the national economy. Informal maternal education is the major driver of child health but has never been formalized. This paper investigates the effects of maternal health knowledge on child health using a survey of 200 households in Ho Chi Minh City, Vietnam. The theory of household production has been applied to create a child health model. Anthropometric indicators of weight-for-age and height-for-age are set as the proxies for child health. The models are regressed separately for the weight-for-age and height-for-age Z-scores of children under five. The research results showed that the number of years of maternal schooling does have a positive impact on child anthropometric outcomes but its effects are crowded out by maternal health gained from the mother's access to health information through public media and genetic inheritance, but these are inferior to environmental factors such as housing, sanitation, and health knowledge. The findings confirm that Vietnam can improve the status of child care and protection can be improved even under the constraints of limited access to maternal formal education).

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## Corresponding Author:

Phong Thanh Nguyen  
Professional Knowledge & Project Management Research Team (K2P), Ho Chi Minh City Open University  
Ho Chi Minh City, Vietnam  
Email: phong.nt@ou.edu.vn

## 1. INTRODUCTION

The care and protection of children are vital because children are the future human capital of the nation, which is the input of the economic growth model [1], [2]. Keeley *et al.* [3] reported that one out of three children (under five years old) in the world has nutritional health problems such as stunting or being underweight or overweight. The number of obese children around the world has increased 10-12 times since the 1970s. In the past, being overweight and obese was considered a signal of wealth [4]. In recent years, this belief has changed as it has been proven that it just indicates a diet of inexpensive calories from high-fat and sugar-rich foods. Children on these diets are at risk for non-communicable diseases in the community, like diabetes. In Vietnam, the national nutrition survey in 2017 showed that 30% of children under five-years-old are malnourished (24% stunting, 6% underweight), 6% are overweight and more than 50% of children are starving. In 2019, a study by the National Institute of Nutrition using survey data of 5,028 students aged 7-17 years from Hanoi, Ho Chi Minh City, Thai Nguyen, Nghe An, and Soc Trang province showed that nearly 42% of children in these urban areas were overweight or obesity, while in rural areas, this figure was 35%.

Nutrition-related factors cause 45% of all deaths in children under five years of age. Malnourished children have a high risk of death when suffering from common childhood diseases such as diarrhea, and measles [5], [6]. The long-term consequences are frequent diseases, poor labor productivity in adulthood, and long-term effects on economic development. This is also a challenge for the United Nations' sustainable development goals to which Vietnam has committed.

The nutrition of children is influenced by many factors such as: i) the individual characteristics of a child; ii) community characteristics; and iii) characteristics of the household [7]–[9]. In particular, cultural behavioral theory has shown that the nutritional health of children depends heavily on the mother's knowledge [10]–[13]. Although there have been many studies investigating the nutritional health of children as well as the role of parental education [14], previous studies have not clarified the difference between formal education and general health knowledge though informal maternal education is the major driver of child health through which child health improvement can be targeted if proper policies can be applied. In addition, the empirical evidence on the intergenerational effects of maternal education on child health in developing countries have been found [1]. Vietnam is expected not to be an exception. Formal maternal education may not result in the significant promotion of child health, but maternal health knowledge can be worth. In this study, the novel approach of maternal knowledge in child health model has been explored so that the channels help improve the nutritional health of children in Ho Chi Minh City, Vietnam have been defined.

## 2. LITERATURE REVIEW

Under the convention on the rights of the child, a child is defined as a person under the age of 18 years [15]–[17]. However, studies on children are often divided into many different age groups depending on the purpose of the research. For this study, groups of children under five years old were selected for analysis. 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. According to Starfield [18], children's health is the ability to recognize inspiration, respond to needs, and adapt to the environment. In general, these child health perspectives have been measured through the following categories: health condition, function, and health potential [19]. Health conditions indicate a child's physical condition and how health measurement affects a child's daily life. Health potential refers to the child's developmental potential, capacity, and abilities [20]. Child health metrics are included mortality rates, morbidity rates, and anthropometric index. In cases of nutritional health, the anthropometric index is preferable [21].

