ASSESSING TRANSITION IN DETERMINANTS OF CHILD MALNUTRITION AMONGST CHILDREN UNDER FIVE YEARS OF AGE IN INDIA OVER A PERIOD OF TWO DECADES: SECONDARY ANALYSIS USING NATIONAL FAMILY HEALTH SURVEYS

JUNE 2021

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B.SC. HOME SCIENCE

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A dissertation submitted in partial fulfilment of the requirements for the degree of Master of Science Food and Nutrition (Public Health Nutrition)

Faculty of Family and Community Sciences

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Certificate

This is to certify that research work presented in this thesis was carried out independently by **Ms. Pranatusmi Sharma** under the guidance of **Dr. Vijayata Sengar** in pursuit of a **Master's degree in Food and Nutrition (Public Health and Nutrition)** and represents her original work.

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Although the cover of my thesis contains merely my name, a lot of individuals contributed to its preparation. I wanted, on this incredible trip, to convey my deepest gratitude for all those who contributed to this thesis.

Thank you, Lord almighty, it's because of you that I could complete my dissertation on time amidst the Novel coronavirus pandemic. Thank you for all the countless blessings and keeping us safe in your mighty hands.

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Pranatusmi Sharma

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ABBREVIATION

ABBREVIATION	FULL FORM
AWC	Anganwadi Centre
AWW	Anganwadi Workers
ASHA	Accredited Social Health Activist
BCC	Behavior Change Communication
BMI	Body Mass Index
EBF	Exclusive breast Feeding
FAO	Food and Agricultural Organization
FNS	Food and Nutrition Security
HAZ	Height for Age
Hb	Hemoglobin
Ht.	Height
ICDS	Integrated Child Development Services
IYCF	Infant and Young Child Feeding
IYCN	Infant and Young Child Nutrition
JSSK	Janani Sishu Suraksha Karyakaram
JSY	Janani Suraksha Yojana
LBW	Low Birth Weight
NFHS	National Family Health Survey
NHE	Nutrition Health Education
NNM	National Nutrition Mission
PMMVY	Pradhan Mantri Matru Vandana Yojana
SDG	Sustainable Development Goals
UNICEF	United Nations International Children's Emergency Fund
WAZ	Weight for Age
WHO	World Health Organization
WHZ	Weight for Height
Wt.	Weight

ABSTRACT

ABSTRACT

Malnutrition is a huge predicament in our society and has dwarfed the lives of billions of people in India. Good nutrition allows children to survive, grow, develop, learn, play, participate and contribute – while malnutrition robs children of their futures and leaves young lives hanging in the balance. The present study dealt with assessing the transition in determinants of child malnutrition amongst children under five years of age in India over a period of two decades. This required nationwide data which was obtained from the National Family and Health Surveys. NFHS surveys are extensive and multi-phased surveys covering all the states and Union territories of India. The primary analysis included children under five years of age from each NFHS surveys NFHS 2 (N= 5,313), NFHS 3 (12,960) and NFHS 4 (48,265) respectively which had complete data on maternal, child health and nutrition parameters. Outcome variables were stunting, wasting and underweight. Bivariate multiple regression analysis was conducted to evaluate the correlation of different parameters with the anthropometric failure. The prevalence of stunting was 38.3%, 47.5 % and 35.5 % in NFHS 2, 3 and 4 respectively. The prevalence of underweight were 40.7%, 47.5% and 45.5% for NFHS 2, 3 and 4 respectively. The prevalence of wasting was 14.2%, 19 % and 21.3 % for NFHS 2, 3 and 4 respectively. The significant factors associated with Stunting were child's age in months, birth order, mother's education, gender of the child and number of ANC visits. Transition in factors were observed showed that number of antenatal visits remained constant challenge in all the three surveys followed by child's age in months and gender which were common in NFHS 3 and 4. Mother's education and wealth index appeared as an important predictor in NFHS 4. The factors associated with underweight were child's age in months, maternal BMI, mothers age at first birth, wealth index and number of antenatal visits. While the transition was observed low maternal BMI and child's age in months was common to all the surveys. The factors associated with wasting were child's age in months, size of the child at birth, number of ANC visits. Gender of the child, low maternal BMI, place of residence. Child's age in months and gender of the child were common in all the surveys. Maternal BMI and size of the child at birth appeared in NFHS 3 and 4. The factors which were common in all the three surveys more emphasis must be laid on those factors child's age in months, gender and number of ANC visits, mother's education, maternal BMI and the wealth index. Existing programmes and policies must be strengthened and must lay emphasis on

factors which were continuously emerged as a predictor over two decades. With ongoing demographic and nutritional transitions in India, policies and programs must be state-specific. Regular monitoring of the programmes whether monthly or yearly target is met by them. Best practices of each state and Union territories must be recognised and appreciated along with it adopted to meet the targets laid by World health assembly.

INTRODUCTION

INTRODUCTION

Sparse and discoloured hair, lifeless and longing eyes as if they have a story to tell, less vigour, bones protruding through the skin. Disparity is what I notice when I see a malnourished child and its heart wrenching to see such a scene. We often say that "Today's children are tomorrow's future" but are we able to provide for each one of them? Seventy-three years of Independence, but are we free? No, it's not the India our freedom fighters fought for. When are we getting freedom from Malnutrition? Eradicating malnutrition is a constant challenge for humanity.

"If we can conquer space, we can conquer childhood hunger." - Buzz Aldrin

Malnutrition is a huge predicament in our society and has dwarfed the lives of billions of people in India. Nutrition is the basis of human development and resultant economic development (Bhattacharya, 2004). Malnutrition refers to a condition that is caused by deficiencies, excesses or imbalances in a person's diet, in the form of energy or other nutrients. Both "undernutrition" and "overnutrition" are forms of malnutrition. Undernutrition results when nutritional reserves are depleted and the intake of nutrients is not enough to meet the daily requirements or metabolic processes (Nix, 2007). **Fig. 1.1** shows the forms of undernutrition used to measure malnutrition are wasting (low weight for height), stunting (low height for age), underweight (low weight for age) and micronutrient deficiencies (lack of vital vitamins and minerals. Stunting is an indicator of chronic malnutrition whereas wasting indicates the prevalence of acute malnutrition followed by physical, geographical or biological emergencies (Subramanyam et al., 2011). Overnutrition is the other form of malnutrition which is due to excess calories in diet resulting in overweight and obesity which further leads to the non-communicable diseases (hypertension, stroke, cardiovascular diseases, diabetes, cancer etc) [1]. The magnitude of the problem of malnutrition is greater in developing countries than in developed countries. It is not that the developed countries are totally free of problems of malnutrition. The developed and the affluent countries suffer from malnutrition at the other spectrum, i.e., overnutrition, diet related degenerative diseases, dietary imbalances and obesity (Bhattacharya, 2004).

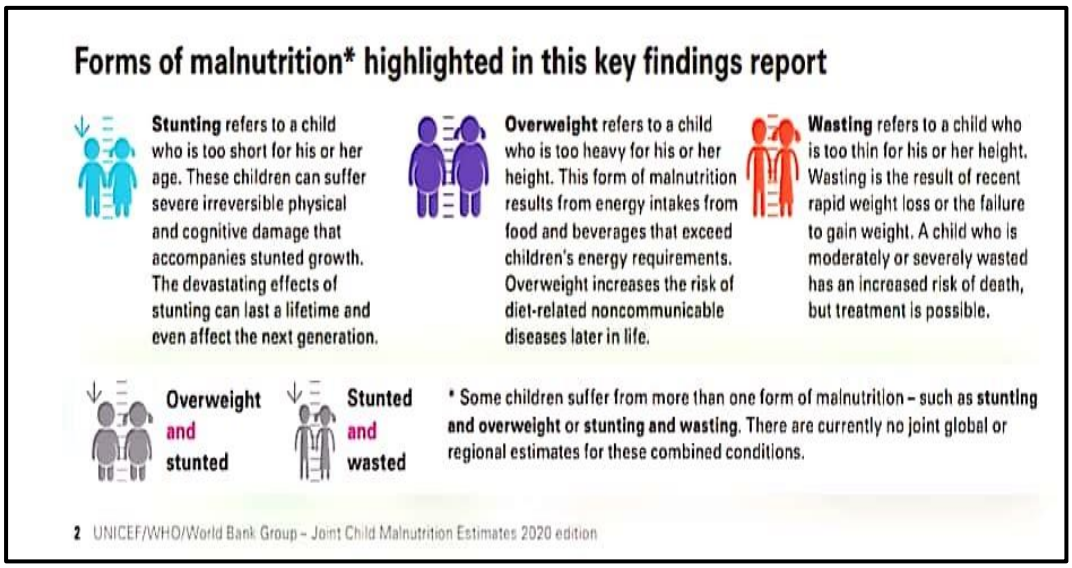
The world experiences a significant malnutrition burden among its under-5 population as shown in **fig 1.2**. The gravity of the situation lies here, when the facts and figures

states that, globally around 45% of death of children under 5 years of age is due to undernutrition further stating that 47 million children under 5 are wasted, 144 million children are stunted, 14.3 million are severely wasted and 38.3 million are overweight or obese. The contradicting fact is that along with higher prevalence of undernutrition, the rates of overnutrition are higher in low- and middle-income countries [1]. According to the Global Hunger Index 2020, India scores 27.2 which indicates that it's a serious issue, as it lies in the yellow zone **(Fig 1.3)**. India ranks 94 out of 107 countries (**Fig 1.4**) [2]. Global Hunger Index is a comprehensive tool, uses four composite indicators i.e., undernourishment, child stunting, child wasting and child mortality for measuring and tracking hunger globally, regionally and at national levels. In the index, out of 100 points, 0 is the best and 100 is the worst possible score [3]. "In avoiding endemic undernutrition and hunger, India has done worse than nearly every country in the world'' quoted by Amartya Sen in 2001(Gaiha et al., 2010). According to the recent reports of NFHS -5, trends witnessed suggested that the parameters of stunting, wasting and undernutrition either has scanty improvements and has exacerbated malnutrition amongst children. States like Telangana, Gujarat, Kerala, Bihar, Assam Maharashtra and West Bengal, populous states observed no improvement or rise in the levels of stunting, wasting and underweight (**Fig 1.5**) [4].

The trend is crystal clear with this rate it is impossible to meet the Global Nutrition Targets by 2025. In the year 2012, World Health Assembly endorsed *a Comprehensive implementation plan on maternal, infant and young child nutrition* (WHO,2014) specified a set of 6 global nutrition targets (WHA, 2012) by 2025 which aims to:

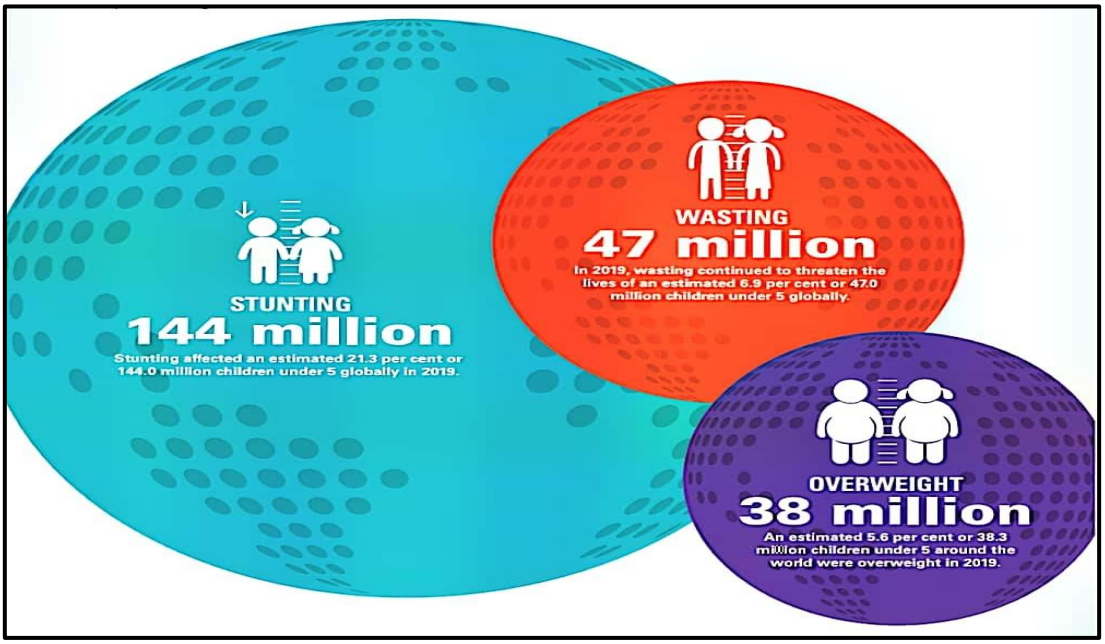
- Achieve a 40% reduction in the number of children under-5 who are stunted;
- Achieve a 50% reduction of anaemia in women of reproductive age;
- Achieve a 30% reduction in low birth weight;
- Ensure that there is no increase in childhood overweight;
- Increase the rate of exclusive breastfeeding in the first 6 months up to at least 50%;
- Reduce and maintain childhood wasting to less than 5% **(Fig 1.6).**

Fig 1.1 - Forms of Undernutrition in children



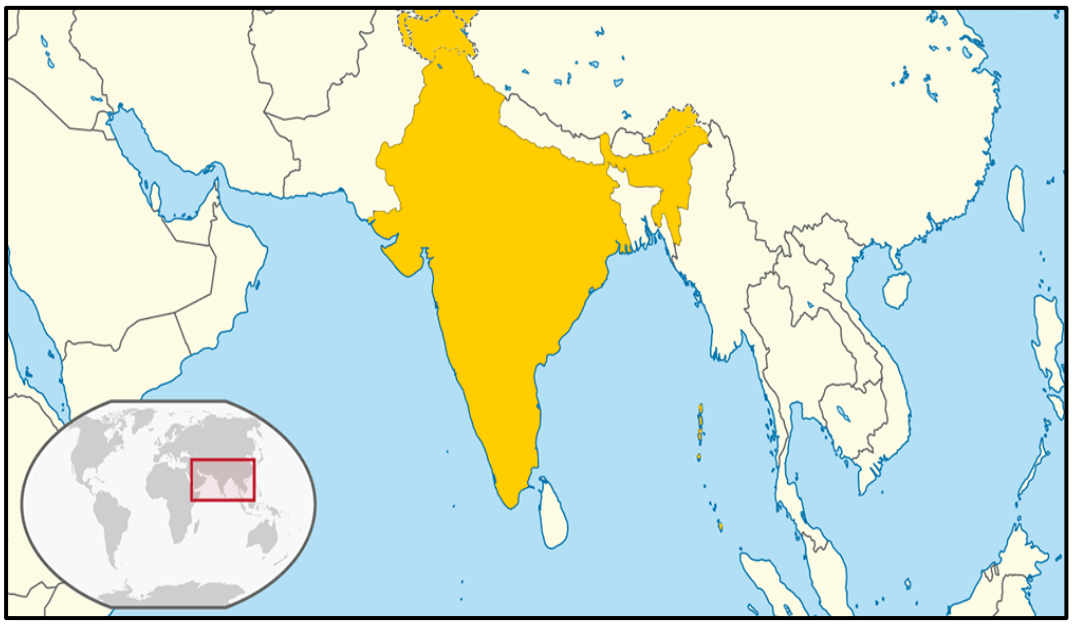
Source - UNICEF/WHO/World Bank Group – Joint Child Malnutrition Estimates 2020 edition

Fig 1.2 Child malnutrition - Levels and trends



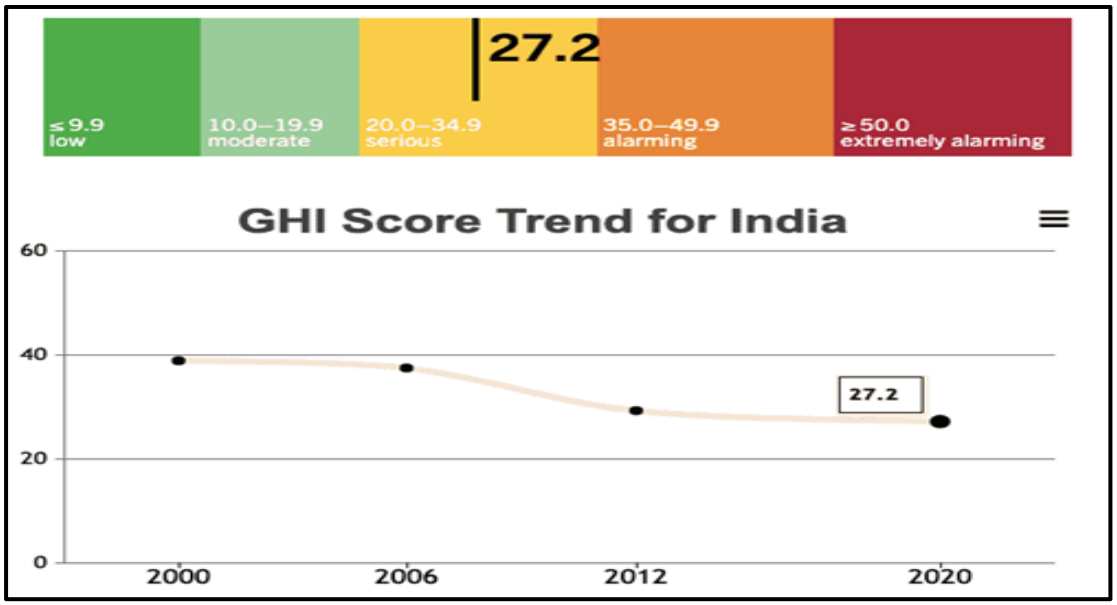
Source - https://www.unicef.org/media/69816/file/Joint-malnutrition-estimates-2020.pdf

Fig 1.3 - Global Hunger Index of India (Yellow Zone)



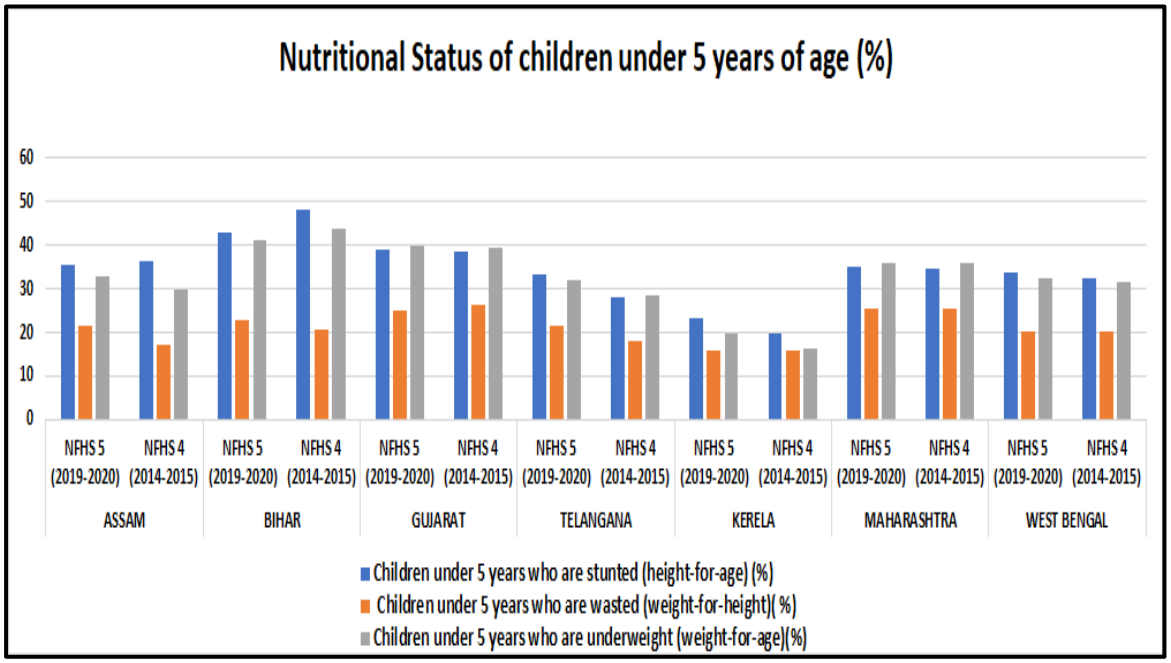
Source -https://www.globalhungerindex.org/images/countries/India.png

