

Guidelines for Enhancing the Growth Potential of Thai Children in Bangkok Metropolitan Areas

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Highlight

This study confirms that the development of height potential among Thai children is of great importance for physical health, immunity, and age-appropriate growth. Government policy demonstrated the strongest direct influence on family support, basic physical activities, long-term genetic enhancement, and the development of height potential.

Abstract

The objectives of this research were: 1) To study the level of height potential development among Thai children in Bangkok, including family support, government policy, basic physical activities, and long-term genetic enhancement. 2) To examine the causal factors of family support, government policy, basic physical activities, and long-term genetic enhancement influencing the development of height potential among Thai children in Bangkok. 3) To propose guidelines for developing the height potential of Thai children in Bangkok. This study employed a mixed-methods research design, integrating quantitative and qualitative approaches. The quantitative sample consisted of 400 parents or guardians aged 35–59 years who had children or grandchildren residing in Bangkok. The sample size was determined using the criterion of 20 times the number of observed variables. Stratified random sampling was applied. Data were collected using questionnaires and analyzed using Structural Equation Modeling (SEM). For the qualitative component, data were collected through in-depth interviews with 17 key informants, including government officials responsible for public policy, experts in nutrition and physical development, sports science specialists, and physical therapy experts. The qualitative data were analyzed using content analysis. The research findings revealed that: 1) The development of height potential among Thai children in Bangkok, including basic physical activities, long-term genetic enhancement, family support, and government policy, was perceived at the highest level. 2) All factors influence the development of height potential among Thai children in Bangkok, which can be ranked as long-term genetic enhancement, government policy, family support, and basic physical activities. 3) The proposed guidelines for developing height potential among Thai children in Bangkok were presented in a diagrammatic model, with long-term genetic enhancement as the foundational driving factor at the base, followed by government policy and family support at the intermediate level, and basic physical activities at the upper level. Furthermore, the development of height potential among Thai children in Bangkok should also result in graceful physical posture, an increase in the number of athletes, improved career opportunities, and enhanced physical and mental well-being. The findings of this study are beneficial to government agencies, as they can serve as guidelines for promoting and developing relevant public organizations. The results can support policy formulation, budget allocation, and concrete activity support aimed at enhancing height development among Thai children. Ultimately, this will generate positive impacts on society and contribute to the overall development of Thailand.

Keywords

Growth potential, height potential development, family support, long-term genetic enhancement.

Introduction

In 2023, the global number of newborns increased by approximately 75 million, resulting in the world population reaching over 8 billion for the first time in 2024. However, the global birth rate has continued to decline, with an annual growth rate of less than 1% (0.95%). In 2024, the average global birth rate is estimated at approximately 4.3 births per second, while the death rate is approximately 2 deaths per second. Due to this slowdown in population growth, the current decade is expected to record the lowest growth rate in newborn populations in history, with an average growth rate of less than 4% between 2020 and 2030.

According to the most recent Multiple Indicator Cluster Survey (MICS), jointly conducted by the National Statistical Office of Thailand and UNICEF, significant progress has been observed in several areas related to children and women, including reductions in adolescent fertility rates and in the use of corporal punishment at home. However, the survey also revealed concerning trends regarding child nutrition and secondary school enrollment. The survey indicated that 13 percent of Thai children under the age of five suffer from stunting as a result of prolonged nutritional deficiencies. Additionally, 8 percent experience wasting, and 9 percent are overweight. Despite the well-documented benefits of exclusive breastfeeding, only 14 percent of infants under six months of age receive exclusive breastfeeding, a decline from previous years. Stunting is a major growth-related issue characterized by delayed physical development in both height and weight compared to age-specific standards. In Thailand, growth assessment follows World Health Organization standards for children under five and Ministry of Public Health growth charts for children over five.

Growth retardation not only affects children physically but also has psychological and social consequences, including low self-esteem, reduced social adaptation, and limited opportunities in sports and future employment. Recognizing the severity of this issue, the Thai government has implemented national strategies aimed at strengthening human capital development. The 20-Year National Strategy (2018–2037) emphasizes holistic human development across all age groups, beginning in early childhood. Research has shown that early childhood, particularly the first eight years of life, represents a critical period for physical, cognitive, and emotional development, with long-term implications for overall human potential. Human height development is influenced by multiple factors, including genetics, nutrition, physical activity, hormonal regulation, and environmental conditions. Family support plays a crucial role in providing appropriate nutrition, adequate rest, physical supervision, and emotional care. In addition, government policies, access to health and sports services, and long-term genetic enhancement strategies contribute significantly to children’s growth potential. Successful international cases, such as China, demonstrate how coordinated government policies, nutritional programs, and family involvement can effectively enhance children’s height development. These experiences highlight the importance of integrating public policy, family support, physical activity, and genetic considerations into a comprehensive development framework (Homla-or, 2020).

Given the increasing concern over child stunting and height-related development in Thailand, particularly in urban areas such as Bangkok, this study aims to address the existing research gap by examining the factors influencing the development of height potential among Thai children in the Bangkok Metropolitan Area. The findings are expected to provide evidence-based guidelines for policy formulation and practical interventions to enhance children’s growth potential and long-term human capital development.

Research Objectives

The objectives of this study are as follows:

1. To examine the level of height potential development of Thai children in Bangkok, including family support, government policy, basic physical activities, and long-term genetic enhancement
2. To investigate the causal factors of family support, government policy, basic physical activities, and long-term genetic enhancement that influence the development of height potential among Thai children in Bangkok
3. To propose guidelines for enhancing the height potential development of Thai children in Bangkok

Metropolitan Area

Research Hypotheses

H1: Government policy, family support, basic physical activities, and long-term genetic enhancement have a direct effect on the height development potential of Thai children in the Bangkok Metropolitan Area.

H2: Government policy, family support, and basic physical activities have a direct effect on long-term genetic enhancement.

H3: Government policy and family support have a direct effect on basic physical activities.

H4: Government policy has a direct effect on family support.