Child nutrition is one of the most serious health problems in Vietnam [22]–[24]. In the 2000s, malnutrition was common, especially in rural, and remote and isolated areas [25]. Along with social and economic development, child malnutrition also has improved. However, the health and nutrition of children face a new challenge, namely overweight and obesity. Giao *et al.* [26] was using survey data of 768 children aged 12–24 months in Ho Chi Minh City. They found that the nutritional health of children is experiencing challenges. Malnutrition and obesity are at 8.2% and 10.7% respectively of the total child population. This is a serious problem in big cities, in particular, and a potential long-term risk for non-communicable diseases. Also, the research has shown that the employment status of mothers and gender are associated with malnutrition, in particular with children whose mothers are at work. Boys are more prone to stunting than girls. Notably, the rate of obesity in children in Ho Chi Minh City is higher than the national average, especially children living in families with good socio-economic conditions, which is a driver of obesity.

Pham *et al.* [27] used survey data of 821 students (11–12 years old) in Hanoi and showed that the rate of malnourished (underweight) children was 4.1%, the rate of overweight was 17.1% and the rate of obesity was 19.1%. This study once again confirms the child nutrition challenges facing big cities like Ho Chi Minh City and Hanoi. Research results showed, though, that the educational attainment of a parent has a positive impact on the health and rates of obesity of children, particularly children in families where a parent has a college or university degree. On the other hand, parents who are overweight or obese obesity also can be shown to lead to overweight or obese children. The weight of a baby at birth also has a statistically significant influence on the health of children. This suggests that the cultures of the parents, their eating habits, along with a child's attributes are all factors that affect children's health.

Do *et al.* [28] confirmed the gender impact on child health in their survey of 2,677 children, aged 3–6 years over three years in both rural and urban regions (2013, 2014 and 2016). The results of the study showed an increase in the rate of overweight from 9.1 to 16.7% over the three years. In particular, the prevalence of overweight in urban areas was higher than in rural areas, and boys were more likely to be obese than girls. The results of this study are an important warning because it was a study of preschool and kindergarten children, and when babies are overweight, often the condition persists over time. Therefore,

there should be an immediate action program to improve the health of children, especially children in urban areas.

Gender also is a factor that explains the difference in health between boys and girls [29]. The WHO Child Health Report 2019 showed that the mortality rate of male children (under five years old) was 11%. Boys do have a higher risk of dying than girls for biological reasons [30]. However, research by Iqbal *et al.* [31] showed that gender inequality was also a cause of child mortality. Analysis of data from 195 countries shows that girls in low and middle-income countries suffer inequality and have a mortality rate for girls that are higher than that of boys. Research by Ranjani *et al.* [32], further, showed that children's nutritional health was associated with factors such as eating habits, physical activity, the living environment, and genetic factors. Children in families with a habit of not cooking or snacking instead of eating meals are prone to being overweight and obese [33]. Besides, the presence of convenience foods in the market, many advertisements for processed food, a busy mother or single moms are also factors that increase the demand for processed foods, one of the leading causes of overweight and obesity in children.

Children today tend to be sedentary [34], [35]. Goyal *et al.* [36] have shown that inactivity harms a child's body weight index (BMI). Overweight or obese children will lose weight if they participate in sports or outdoor activities. In addition, changing travel habits such as using private means of transportation instead of public transport are also factors that contribute to weight problems. All of the above habits noted above (eating and exercising) are influenced by the social environment (home, school, friends, the food market, and the media). In developed countries, children in low-income families are at higher risk of being fat. This tends to be the opposite of developing countries [32]. Similarly, Li *et al.* [37] observed 6,826 children aged 7-17 years old in China. Research results showed a positive correlation between overweight children and overweight parents. The rate of overweight and obese children increased to 12.2% if both parents were obese. This showed that both genetic and environmental factors affect the formation and development of body size.