Fig 1.4 - India's score in Global Hunger Index



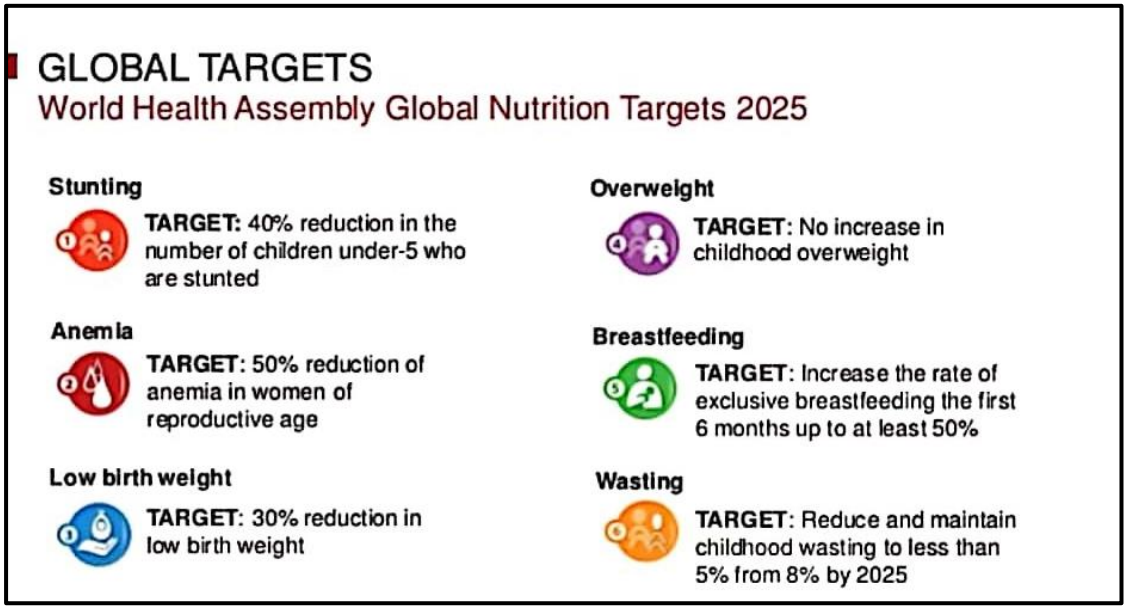
Source - B., & IASbhai, T. (2020, October 20). 2020 Global Hunger Index: UPSC.Retrieved January 22, 2021, from https://iasbhai.com/2020-global-hunger-index-upsc/

Fig 1.5 – Nutritional status of children under 5 years of age (NFHS 4 v/s 5)



Source - http://rchiips.org/nfhs/factsheet_NFHS-5.shtml

Fig 1.6- The Global Nutrition Targets



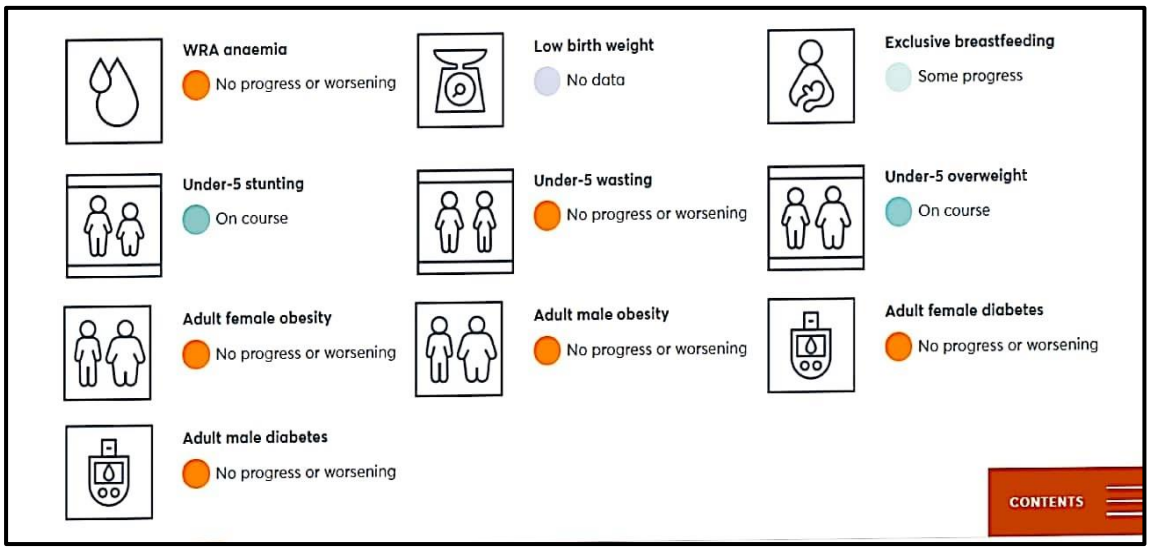
Source- https://pt.slideshare.net/Glo_PAN/shawn-baker-presentation-a/5

According to the Global Nutrition Report 2020, **fig 1.7** shows India is on course to meet two of the nutrition targets i.e., under five stunting and under five overweight. India is 'on course' to meet the target for stunting, but 34.7% of children under 5 years of age are still affected, which is higher than the average for the Asia region (21.8%). India has made no progress towards achieving the target for wasting, with 17.3% of children under 5 years of age affected, which is higher than the average for the Asia region (9.1%) and among the highest in the world. The prevalence of overweight children under 5 years of age is 1.6% and India is 'on course' to prevent the figure from increasing. No progress or worsening is observed in the rates of Anaemia in Women of reproductive age group. There is insufficient data to assess the progress made by India in achieving the Low- birth weight. Some progresses are noticed in the rates of exclusively breastfeeding [5].

Sustainable Development goals earlier known as Millennium Development goals were adopted by United Nations member states in 2015.The 2030 agenda for sustainable development goals informs about the 17 SDGs. Out of all the 17 targets, the SDG 2 **(Fig 1.8)** states that “End hunger, achieve food security, improve nutrition and promote sustainable agriculture” which should be achieved by 2030 [6]. It's time to ponder upon the facts and figures available which show slower progress along with that health and nutrition crises, the COVID -19 pandemic augment it.

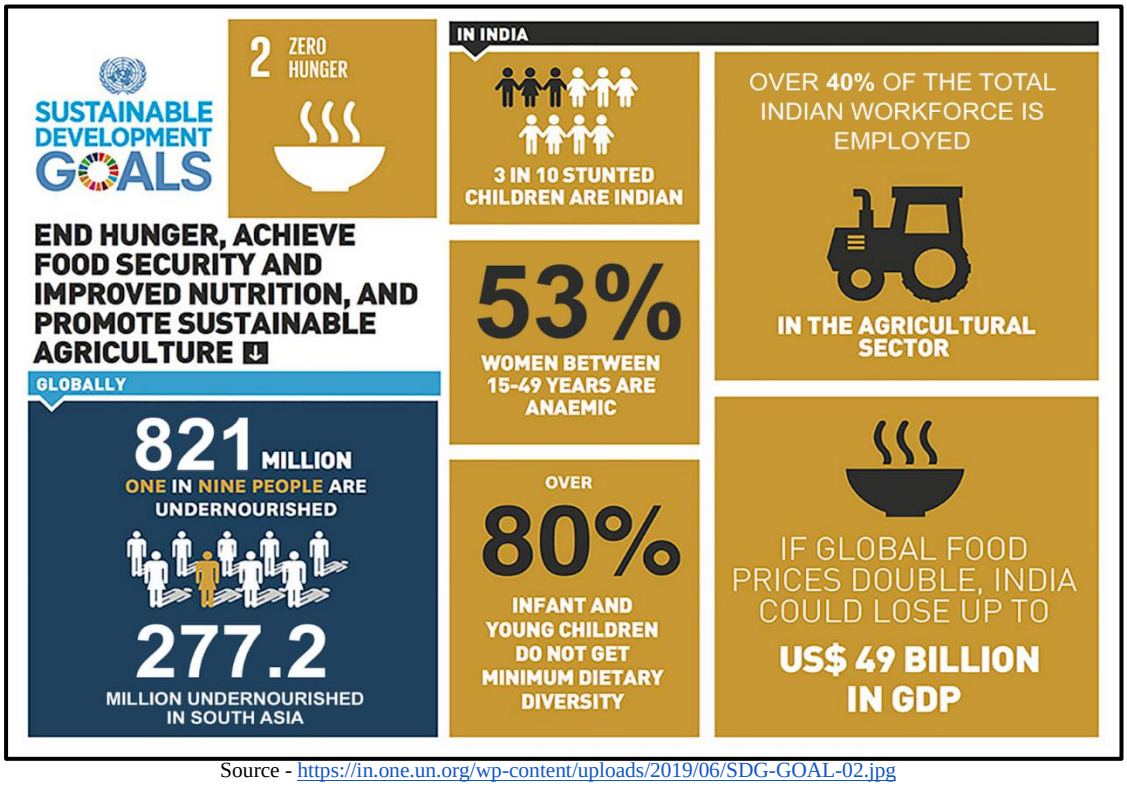
Good nutrition allows children to survive, grow, develop, learn, play, participate and contribute – while malnutrition robs children of their futures and leaves young lives hanging in the balance (Global Nutrition Report, 2019). Undernourished children are vulnerable and more susceptible to infections and diseases. Most of them are born in deprived conditions, they suffer emotionally, physically, mentally. Their cognitive abilities are hampered which leads to lower economic productivity and the intergenerational cycle of poverty repeats and continues. **Fig 1.9**, shows that Optimal health and nutrition are a basic right of every child. Evidence shows that only economic growth is not sufficient enough to reduce malnutrition in our society.

Fig 1.7 - Progress towards Global Nutrition targets in India



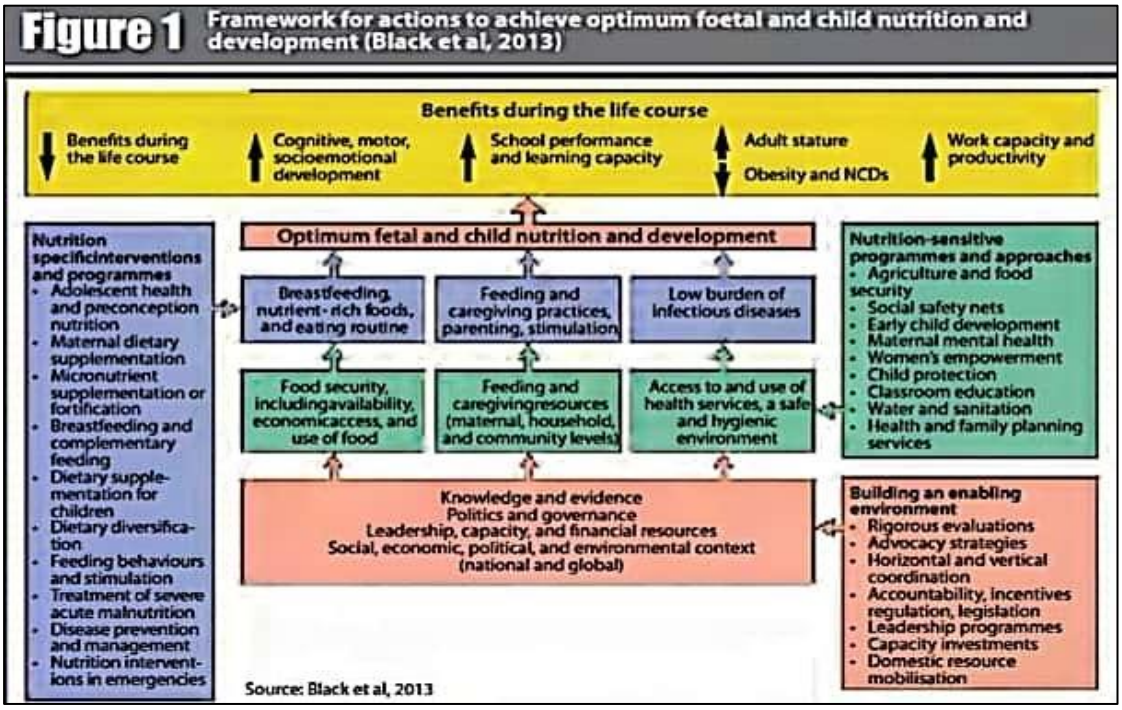
Source- WHO Global Health Observatory 2017; UNICEF/WHO low birthweight estimates, 2019; UNICEF global databases Infant and Young Child Feeding, 2020; UNICEF/WHO/World Bank Joint Child Malnutrition Estimates Expanded Database: Stunting, Wasting and Overweight (July 2020, New York); NCD Risk Factor Collaboration 2016-2017.https://globalnutritionreport.org/resources/nutrition-profiles/asia/southern-asia/india/

Fig 1.8 - Sustainable Development Goal 2 "End hunger, achieve food security, improve nutrition and promote sustainable agriculture"



Source - https://in.one.un.org/wp-content/uploads/2019/06/SDG-GOAL-02.jpg

Fig 1.9 - Framework for action to achieve optimum foetal and child nutrition development



Source- Black et al,2013

Along with socio- economic development, parents' education, health, BMI, care practices, women empowerment and their status in the household plays an important role (Corsi et al., 2016).

The Lancet series suggests that Nutrition specific interventions are not enough to combat the multifaceted burden of malnutrition. Nutrition specific interventions play an important role too (Marie & Harold, 2013). Nutrition specific interventions are those interventions whose primary objective is to focus on nutrition, targeting the immediate cause of undernutrition. For e.g. - Targeted supplementary feeding, blanket supplementary feeding and distribution of micronutrient powders etc. Whereas, Nutrition sensitive interventions are those whose primary objective is not nutrition, but the underlying causes of malnutrition which has the potential of improving the malnourished state of the beneficiary. Nutrition sensitive interventions when implemented at a larger scale are effective and prove to be beneficial to the poor population, who fall into the vicious cycle of malnutrition. These interventions can serve as a delivery platform for nutrition specific interventions. It is aforesaid that accelerating progress in nutrition requires increasing the nutritional impact of effective, large scale, nutrition-sensitive development programmes. For e.g. - Agriculture and Food security, Women empowerment, Social safety nets, child protection, water sanitation and hygiene (Marie & Harold, 2013; WFP, 2014).

Justification of the study

The determinants of child malnutrition differ from one study to the other due to differences in the country settings.

Thus, there is a strong need to observe and analyse the transition in the determinants of child health and nutrition over a period of two decades. An in-depth understanding of the transition in the determinants, if any, will help in understanding the prospective changes in future. In order to support the ongoing programmes for healthcare and nutrition, an understanding of the determinants will help in coming up with recommendations for reducing adverse outcomes.

Also, large secondary datasets are available for health policy research. Health policy research in a country like India requires large sample sizes, cutting across geographic, demographic, and other relevant population categories. Obtaining such data directly

from the field proves time-consuming and expensive for individual researchers (Iqbal, 2013). In comparison, available secondary data constitute a low-cost alternative for policy studies (Best, 1999).

OBJECTIVES

Broad Objective - To assess the determinants of child malnutrition amongst children under 5 years of age in India over a period of two decades by conducting secondary analysis of data obtained from National Family and Health Surveys

Specific objectives -

- To identify the common indicators of malnutrition amongst children under 5 years of age using data sets.
- To assess the determinants of child malnutrition in individual data sets.
- To evaluate the transition in the determinants of child malnutrition amongst children under 5 years of age and arrive at predictive factors.

REVIEW OF LITERATURE

REVIEW OF LITERATURE

Malnutrition is public health havoc which leads to almost 45% of deaths amongst children under 5 years of age especially in low- and middle-income countries (Black R E et al.,2013; Akombi et al, 2017). One of the main reasons for childhood mortality and morbidity is child undernutrition (Bryce et al. 2005). Malnutrition encompasses two different forms i.e., Undernutrition (Stunting, Wasting, Underweight and Micronutrient deficiencies) and Overnutrition (Overweight and obesity).

“Close to a billion people- one - eighth of the world’s population - still live-in hunger. Each year 2 million children die through malnutrition. This is happening at the time when doctors in Britain are warning of the spread of obesity. We are eating too much while others starve." _Jonathan Sacks_

The quote mentioned above lets us ponder upon the two paradoxical situations that arise in different parts of the globe. In a cross-country analysis by **Lisa. C. Smith and Lawrence Haddad** explained how malnutrition, particularly undernutrition, takes shape in developing countries, where one out of three children under five years of age are malnourished causing human sufferings in physical and emotional forms (Smith & Haddad, 2000) [7]. Malnutrition is not only a result of a single factor but is caused due to insufficient or poor diet; occurrence of diarrhoeal episodes and recurrent infections; poor sanitation facilities and parental education too (Tibilla, 2007; Birara & Amsalu, 2014). Malnourished children are prone to weaker or impaired immune diseases, poor cognition, lower economic productivity as a grown-up adult, more susceptible to non-communicable diseases such as Hypertension, Cardiovascular diseases in the near future (Smith & Haddad, 2000; Leroy et al., nd; Pelletier et al., 2006; Asad & Mushtaq, 2012; Ali et al, 2005). If a malnourished child is born in an economically weaker section of a society the consequences impose stress on the parents too as they have to pay extra attention and care for their children which hampers their source of income and leads to the intergenerational cycle of poverty. Nutritional challenges like undernutrition are violation of Child’s human rights (Smith & Haddad, 2000). Malnutrition proves to be not only a health concern but has adverse effects on productivity, economic growth and poverty reduction. It is estimated that by eradicating malnutrition, 32% of the global

burden of disease would be eradicated (WHO, 2020). Eradicating malnutrition is a constant challenge for humanity.

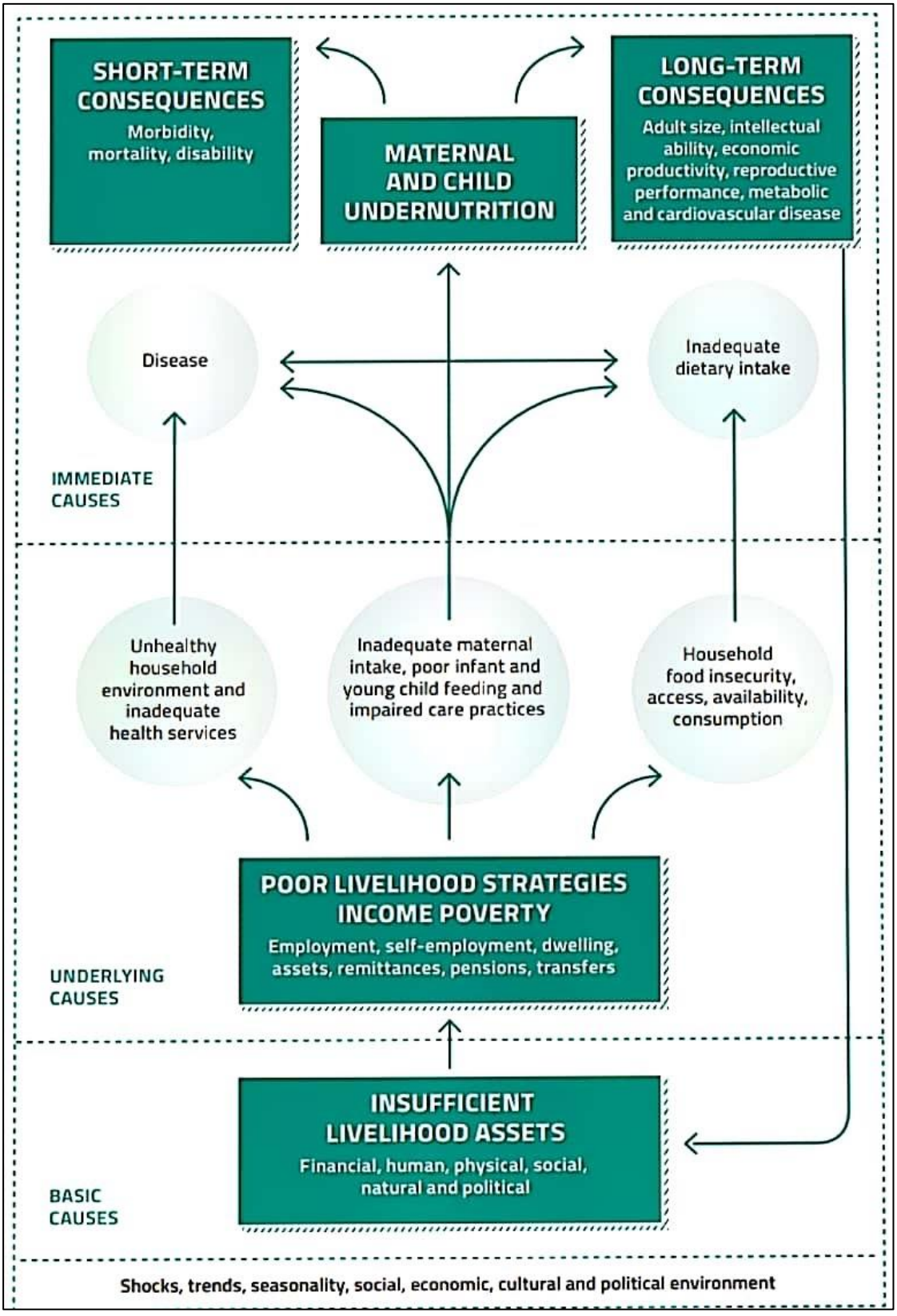
Vulnerable groups

Malnutrition targets almost everyone but proves to be fatal to poverty-stricken people, living in deprived conditions, refugees, and physiologically weaker sections of the society i.e., children under 5 years of age, adolescents, pregnant and lactating mothers, disabled and elderly lie in the vulnerable groups (Dukhi, 2020). Pregnant and lactating mothers, infants and preschool children are vulnerable, these individuals require more food due to physiological stress and it's the period of rapid growth spurt respectively. Malnutrition in these groups is a cause of great concern. Geriatric population are considered vulnerable due to senescence their eating habits and intake gets reduced and altered metabolism. Poor nutrition during these stages of life has significant impact on growth and developments and also has adverse lifelong impacts on health, increased occurrence of Non – communicable diseases, healthcare costs, disease burden, and human productivity (Devine & Lawlis, 2019).

Causes of malnutrition

Causes of malnutrition are numerous and multifaceted. According to a framework developed by the Sphere project **(Fig 2.1)**, it explains the causes of malnutrition [8]. Inadequate diet and frequent occurrence of diseases are the immediate causes of malnutrition. The underlying causes are attributed to household food insecurity, poor feeding and care practices, unhealthy household environment and inadequate healthcare. Food assistance alone is not sufficient enough to combat malnutrition. Food and Nutrition programmes along with WASH, shelter and settlement and healthcare programmes should run in a coordinated approach to address the causes of malnutrition. For e.g. - Adequate quantity and quality of water is required to prepare a nutritious meal, for safe feeding practices and will even reduce the risk of disease. Having access to shelter will provide a cooking space and protect them from extreme weather conditions. They are likely to have greater nutritional status if people have access to adequate health care. In turn, this boosts their ability to livelihood opportunities.