Conceptual Framework

The conceptual framework of this study is designed to explain the causal relationships among key factors influencing the development of height potential among Thai children in Bangkok. The framework identifies government policy, family support, basic physical activities, and long-term genetic enhancement as the primary

latent variables affecting children’s height potential development. Government policy influences family support, basic physical activities, and long-term genetic enhancement through clear policy formulation, budget allocation for nutritional support, establishment of community consultation centers, and control of affordable sports and medical equipment. Family support directly contributes to children’s growth through nutritional management, adequate rest, physical supervision, and psychological care.

Basic physical activities, including regular exercise, physical therapy, body mass index control, and the use of technology and innovation, support skeletal growth and hormonal stimulation. Long-term genetic enhancement, encompassing genetic education, premarital counseling, genetic promotion, and sports science advancement, is a foundational factor directly influencing the development of height potential. These interrelated factors collectively contribute to the development of Thai children’s height potential, which further leads to positive outcomes such as improved physical posture, increased participation in sports, enhanced career opportunities, and better physical and mental well-being.

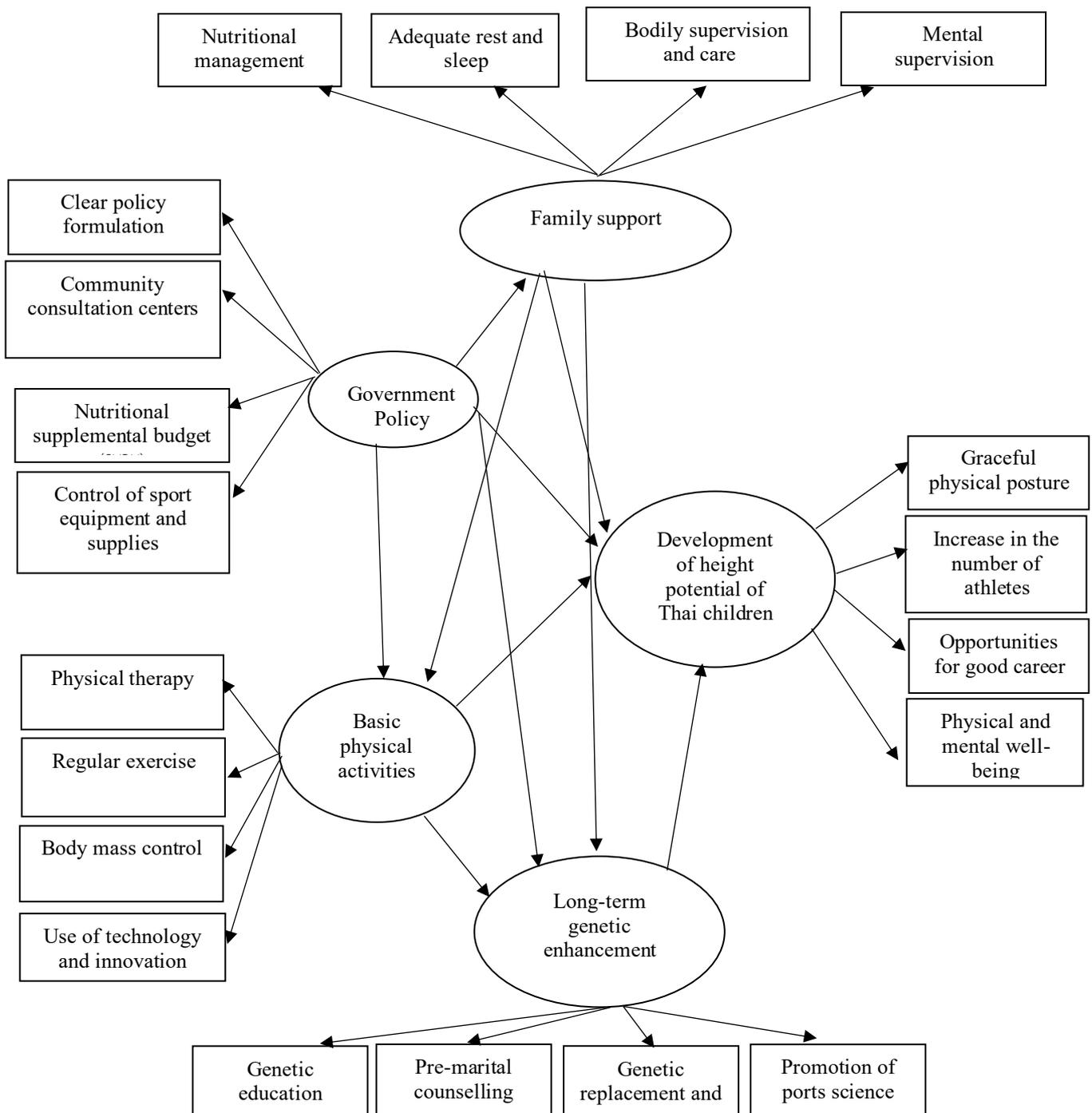


Figure 1. Research Conceptual Framework

Methodology

This study employed a mixed-methods research design, integrating both quantitative and qualitative approaches in order to obtain comprehensive and in-depth findings.

Population and Sample

For the quantitative component, the population consisted of 300,303 parents or guardians residing in the Bangkok Metropolitan Area. The sample size was determined based on the criterion of 20 times the number of observed variables, resulting in a total sample of 400 respondents, which is considered appropriate for Structural Equation Modeling (SEM). Multi-stage sampling was used to select participants. Data were collected using a structured questionnaire.

For the qualitative component, key informants were selected through purposive sampling. The informants included government officials involved in public policy (5 persons), experts in nutrition and physical development (4 persons), sports science specialists (3 persons), and physical therapy experts (3 persons), for a total of 15 key informants. Data were collected through in-depth interviews.

Research Instruments and Data Analysis

The quantitative research instrument was a questionnaire divided into six sections: demographic information, government policy, family support, basic physical activities, long-term genetic enhancement, and height potential development of Thai children. Content validity was assessed by five experts using the Index of Item-Objective Congruence (IOC), with values ranging from 0.60 to 1.00. A pilot test was conducted with 30 respondents, and reliability analysis using Cronbach's alpha coefficient yielded a value of 0.982, indicating high reliability.