Parents are responsible for their child's diets [38]. According to Paeratakul *et al.* [39], diet also affects health. The consumption of foods containing too much energy and fat has made Chinese children overweight. Research by Hu *et al.* [40] also showed that the use of public transport is beneficial for health, while private transport has been associated with higher weights. This finding corresponded with the research results of Li *et al.* [37]. Their statistical results revealed that overweight children spend very little time doing physical activities, such as housework or using public transport.

### 3. RESEARCH METHOD

Child health is measured by two indicators including *HAZ* and *WAZ*. Height-for-age Z-score, as shown in (1).

$$Z = \frac{H_i - H_r}{SD_r} \quad (1)$$

Where,

$H_i$  is the height of child  $i$ ;

$H_r$  is the median height of healthy children of the same age and gender with an international reference population; and

$SD_r$  is the standard deviation of child height at the same age and gender as the international reference population.

And weight-for-age Z-score, as shown in (2).

$$Z = \frac{W_i - W_r}{SD_r} \quad (2)$$

Where,

$W_i$  is the weight of child  $i$ ;

$W_r$  is the median weight of healthy children at the same age and gender of the international reference population; and

$SD_r$  is the standard deviation of child weight at the same age and gender of the international reference population.

Two other important criteria of the survey are representativity and reliability [41], [42]. The design of this survey relied on these constraints. Regarding reliability, the issue of how much precision is discussed. This relates to the sample size. The precision of the estimate rises with an increase in the sample size. The following steps of the calculation show the requested minimum number of under-five children for a survey is 108.

a) The sample size is calculated as detailed in this formula (3);

$$n = \left[ \frac{z_{\alpha/2} \sigma}{E} \right]^2 \quad (3)$$

where:

n: sample size;

1-  $\alpha$  : confidence interval;

$z_{\alpha/2}$  : critical value;

$\sigma$  : population standard deviation; and

E: the maximum difference between the observed sample mean and the true value of the population mean.

b) A pilot survey of 40 samples in which 20 samples were randomly selected from each district generated the sample standard deviation  $s$  ( $s=1.86$ ) of a height-for-age Z score (HAZ). According to the rule of thumb,  $s$  can be used to replace  $\sigma$ .

The under-five children must be randomly selected to be sure that the sample mean is within the error margin of 0.35 standard deviation score compared to the population mean at a 95% confidence. A 95% confidence corresponds to  $\alpha=0.05$  and  $\alpha/2=0.025$ . The area from 0 until  $z_{\alpha/2}$  equals 0.475 ( $=0.5-0.025$ ). And an area of 0.475 corresponds to a z value of 1.96. Therefore, the critical value  $z_{\alpha/2}=1.96$ .

Using the formula (3):

$$n = \left[ \frac{z_{\alpha/2} \sigma}{E} \right]^2 = \left[ \frac{1.96 * 1.86}{0.35} \right]^2 = 108$$

It was assumed that some households had more than one under-five child, but they may not have a volunteer for the survey. Therefore, it's initial set at 200 households of children under five for the survey with the expectation of getting at least 108 observations in this research. A multi-staged sampling design and probability sampling method were applied to reach "representativity." The sample was selected in three stages: districts, wards, and households. Theories and empirical studies relating to the child health determinants were reviewed. Child attributes, community characteristics, household features, and maternal attributes were the key factors impacting on child health. As a result, the suggested research models are (4) and (5).

$$HAZ_i = \alpha + \beta_1 X_i + \beta_2 X_h + \beta_3 I_h + \beta_4 X_m + \beta_5 X_c + \mu \quad (4)$$

$$WAZ_i = \alpha + \beta_1 X_i + \beta_2 X_h + \beta_3 I_h + \beta_4 X_m + \beta_5 X_c + \mu \quad (5)$$

The health production (4) and (5) describe the relationship between child health (HAZ and WAZ are used as the proxies) and its determinants. The left-hand side (LHS) of (4) and (5) are dependent variables and the right-hand side (RHS) is independent variables. Ordinary least square (OLS) was applied to analyze the dependent variable because it is continuous and fully observed. Attention was focused on the impact of maternal health knowledge on the child's health outcome. The econometric model analyzed the direct and indirect impact of health knowledge on child health. Attention was paid to the different mechanisms through which the health knowledge was obtained e.g. formal education at school, access to health knowledge sources such as newspapers, television, and radio for indicative policies.