Fig 2.1- Causes of malnutrition



Source- The Sphere Handbook: Humanitarian Charter and Minimum standard (2011)

Intergenerational Cycle of Malnutrition

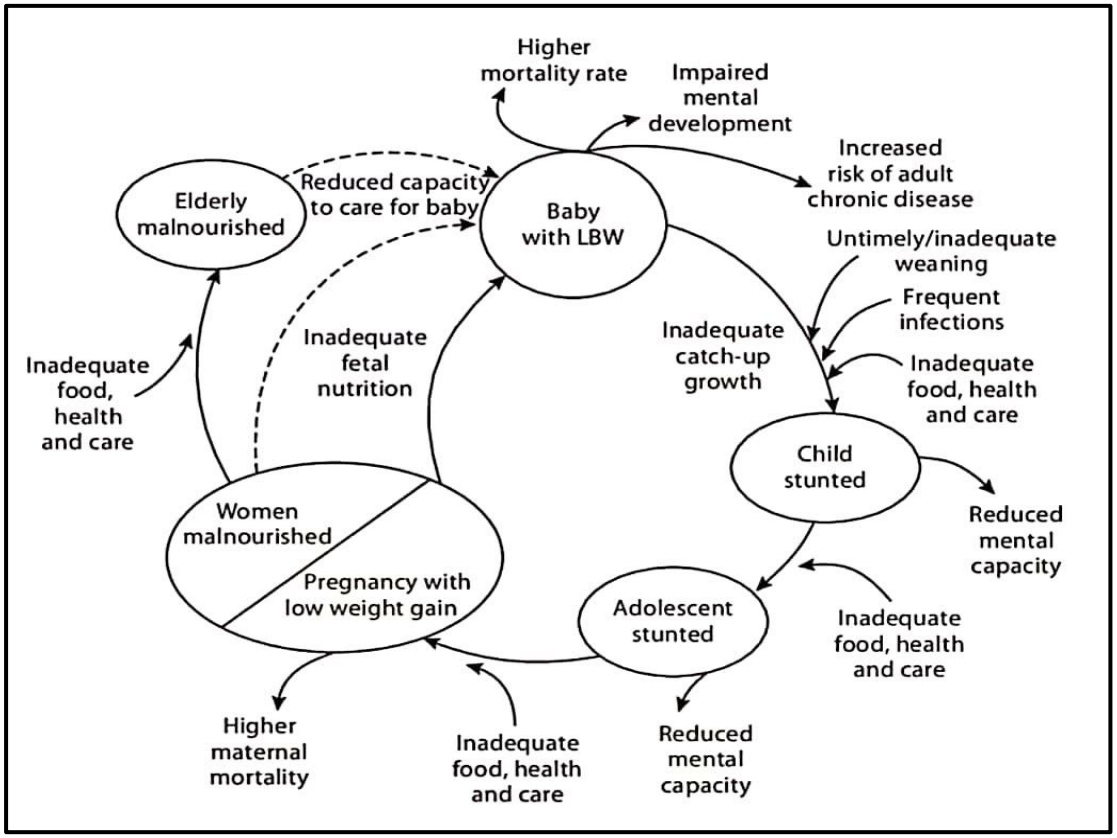
Recognising and tackling the intergenerational cycle of malnutrition is critical to address childhood malnutrition Recognizing the intergenerational cycle of hunger is critical to addressing child malnutrition. Individuals who are malnourished are trapped in a vicious cycle that begins at infancy (low birth weight, anaemia); persists into childhood (children that are stunted, wasting, or underweight); adolescent and thereby malnourished reproductive age women who on the other hand gives birth to a malnourished child. Fig 2.2 shows how the cycle repeats (UNICEF, 2018).

Prevalence of child malnutrition

Global Scenario

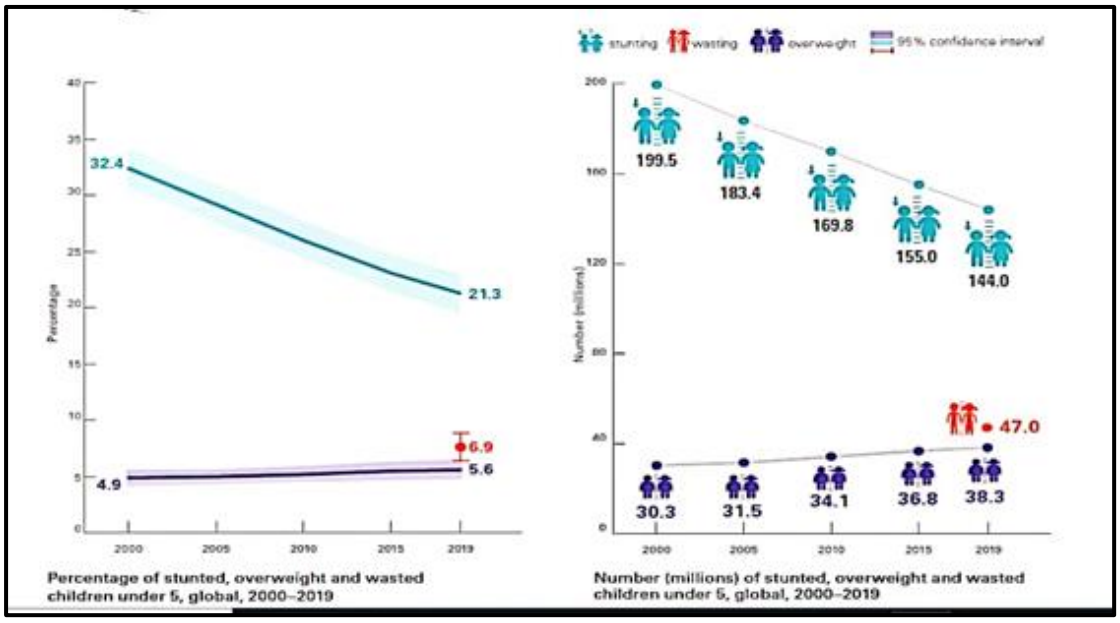
Hunger and malnutrition are prevalent far and wide across the globe. **Fig 2.3**, looking at the global scenario, one in three children under five suffer from anthropometric failure. Stunting (Low height for age) affected 144 million children under five years of age i.e., 21.3 % in 2019. Number of children under five affected from wasting (Low weight for height) was 47 million i.e., 6.9% in 2019. The prevalence of overnutrition is on rise too, 38 million children under five suffer from being overweight. In the past few decades overweight and obesity has increased with transition in lifestyle and aping the western world (Levels and Trends in Child Mortality, WHO, 2019) **(Fig 2.4 and 2.5)**.

Fig 2.2 - Intergenerational cycle of malnutrition



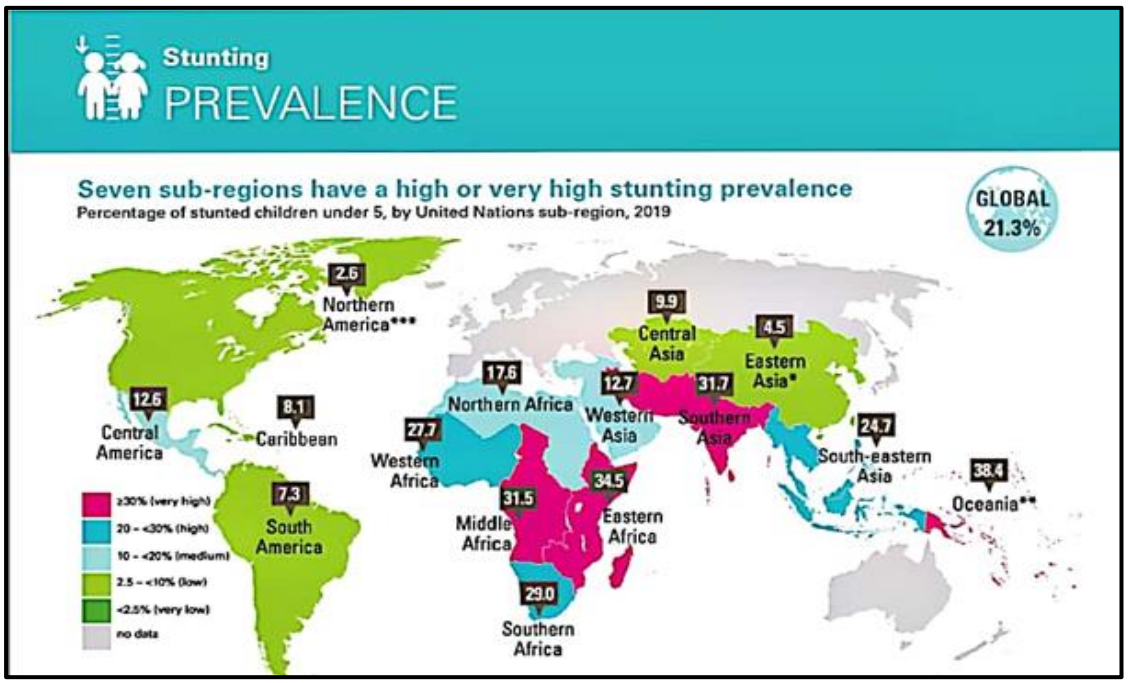
Source -https://www.researchgate.net/figure/Nutrition-through-the-life-cycle-showing-the-effects-of-LBW-including-increased-risk-of_fig1_235680436

Fig 2.3 – Global overview of Prevalence of Undernutrition



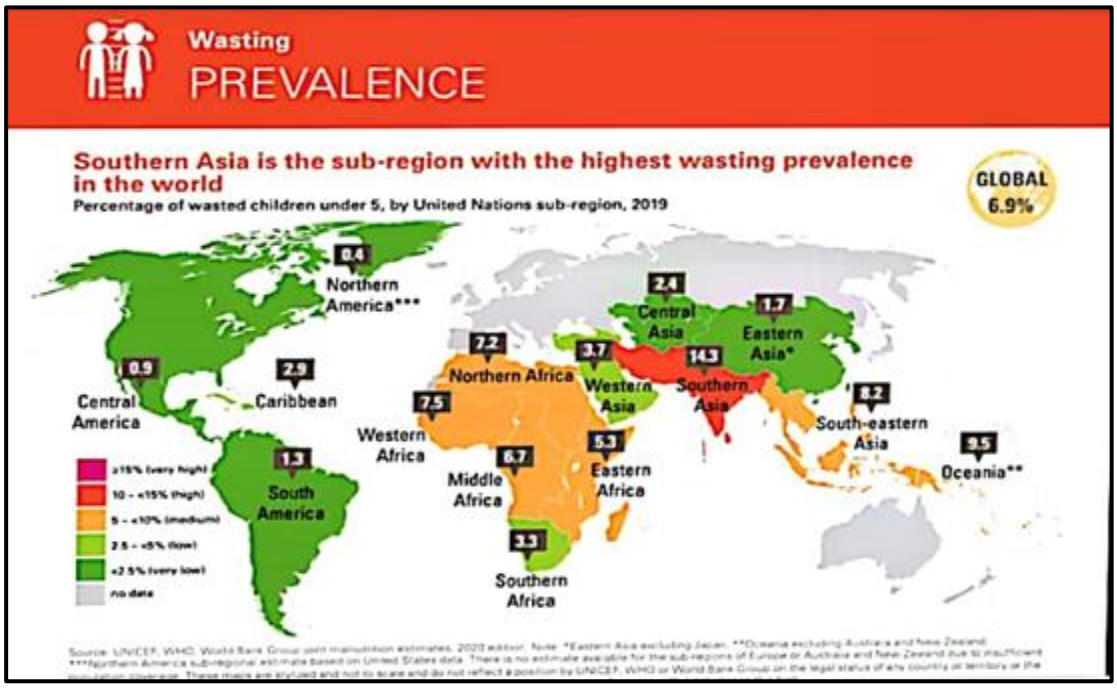
Source - https://www.unicef.org/media/69816/file/Joint-malnutrition-estimates-2020.pdf

Fig 2.4- Prevalence of Stunting (Regional Distribution)



Source - https://www.unicef.org/media/69816/file/Joint-malnutrition-estimates-2020.pdf

Fig 2.5- Prevalence of wasting (Regional Distribution)



Source - https://www.unicef.org/media/69816/file/Joint-malnutrition-estimates-2020.pdf

Papua New Guinea (PNG), a country in Oceania, faces a health transition. Non-communicable diseases were on rise in the country. The triple burden of malnutrition affected the children under 5 Years of age. Data was obtained from Comprehensive Health and Epidemiological Health Surveillance System (CHESS) in PNG. The 2006 WHO Standard Growth Standards were used to determine wasting, stunting, overweight, and underweight statistics, as well as wasting, stunting, overweight, and underweight data. The prevalence of wasting was 13.8% out of which 8% were severely stunted and the remaining 5.8% were moderately stunted. The prevalence of wasting was higher in urban areas as compared to the rural areas. Wasting, stunting, underweight, and overweight children were found to be prevalent in 13.8, 46.5, 18.2, and 18 %, respectively (Pham et al., 2021).

A cross sectional survey was conducted amongst 175 children under 2 years of age and 121 adults in western Kenya. The caregivers of the respective child were interviewed. During home visits, primary caregivers were interviewed to assess agriculture and sanitation resources, child feeding practises, and nutritional status of their children aged 5 and below. The prevalence of stunting was 23%. 10% children out of 1004 children were underweight and 6 % were wasted out of 1004 children in Kitui and Machakos countries of Eastern Kenya (Bloss E., 2004).

The prevalence of stunting is higher in developing countries which affects the children under 5 years of age. Because of inadequate food intake, a lack of sufficient care, and recurring illnesses, children in developing nations are particularly vulnerable to stunted physical growth. From October 15 to December 15, 2015, a community-based cross-sectional study was undertaken in Libo-Kemkem. To select 1,320 children aged 6-59 months, a multistage sampling procedure was used. Data was collected by community health extension workers who were supervised on a regular basis. The study reveals the prevalence of stunting i.e., 49.4% (Berhanu et al., 2018).

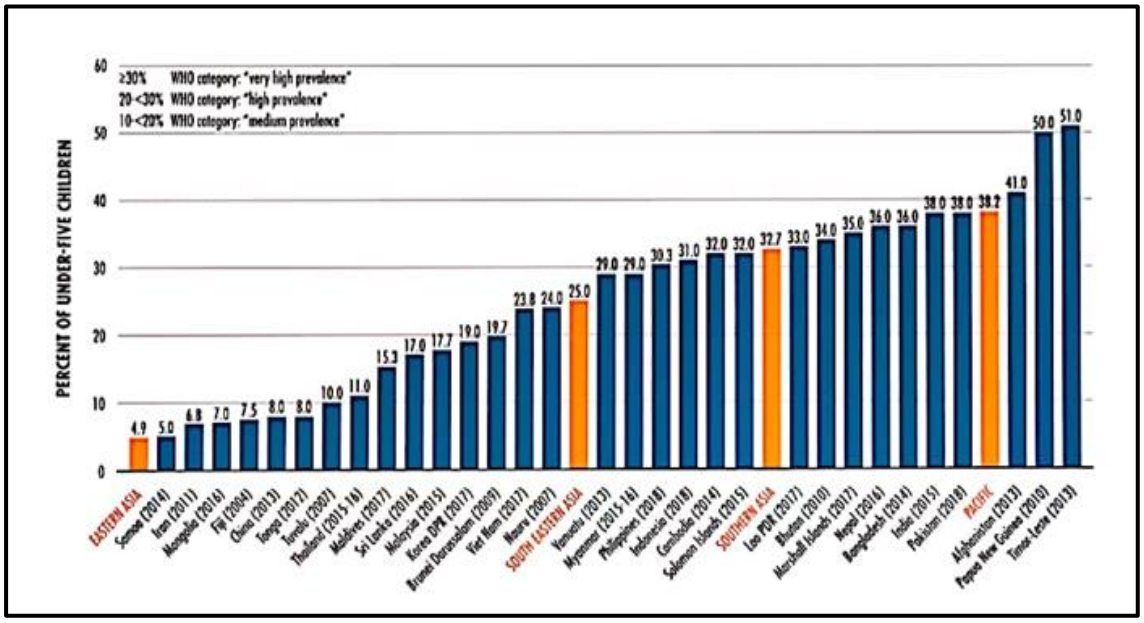
According to a UNICEF Egypt report named Child Malnutrition: Unfolding the situation in Egypt, reveals the alarming rate of prevalence of childhood malnutrition which affects the economy of the nation. Stunting is still a major public health issue in Egypt, impacting one out of every five children. According to Egypt Demographic health survey Child wasting has increased from 3 % in 2000 to 8 % in the year 2014. Underweight stands at 6%. The incidence of Anaemia is as high as 27% (UNICEF,2018).

Regional Prevalence of Undernutrition

Asia and the Pacific Regional overview of Food security and Nutrition report of 2019, assessed the progress of SDG 2 eliminating hunger and malnutrition by 2030. In the Asia and Pacific region, the number of stunted children under 5 years of age was 77.2 million in 2018. The largest number of stunted children were in South Asia i.e., 58 million **(Fig 2.6)**. The level of stunting has declined in Eastern Asia, South- East Asia and Southern Asia. The prevalence declined by 35% in Southern Asia **(Fig 2.7)**. In Pacific the stunting levels have increased instead of decreasing. The progress is slow and it seems impossible to achieve the World Health Assembly's target of 40% reduction by 2025 in the number of children who are stunted under 5 years of age. Countries such as India, Indonesia, Myanmar, Nepal and Vietnam have reduced the level of stunting but the improvements are not sufficient enough to meet the targets. On the other hand, countries such as Bangladesh, China, Mongolia and Thailand are on track to achieve the target (Food and Agriculture Organization of the United Nations, 2019).

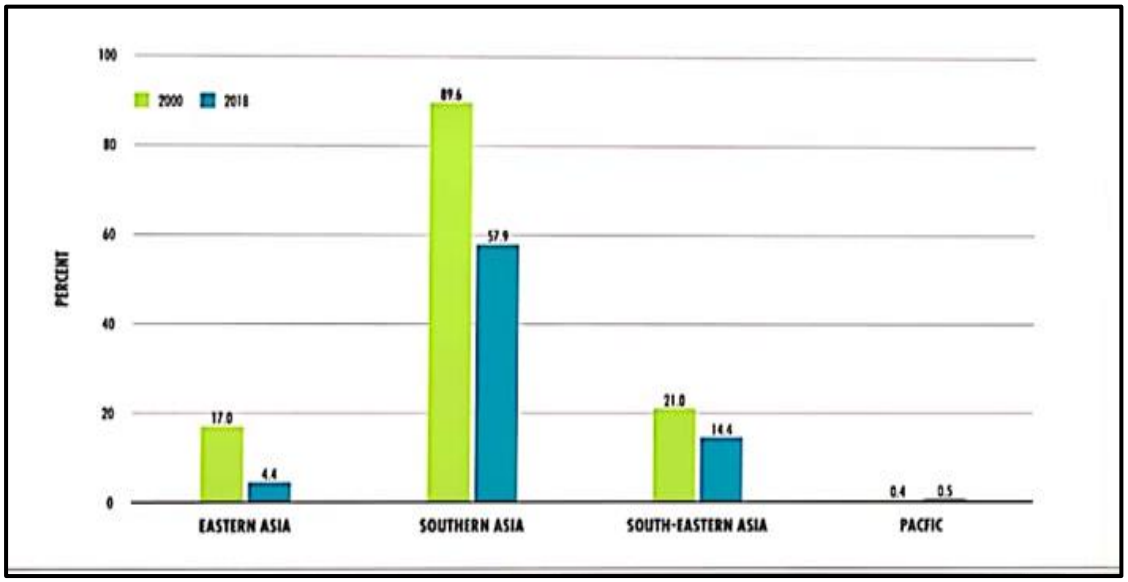
The prevalence of wasting was highest in Asia and the Pacific region with nearly one out of 10 children at the risk of dying due to wasting **(Fig 2.8)**. The largest burden of wasting was in South Asia, which is home to more than half of the world's stunted children under 5 years of age. The prevalence of wasting was 14.6% in South Asia, 8.7 % in South- Eastern Asia, 9.7 % in pacific and 1.7% in Eastern Asia. At this pace it seems impossible to reduce stunting to less than 3%, the WHA target set for 2025 (Food and Agriculture Organization of the United Nations, 2019).