Descriptive statistics included frequency, percentage, mean, and standard deviation. Inferential statistics involved Confirmatory Factor Analysis (CFA) and Structural Equation Modeling (SEM) using statistical software. Qualitative data validity was ensured through triangulation, including data source verification. Reliability and trustworthiness were evaluated based on credibility, dependability, transferability, and bias reduction (Suksit, 2019). Interview data were transcribed and analyzed using content analysis. Integration of quantitative and qualitative findings was achieved by using quantitative results with lower total effects as focal points for qualitative interviews, thereby strengthening and validating the quantitative findings.

Results

The research results in this study were presented according the research objectives as follows:

Results of objective 1: To examine the level of height potential development among Thai children in Bangkok, including family support, government policy, basic physical activities, and long-term genetic enhancement. The results indicated that the development of height potential among Thai children in Bangkok was perceived at the highest level (Mean = 4.40, SD = 0.63), followed by basic physical activities (Mean = 4.39, SD = 0.59), long-term genetic enhancement (Mean = 4.36, SD = 0.63), family support (Mean = 4.30, SD = 0.66), and government policy (Mean = 4.27, SD = 0.63) respectively. Each latent variable was rated at the highest level (Table 1).

Table 1. Mean and standard deviation of latent variables

Latent variables	Mean	SD	Ranking	Interpretation
Development of height potential of Thai children in Bangkok	4.40	0.63	1	Highest
Family support	4.30	0.66	4	Highest
Government policy	4.27	0.63	5	Highest
Basic physical activities	4.39	0.59	2	Highest
Long-term genetic enhancement	4.36	0.63	3	Highest

Results of objective 2: To investigate the causal factors of family support, government policy, basic physical activities, and long-term genetic enhancement that influence the development of height potential among Thai children in Bangkok. The alternative structural equation model developed by the researcher demonstrated a good fit with the empirical data. All goodness-of-fit indices met the established criteria ($\chi^2 = 101.92$, $df = 87$, $p > 0.05$, GFI = 0.98, AGFI = 0.94, RMSEA = 0.021, CFI = 1.00, CN = 469.39) (Table 2).

Table 2. Goodness-of-Fit Indices for the Hypothesized Model and the Alternative Model

Fit Indices	Cut-off value	Hypothesized Model	Alternative Model
1. Chi-square (χ^2)	* Close to 0	767.67	101.92
Relative Chi-square	* Equal to df (χ^2 / df) < 2.05	160	87
2. GFI	> 0.90	0.84	0.98
3. agfi	> 0.90	0.79	0.94
4. rmr	Close to 0.00	0.008	0.003
5. rmsea	< 0.05	0.098	0.021
6. cfi	*0.00-1.00	0.99	1.00
7. cn	> 200	105.63	469.39

The research results showed that the factor exerting the strongest total effect on the height development potential of Thai children in the Bangkok Metropolitan Area (DTPC) was long-term genetic enhancement (LTGN) with a total effect value of 0.98. This was followed by government policy (GOPO) with a total effect of 0.94, family support (SUFU) with 0.56, and basic physical activities (PHBY) with 0.52. All effects were statistically significant at the 0.01 level (Table 3).

Table 3. Direct Effects (DE), Indirect Effects (IE), and Total Effects (TE) of Latent Variables Based on Beta and Gamma Coefficients

Variables	Effects	Independent Variables				
		GOPO	SUFU	PHBY	LTGN	DTPC
SUFU	DE	0.95**	N/A	N/A	N/A	N/A
	IE	N/A	N/A	N/A	N/A	N/A
	TE	0.95**	N/A	N/A	N/A	N/A
PHBY	DE	0.82**	0.22**	N/A	N/A	N/A
	IE	0.15**	N/A	N/A	N/A	N/A
	TE	0.97**	0.22**	N/A	N/A	N/A
LTGN	DE	0.39**	0.26**	0.35**	N/A	N/A
	IE	0.57**	0.14**	N/A	N/A	N/A
	TE	0.96**	0.40**	0.35**	N/A	N/A
DTPC	DE	0.16*	0.24**	0.18**	0.98**	N/A
	IE	0.89**	0.32**	0.34**	N/A	N/A
	TE	0.94**	0.56**	0.52**	0.98**	N/A

Chi-Square= 101.92, df=87 p-value = 0.131, GFI=0.98, AGFI=0.94, RMR=0.008, RMSEA=0.021, CFI=1.00, CN=469.39

Results of objective 3: To propose guidelines for enhancing the height potential development of Thai children in Bangkok Metropolitan Area

Figure 3 illustrates the guideline model for enhancing the height development potential of Thai children, presented in a diagrammatic form. The model is structured hierarchically, with long-term genetic enhancement serving as the foundational driving factor at the lowest level, as it exerts the strongest total effect. At the intermediate level are family support and government policy, which function as key supportive mechanisms. Basic physical activities are positioned at the upper level, directly contributing to the enhancement of children's height development.

The structure of this diagram is derived from the analysis of direct effects, indirect effects, and total effects among the latent variables, all of which interact and jointly influence the height development potential of Thai children.