The following steps were done to get the estimation results:

Step 1: Regression the two equations with two independent variables i.e. HAZ and WAZ as shown in (6).

$$HAZ_i/WAZ_i = \alpha + \beta_1 BWEIGHT + \beta_2 CGENDER + \beta_3 CAGE + \beta_4 FHEIGHT + \beta_5 LFEDUCATION + \beta_6 LMEDUCATION + \beta_7 MCARE + \beta_8 SANITATION + \beta_9 MEDIA + \beta_{10} MHEIGHT + \mu \quad (6)$$

Based on the justification of literature reviews and data description, the following model specification was justified for regression purpose,

$HAZ/WAZ = f(\text{child characteristics, household characteristics, maternal attributes, community characteristics})$   
 Step 2: Diagnostic tests including Ramsey's reset test for correct model specification, white's general Heteroscedasticity test, normal distribution of residuals, and remedies (if necessary).  
 Step 3: Report and interpret the estimation results.

#### 4. RESULTS AND DISCUSSION

The desirable result of the OLS procedure is best linear unbiased estimates (BLUE). As a result, diagnostic tests have been done to ensure the validity of assumptions of the regressions. The results below reasonably satisfy the assumptions of OLS regression. In model 1,  $R^2$  and adjusted  $R^2$  are 0.65 and 0.62 respectively as shown in Table 1. In model 2,  $R^2$  is 0.5 and the adjusted  $R^2$  is 0.47. It is theoretically implicated that adjusted  $R^2$  should be used to interpret the fitness of the regression because  $R^2$  tends to give an overly optimistic picture, particularly when there are a large number of explanatory variables compared to the observation. As a result, we can conclude that the explanatory variables explain about 62% and 47% variation in the child health outcome in models 1 and 2, respectively after taking into account the number of regressors. These values are rather high, especially when using cross-sectional data. Therefore, this suggests that the explanatory variables explain well the dependent variables in both models.

Table 1. Child health regression model

| Independent variables | Model 1-HAZ         | Model 2-WAZ      |
|-----------------------|---------------------|------------------|
| BWEIGHT               | 0.985***<br>(0.354) | 0.604* (0.365)   |
| CGENDER               | -                   | -                |
| CAGE2                 | -0.075**<br>(0.044) | -0.081* (0.046)  |
| FHEIGHT               | 0.0395*<br>(0.0212) | -                |
| LFEDUCATION           | -                   | 0.529** (0.269)  |
| LMEDUCATION           | -                   | -                |
| MKNOW                 | 0.152***<br>(0.057) | 0.103* (0.058)   |
| SANITATION            | 0.523***<br>(0.150) | 0.476*** (0.155) |
| MEDIA                 | 0.571* (0.303)      | -                |
| MHEIGHT               | -                   | -                |
| R-squared             | 0.652               | 0.509            |
| Adjusted R-squared    | 0.621               | 0.465            |

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

CHILD WEIGHT AT BIRTH (BWEIGHT) is statistically significant at 1% and 10% in models 1 and 2, respectively. The positive sign of this variable shows that low child weight at birth negatively impacts a child's health outcomes, which corresponds with both the theory and the empirical studies. This finding helps public health policymakers focus on prenatal care intervention programs because it is an important period for a healthy child. However, CHILD GENDER (CGENDER) is not statistically significant in either model. The result verified the findings of previous studies on Vietnamese children's health of Knodel *et al.* [43]. It also confirmed the authors' assumption that there was little or even no gender discrimination in child health treatment thanks to the spread effects of the family planning policy launched by the government. Most families have only two or three children. Therefore, either male or female is treated equally nowadays.