Fig 2.6 – Prevalence of Stunting in Children Under-Five Years of Age in Asia and The Pacific, By Country, Latest Available by Year



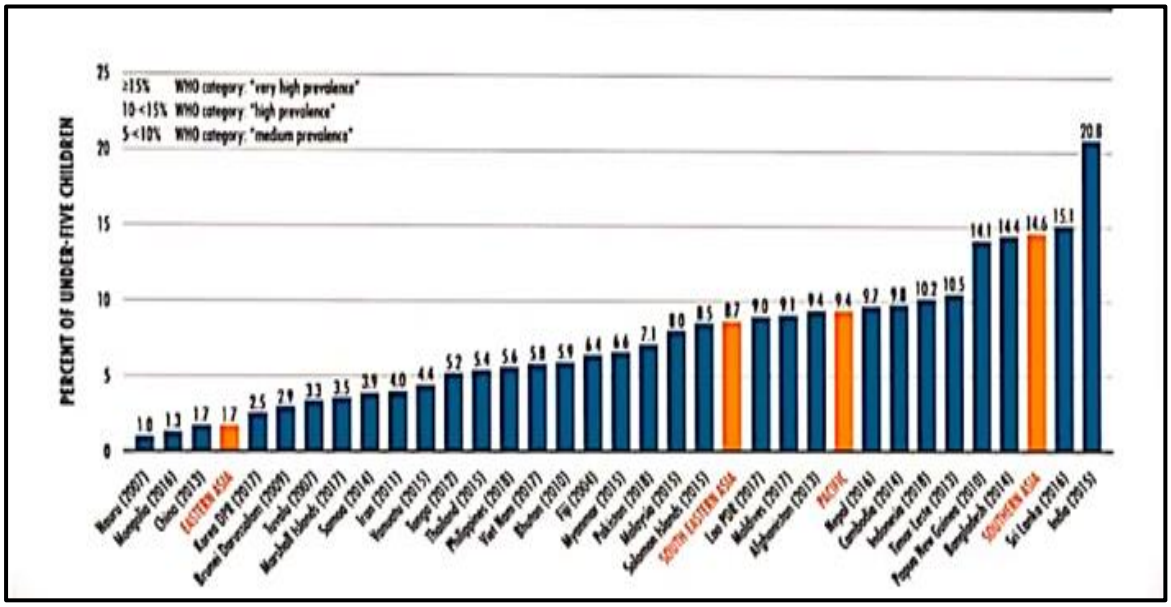
Source - Asia and the Pacific Regional overview of Food security and Nutrition report, 2019

Fig 2.7 – Decrease in Number of Stunted Children Under 5 Years of Age in Asia and The Pacific, By Subregion, 200-2018



Source - Asia and the Pacific Regional overview of Food security and Nutrition report, 2019

Fig 2.8 – Percentage of Children Under-Five Years of Age Suffering from Wasting in Asia and The Pacific, By Country, Latest Available Year



Source - Asia and the Pacific Regional overview of Food security and Nutrition report, 2019

National Prevalence of Malnutrition

India is a home to thousands of homeless and poverty-stricken people. The children living in slums do not get the optimal opportunities and necessary love, care and attention to grow and develop as an individual. A study from urban slums of Mumbai included 323 mother and child pairs obtaining anthropometric data, demographics and complete blood counts for haemoglobin concentration from them. The prevalence of stunting was 31.2%, underweight 25.1%, wasting 9% and anaemia 76% amongst children of 10- 18 months old. Male children as compared to the female counterparts had higher prevalence of poor growth (Huey et al., 2019).

Despite the economic growth the rates of undernutrition have shown no improvement in India. In a cross-sectional study, where 16 clusters were selected randomly from 2 districts of Maharashtra state, data was obtained from 2929 mothers and their 3671 children under 5 years of age. The prevalence of Stunting, wasting and underweight were 49.5%,17.1% and 35.4% respectively (Muarkar et al., 2020).

Tribes in India constitute a major part of the population. One such tribe is the Santhal Adivasi tribe of West Bengal. The tribal population are one of the vulnerable groups. The study was conducted on 21 Santhal villages, and Birbhum district of West Bengal. The results showed the prevalence of Stunting (51.9%), wasting (49.2%), underweight (19%) and anaemia (73.3%). It even revealed how the Adivasi children lagged behind (Stiller et al., 2020).

National Family Health Surveys

National Family and Health Surveys are the surveys which are carried out in the entire India which consists of detailed information on the Health and Nutrition of the population. It is one of the most extensive, multi-round and large-scale surveys covering all the states of India and the Union territories. Since the initial survey in 1992-93, three rounds of the survey have been undertaken in the years 1998-1999, 2005-2006, 2015-2016, 2019-2020 respectively. The study collects data on fertility, infant and child mortality, family planning use, maternal and child health, reproductive health, nutrition, anaemia, and the use and quality of health and family planning services in India. The Government of India's Ministry of Health and Family Welfare (MOHFW)

has selected the International Institute for Population Sciences (IIPS) Mumbai as the nodal agency for the survey's coordination and technical advice [9].

On Universal Health Coverage Day, December 12, 2020, Dr. Harsh Vardhan, India's Union Minister of Health and Family Welfare, released Factsheets of key indicators on population, reproductive and child health, family welfare, nutrition, and other topics for 22 States/UTs from the first phase of the 2019-20 National Family Health Survey - 5. The Phase I which encompasses 22 states the factsheets are available in the website www.mohfw.gov.in, http://rchiips.org/nfhs/factsheet_NFHS-5.shtml, containing 131 indicators. The remaining 14 states are included in phase II of the survey which is not completed yet due to the Novel Coronavirus pandemic. The NFHS-5 is being carried out in about 6.1 lakh sample households in order to provide disaggregated data up to district levels. And, once done, the data generated would be comparable to NFHS-4 without any information loss [10].

These key indicators on population, health and family welfare, nutrition, and other topics will aid in tracking the country's progress toward the Sustainable Development Goals (SDGs).However, NFHS-5, which includes new focal areas such as expanded domains of child immunisation, micronutrient components for children, menstrual hygiene, frequency of alcohol and tobacco use, additional noncommunicable disease (NCD) components, and expanded age ranges for measuring hypertension and diabetes among all, aged 15 years and above, will provide necessary input for strengthening existing systems and evolving new systems for policy interventions. Many of the indicators in NFHS-5 are comparable to those in NFHS-4, which was conducted in 2015-16 to provide for over time comparisons [11].

Many researchers have shown that poor nutrition during the first 1000 days of life leads to stunting, reduced mental and cognitive development, poor school and work performance (Pelletier et al.,2006; Asad & Mustaq,2012; Ali et al, 2005). “Policy makers must lay more emphasis on the first 1000 days of life”-Dr Harsh Vardhan, Union Minister of Health and Family Welfare recently released the key findings of reproductive child health, child and maternal nutrition, and the population over 22 states and Union territories as the first phase of NFHS 5 (2019- 2020). The major states such as Telangana, Gujarat, Maharashtra, West Bengal, Kerala and Assam show increasing levels of stunting as shown in **fig 2.9**. Stunting refers to chronic malnutrition which has

a significant effect on the child's health, physical, reproductive and cognitive development [12].

Fig 2.10 reveals the nutritional status of children under 5 years of age. NFHS 4 was carried out in the time period 2014-2015 and NFHS 3 was carried out in 2005 – 2006. There was no significant improvement in the anthropometric measurements. Stunting levels had reduced from 48 % to 38.4 % in NFHS 4. The percentage of wasted children had risen to 21% in 2014-2015. Prevalence of underweight amongst children had declined to 35.8 % from 42.5% in 2005-2006. Similarly, prevalence rates in different states mentioned as shown in **fig 2.11** showed no significant improvement. At this rate, the WHA targets might not be fulfilled by 2025 [11].

Determinants of child Malnutrition

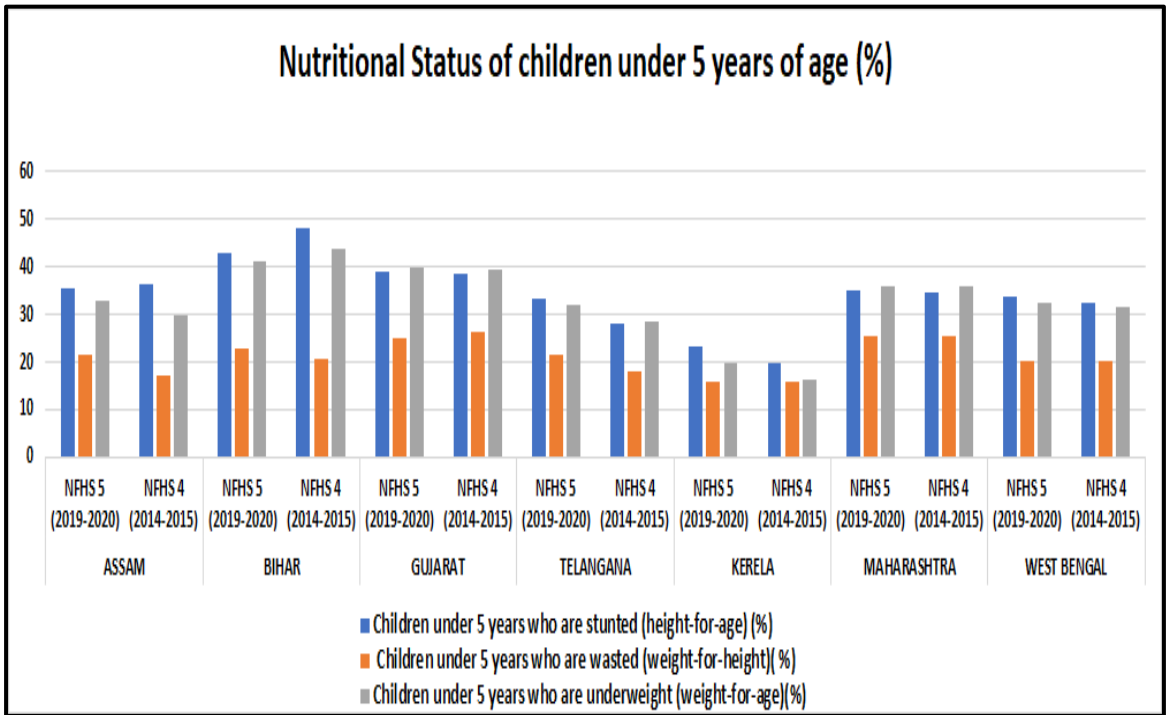
Global

Explaining child malnutrition in developing countries: A cross-country analysis report finds women's education and status relative to men to be strongly associated with child malnutrition in developing countries. Improvements in female secondary school enrolment rates are estimated to be responsible for 43% of the total 15.55% reduction in child underweight rate in developing countries during the period 1970-1995 (Smith & Haddad,2000) [32]. Most studies addressing the causal link between income growth and malnutrition have focused on the response of nutrient consumption to changes in income (Strauss & Thomas,1955).

Another study on prevalence of undernutrition and its determinants in Fars Province of Iran included 15408 children between 0-6 years of age from 30 cities of the province. Rates of stunting, underweight, and wasting were 9.53%, 9.66% and 8.19% respectively. The predictors mentioned in the study were low maternal education, low family income and non -access to health services. Two other significant predictors of underweight were found to be unsafe water supply and large family size since children in households with2 more than 4 members were 1.35 times more likely to be underweight relative to 1–4 members (Kavosi et al., 2014).

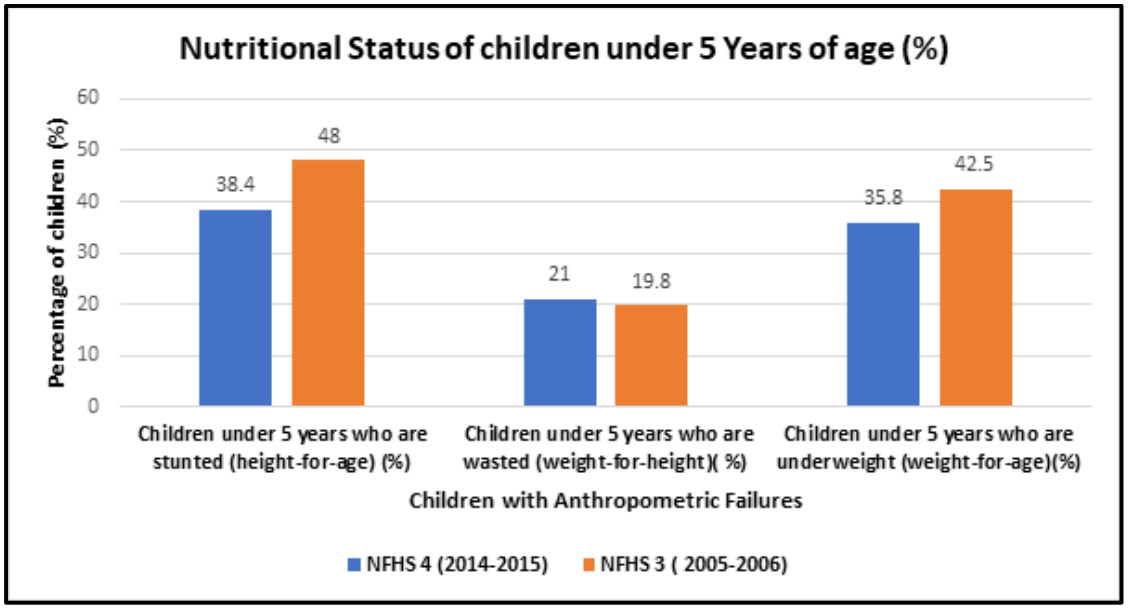
Childhood Malnutrition and its determinants among under-five children in Ghana showed that longer breast-feeding duration, multiple births, experience of diarrhoeal episodes, small size at birth, absence of toilet facilities in households, poor

Fig 2.9 - NFHS 5 - Nutritional status of Children under 5



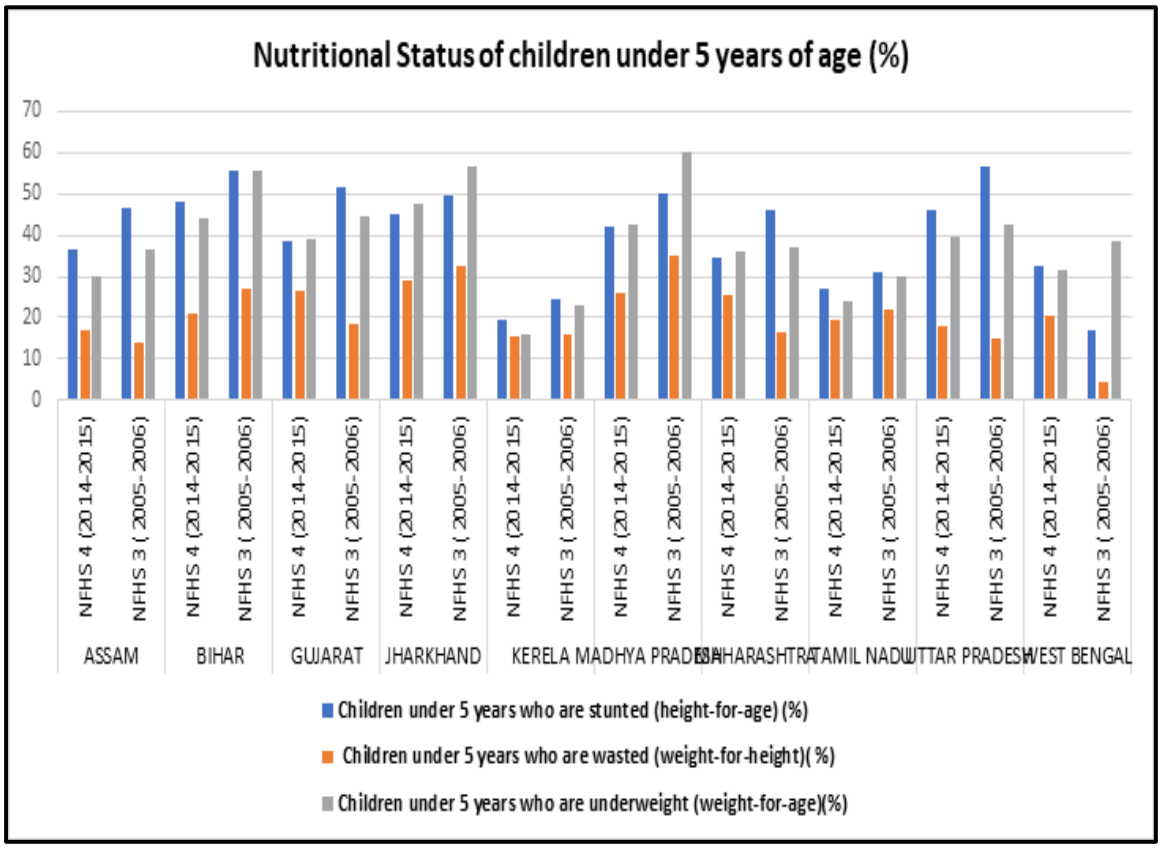
Source - http://rchiips.org/nfhs/factsheet_NFHS-5.shtml

Fig 2.10 – Nutritional Status of children under 5 years of age in India, comparing NFHS 3 and 4.



Source -http://rchiips.org/nfhs/factsheet_NFHS-4.shtml

Fig 2.11 - Nutritional status of children under 5 years of age in different states of India, comparison between NFHS 3 and NFHS 4.



Source -http://rchiips.org/nfhs/factsheet_NFHS-4.shtml

households, and mothers that are not covered by national health insurance were associated with increased risk of malnutrition. Mother's years of education and body mass index, if increased somehow, were associated with decrease in malnutrition. The study concluded that policies and intervention strategies aimed at improving childhood nutrition and health should address the risk factors identified and the need to search for additional risk factors that might account for the unexplained household-level variations (Aheto et al., 2015).

In poor nations, child malnutrition remains the most serious public health issue. Malnutrition is a primary cause of sickness and mortality in Ethiopian children. To quantify the prevalence of malnutrition, the composite index of anthropometric failure (CIAF) was recently introduced. When compared to earlier conventional indices, this index provides a fuller view. In this study, CIAF was used to estimate the prevalence of malnutrition in children aged 0–59 months in rural Ethiopia in this study. The analysis covered a total of 3095 children. The nutritional status of the children was assessed using the composite indicator of anthropometric failure (CIAF). STATA 13 was used to build a logistic regression model to find characteristics linked with malnutrition among children in rural Ethiopia. Malnutrition affected 48.5 percent of Ethiopian children in rural areas. The nutritional condition of children in rural areas was independently connected with child age, previous birth interval, mother's educational status, wealth index, and location (Endris et al., 2017).

Malnutrition is one of Ethiopia's most critical public health issues. The goal of this study was to determine the prevalence of malnutrition and associated factors among children under the age of five in pastoral villages in Northeast Ethiopia's Afar Regional State. From March 1 to March 25, 2017, 840 children aged 6 to 59 months participated in a community-based cross-sectional research. The research participants were chosen using a multistage cluster sampling procedure. The variables associated with malnutrition were identified using bivariate and multivariable logistic regression analysis. The prevalence of wasting, stunting, and underweight was 16.2% (95% CI: 13.8–18.8%), 43.1% (95% CI: 39.8–46.5%), and 24.8% (95% CI: 21.9–27.8%), respectively. Families with five or more members, prolateral feeding, and diarrhoea in the previous two weeks were all linked to wasting. Increased stunting was associated with a male child, increasing age, and a child who was not completely immunised.

Underweight was caused by maternal illiteracy, a male child, prelacteal feeding, and a child who was not completely immunised. Promoting family planning, reducing diarrhoeal infections, and immunising children with nutrition education programmes are all important strategies to enhance children's nutritional status (Gebre et al., 2019).

Study conducted on the Rwandan population to determine the determinants responsible for stunting, wasting and underweight using a joint multivariate generalized linear mixed model (F. Habyarimana, T. Zewotir, and S. Ramroop, 2016). Data was obtained from Rwanda Demographic health surveys, female of age group 15 -49 years and 4,356 children under 5 years of age were chosen. The study used variables such as height & weight, age in months, birth weights, occurrence of anaemia, gender, multiple births, birth order, mothers BMI, wealth quintiles, residence, type of toilet facilities, illness such as diarrhoea and fever, nutritional knowledge and education of parents were considered explanatory variables to determine malnutrition. It discussed that the joined model proved to be commanding in the three forms of malnutrition. It was used simultaneously to find the correlation between them. It showed that reduction in stunting has a positive correlation with reduction in underweight. Undernourished mothers are more likely to give birth to an undernourished child suggesting mothers' nutrition status affected the child. Parents' education, particularly mother's education, was important to make informed choices related to the nutritious food that is to be fed to the child. The study concluded that the variables mentioned above were the key determinants of the increasing incidence of malnutrition amongst the under 5 population (Habyarimana, 2016).

A study on determinants of wasting amongst children under 5 in Ghana showed that there was a significant difference between the prevalence of wasting among these children according to the age of the child, region and wealth status. The odds of wasting were lower among children aged 24–35 months according to households of the middle wealth quintile. The paper concluded with a suggestion to strengthen the socio-economic status of mothers to enable them to provide adequate nutrition and improve access to health insurance for their children in order to reduce the incidence of wasting among these children. Introduction of programmes and policies which aim to ensure the survival of children during the first 24 months of life should be strengthened to reduce the risk of wasting amongst children under 5 years (Darteh et al., 2017).

Zakari Ali and the other co-authors in 2017 conducted a study on a sample of 425 mother and child pairs from 25 clusters in Northern Ghana. It studied the effect of maternal and child risk factors on childhood malnutrition (stunting, wasting and underweight). Bivariate and multivariate analysis was done on the Socio- demographic, child feeding practices and anthropometric measurements, which were obtained through semi-structured interviews. According to the results, the prevalence of stunting was 28.2%, wasting was 9.9% and underweight was 19.3%. It showed that male children and mothers less than 150 cm were more prone to stunting. Higher odds of wasting were seen on male children who consumed less than 4 food groups and underweight mothers. The low-birth-weight male children were associated with underweight (Ali, 2017).