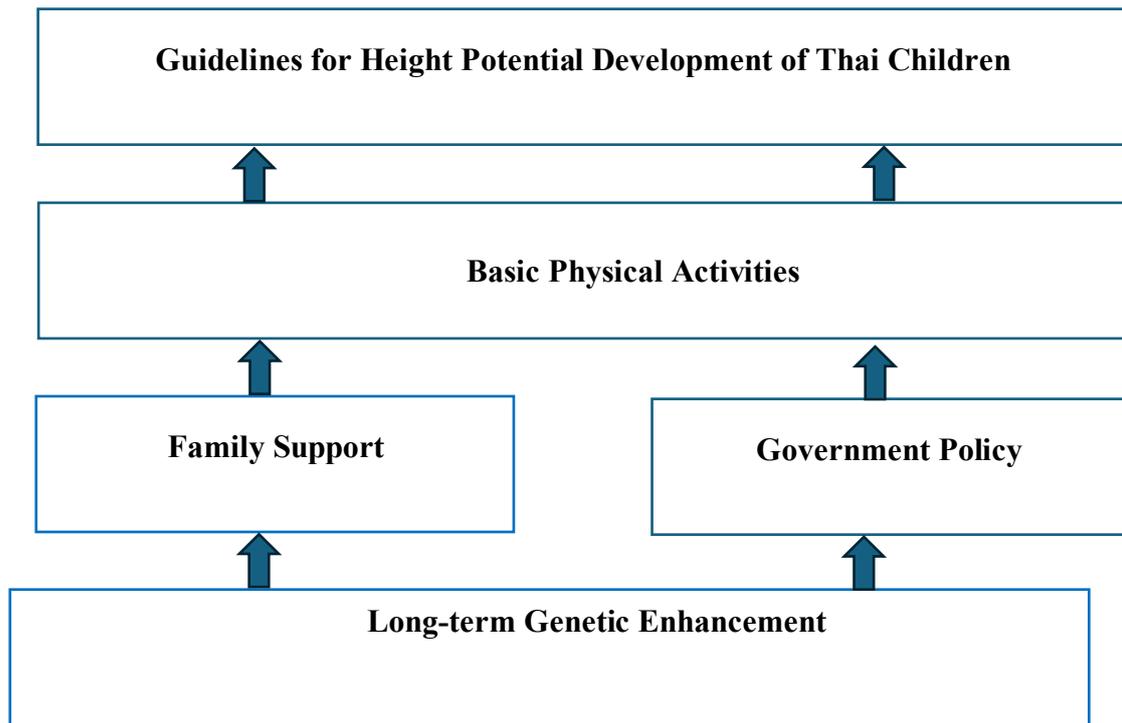


Figure 2. A Diagrammatic Model of the Guidelines for Enhancing the Height Potential Development of Thai Children

Discussion

This study aimed to develop the potential for enhancing the height of children in Bangkok. The discussion of the findings is divided into two parts: (1) a discussion of the hypothesis testing results in accordance with the research objectives, and (2) a discussion of the quality of the research methodology and the proposed policy implications derived from the findings.

1. Discussion on Hypothesis Testing Results Based on the Structural Equation Model

The structural equation model was employed to analyze the relationships among factors with direct and indirect influences. The findings are discussed as follows.

1.1 Government Policy (GOPO)

Government policy (GOPO) showed the strongest direct relationship with family support (SUFU), with a coefficient of 0.95. It also had direct effects on physical activity behavior (PHBY), long-term genetic promotion (LTGN), and the development of children's height potential in Thailand (DTPC), with coefficients of 0.82, 0.39, and 0.16, respectively. In addition, government policy had indirect effects on the development of children's height potential (DTPC) through long-term genetic promotion (LTGN) and physical activity behavior (PHBY), with coefficients of 0.89, 0.57, and 0.15, respectively. These findings may be explained by the fact that public policies such as government measures related to public health promotion, budget allocation for nutritional supplementation programs, and regulation of physical activity equipment and access at affordable prices significantly contribute to enhancing children's height potential in Bangkok.

1.2 Family Support (SUFU)

Family support (SUFU) had a direct relationship with long-term genetic promotion (LTGN), with a coefficient of 0.26. It also directly influenced the development of children's height potential (DTPC) and physical activity behavior (PHBY), with coefficients of 0.24 and 0.22, respectively. Furthermore, family support exerted indirect effects on children's height potential (DTPC) through long-term genetic promotion (LTGN), with coefficients of 0.32 and 0.14, respectively. These results may be attributed to family-related factors such as parental support, nutritional planning, adequate rest, and proper healthcare and physical care, all of which positively influence children's growth and height development.

1.3 Physical Activity Behavior (PHBY)

Physical activity behavior (PHBY) was found to have direct relationships with long-term genetic promotion (LTGN) and the development of children's height potential (DTPC), with coefficients of 0.35 and 0.18, respectively. It also had an indirect effect on children's height potential (DTPC) with a coefficient of 0.34. These findings can be explained by the fact that children who regularly engage in physical therapy, exercise, body composition control, and the use of technology and innovation in physical activity tend to experience improved growth and height development.

1.4 Long-Term Genetic Promotion (LTGN)

Long-term genetic promotion (LTGN) showed a very strong direct relationship with the development of children's height potential in Thailand (DTPC), with a coefficient of 0.98. This result may be explained by long-term genetic promotion strategies such as providing genetic education, premarital counseling, genetic screening, and the promotion of sports science knowledge.

2. Discussion on Research Methodology Quality and Policy Implications

Based on the presentation of findings and the discussion above, the quality of the research methodology can be summarized as follows.

2.1 Quality of the Research Methodology

This study employed a mixed-methods design, integrating quantitative and qualitative approaches. The quantitative component utilized a questionnaire survey, with validity assessed through item-objective congruence (IOC) and reliability tested using Cronbach's alpha coefficient. Data were collected from a sufficient sample size.

The quantitative analysis involved structural equation modeling (SEM), which allowed for the analysis of causal relationships among latent variables. Factor analysis, path analysis, and regression analysis were conducted using structural equation modeling software. SEM was selected because it is an advanced quantitative data analysis technique that is widely accepted in contemporary research. It enables the simultaneous analysis of measurement models and structural models, as well as the estimation of direct and indirect effects.

In addition, SEM allows for the assessment of model fit and model stability, including the examination of dynamic changes and invariance testing when sample conditions change. Therefore, the use of SEM in this study is considered appropriate, accurate, and methodologically rigorous. For the qualitative component, in-depth interviews were conducted with key informants, including government officials involved in public policy, experts in planning and development, sports science specialists, and health experts, totaling 15 participants.

2. Literature Review, Variable Selection, and Model Validation

This study required a comprehensive review of the literature to identify variables derived from theoretical foundations, develop the research model, and examine model validity using empirical data in a systematic sequence. Such procedures ensure that data organization is conducted rigorously and logically. The researcher must possess thorough knowledge of the relevant theories and principles associated with the variables under investigation. Appropriate variables or key components must be carefully selected, along with a model that clearly demonstrates causal relationships among variables and aligns with the research objectives.

The proposed relationships were subsequently tested against the empirical data collected to confirm the validity of the constructed model. This process allowed for the assessment of whether the hypothesized relationships were consistent with or contradicted the empirical evidence. The findings can be utilized by relevant stakeholders and interested parties as a guideline for developing children's growth and development in accordance with international standards among organizations in Bangkok and the surrounding metropolitan areas. The results of this study are consistent with existing concepts and theories derived from the literature review, particularly regarding the relationships among variables, as evaluated through factor loadings.