Next, CHILD AGE (CAGE2) has a negative effect on child height-for-age and weight-for-age at 5% and 10% significance levels, respectively. The coefficient's sign indicated that the children at ages equal or over 2 are more prone to poor health development. This is because children at this age are more sensitive to diseases and illness because of less maternal care, more exposure to the environment, and an incomplete immunologic system. This is the period the children stop breastfeeding and begin to be fed with supplementary foods. In the research areas, children at this age group were more likely to be sent to nursery school because their mothers are back at work. Therefore, child health outcomes are much more dependent on the quantity and quality of food. As a consequence, children can experience negative influences on their health during this transitional period.

FHEIGHT, the variable representing the genetic endowment of child health, was statistically significant and positive at 10% in model 1 but insignificant in model 2. The significant and positive coefficient of the variables in the regression result with the dependent variable "height-for-age Z-score" can be logically understood that taller fathers are likely to have better stature children. MHEIGHT is insignificant in both models. This conveys the message that the height variation caused by environmental factors may be much greater than genetic factors. Japan's experience illustrates this argument. The government efforts to improve the stature of the Japanese over the past 30 years have to lead to considerable improvement in the average heights of the young generation, even though the Japanese were considered to be genetically a short stature people.

PARENTAL EDUCATION showed no impact on the child height-for-age model while the schooling years of the father were significant at 5% in the child weight-for-age equation. Thus, child health in terms of weight-for-age is influenced by the material prosperity of the household. High parental education levels typically result in better earnings and the prosperity of a family. As a result, the children are provided with high energy food, which may lead to weight gain. However, the effects, in the long run, do not occur. Hence, the coefficients of the explanatory variable become insignificant in the regression model with height-for-age as a proxy for child health. The regression result of these variables in model 1 conflicts with the theory and the literature review, but it is not surprising because the education effects of a father and mother may be captured through housing quality (housing sanitation conditions), maternal health knowledge, and maternal exposure to media.

The explanatory variables such as MKNOW, and SANITATION are positive and statistically significant in both models. Thus, parents with high education levels are more likely to have good economic conditions with better housing quality. Also, mothers with higher education tend to have more opportunities to access health knowledge information because they can read newspapers, books, etc. As a result, they can take care of their children better. The insignificant coefficients of parental education in model 1 showed a similar result to the findings of Thomas *et al.* [44]. In addition, the regression result of Behrman and Wolfe [45] showed an insignificant impact on maternal education in the health of Nicaraguan children's health when adding the data on the mother's siblings.

MEDIA showed a strong effect on child height-for-age, but it became insignificant in the equation of child weight-for-age. This may be because maternal health knowledge perceived through media is accumulative, and it takes time to convert the knowledge into effects on child health. Therefore, the positive and significant coefficient of this variable is noted in model 1 with the height-for-age dependent variable as a long-term child health indicator. In summary, the findings of this research are consistent with the theory and research hypotheses. The most important finding was the impact of an effective and efficient health education program. Further, maternal health knowledge significantly and positively impacts child health, especially in the long-run because negative factors such as low birth weight, poor quality of supplementary food, lack of immunization, will be diminished with an increase in health knowledge. In the short-run, the effect crowds out the disadvantage of low birth weight. Thus, along with the public health interventions fighting against low birth weight, improving maternal health knowledge needs more focus and attention. The research findings shed the light on the importance of diversifying health education strategies to improve child health. Formal education is good, but it is not the only measure. General education via media is another method for increasing maternal health knowledge.