Six thousand three hundred and thirty-seven children under 5 years of age and their mothers participated in a cross-sectional population- based study in Burkina Faso, West Africa in 2017. It was a secondary data analysis study from Burkina-Faso Demographic Health Surveys 2010. SAS procedures were used to analyse the risk factors. Findings suggested that improving the wealth index, educating the mothers, and nutritional education of the mothers should be considered important when programmes and policies are implemented (Poda et al., 2017).

Determinants of malnutrition among children under age 5 in Ethiopia found that child, maternal, and household characteristics were significantly associated with stunting and wasting among children under age 5. The study proposed that a multi-sectoral and multidimensional approach is important to address malnutrition in Ethiopia. The education sector should promote reduction of cultural and gender barriers that contribute to childhood malnutrition. The health sector should encourage positive behaviours toward childcare and infant feeding practices (Amare et al, 2019).

According to Nik Spencer in 2018, it was the social inequities in the population which led to child mortality and morbidity. Internationally, social determinants were liable for most childhood diseases and death. Social determinants were significantly affected by social and political choices which were outside the ability to control guardians and individual paediatricians. This concise review summed up the effect of social determinants on children's health and wellbeing in the UK and considered the paediatrician's role in decreasing the health disparities created by these determinants.

The United Kingdom being one of the wealthiest countries relatively had higher rates of child poverty (refers to deprived states of child's living conditions) and health inequalities as compared to other wealthy nations (Spencer, N. 2018).

A study conducted in Blue Hora district of South Ethiopia on prevalence of undernutrition and the risk factors associated with it amongst six- to fifty-nine-month-old children. To find factors associated with children's nutritional status, bivariate and multivariate logistic regression analyses were performed. If the p-value was less than 0.05, the statistical association was considered significant. Anthropometric measures as well as determining factors were gathered. Being underweight was substantially linked with the presence of diarrhoea in the previous two weeks, male sex, illiterate fathers, and having more four children born to a mother. Stunting was substantially related with the presence of diarrhoea in the previous two weeks, male sex, and pre–lacteal feeding. Similarly, the prevalence of diarrhoea in the previous two weeks, the age at which complementary feeding began, and not utilising family planning methods were all linked to wasting. Thus, nutritional intervention programmes in Ethiopia's Bule Hora area should concentrate on these aspects (Asfaw et al., 2015).

Parent interviews done by skilled data collectors were used to analyse household and maternal factors. To report relationships between selected socioeconomic variables and child malnutrition outcomes, multivariate logistic regression analyses were done. The hypothesis was that malnutrition outcomes in children under the age of five were linked to household socioeconomic status and maternal socioeconomic demographic factors. Children in urban regions were more likely to be wasted than those in rural locations. Children from households where there had been a food scarcity in the previous 12 months were more likely to be wasted than those from families where there had not been a food crisis. The gender of the child played a significant role in child wasting, with male children being less likely to be wasting than their female counterparts. Children in the poorest quintile of household wealth were more likely to be stunted than those in the richest quintile. Children whose mothers were currently married or had partners were less likely to be stunted than those whose mothers were not married or had no partners (Pham et al., 2021).

The purpose of the study was to determine the prevalence of stunting and its associated determinants in children aged 6 to 59 months in the Libo-kemkem district in Northwest

Ethiopia. The multivariate binary logistic regression model included child age, family size, father's educational status, household head's occupational status, child morbidity status, and parents' marital status. Stunting was substantially correlated with child age, family size, father's educational status, and employment status, according to the results of the multivariate binary logistic regression (Berhanu et al., 2018)

Regional

According to Rahman et al, malnutrition has always been a problem for developing countries. The study used data from Bangladesh Demographic health surveys and showed the relationship among malnutrition and Low Birth weight, examined by adjusted risk ratio proportion (RR) which controlled for expected confounders like education of mothers, child's age and sex, length of preceding birth interval, food accessibility, residential area, family unit financial status. Cochran- Mantel-Haenszel approach and multivariate logistic regression models were calculated. Advanced education of mothers, better family unit financial conditions and delayed birth intervals alone were not adequate in achieving considerable decreases in prevalence of child malnutrition in Bangladesh. Study findings suggested that interventions focusing on the target group i.e., Low birth weight in this case along with financial status and education of parents may reduce malnutrition amongst children. The study expected to find out the risk factors and aid the decision makers in designing and implementing policies which may help in reducing the malnourished population in Bangladesh and other developing countries with similar nutritional problems (Rahman et al., 2016).

According to Nehal Joshi et al, a study from Central Asia i.e., Mongolia, which is one of the fastest growing economies amongst the LMICs, studied the trends of socio-economic status and the regional factors responsible for child health outcomes. The data was obtained from Mongolian multiple indicator cluster survey from 2000 to 2010, showing improvement in the three dependent indicators of malnutrition but the impact of socio-economic activity on stunting and wasting increased. Access to health care was measured by children under 5 years of age who were fully immunized (Joshi et al., 2017).

Malnutrition among children is still a serious public health issue in many areas of the world, particularly in developing countries like Bangladesh. This situation is caused by

a number of socioeconomic and demographic reasons. The study used data from a nationally representative Bangladesh Demographic and Health Survey (BDHS) in 2014 to discover the risk variables related with malnutrition among under-five children in Bangladesh. By computing the weight-for-age Z score, the ordinal dependent variable—child nutrition status (severely malnourished, moderately malnourished, and nourished)—was established (WAZ).To investigate the relationship between child nutrition status and chosen independent factors, bivariate analysis was carried out using the gamma measure and the chi-square test of independence. A prominent ordinal model, the proportional odds (PO) model, was used to determine the adjusted effects of covariates. In the bivariate design, all of the selected covariates were shown to be highly significant (p 0.01). In the multivariate analysis, however, father and mother's education, wealth index, mother's BMI, and prenatal care service during pregnancy were all revealed to be highly significant (p 0.01) determinants for child malnutrition. At a 5% level of significance, the birth interval of children was also found to be a significant effect. Finally, the findings of this study clearly demonstrated the need of raising parent education levels, improving mother nutrition, and expanding prenatal care facilities in Bangladesh in order to improve nutrition among Bangladesh's under-five children (Talukder, 2017).

Khan et al. in 2019 using the Pakistan Demographic Health Surveys 2012-2013 sample size included 3071 children under 5 years of age who were measured for their anthropometric indices. Nutritional status was evaluated using the three anthropometric measurements namely height for age, weight for age, weight for height. The association between selected maternal-sociodemographic and child level variables (such as child sex, age, birth weight or size at birth, antenatal clinic visits, recent diarrheal incidence, and breastfeeding status) and three proxy measures of child nutritional status was investigated using univariate and multivariate binary logistic regressions. Around 44.4 percent of children under the age of five were stunted, 29.4% were underweight, and 10.7% were wasting. Children whose mothers lived in rural areas (OR = 0.67, 95 percent CI 0.48–0.92), were under the age of 18 at the time of marriage (OR = 0.76, 95 percent CI 0.59–0.99), and had visited an antenatal clinic more than three times during pregnancy (OR = 0.61, 95 percent CI 0.38–0.98) were less likely to be stunted. The child's underweight status was strongly linked with the mother's poor educational level (OR = 2.55, 95 % CI 1.26–5.17), short stature (OR = 2.31, 95 % CI 1.34–3.98), child's

small birth size (OR = 1.67, 95 % CI 1.14–2.45), and mother's BMI. Children with mothers who did not have a high school degree were more likely to be wasted (OR = 3.61, 95% CI 1.33–9.82). According to the findings, the majority of the variables that contributed to malnutrition in Pakistani children (such as the mother's age at marriage, educational level, and nutritional status) are avoidable. As a result, initiatives that can address these determinants, such as community-based education and focused nutritional interventions, are needed to minimise the impact of malnutrition (Khan et al.2019).

The study assessed the prevalence, trends, and variations in regional determinants of stunting among children aged 6–59 months using combined repeated cross-sectional nationwide Bangladesh Demographic and Health Surveys (BDHS 2011 and 2014) using bivariate and logistic regression analyses. Rural children were 19 percent less likely than their urban counterparts to be stunted. Stunting covariates vary by region. In Bangladesh, however, children's age, household wealth, mother's height, and parental education were all significant determinants of stunting. The study highlighted upon strengthening the national programs, making it region specific and addressing the specific causes existing in the area to reduce undernutrition. Major emphasis was laid upon the father’s role in family planning, reducing fertility, improving mother’s health along with strengthening economic and educational status (Saha et al., 2020)

In comparison to other developing nations, Pakistan has one of the highest rates of child malnutrition. The goal of this narrative review was to look at the empirical literature on children's nutritional status in Pakistan. The goals of this study were to learn about the methods employed in prior research, to assess the overall nature of childhood malnutrition, and to identify areas that have not previously been researched. This investigation collected the most recent and relevant studies published between 2000 and 2016. The research publications including data on child malnutrition in Pakistan were evaluated. A total of 28 studies were examined, and nearly identical methodologies were employed in almost all of them. The majority of the researchers used structured interviews to perform cross-sectional quantitative and descriptive studies to determine the causes of child malnutrition. Only one research collected data from respondents using the mix method methodology. Early marriages, big family sizes, high fertility rates with insufficient birth spacing, poor income, a lack of breastfeeding, and exclusive breastfeeding were identified to be recurring themes in the

examined literature. There is an urgent need for qualitative and mixed method research in Pakistan to understand and gain insight into the fundamental causes of child malnutrition (Asim & Nawaz 2019).

In a cross sectional study, including 299353 children belonging to the age group 12 to 59 months of non-pregnant mothers (sample size) was used to assess the factors or determinants responsible for causing anthropometric failures amongst children across 35 Low and Middle income countries. Twenty-six factors were exposed and their strength of association with the anthropometric failures were evaluated, out of which 9 were direct factors namely Dietary diversity score; breastfeeding initiation; vitamin A supplements; use of iodized salt; infectious disease in the past two weeks; oral rehydration therapy for children with diarrhoea; care seeking with suspected pneumonia; full vaccination and indoor pollution. The 17 indirect factors were assessed namely household wealth; parent's education; parents height and body mass index; maternal autonomy for health care, movement, money; water source; sanitation facility; stool disposal; antenatal care; skilled birth attendant at delivery; family planning needs; maternal marriage age. Short maternal height had the strongest association with stunting which was then followed by lack of mother's education, poorest household wealth, and low BMI. Short maternal stature had the strongest association with underweight as well followed by maternal BMI, poor socio-economic status and lack of maternal education and poorest household wealth. Similarly, low maternal BMI had one of the strongest associations with wasting followed by the other factors such as maternal education, poor dietary diversity and poorest household wealth. Through supplementary analyses it was concluded that paternal, height, weight, BMI, and education had weaker association to the maternal factors. Study findings suggested changes were needed to be brought in policies and programmes related to health and more emphasis should be laid on the mother's nutrition status, socio economic status being the strongest factors. Improving these factors can reduce anthropometric failures (Li, Z. et al., 2020).

Maternal stature is considered as one of the important indicators as well as a simple, stable and useful factor to assess the intergenerational effects it causes of low birth weight and intrauterine growth restriction in the developing nations. A study was conducted to examine the association between the factors using the 109 Demographic

health surveys in 54 low- and middle-income countries. The research revealed the inverse association of maternal stature to child mortality, stunting, wasting and underweight. It showed a weaker association with wasting probably because it is resultant of acute malnutrition and might be due to some immediate factors instead of the long term. Almost 90% of the countries showed that children were more likely to die, be stunted and underweight of mothers with short stature (Özaltin et al., 2010).

For a holistic development of a child there exists a complex interplay of child, maternal, household, environmental and socio- economic factors. Afghanistan, Bangladesh, India, Nepal and Pakistan were considered home to 95% malnourished children in South Asia. The correlates that were used in the study namely complementary feeding, breastfeeding, feeding frequency, dietary diversity, maternal height, BMI, Education, age at marriage, child vaccination, access to improved drinking source, sanitation facilities, household wealth, household indoor air quality. The findings of the pooled analysis, showed that maternal short stature and the lack of complementary feeding were significant to higher rates of stunting among infants of 6 - 8 months. Factors such as maternal short stature, socio economic status, maternal underweight, not meeting the dietary requirements as per minimum dietary diversity, lack of education among parents, mothers age at marriage were considered important risk factors of stunting amongst children 6-23 months. Predictors of severe stunting among children 6- 23 months were Immunization and meeting the minimum feeding frequency. Laying more stress on the first 1000 days of life and a multi factorial approach would help policy makers to bring a change in the scenario (Kim et al., 2017).

Maternal height was found to be a major predictor of child survival in both global and regional studies. However, there is minimal evidence in Bangladesh to support the intergenerational effect of short maternal height on the risk of child mortality. As a result, the purpose of this study was to look at the relationship between maternal height and neonatal, infant, and under-five mortality in Bangladesh. It was based on data from four rounds of Bangladesh Demographic and Health Surveys, conducted in 2004, 2007, 2011, and 2014. We included 29 698 singleton children aged 0–59 months born to women aged 15–49 years. Mothers were interviewed in order to gather information on maternal and child features, as well as socio-demographic information. Maternal height was measured using a millimetre-calibrated adjustable measuring board. STATA

V.14.2 was utilised, and the cluster sampling design was adjusted. To investigate the relationship between mother height and infant death, a multivariate ‘Modified Poisson Regression' was done utilising stepwise backward elimination processes. In Bangladesh, maternal height shows a strong negative relationship with neonatal, infant, and under-five mortality. When compared to the highest maternal height group (155 cm), short maternal height (145 cm) had 1.73 times the risk of neonatal death, 1.60 times the risk of infant mortality, and 1.48 times the risk of under-five mortality. These data suggest a substantial intergenerational relationship between low mother height and the probability of offspring death in Bangladesh between the ages of 0 and 59 months (Khatun et al., 2007).

The drivers of nutritional status of the children were studied in four South Asian countries Bangladesh, Nepal, India and Pakistan. In Bangladesh (1996/1997–2011), India (1992/1993–2005/2006), Nepal (1997–2011), and Pakistan (1991–2013), the factors influencing long-term improvements in child height for age z-scores are quantified. We use the same statistical approaches to analyse data from a single data source, from which we generated a collection of explanatory variables that encapsulate ‘nutrition-sensitive' aspects. Improvements in material well-being, increases in female education, and improvements in sanitation are three factors that are particularly essential in explaining height for age z-score variations during these timeframes. All four nations show similar relationships with these factors (Headey et al., 2016).

National

The study was conducted in urban areas of Allahabad to study the nutritional status of under- five children and to assess infant feeding practices that are associated with undernutrition in Anganwadis. The research included children under the age of five and their mothers in four anganwadi areas of Allahabad (UP). A normal test of proportions, a Chi-square test for examining the relationship between nutritional status and other attributes, and a risk analysis utilising odds ratios with 95% confidence intervals were also performed. 36.4 percent of children under the age of five were underweight (2SD weight-for-age), 51.6 percent were stunted (2SD height-for-age), and 10.6 percent were wasting (2SD weight-for-height). Breast-feeding after six hours of delivery, colostrum loss, and inadequate complementary feeding were all revealed to be significant (P 0.05)

risk factors for underweight. Wasting was not shown to be connected with any of the baby feeding practises evaluated (P>0.10). The nutritional condition of children who received ICDS subsidies did not improve. The research concluded the factors responsible for under five undernutrition in urban areas of Allahabad were Delayed initiation of breast-feeding, deprivation from colostrum, and improper weaning (Kumar et al.,2006).

A study on nutritional status of children in India and household socio economic condition as a contextual determinant stated that inequality is one of the pressing issues in the country India. The study presented the correlation between socio-economic inequality and chronic malnutrition amongst children. In this study the author used NFHS -3 surveys and assessed the socio-economic inequality in stunting amongst children across the states through concentration index. Multilevel models, random coefficients and random slopes were used to study the influence of the household socio economic status on chronic childhood malnutrition (Kanjilal et al., 2010).

The goal of this study is to emphasise the factors that contribute to malnutrition in children under the age of five in India's urban and rural areas. The ultimate goal is to develop policy recommendations for children's nutritional well-being. The logit model is used to analyse 9,381 observations from urban regions and 18,418 observations from rural regions in this empirical investigation. The composite index of anthropometric failure is designed to be used as a malnutrition indicator. The findings demonstrated that the risk of anthropometric failure increased with age, birth order, and breastfeeding duration. In both urban and rural locations, the birth interval, hospital delivery, family wealth index, mother's BMI, and mother's education were found to have a negative impact on children's malnutrition. In both urban and rural areas, the gender of the kid has no effect on malnutrition. From a policy standpoint, extending the birth interval through family planning programmes and shortening the length of nursing by providing subsidised supplement meals may help to improve children's nutritional status. Policymakers must pay attention to the long-term socioeconomic situation of the home and the BMI of mothers (Khan & Raza, 2016).

A profound question arises whether rise in economic conditions amongst the population aids in increased supply of food and ultimately reduction in child malnutrition. Another study conducted to understand the relation between women empowerment and child

malnutrition was carried out as a cross country analysis of 50 developing countries. Data was obtained from Demographic health surveys and the World bank. Results showed that the multi-level model improving women's status in the society be it their education, gender inequality and their decision on bearing children, their decision-making ability, representing national politics and household wealth shows positive correlation with food security (Burroway, 2016).

The associated risk factors of malnutrition amongst children under 5 years were Vitamin A Supplementation, Vaccination, iodized salt, household air quality, improved sanitary practices, safe disposal of stools. improved drinking water, prevalence of infectious disease, initiation of breastfeeding, dietary diversity, age at marriage, maternal BMI, Height, Education. In the mutually adjusted multivariate model the predictors of childhood stunting and underweight were short maternal stature, mothers having no education, households in lowest wealth quintile, poor dietary diversity and maternal underweight. Data obtained from the NFHS 3 (2005- 2006) sample included married and unmarried women of age 15-49 years and children under 5 years of age. It is the need of the hour to adopt a multi sectoral approach and mainstreaming nutrition in order to combat malnutrition amongst children under 5 years of age (Corsi, 2016).

Despite widespread agreement that expenditures in nutrition-sensitive programmes are necessary to prevent child malnutrition, empirical studies and interventions tend to isolate a few nutrition-specific risk variables. The 2015–16 National Family Health Survey provides the first opportunity in more than a decade to conduct an up-to-date comprehensive evaluation of the relative importance of various maternal and child health and nutrition (MCHN) factors in respect to child anthropometric failures in India. A total of 140,444 infants aged 6–59 months were included in the initial study, with complete data on 20 MCHN variables, and a subgroup of 25,603 infants with extra paternal data were included in the secondary analysis. Stunting, underweight, and wasting were the outcome factors. We used logistic regression models to analyse each correlate independently in age- and sex-adjusted models before combining them in a mutually adjusted model. Short maternal stature (OR: 4.39; 95 % CI: 4.00, 4.81), lack of maternal education (OR: 1.74; 95 % CI: 1.60, 1.89), low maternal BMI (OR: 1.64; 95 % CI: 1.54, 1.75), poor household wealth (OR: 1.25; 95 % CI: 1.15, 1.35) and poor household air quality (OR: 1.25; 95 % CI: 1.15, 1.35) were the strongest correlates for

stunting (OR: 1.22; 95 % CI: 1.16, 1.29). Other variables, such as dietary diversity, vitamin A supplementation, and breastfeeding initiation, had weaker relationships. When the results were stratified by age (6–23 vs 24–59 months) and sex (girls vs boys), as well as low birth weight, the results remained constant (Kim et al., 2019).

For improving the child's nutritional status, the intergenerational cycle of poverty as well environmental conditions should be improved. The variables that showed strongest correlates were short maternal stature, lack of education, low socioeconomic status, low maternal BMI, poor household air quality. The paternal factors were important predictors but as compared to mothers were of lesser degree. Vitamin A supplementation, dietary diversity and breastfeeding initiation showed weaker association with these correlates (Pratim Roy, 2019).

Discrimination was prevalent in India since time immemorial. Gender inequality in nutritional status among under 5 children in the Hooghly district of West Bengal, found that there was a significantly higher proportion of malnutrition among female children (55.9%) compared to the males (46.6%). Higher birth order and lower per capita income were factors strongly related to malnutrition (Dey & Chaudhuri, 2008).

Using data from NFHS 4 surveys identifying the geographical areas where the prevalence of child undernutrition was high and evaluating the geographical variance of the children under five years of age and its related covariates was done across the Indian districts. It revealed that South Indian districts were performing well in terms of child's growth and nutritional status as compared to the central, rural and so-called tribal belts of India. When it comes to a conducive environment, living conditions and healthy childhood development north - eastern districts of India were performing well. High poverty, Low female education, low BMI of mother's, high prevalence of 4+ teenage pregnancies coincided with the geographical clustering of child malnutrition (Striessnig & Bora, 2020).

A cross sectional study which assessed nutritional status of 1751 preschool children suggested that household wealth, mother's education and personal hygiene were few factors which were important predictors of child malnutrition (Meshram et al., 2012).

Child malnutrition is a persistent problem around the world, but it is understudied, particularly in vulnerable settings like urban slums, where undernutrition is common, as this study shows. This is one of the first studies to look into the prevalence of undernutrition and anaemia, as well as the impact of commonly-reported correlates on the risk of undernutrition among young children living in Mumbai slums. Male children had a higher rate of poor growth indices and anthropometric Z-scores than female children. In multivariate models, male sex, low birthweight, shorter maternal height, reporting of more than equal to one episode of illness within the previous month, older mothers, and birth order 2 were also linked to poor growth and anaemia. Females and males have different undernutrition correlates. Male children who were firstborn had a 20 % lower risk of anaemia associated with diarrhoea, while female children had a 40% higher risk of anaemia associated with diarrhoea (Huey et al., 2019)

In urban slums of Maharashtra, wasting, stunting, and underweight were more common than in a rural region. Exclusive breast feeding and acute diarrhoea were linked to wasting in rural regions, while stunting was linked to children with birth orders of 2 or less than 2, and exclusive breastfeeding and low mother education were linked to underweight. In the urban slums, exclusive breast feeding was associated with wasting, sex of the child and family type with stunting, and low family income with underweight (Murarkar et al., 2020).