2.1 Physical Activity Behavior

Physical activity behavior consists of physical therapy, regular exercise, body mass control, and the use of technology and innovation. Among these components, technology and innovation exhibited the highest factor loading, followed by physical therapy, body mass control, and regular exercise. These findings are consistent with studies by Bangbon et al. (2023) and Channuwong et al. (2022), who found that physical activity behavior

significantly influences the development of children's height potential in Bangkok. Regular physical exercise stimulates growth hormone secretion and promotes bone and muscle development. Physical therapy improves bodily structure and reduces the risk of musculoskeletal abnormalities. Body mass control helps maintain appropriate weight, thereby reducing stress on the skeletal system, while the use of technology and innovation enables systematic monitoring, planning, and evaluation of children's health and physical performance.

These results are consistent with the studies by Ebekozi et al. (2025), Sutthipong (2020) and Kanchanawit (2020), which examined approaches to promoting growth and development among preschool children under the supervision of local administrative organizations in Phrao District, Chiang Mai Province. The study found that the implementation of early childhood development programs encountered certain challenges, leading to the formulation of guidelines for enhancing and promoting preschool children's growth and development. These guidelines included:

1. Development of appropriate physical environments,
2. Provision of balanced nutrition,
3. Promotion of regular and age-appropriate physical activity, and
4. Enhancement of parental involvement. The outcomes demonstrated that the number of underweight and overweight children decreased or was eliminated following program implementation.

2.2 Family Support

Family support comprises dietary management, adequate rest, physical care, and mental and emotional care. Among these components, mental and emotional care showed the highest factor loading, followed by adequate rest, dietary management, and physical care. These findings are consistent with the prior studies of Channuwong et al. (2022) and Khan et al. (2026), indicating that family support plays a crucial role in enhancing children's height potential in Bangkok. Proper dietary management and adequate rest stimulate growth hormone secretion and support muscle and bone development. Physical care reduces health risks, while mental and emotional care fosters emotional stability, self-confidence, and readiness for learning, thereby enabling children to achieve their full growth potential. This finding is consistent with the study by Homla-or (2020), which examined factors related to nutrition and development among preschool children in early childhood development centers in Bang Khla District, Chachoengsao Province. The results revealed that parental educational level was significantly related to children's nutritional status; receipt of nutritional supplements was significantly associated with children's physical development; illness episodes during the past month were significantly associated with social development; and parental knowledge was significantly related to children's social development at the 0.01 level of statistical significance.

2.3 Government Policy

Government policy consists of the formulation of clear policy directions, the establishment of community consultation centers, the allocation of budgets for nutritional supplementation programs, and the regulation of sports equipment and facilities at affordable prices. Among these components, budget allocation for nutritional supplementation exhibited the highest factor loading, followed by the regulation of sports equipment and facilities at affordable prices, the establishment of community consultation centers, and the formulation of clear policies. These findings are consistent with previous research indicating that government policy exerts a significant influence on the development of children's height potential in Bangkok. Clearly defined policies enable relevant agencies to operate in a unified direction. The establishment of community consultation centers provides families with guidance on child health and development. Budget allocation for nutritional supplementation programs enhances children's nutritional status, while the regulation of sports equipment and facilities at affordable prices reduces inequality in access to health-related resources. These results are consistent with the study by Wetsanuwat (2020) and Kulsuma (2014), which examined the outcomes of implementing programs aimed at promoting growth and height development among primary school students in Suphan Buri Province. The findings indicated that government support and the provision of knowledge were essential, and that children should be encouraged to participate in five key activities: (1) consumption of milk at least two cartons per day, (2) daily intake of one egg, (3) engagement in physical activities such as rope jumping, hula hooping, and cycling, (4) obtaining adequate sleep of at least 9–11 hours per day, and (5) maintaining proper oral health through correct tooth brushing.

Statistical analyses, including descriptive statistics (frequency, percentage, mean, standard deviation) and inferential statistics (paired-sample t-test and McNemar's chi-square test), revealed that: (1) the mean height of students significantly increased after the intervention compared to before the intervention ($p < 0.001$); (2) the

proportion of underweight students significantly decreased after the intervention ($p < 0.001$); (3) the proportion of students classified as underweight before the intervention significantly shifted to normal weight status after the intervention ($p < 0.01$); and (4) the proportion of students classified as overweight before the intervention significantly changed to normal weight status after the intervention ($p < 0.001$).

Based on these findings, the study recommended that parents and guardians support children with growth retardation by encouraging participation in the five key activities and ensuring daily milk consumption of at least 200 grams combined with regular physical activities such as rope jumping, hula hooping, and cycling to promote growth toward normal standards. These findings are also consistent with the study by Somwut (2020) and The Matter (2020), which reported that nutrition during the first 20 years of life plays a critical role in determining adult height. While genetics is a key determinant of human height, adequate nutrition is equally important. The study further indicated that countries lacking adequate nutrition tend to have shorter average adult height.

International longitudinal research examining height and weight changes among approximately 65 million individuals aged 5–19 years, based on over 2,000 surveys conducted between 1985 and 2019, demonstrated substantial global disparities in height and BMI. In 2019, children and adolescents in Northern and Central Europe had the highest average heights, whereas those in South and Southeast Asia, Latin America, and Eastern Africa had the lowest, with differences of up to 20 centimeters. The analysis further revealed that 19-year-olds in Laos had an average height comparable to that of 13-year-olds in the Netherlands, while 19-year-olds in Timor-Leste had an average height similar to that of 11-year-olds in the Netherlands.

These disparities reflect the combined influence of nutrition, physical activity, and environmental conditions at home, school, and community levels. Supportive environments facilitate optimal growth and physical development. In addition to height, BMI was examined to assess its association with body weight. Adolescents with the highest BMI were found in Central and Eastern Europe, the United States, and New Zealand, whereas those with the lowest BMI were observed in South and Southeast Asia and East Africa. The difference between countries with the highest and lowest BMI was equivalent to approximately 25 kilograms in body weight. Andrea Rodriguez Martinez, a researcher at Imperial College London, noted that these findings highlight the importance of family support, physical activity behavior, and government-led nutrition promotion policies. The findings of this study further suggest that government policies should emphasize targeted assistance for disadvantaged populations, such as the provision of nutritious food baskets for low-income families and free school meal programs implemented through national policy initiatives.