Vietnam is one of the emerging markets with moderate economic growth [46]–[48]. This growth also brings with it problems of health care for children. The analysis showed that all of the research hypotheses were appropriate. Also, the findings provided a comprehensive view of the role of the general health knowledge of the mother. First, parental education positively impacts child health. Second, the role of media such as television, radio, and newspapers can provide mothers with valuable health knowledge that they can use in the long run. Third, maternal health knowledge has both positive and significant effects on child health [49]. Besides, the survey revealed that family members such as grandparents, brothers, sisters also participate in the care of the children even though the mothers are reported as the main child caregivers. Family member participation was more common when children reached the age of 2 because their mothers often go back to work and have less time for childcare. This is consistent with the regression results of the child health age pattern. Fourth, low birth weight was an important predictor of poor child health. Fifth, good sanitation positively impacts child health. Its effect is consistent with both models at around the 5% significance level. This indicates that education on keeping hygienic living conditions is extremely important. Finally, genetics was significant, but the effect can be crowded out by environmental factors. The finding verifies that the future generations of Vietnamese can achieve their desired stature even though their parents' heights are only moderate.

## 5. CONCLUSION

The findings of this paper have shown that formal education is essential for improvements in child health, but it is not sufficient. General education on health is an appealing alternative because it is an effective and timely measure for improving child health. Moreover, the lag effect of health knowledge received from a specific training course, propaganda program, or media can be minimized. General education should be implemented as follows. First, it should be provided for all people or facilities that take care of children including childcare centers (e.g. commune health workers), kindergartens, and family members. Further, when the knowledge of health workers is better, there is an improved quality in health consultancy and propaganda, which contributes to health knowledge in the community. The knowledge of nurse-maids will benefit children at nursery schools. And it will help family members, who typically step up when the

mothers go back to work. Secondly, the periodic organization of training courses is proposed to ensure updated health knowledge and information. For instance, the current death of infants after being immunized hepatitis B strongly indicates regular general education regularly. Vaccine maintenance and injections, vaccination timing and safety, the physical status of children before immunization are among the information that child care attendants have to be updated to ensure the quality of child immunization. Third, prenatal care education must be enhanced because it can help reduce, in particular, the prevalence of low birth weight, a contributor to poor child health.

Moreover, research findings have found that television, radio, and newspapers are helpful channels for health knowledge propaganda. However, more interactive activity is suggested because a theoretical and practical combination generates the optimal result. For instance, a child-care club can be an effective and efficient provider of informal education because child care providers can learn health knowledge and caring practice from professional consultants. Besides, these clubs can be an opportunity to exchange experiences on prenatal and other childcare as well as a basis to compare the growth of their children. Moreover, club activities can help get positive information to will help the child care workers learn about healthy behavior in an entertaining way. In conclusion, besides formal education, general training on hygienic living, healthy childcare practice, and prenatal care can significantly improve child health. The increase in health campaign via public media and duplicate the childcare club model are efficient measures to improve child health.

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**BIOGRAPHIES OF AUTHORS**

**Tuyen Thi Mong Nguyen**     Dr. Tuyen is currently working as a senior lecturer of Department of Fundamental Studies, Ho Chi Minh City Open University, Ho Chi Minh City, Vietnam. Her research interest includes politics, social sciences and humanities. She can be contacted at email: [tuyen.ntm@ou.edu.vn](mailto:tuyen.ntm@ou.edu.vn).



**Quyen Le Hoang Thuy To Nguyen**     Dr. Quyen is currently working at Office of Cooperation & Research Management, Ho Chi Minh City Open University, Vietnam. Her research interest includes economics & society, health and sustainable development. She can be contacted at email: [quyen.nlhtt@ou.edu.vn](mailto:quyen.nlhtt@ou.edu.vn).



**Phong Thanh Nguyen**     Dr. Phong is currently a member of Professional Knowledge & Project management team (K2P), Ho Chi Minh City Open University, Vietnam. His teaching and research interests are construction & project management, decision support systems, quantitative analysis for construction economics, business, education and risk management. He can be contacted at email: [phong.nt@ou.edu.vn](mailto:phong.nt@ou.edu.vn).