Undernutrition and anaemia afflict India's Adivasi scheduled tribe group disproportionately, placing them in the bottom wealth deciles, making them socially and economically vulnerable. The goal of this study was to determine the extent of child malnutrition (via the conventional and composite index of anthropometric failure (CIAF) classifications), as well as the burden of anaemia in children and its independent nutrition specific and sensitive drivers, as well as to reflect the living conditions of the Santhal Adivasis. Low WAZ scores, morbidity (any fever, diarrhoea, or respiratory infection) on the check-up day or in the previous week, low maternal Hb level, and lack of dietary diversification were identified as predictors for anaemia, indicating the need for targeted interventions to reduce the high anaemia rates observed in the study site (Stiller et al., 2020).

Based on the review of literature, the figures below show some common determinants of stunting wasting and underweight (Fig 2.12-2.14).

Fig 2.12 Some common determinants of Stunting

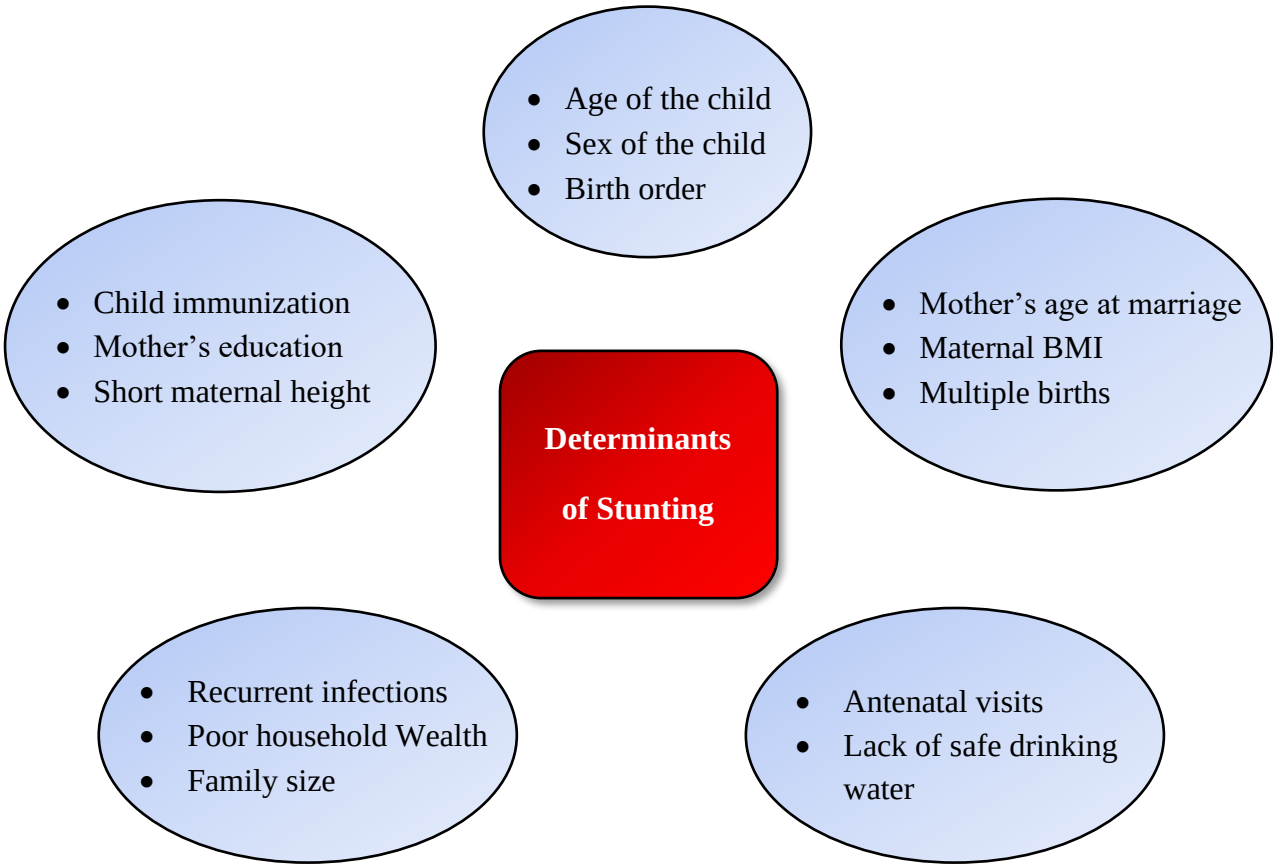


Fig 2.13 Some common determinants of Wasting

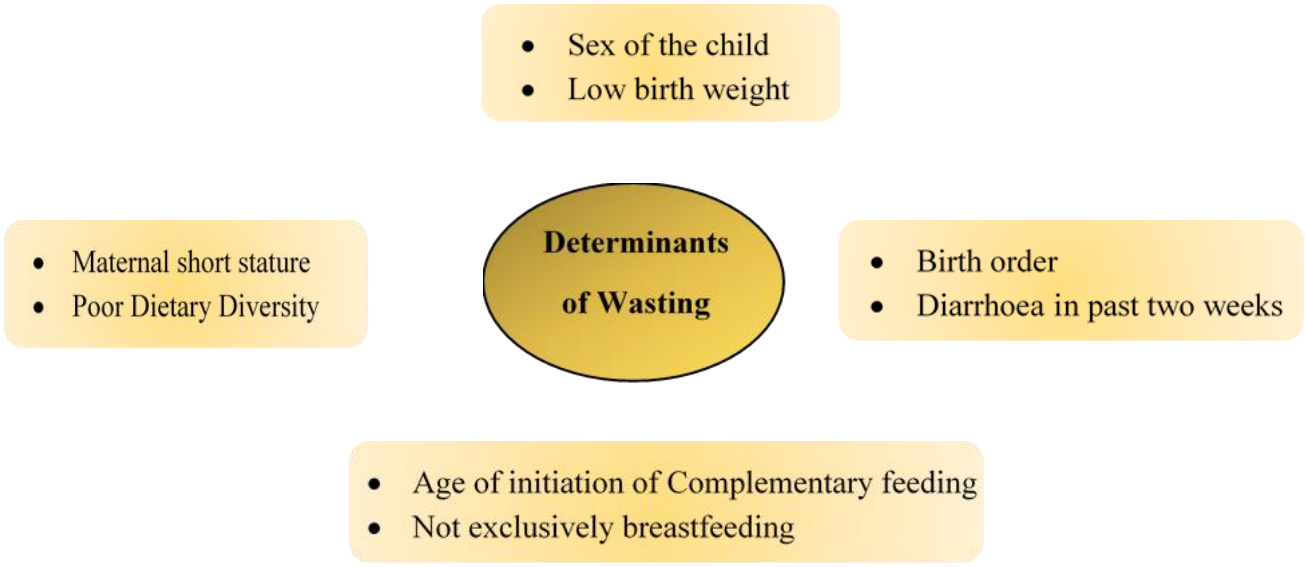
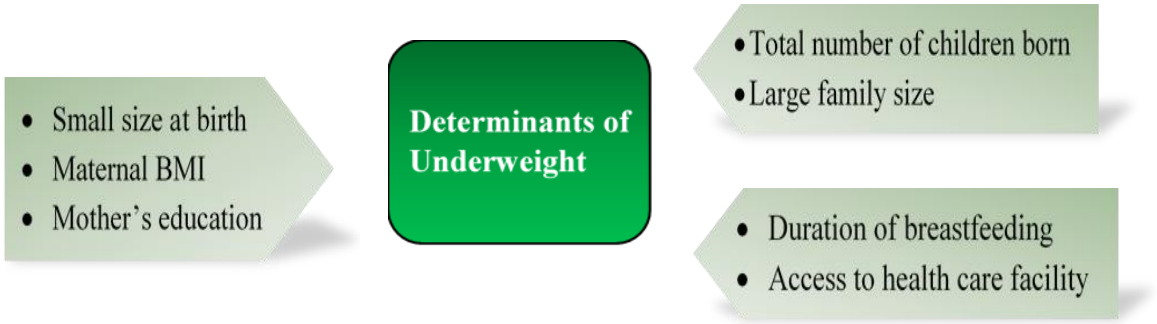


Fig 2.14 Some common determinants of Underweight



METHODS AND MATERIALS

METHODS AND MATERIALS

The present study dealt with assessing the transition in determinants of child malnutrition amongst children under five years of age in India over a period of two decades. This required nationwide data on which was obtained from the National Family and Health Surveys. NFHS surveys are extensive and multi-phased surveys covering all the states and Union territories of India. The households were selected from clusters which are representative samples of the entire country. Until now four surveys have been conducted from 1992 to 2015. The fifth NFHS is on-going not yet completed due to the novel Coronavirus 2019.The surveys are conducted by Ministry of Health and Family Welfare, Government of India with Indian Institute of Population sciences serving as the nodal agency.

NFHS contains essential information on Health and Nutrition of the population and helps in the formation of policies and programmes which aids in knowing the progress of the ongoing programmes related to health and family welfare. It even sets benchmarks and examines the progress made in the country over time. The surveys provide information on fertility, infant and child mortality, family planning, maternal and child health, reproductive health, nutrition, anaemia and utilization and quality of health and family planning services.

Each round of the NFHS had two precise objectives:

- To provide necessary data on health and family welfare needed by the Ministry of Health and Family Welfare (MOHFW) and other agencies for policy and programme purposes
- To provide necessary information on emerging health and family welfare concerns.

The first National Family and Health Survey proved to be a major landmark in the development of a comprehensive demographic and health database of India. The second **National Family Health Survey (NFHS-2)** was conducted in 1998-99. The main indicators, in addition to the ones included in NFHS 1, which were covered by the survey include information on the quality of health and family welfare services, status of women, women's reproductive health, domestic violence, nutritional status of women, height and weight measurements of all eligible women and young children, blood testing of ever-married women and their children below age three. A sample of about 91,000 ever-married women aged 15-49 from 26 states was covered by the survey in India. In the NFHS-2, the sample frame was ever-married women, 15-49; anthropometric data were collected from women completing the women's questionnaire and all children under the age of three living with their mother and whose mother completed the women's questionnaire.

After the successful completion of National family and Health Survey one and two respectively. The third **National Family Health Survey (NFHS-3)** was accompanied in 2005-06. NFHS-3 covers 99% of Indian population taking sample from 29 states. In NFHS-3 more than 230,000 women age 15-49 and men age 15-54 are interviewed throughout India. Also, more than 100,000 women and men were tested for HIV and more than 200,000 adults and young children for Anaemia. In the NFHS-3, the sample frame was all women, 15-49; anthropometric (measurement of the size and proportions of the human body) data were collected from women completing the women's questionnaire and all children under the age of five listed in the household questionnaire. Additionally, to information obtained from the National Family and Health Survey two the new emerging indicators in the National family and Health survey three were family life education, safe injection, perinatal mortality, adolescent reproductive health, high risk sexual behaviour, tuberculosis, and malaria. The special feature of the survey was a blood test for detection of HIV.

Fig 3.2 – National Family and Health Survey 2 (1998-1999) Sample size

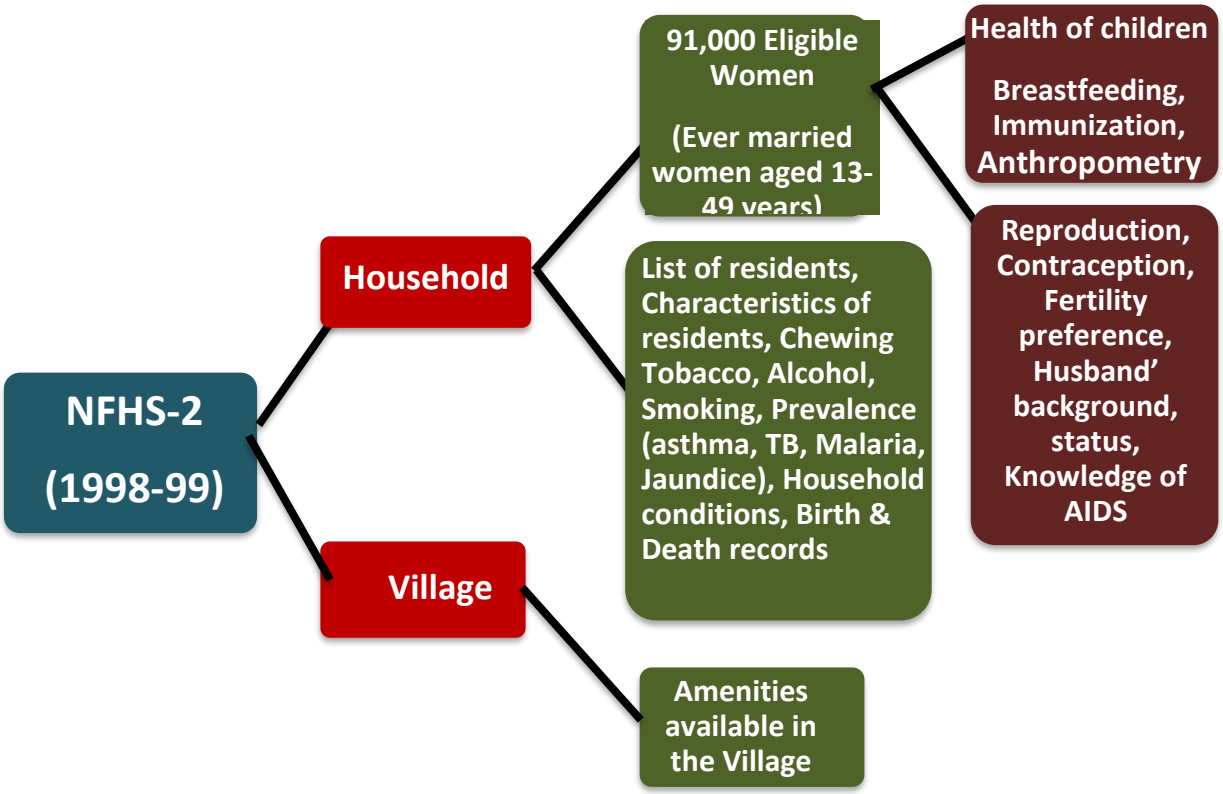
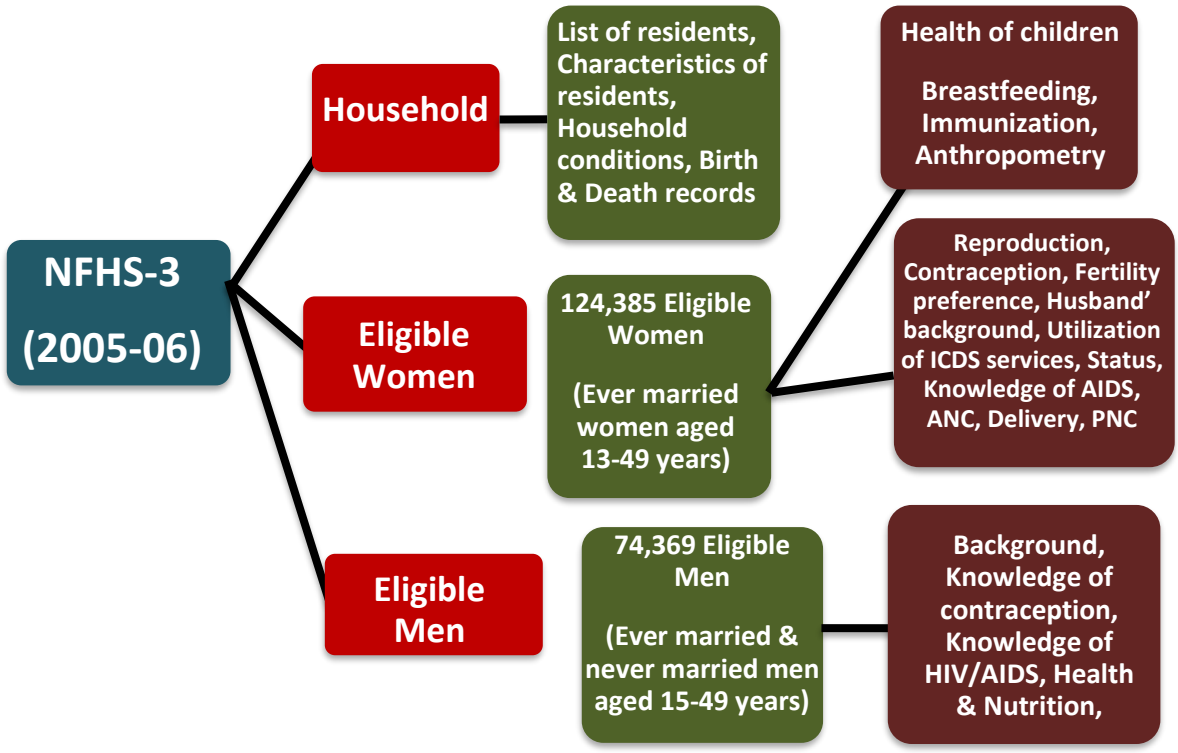
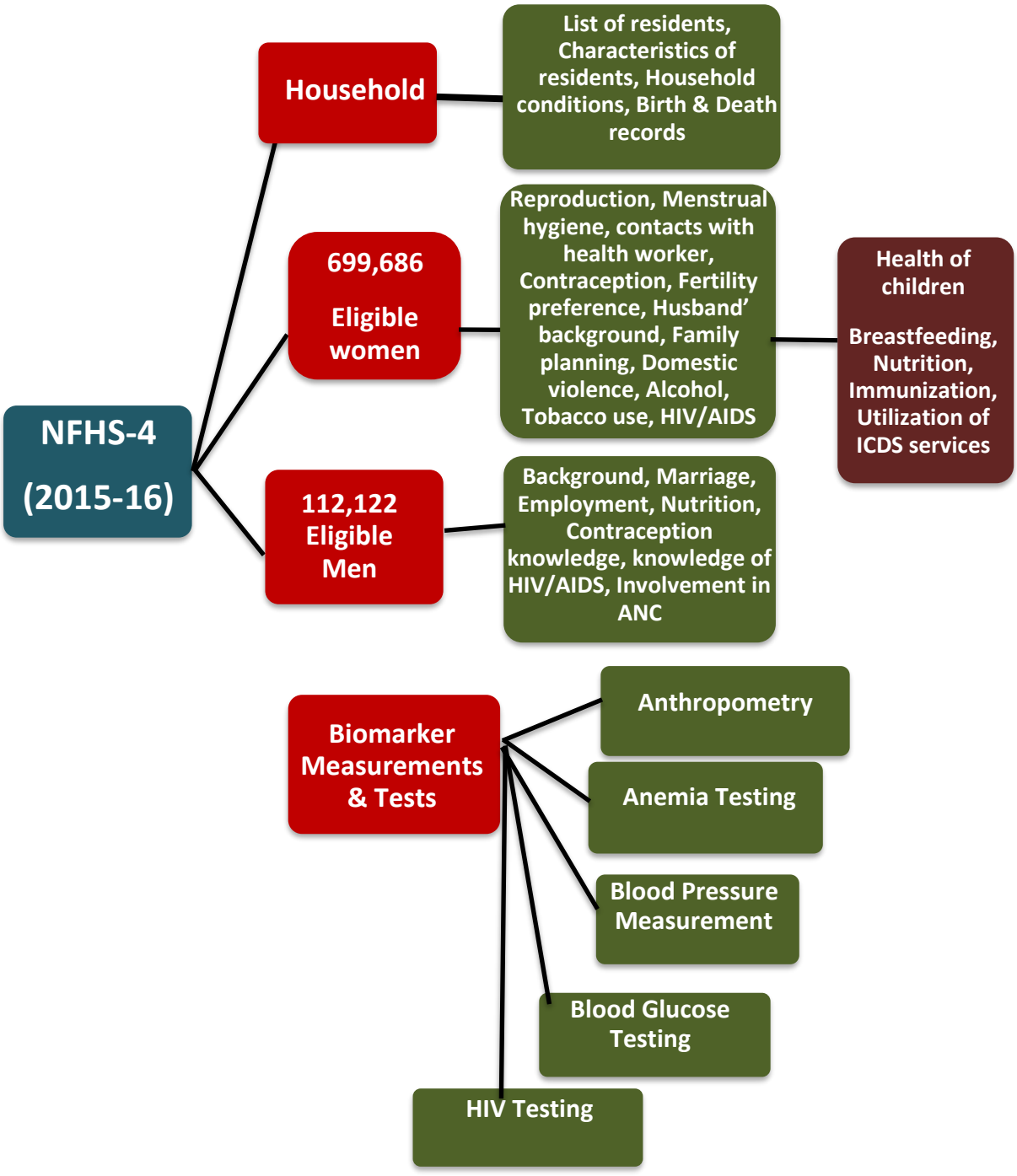


Fig 3.3 National Family and Health Survey 3 (2005-2006) Sample Size



Over the years NFHS has expanded its scope and coverage to fill the gap in the data required by government, NGOs and Researchers on health and nutrition of the population. Fourth **National Family Health Survey (NFHS-4)** was carried out during the time period 2014-15. It covered the entire country for the first time. For the first time 640 districts were covered to estimate and give conclusions regarding the crucial indicators in all the states and the districts. This is useful to prioritize the health-related issue and address it depending upon the states and districts which perform poorly. The special feature of NFHS- 4 is that blood glucose test, hypertension and HIV testing were done. All the 29 states and 7 union territories were surveyed and most indicators were selected at district level, covered in 2011.The clinical, anthropometric, and biochemical (CAB) component of NFHS-4 was designed to provide vital estimates of the prevalence of malnutrition, anaemia, hypertension, HIV, and high blood glucose levels through a series of biomarker tests and measurements. In NFHS-4, 699,686 women age 15-49- and 112,122-men age 15-54 were interviewed throughout India.