2.4 Long-Term Genetic Promotion

Long-term genetic promotion consists of providing genetic education, premarital counseling, genetic screening and support, and the promotion of sports science. Among these components, genetic screening and promotion exhibited the highest factor loading, followed by genetic education, the promotion of sports science, and premarital counseling. These findings are consistent with previous research indicating that long-term genetic promotion is a critical factor in enhancing the height potential of Thai children. Genetic education helps families develop an accurate understanding of hereditary factors, while premarital counseling reduces the risk of genetic disorders. Genetic screening and promotion increase opportunities for healthy child development, and the promotion of sports science enhances physical performance in conjunction with genetic potential.

These findings are consistent with the study by Van Rossem and Pannecoucke (2019) and Damrongsiri et al. (2022), which examined growth inequality and height development during childhood. The results demonstrated that growth indicators at birth, including gestational age and birth length, are strongly associated with standardized height across childhood. Multiple growth indicators were used to assess the risk of growth retardation. For the analysis of growth development from birth, linear and logistic regression models were applied. Linear growth curve models were also used to analyze height development during early childhood.

The findings revealed that the risk of growth retardation has a direct and persistent effect on gestational age and birth length throughout childhood. A negative association was observed between growth retardation risk and standardized height when adjusted for age. However, the magnitude of this effect varied across developmental stages. Children with a higher risk of growth retardation exhibited shorter height at birth, with the negative impact most pronounced between 6 and 18 months of age, after which the effect gradually diminished. Nevertheless, by the end of the study period, children born into families with growth retardation risk still exhibited delayed

height recovery. These findings indicate that height catch-up growth during late childhood may only partially compensate for early growth deficits occurring at birth.

2.5 Development of Thai Children's Height Potential

The development of Thai children's height potential comprises the attainment of an attractive physical appearance, increased participation in sports, enhanced career opportunities, and improved physical and mental well-being. Among these components, physical and mental health exhibited the highest factor loading, followed by attractive physical appearance, career opportunities, and increased participation in sports. These findings are consistent with prior studies indicating that the development of children's height potential yields multidimensional benefits. Greater height contributes to enhanced physical appearance and self-confidence, expands opportunities for participation in sports, broadens career prospects, and promotes balanced physical and mental health. These results are consistent with the study by Phisanuprasan (2021) and Channuwong et al. (2025), which examined strategies for promoting early childhood health and growth toward national development goals under Thailand 4.0 using the PPCT Model. The findings revealed that early childhood is a critical period requiring holistic development across physical, cognitive, emotional, social, and moral dimensions. Parents play a vital role in supporting early childhood growth and development.

However, national survey data indicated that only 49.5% of Thai preschool children met age-appropriate height standards, and 1 in 10 children experienced growth retardation, reflecting ongoing nutritional and developmental challenges. These issues have been recognized as priority national public health concerns. Consequently, strategic planning and policy development for enhancing early childhood potential have been integrated into Thailand 4.0 human resource development initiatives. These initiatives emphasize collaboration among families, communities, and relevant social institutions to address growth and health challenges in alignment with the PPCT Model. This model was developed to guide human potential development toward desired behavioral and health outcomes, promoting sustainable health enhancement and problem-solving.

These findings are further supported by studies by Wang et al. (2017), Wei and Gregory (2009), and Sutthadaanantaphokin et al. (2025), which investigated research and development strategies to enhance child growth and health outcomes, emphasizing integrated approaches to physical development, health promotion, and sustainable well-being. Concerns regarding children's anxiety and appropriate sleep behaviors should be addressed by referring at-risk cases to public health service centers of the Bangkok Metropolitan Administration or affiliated hospitals when risk is identified. At the community level, district offices, community family development centers, and village health volunteers should organize activities that strengthen family relationships, such as healthy family programs, family exercise activities, and positive communication initiatives. These efforts help foster an emotional environment conducive to quality sleep and healthy child growth and development. Continuous mental health care contributes to emotional stability and enables children to reach their full height potential.

1.3 Office of the Basic Education Commission (OBEC)

The Office of the Basic Education Commission, in collaboration with the Ministry of Public Health, the Bangkok Metropolitan Administration, and the Food and Drug Administration (FDA), should establish a policy framework for age-appropriate nutritional supplementation for children. This framework should define safe, high-quality, and growth-appropriate nutritional supplements. The Bangkok Metropolitan Administration should allocate additional per-capita budgets to schools in vulnerable areas to support essential nutritional supplementation, such as calcium-fortified milk, high-protein foods, and vitamin and mineral supplements necessary for bone development. A continuous monitoring system for children's nutritional programs should be implemented through local public health service centers.

In addition, the National Health Security Office (NHSO) should provide financial support through local health funds to implement nutrition promotion activities for parents and teachers. A district-level working group—comprising district offices, schools, and public health service centers—should oversee budget utilization to ensure transparency and effectiveness, thereby ensuring equitable nutritional opportunities for all children.

1.4 Department of Health and Department of Medical Services, Ministry of Public Health

The Department of Health and the Department of Medical Services, Ministry of Public Health, in collaboration with hospitals under the Bangkok Metropolitan Administration, should provide systematic genetic counseling and risk screening services for couples and pregnant women. Genetic promotion initiatives should emphasize

maternal health promotion, prenatal monitoring, and continuous surveillance of fetal and early childhood development. Public health service centers and quality maternal and child clinics should serve as the primary service units.

Furthermore, the Bangkok Metropolitan Administration should support public education campaigns on genetics and child growth using accessible communication materials to raise public awareness. The Food and Drug Administration (FDA) and the Office of the Consumer Protection Board (OCPB) should strictly regulate advertisements for products claiming genetic enhancement. Long-term genetic promotion should be implemented alongside health promotion and sports science initiatives to ensure balanced and sustainable child development.

1.5 Bangkok Metropolitan Administration and Ministry of Education

The Bangkok Metropolitan Administration (Departments of Health and Education), in collaboration with the Ministry of Education through the Office of the Basic Education Commission, should implement a “School-Based Holistic Health Care System” as a core institutional policy. Under this system, school nurses and public health teachers should work jointly with homeroom teachers, guidance counselors, and educational psychologists to monitor four key domains: (1) growth and development (height, weight, BMI), (2) sleep patterns, (3) nutrition, and (4) basic mental health.

The collected data should be used to develop continuous individualized care plans. Operationally, clear referral pathways should be established between schools and Bangkok public health service centers to ensure that at-risk children (e.g., abnormal BMI, insufficient sleep, high stress, depression, or chronic illness) receive timely screening and referral. Convenient referral channels—such as child clinics or student clinics at public health centers and online counseling services after school hours—should be utilized to reduce time and travel barriers. The Bangkok Metropolitan Administration (through the Bureau of Medical Service and the Bureau of Education), in collaboration with the Ministry of Education (via the Office of the Basic Education Commission), should establish a “School-Based Physical and Mental Health Care System” as a core policy for educational institutions. Under this system, school nurses and health teachers should work collaboratively with homeroom teachers, guidance counselors, and physical education teachers to monitor four key domains: (1) physical growth (height, weight, and BMI), (2) sleep behavior, (3) dietary intake, and (4) basic mental health status. The collected data should be utilized to develop individualized and continuous care plans for students.

CONCLUSION

The findings of this study support all proposed research hypotheses and are consistent with existing theoretical and empirical literature. Government policy demonstrated the strongest direct influence on family support, basic physical activities, long-term genetic enhancement, and the development of height potential. This may be attributed to clear policy formulation, establishment of community consultation centers, allocation of nutritional budgets, and regulation of affordable sports and medical equipment. Family support showed significant direct and indirect effects on long-term genetic enhancement, physical activities, and children’s height potential development. Adequate nutrition, sufficient rest, physical supervision, and psychological care provided by families contribute directly to optimal growth and development. Basic physical activities had significant effects on long-term genetic enhancement and height development. Regular exercise, physical therapy, BMI control, and the use of technology and innovation stimulate growth hormone secretion and support skeletal and muscular development. Long-term genetic enhancement exerted the strongest direct influence on children’s height potential development. This reflects the importance of genetic education, premarital counseling, genetic promotion, and the advancement of sports science as long-term strategies for human capital development. Overall, the results emphasize that height potential development among Thai children requires an integrated approach combining public policy, family support, physical activity, and genetic considerations.

Recommendations

The Bangkok Metropolitan Administration (BMA), through the Bureau of Medical Service and the Bureau of Education, in collaboration with the Department of Health, Ministry of Public Health, and the National Health Security Office (NHSO), should establish a Digital Growth Monitoring System to continuously monitor children’s height, weight, and physical activity levels within schools and public health service centers. At the educational level, the Office of the Basic Education Commission (OBEC), the Bangkok Metropolitan Education Department, and BMA-affiliated schools should integrate health promotion programs that emphasize age-appropriate physical

activity, reduction of sedentary behavior, appropriate nutrition, and regular monitoring of children's movement patterns to foster motivation and consistent physical activity behaviors.

In addition, budgetary support from the Bangkok Metropolitan Administration and local health funds should be allocated for the provision of essential technological equipment, such as automatic height measurement devices, digital weighing scales, and interactive learning media, to enable accurate monitoring of children's development in schools. Furthermore, the Department of Health should serve as a core agency in establishing academic standards and providing professional guidance to ensure the effective use of technology and innovation, thereby maximizing the systematic and sustainable benefits for children's development.

The Department of Mental Health, Ministry of Public Health, in collaboration with the Bangkok Metropolitan Administration and the Office of the Basic Education Commission, should implement programs to enhance caregivers' competencies in promoting children's mental health. These programs should emphasize positive communication, confidence building, and stress management related to the cultivation of healthy lifestyle behaviors.

At the school level, routine mental health screening should be conducted, and collaborative referral mechanisms should be established involving homeroom teachers, guidance counselors, school nurses, and psychologists to identify risks related to stress, anxiety, and inappropriate sleep behaviors. When risks are identified, timely referrals should be made to Bangkok Metropolitan public health service centers or affiliated hospitals. At the community level, district offices, community family development centers, and village health volunteers should organize family-based activities—such as healthy family programs, family exercise initiatives, and positive parenting activities—to foster an emotional environment conducive to quality sleep and healthy child development. Continuous mental health monitoring will help strengthen children's emotional resilience and support optimal growth and development.

The Office of the Basic Education Commission, in collaboration with the Ministry of Public Health, the Bangkok Metropolitan Administration, and the Thai Food and Drug Administration (FDA), should formulate a policy on dietary supplementation for school-aged children by specifying a list of supplements that are safe, high-quality, and appropriate for growth and development. The Bangkok Metropolitan Administration should allocate additional annual budgets to schools in high-risk areas to support essential supplements, such as calcium supplements, high-protein foods, and vitamin and mineral supplements necessary for bone development. In addition, a continuous system for monitoring children's nutritional status should be implemented through local public health service centers. The National Health Security Office should support community-based health promotion initiatives focusing on nutrition for children and caregivers, with district offices, schools, and public health service centers serving as key stakeholders. Transparent and efficient budget monitoring mechanisms should be established to ensure equitable access to nutritional services for all children.

The Department of Health and the Department of Medical Services, Ministry of Public Health, in collaboration with hospitals under the Bangkok Metropolitan Administration, should provide systematic genetic counseling and risk screening services for high-risk groups and pregnant women. Policies promoting genetic health should emphasize prenatal care and continuous monitoring of developmental risks in children, with public health service centers and clinics serving as primary care units. Furthermore, the Ministry of Public Health and the Bangkok Metropolitan Administration should support public communication initiatives that disseminate clear and accessible information on genetics and child development to raise public awareness. The Thai Food and Drug Administration and the Office of the Consumer Protection Board should strictly regulate advertising related to genetic products. Integrating genetic screening with health promotion and scientific communication will help ensure optimal and sustainable child development in the long term. In practice, clear referral pathways should be established between schools and Bangkok Metropolitan public health service centers to ensure that at-risk children (e.g., those who are underweight, experience insufficient sleep, exhibit high stress levels, depressive symptoms, or suffer from chronic illnesses) receive timely screening and referral services. Convenient appointment channels—such as child health clinics or student clinics within public health service centers—should be utilized. In addition, online counseling services after school hours should be provided to reduce barriers related to time constraints and travel, thereby improving access to care and early intervention.