Fig 3.4 – National Family and Health Welfare- 4 (2014-2015) Sample size



NFHS mainly uses the following types of questionnaires:

- Household Questionnaire
- Women's Questionnaire
- Man's Questionnaire
- Biomarker Questionnaire

The questionnaires used are mainly bilingual, consisting of questions in both the state language and English. The questionnaire is first translated to the local language and then translated back to English once the information is obtained.

Household Questionnaire:

One of the main objectives of the household questionnaire was to find the women who are eligible to answer to the Women's Questionnaire, including only ever married women, age 13 – 49 years. The Household Questionnaire listed all the residents of the household and also those persons who stayed there during the night. The basic information of the listed persons such as, sex, age, education, marital status, occupation and relationship to the head of the household was also collected. It also covered information on the type of toilet facilities, cooking fuel used, source of water for drinking purposes, treatment of water, materials used for construction of the roof and floors, lighting, agriculture and live-stock. It obtained information about the socio – economic status of the family by collecting information on the material possessions of the family. Salt samples were collected from the households to check whether iodized salt was used in the family. Religion, caste, place and records of birth and death, within last two years, were also recorded.

Women's Questionnaire:

The Women's Questionnaire used by NFHS highlighted the information collected from all ever-married women, usual residents as well as visitors, age 13-49 years. The questionnaire is divided into seven parts. These are:

Respondents Background: Information on age, marital status, age at marriage, education, caste and exposure to media of the eligible women as well as visitors (if any) own household information was covered.

Reproduction: Total number of children that a woman had given birth to, stillbirths and abortions, birth and death history of children, current pregnancy and menstruation status.

Contraception and Menstrual hygiene: Use of and attitudes toward various family planning methods. Data was obtained on ways and methods through which they maintain hygiene.

Health of Children: Births in the year of the survey and previous four calendar years and health of the children.

Fertility Preferences: Desire for additional children, sex composition of children, family size, birth intervals and husbands' attitude toward family size.

Husbands Background and Women's Work: Age, education and work status of the woman and her husband.

Height and Weight: The height and weight of children mostly under age four were measured to check the nutritional status and health of children.

Women empowerment: Information on women's capability on making household decisions, ownership of land or house and ability to avail to health care services.

Man's Questionnaire:

The Man's Questionnaire was designed to interview men aged 15-54 who are usual residents of the sample household or visitors who stayed in the sample household the night before the survey. It contained a subset of questions that were covered in the Women's Questionnaire such as age, marriage, employment, number of children, their fertility preferences, ANC visits plus some additional questions only administered to men such as reproductive behaviour and intentions, knowledge and use of contraception, male involvement in health care, attitude toward gender roles and sexual life.

Village Questionnaire:

The Village Questionnaire is another important questionnaire used by the NFHS to collect information on various amenities in the villages covered under the NFHS such as water, transport, health and educational facilities. The Village Questionnaire was managed only in the rural areas

Biomarker Questionnaire:

It covered measurements of height, weight, and haemoglobin for children, and measurements of height, weight, haemoglobin, blood pressure, and random blood glucose for women age 15-49 and (in the state module subsample of households only) men age 15-54. In addition, eligible women and men were requested to provide a few drops of blood from a finger prick for laboratory testing for HIV.

Demographic Health Survey

Demographic Health Surveys (DHS) was the original survey tool developed by The DHS Program in 1984. More than 400 DHS surveys have been conducted over 90 countries. It improves the collection, analysis, dissemination of data which includes information about the population, health and nutrition. The data collected is important for policy and decision making, planning as well as program management.

Procurement of data: Through the DHS website https://dhsprogram.com/ the data was obtained for country India. Applications were made for procurement of data to the DHS Program. Post permission from the agency data was downloaded in the required SPSS format. Data was extracted and the variables related to child undernutrition and the determinants responsible were selected from all the National Family and Health Surveys. Data analysis was carried out using SPSS version 20 and above.

Demographic Health Survey Program contains datasets or data files. The data set or data file refers to data in format like STATA, SPSS or SAS. The DHS data has different data files for different unit of analysis. The different units of Analysis are the Household, Women (15-49 years women are interviewed), Men (15-54 years men are interviewed) and children. Each unit of analysis has a separate file. As part of the current study, data was obtained from **KR file** which contains information about children under 5 years of age of interviewed women. Variables of interest were selected from KR data file.

The different types of file present for analysis were **(Fig 3.6)** –

- **Household Recode (HR file**)- contains all the households that are interviewed in the survey.
- **Person Recode (PR file)-** has data of every household member.
- **Individual Recode (IR file)** – has data for all the eligible women i.e., usually all women aged 15- 49 years with completed interviews.
- **Children's Recode (KR file)** – contains data for children under 5 years of age of interviewed women.
- **Birth Recode (BR file) –** has data for all births to interviewed women.
- **Male Recode (MR file)-** has data for all the eligible men with completed interviews.
- **(CR file)-** has data for men and women with completed interviews who both declared to be married to each other or living together.
- **(AR file) –** contains HIV tests results of the people who got tested in the survey.

Fig 3.5 – Unit of Analysis

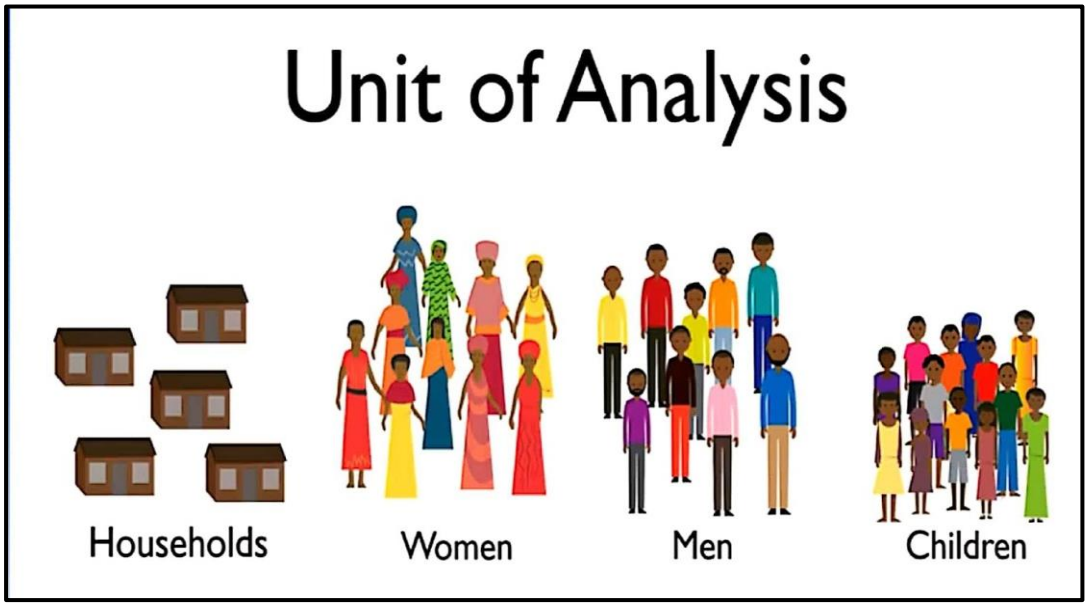


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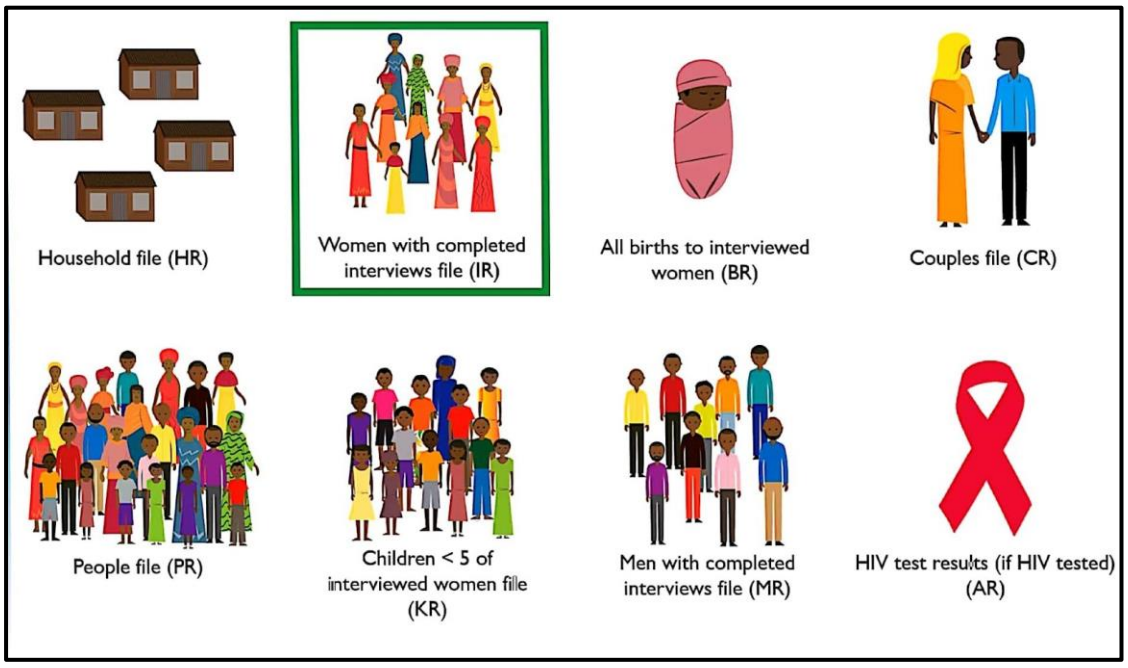
Fig 3.6- Different files for unit of Analysis



Source – https://youtu.be/JGRJZCGiCJw

The study was divided into two phases.

Phase I A – Selection of survey for analysis i.e., NFHS 1, 2, 3, and 4

- Questionnaires were reviewed
- Registered for accessing data
- Downloading the datasets from The DHS program
- Identification of indicators of child health and Nutrition

Phase I B – Conducting descriptive Statistical analysis for identifying determinants in individual datasets

Phase II- Identify Transition in determinants over a period of two decades comparing the 4 datasets

Data Analysis

Determinants of malnutrition amongst children were assessed for 3 different forms of malnutrition i.e., stunting, wasting and underweight. The independent variables that were included for analysis were age in months, size at birth, recent illness, diarrhoea, immunization, Childhood anaemia, Duration of breastfeeding, mothers' education (illiterate, primary, secondary, higher), birth order (first birth order, two or more birth order and less than 24 months, two or more birth order and more than 24 months), region of residence (rural, urban), wealth index (poorest, poorer, middle, richer, richest), ANC, maternal BMI, maternal anaemia, institutional birth, Access to health facility, mother's age at marriage, mothers' age at first child's birth, Female headed household, household composition, access to WASH services, toilet facility,

The data was analysed using SPSS version 20 or above.

- Percentages were calculated for all parameters that could be expressed in a rank order fashion.
- Means and standard errors were calculated for all parameters that were expressed numerically.
- Crosstabs were computed between indicators of nutritional status and other parameters of interest.
- Binomial logistic regression analysis was performed to establish the determinants.

Figure 3.7: Scheme for selection of Sample for Analysis (NFHS 4)

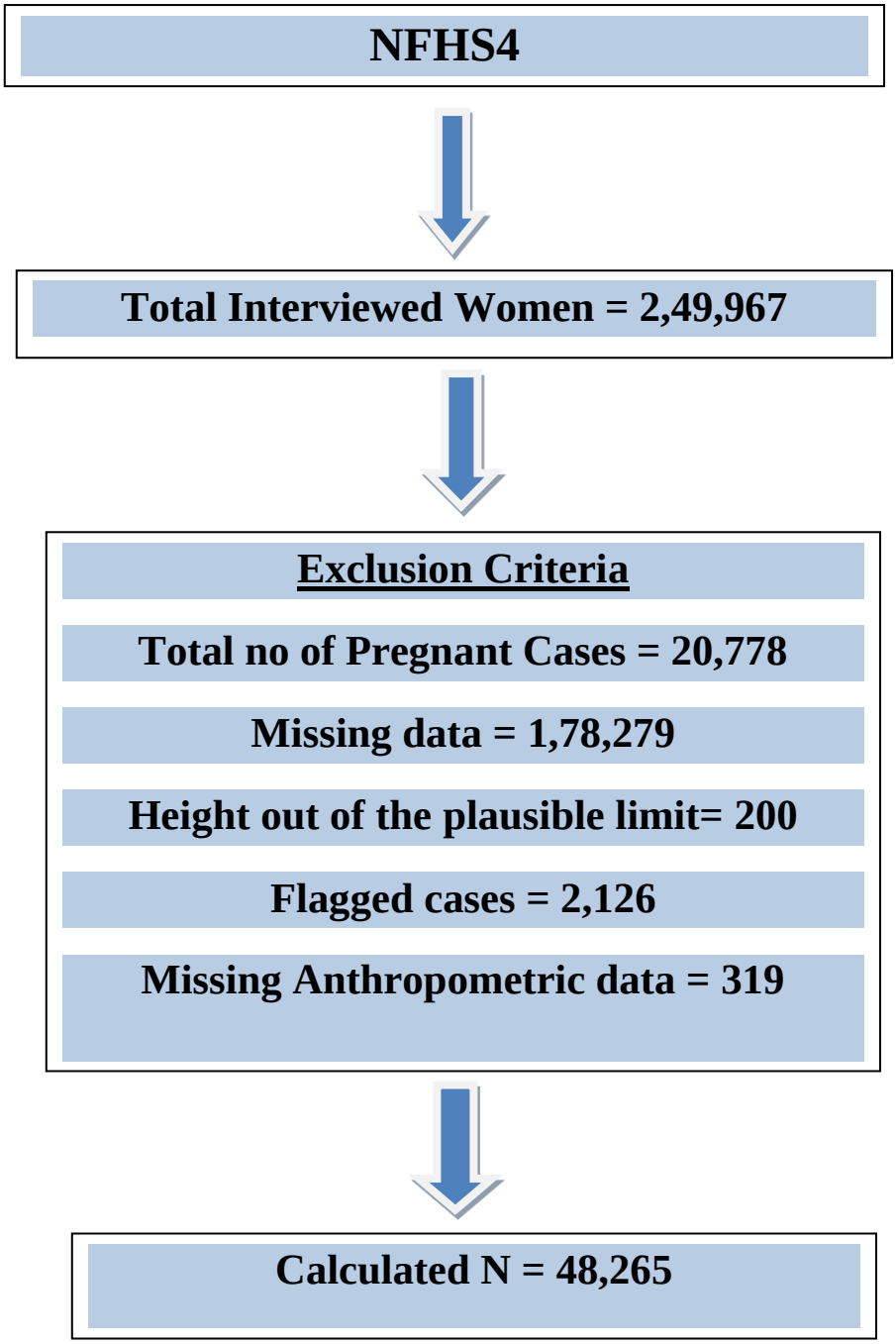


Figure 3.8: Scheme for selection of Sample for Analysis (NFHS 3)

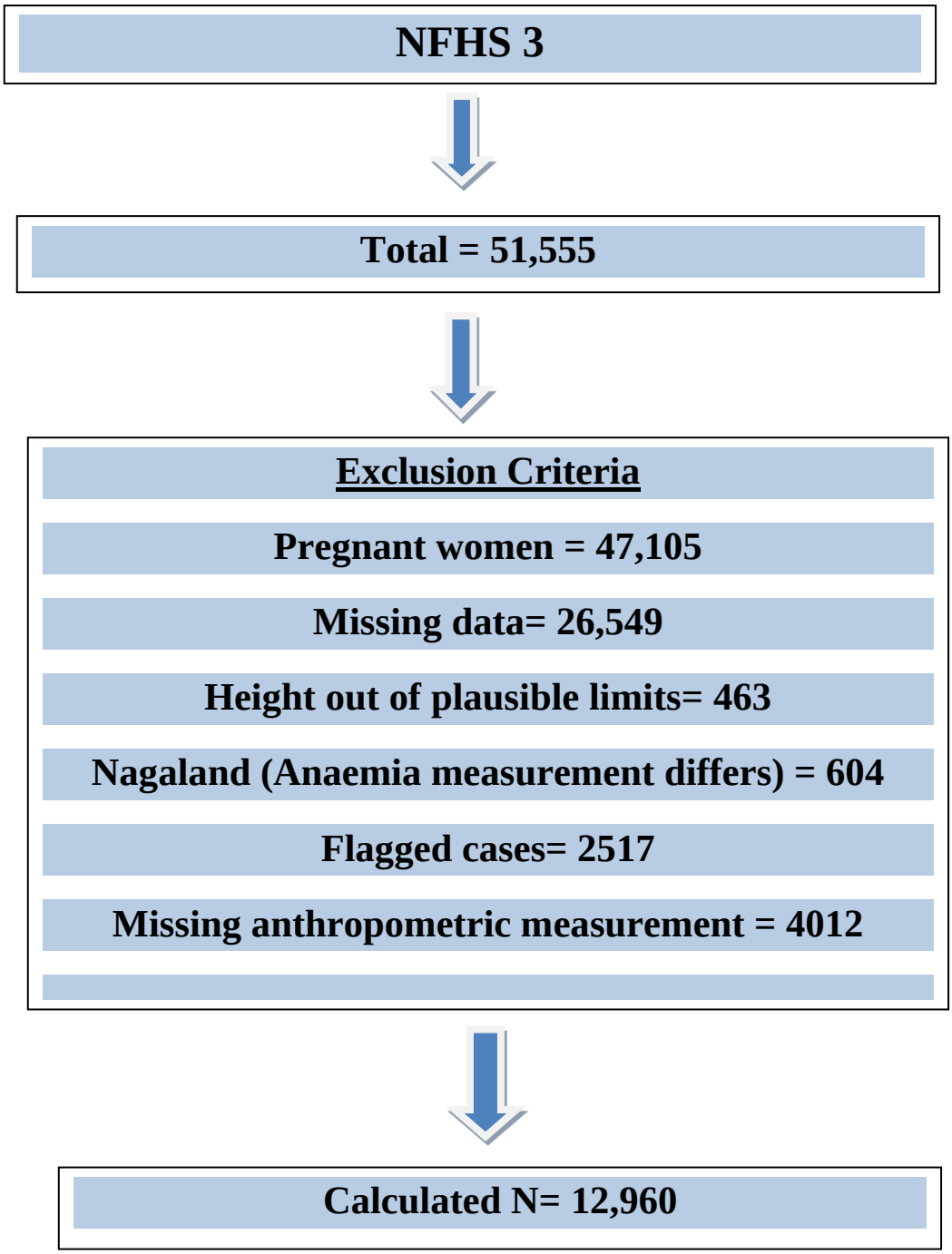
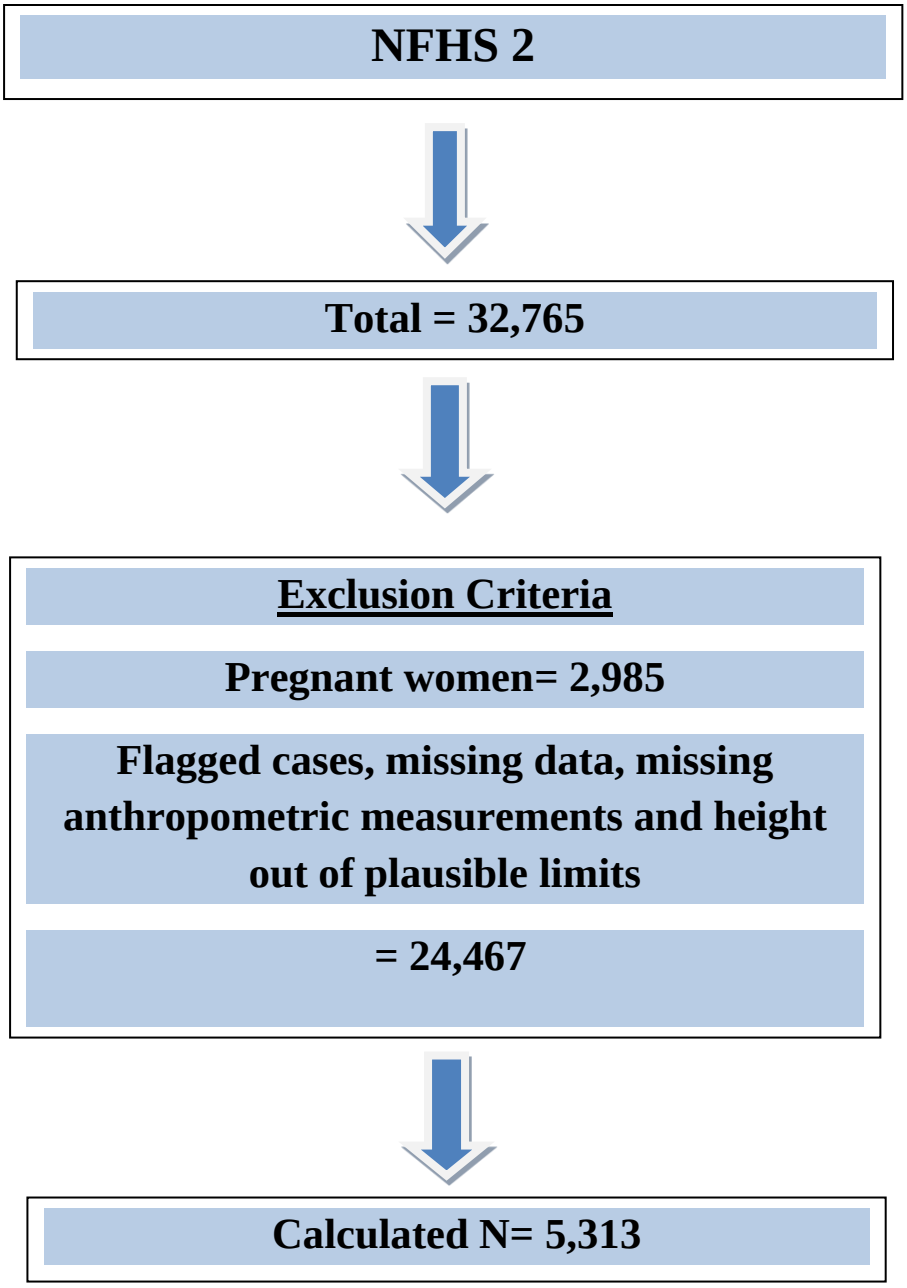


Figure 3.9: Scheme for selection of Sample for Analysis (NFHS 2)



RESULTS AND DISCUSSION

RESULTS AND DISCUSSION

The present study involved secondary data analysis to assess the transition in the determinants of malnutrition amongst children below 5 years of age over a period of 2 decades. Secondary data was obtained from National Family Health Surveys II, III and IV covering a period of 22 years between 1998- 2021. According to the objectives of the study, data was cleaned and exclusions were made to arrive at the final sample for statistical analysis.