This study offers several recommendations for future research related to the development of Thai children's height potential in the Bangkok Metropolitan area. Building upon the findings of the present study, future

research should consider the following directions. Future studies should expand the sample population beyond the Bangkok Metropolitan area to include suburban areas and various regions of Thailand. This would allow for comparative analysis of environmental, social, and economic factors influencing children's height potential. Such an approach would enable more comprehensive conclusions and support the formulation of more appropriate national-level policies.

Future research should employ experimental or quasi-experimental designs by implementing height-promotion programs, such as physical activity programs, nutritional interventions, or mental health support programs, among children in different age groups. This would facilitate the evaluation of causal effects and provide empirical evidence regarding which activities or interventions most effectively enhance children's height potential. Further studies should investigate additional factors, such as learning organizations and strategic leadership, to support the development of stakeholders' potential for export-oriented growth in both the Bangkok Metropolitan area and suburban regions. Future research should explore models for developing the capacity of health and beauty industry operators to support export-oriented growth in Bangkok and surrounding metropolitan areas.

REFERENCES

Bangbon, P., Channuwong, S., Amponstira, F., Rungsuk, A., & Snongtaweepon, T. (2023). The influence of transformational leadership on organizational sustainability: A case study of business companies in Bangkok. *Journal of Namibian Studies*, 33, 4077–4095.

Bangkokbiz News. (2023). *Global population situation and new birth rates*. Bangkokbiz News.

Channuwong, S., Ruksat, S., & Srivinayaphon, P. (2022). The relationship between the four foundations of mindfulness and mental health development. *Kasetsart Journal of Social Sciences*, 43(1), 166–172. <https://doi.org/10.34044/j.kjss.2022.43.1.23>

Channuwong, S., Tongvijit, M., Bangbon, P., Siripap, P., Weerachareonchai, P., Rattananda, N., Samapat, P., & Wongwean, B. (2025). The influence of cultural factors on organizational justice of public organizations in Bangkok. *Journal of Neonatal Surgery*, 14(3), 1–9.

Damrongsiri, T., Harnphanich, B., Snongtaweepon, T., Channuwong, S., Benjawatanapon, W., Raktakanishtha, P., Wongsurakrai, S., & Siribensanont, C. (2022). Leadership of administrators for improving mission implementation of Thai private higher education institutions. *Journal of Positive School Psychology*, 6(9), 2558–2568.

Ebekozien, A., Aigbavboa, C., Hafez, M., Samsurijan, M. S., & Oke, A. E. (2025). Appraising sustainable and resilient physical infrastructure facilities in higher education institutions: The role of smart maintenance management. *Facilities*, 43(13), 1094–1113. <https://doi.org/10.1108/F-122024-0173>

Homla-or, A. (2020). *Factors related to nutritional status and development of preschool children in early childhood development centers, Bang Khla District, Chachoengsao Province* [Master's thesis, Burapha University].

Kanchanawit, D. (2020). *Development of guidelines for promoting growth and development of preschool children in early childhood development centers under local administrative organizations, Phrao District, Chiang Mai Province* [Master's thesis, Chiang Mai University].

Khan, M., Channuwong, S., Siripap, P., Dhammahansakul, N., Wongwisutthirat, K., & Islam, M. M. (2026). Integrated management systems influencing sustainable business development of Thai real estate companies. *Perinatal Journal*, 43(1), 280–290. <https://doi.org/10.57239/prn.26.03410031>

Kulsuma, S. (2014). *Nutrition and child growth*. Medical Publishing House.

National Statistical Office of Thailand. (2022). *Report on children and nutrition in Thailand*. National Statistical Office.

National Statistical Office of Thailand. (2023). *Bangkok population statistics*. National Statistical Office.

Office of the Prime Minister. (2017). *Early childhood development plan B.E. 2017–2021*. Office of the Prime Minister.

Phatthanaphisit, C. (2018). *Report on the situation of early childhood development in Thailand*. Department of Health.

Somwut, J. (2020). *Child growth and development*. Medical Publishing House.

Sports Authority of Thailand. (2022). *Sports science and health promotion*. Sports Authority of Thailand.

Sudarmo, S. M., Ranuh, R. G., Athiyyah, A. F., Darma, A., Diana, V., Hidajat, B., Hidayati, S. N., & Endaryanto, A. (2022). The effects of probiotic and prebiotic administration in children with acute diarrhea at day-care centers. *International Journal of Probiotics and Prebiotics*, 17(1), 27–32. <https://doi.org/10.37290/ijpp2641-7197.17:27-32>

Suksit, P. (2019). *Mixed methods research design*. University Publishing House.

Sundari, P. S., Biswas, D., Sinha, S., Nandy, M., & Alzubaidi, L. H. (2024). An integrated deep-learning model-based precise forecasting model for sustainable energy systems. *Acta Innovations*, 12–22. <https://doi.org/10.62441/actainnovations.vi.395>

Sutthadaanantaphokin, K., Channuwong, S., Moolngearn, P., Luangsmarnkul, P., & Wang, S. (2025). Transformational leadership influencing mission implementation of Thai universities. *Sciences of Conservation and Archaeology*, 37(3), 58–67. <https://doi.org/10.48141/sci-arch-37.3.25.7>

Sutthipong, W. (2020). *Stunting among Thai children*. Health Publishing House.

The Matter. (2020). *Nutrition and global height inequality among children*. The Matter.

UNICEF Thailand. (2019). *Multiple indicator cluster survey (MICS)*. UNICEF.

Wang, L., Shi, C., & Zhao, Z. (2017). The research and development of growth curve for children's height and weight on Android platform. In *Proceedings of the 2017 10th International Congress on Image and Signal Processing, BioMedical Engineering and Informatics (CISP-BME)* (pp. 1–5). IEEE.

Wei, C., & Gregory, J. W. (2009). Physiology of growth. *Journal of Endocrinology*, 201(1), 1–10.

Wetsanuwat, S. (2020). *Effects of a growth promotion program on height development of primary school students in Suphan Buri Province* [Master's thesis, Mahidol University].

World Health Organization. (2004). *Global database on child growth and malnutrition*. WHO.