This chapter presents the findings of secondary data analysis conducted on NFHS datasets obtained from the Demographic Health Surveys program post permissions and ethical clearance by Department and Faculty level technical and ethical committees.

The present study was divided into 2 phases:

Phase I A – Selection of survey for analysis i.e., NFHS 2,3,4 and understanding the variables and the records.

Phase I B – Conducting descriptive statistical analysis for identifying determinants in individual datasets

Phase II- Identify transition in determinants over a period of two decades comparing the datasets

Findings of the study are presented in this chapter as follows:

1. Socio Demographic profile of the population
2. Maternal characteristics and birth order
3. Assessing nutritional status of the children
4. Practices during pregnancy, delivery and post birth
5. IYCN practices
6. Interrelationships between the variables
7. Assessment of the determinants of stunting, wasting and underweight

Socio Demographic profile of the population

As shown in **fig 4.1**, type of place of residence depicts where the household or the interviewed women resided. NFHS 2 the women selected, keeping aside the exclusion criteria, were 5,313 out of which 35.6 % (1889) resided in urban areas and 64.4% resided in rural areas. NFHS 3 the sample size of women selected were 12,960 out of which 34.4% (4463) dwelled in urban areas and 65.6 % (8497) dwelled in rural areas. According to NFHS 4 the sample size was 48,265 out of which 13,583 (28.1 %) interviewed women were from urban areas and 34682 (71.8%) belonged to the rural areas. An increase in women dwelling in rural areas were observed in NFHS 4.

Source of drinking water was considered safe if 'piped into dwelling or yard/plot', 'public tap/standpipe', 'tube well or borehole', 'protected well or spring', or 'rain water' **(Table 4.1).** In NFHS 2 -Sources of drinking water piped to yard 27.4%, public tap/standpipe were 21.2%, tube well or bore well were 15.1 % and protected well were 0.7 %. These sources are considered safe. In NFHS 3 - Sources of drinking water piped into dwelling 11.8%, piped into yard 11%, Public tap 14.5 %, Tube well or bore well 35.5 %, Protected well 1.9%, protected spring 1.8 %, rainwater 0.2%, 0.3% bottled water were considered safe. In NFHS 4- Sources of drinking water piped into dwelling 11.6%, piped into yard 10.9%, Public tap 10.9 %, Tube well or bore well 44.1 %, Protected well 1.9%, protected spring 0.2%, rainwater 0.2%, Community RO plant 0.4%, 2.3% bottled water were considered safe.

The **sanitation facility** was defined as improved if households had 'flush to piped sewer system', 'flush to septic tank or pit latrine', 'ventilated improved pit latrine', 'pit latrine with slab', or 'composting toilet' **(Table 4.2)**. In NFHS 3- Type of toilet facilities which are considered safe or hygienic are flushed to piped sewer (10%), flushed to septic tank (18.2%), flush to pit latrine (5.2%), had pit latrine (5.2 %). In NFHS 4 – 6.5% had flush to piped sewer system, 25.3% had the facility of flush to septic tank, 6.3% had flush to pit latrine ,0.5% had ventilated improved pit latrine and 3.3% had pit latrine with slab and the following toilet facilities are considered hygienic.

Household air quality was characterized as use of non-solid fuels (i.e., best quality), solid fuels in separate kitchens, and solid fuels in non-separate kitchens (Bassani et al.,2010). In NFHS 3, the non-solid fuels were Electricity (0.4%), LPG/ natural gas 22% and Kerosene usage was 3.2%. Similarly, in NFHS 4, the usage of electricity

(0.5%), LPG/natural gas was 29.4% and kerosene usage was 1.0 % these sources were considered as cleaner fuel as compared to the solid fuels.

As shown in **fig 4.2**, **wealth index** is a composite measure generated with statistical procedure known as principal components analysis. Wealth index is divided into 5 categories: poorest, poorer, middle, richer and richest. In NFHS 3, households belonging to poorest families were 20.4 % (n=2646), middle class were 20.6 % (n= 2665) and richest families were 19 % (n= 2456). According to NFHS 4 - 27.7 % (n=13375) belonged to the poorest families, 18.9% (n=9118) belonged to middle class families and 14.3% (n=6894) belonged to the richest families. An increase in the percentage of poorest family were observed along with decline in middle and richest families. Researchers have concluded that children belonging to richer or richest families are less likely to be undernourished as compared to poorer or poorest families ((Ekholuenetale et al., 2020).

As shown in **figure 4.3**, **Number of members in a household** ranges from 0 to 25 and others. The parameter gives an idea of the number of members in the family. In NFHS 2, households which consisted of 0 to 5 members were 32.3%, 6 to 10 members were observed in 49.0%. In NFHS 3, Households consisting of 0 to 5 members were 41.8 %. Households ranging from 6 to 10 members were 48.4% and. In NFHS 4, 0- 5 members (42%), 6 to 10 members (48.5%), 11 to 15 members (7.9%) and 21 to 25 members (0.3 %) respectively.

Fig 4.1 - Type of Place of Residence

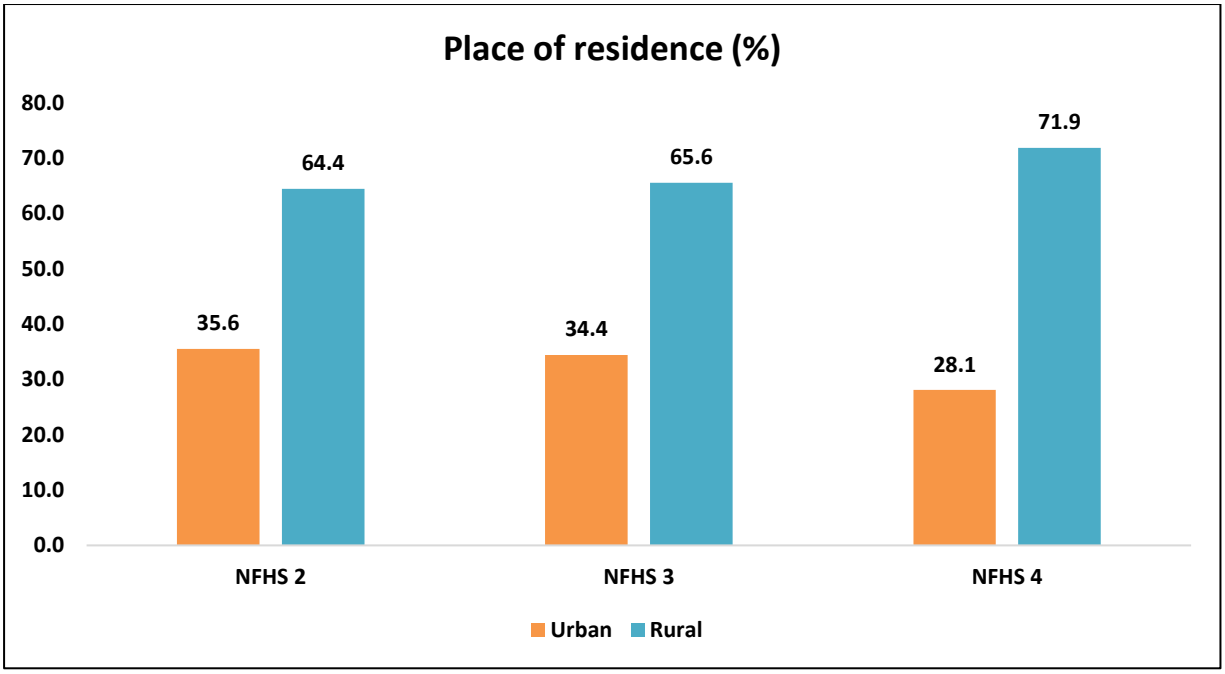


Fig 4.2- Wealth index (Quintiles)

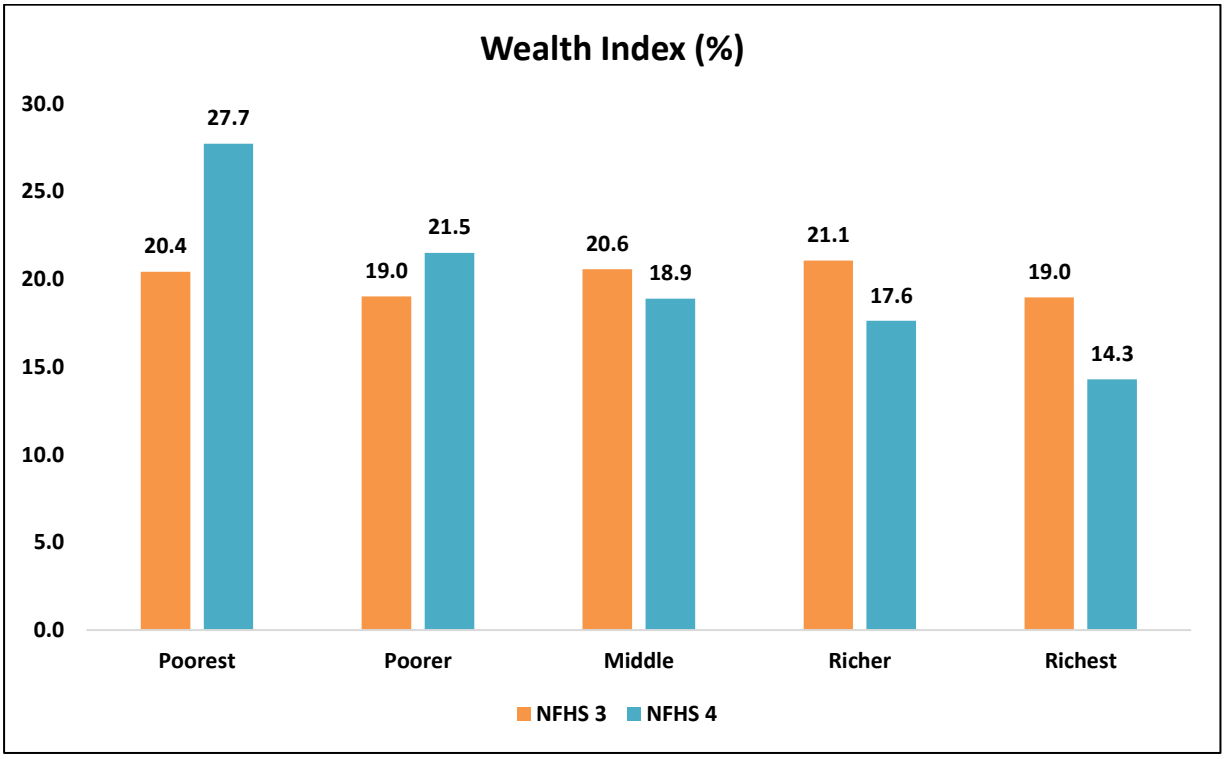


Fig 4.3 Number of members in a household

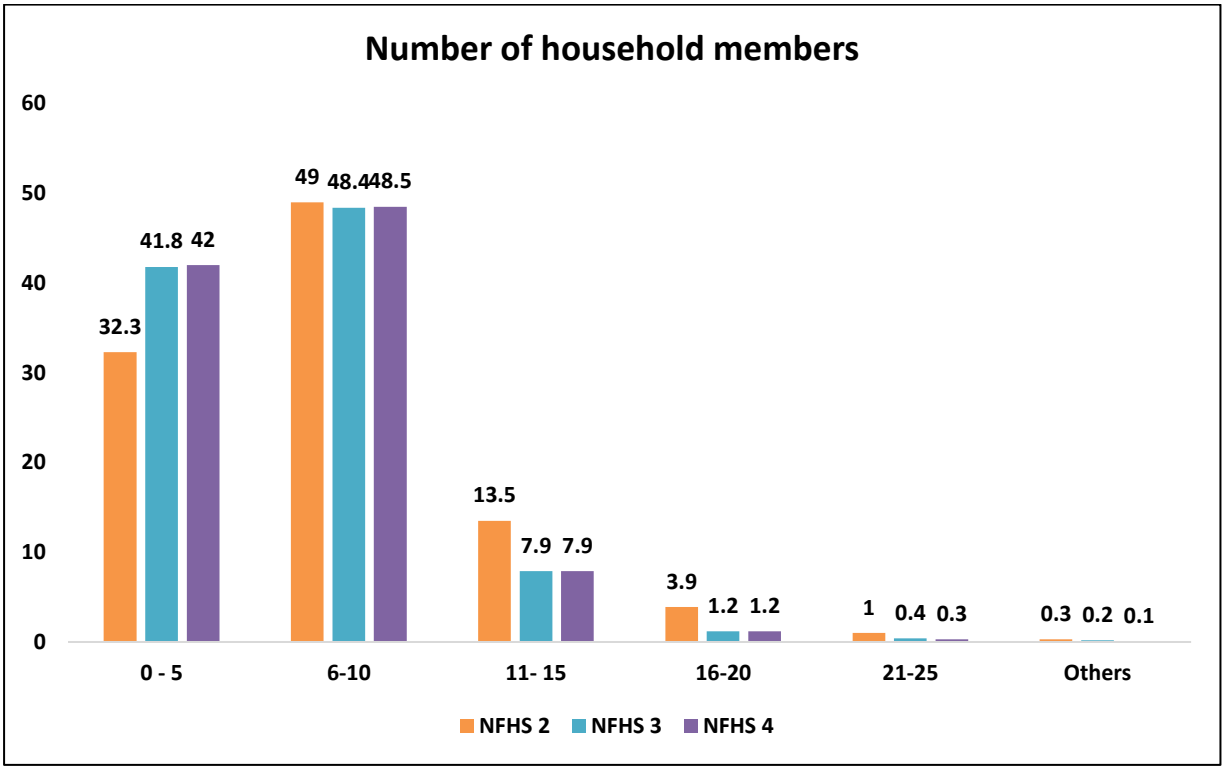


Table 4.1: Socio Demographic profile of the population

	NFHS 2 % (n)	NFHS 3 % (n)	NFHS 4 % (n)
Source of Drinking Water			
Piped into dwelling	0(0)	11.8 (1535)	11.6 (55833)
Piped to yard/plot	27.4 (1458)	11.0 (1428)	10.9 (5261)
Public tap/standpipe	21.2 (1128)	14.5 (1877)	10.9 (5263)
Tube well or bore well	15.1 (804)	35.5 (4605)	44.1 (21268)
Protected well	0.7 (37)	1.9 (244)	1.9 (908)
Unprotected well	5.6 (296)	9.2 (1188)	4.9 (2346)
Protected spring	0(0)	1.8 (227)	0.2 (114)
Unprotected spring		2.3 (301)	0.5 (230)
River/dam/lake/ponds/stream/ canal/irrigation channel	1.3 (73)	2.7 (351)	0.8 (363)
Rainwater	0.1 (3)	0.2 (29)	0.2 (118)
Tanker truck	0.2 (12)	0.8 (102)	1.3 (619)
Cart with small tank	0(0)	0.2 (32)	0.2 (73)
Bottled water	0(0)	0.3 (34)	2.3 (1100)
Community RO plant			0.4 (191)
Other	0.4 (22)	0.1 (19)	0.1 (62)
Not a de jure resident	0(0)	7.6 (988)	9.8 (4766)
Type of toilet Facilities			

	NFHS 2 n (%)	NFHS 3 n (%)	NFHS 4 n (%)
Flush to piped sewer system		10.0 (1289)	6.5 (3119)
Flush to septic tank		18.2 (2358)	25.3 (12210)
Flush to pit latrine		5.2 (679)	6.3 (3042
Flush to somewhere else		2.2 (288)	1.0 (499)
Flush, don't know where		0.1 (13)	0.1 (36)
Ventilated Improved Pit latrine (VIP)		0.2 (23)	0.5 (218)
Pit latrine with slab		3.8 (487)	3.3 (1611)
Pit latrine without slab/open pit		3.6 (471)	1.5 (710)
No facility/bush/field		47.7 (6174)	44.9 (21687)
Composting toilet		0.1 (17)	0.2 (74)
Dry toilet		1.0 (133)	0.4 (183)
Other		0.2 (29)	0.2 (110)
Not de jure resident		7.6 (988)	9.9 (4766)
Type of cooking fuel			
Electricity	-	0.4 (54)	0.5 (248)
LPG, natural gas	-	22 (2856)	29.4 (14170)
Biogas	-	0.3 (37)	0.4 (215)
Kerosene	-	3.2 (419)	1.0 (477)
Coal, Lignite	-	1.2 (150)	0.8 (363)

	NFHS 2 n (%)	NFHS 3 n (%)	NFHS 4 n (%)
Charcoal	-	0.5 (65)	0.4 (213)
Wood	-	48.6 (6292)	41.9 (20240)
Straw/shrubs/grass	-	3.4 (446)	2.5 (1204)
Agricultural crop	--	2.6 (335)	3.3 (1613)
Animal dung	-	10.1 (1314)	9.8 (4726)
No food cooked in house	-		.0 (11)
other	-	.0 (1)	.0 (19)
Not a de jure resident	-	7.6 (988)	9.9 (4766)

Maternal characteristics and birth order

Table 4.2, mean age of the mothers was found to be 24.75 + 4.97, 27.85 ± 5.69 and 28 + 5.388 years in NFHS 2, 3, and 4 respectively. Mean age of the mothers at first birth has increased over the years from 19.48 ± 3.29 (NFHS2), 19.64 ± 3.64 years (NFHS 3) to 20.84 ± 3.487 years (NFHS4).

As shown in **fig 4.4,** In NFHS 3, **Mother's aged** 15-19 years were 3.9% (n=499) and 3.9% (n= 506) mothers were aged 40- 49 years. Similarly, in NFHS 4 mothers in age group 15 to 19 were 2.0% and 3.9% (n=1871) mothers belonged to the age group 40 to 49 years.

Mothers age at first birth depicts how old was the mother when she had her first child. In NFHS 2, It is noticed that 51.7% (n=2747) had their first child at an early age which ranged from 15 to 19 years. 43.6% (n=2317) had their first child at an age ranging from 20 to 29 years. In NFHS 3, it was noticed that 52.7% (n=6550) had their first child at an early age which ranges from 15 to 19 years. 45.6% (n=5668) had their first child at an age ranging from 20 to 29 years. In NFHS 4, it was observed that 39.4 % (n=19017) had their first child at an early age which ranges from 15 to 19 years. 58.5% (n=28203) had their first child at an age ranging from 20 to 29 years. **(Table 4.3)**.

Studies have concluded that **Maternal short stature** is significantly associated with child undernutrition (Berhe et al., 2019; Corsi et al., 2016). In NFHS 2, mothers with 144.9 cm or below were 10.5% (n=559), mothers with 145 - 149.9 cm were 27.7% (n=1472). In NFHS 3, mothers with 144.9 cm or below were 37.5 % (n=4864). In NFHS 4, mothers with 144.9 cm or below were 11.6 % (n=5592), mothers with 145 - 149.9 cm were 26.4% (n=12737) **(Table 4.3)**.

Maternal BMI is significantly associated with low birth weight, small for gestational age infants (Rahman, 2015). In NFHS 2, 5.6% (n= 296) mothers had BMI 15.9 kg/m^2 or lower. 48% (n=2550) mothers had BMI ranging from 18.5 - 22.9 kg/m^2. In NFHS 3 5.8% (n= 756) mothers had BMI 15.9 kg/m^2 or lower. 46.1% (n=5969) mothers with BMI ranging from 18.5 - 22.9 kg/m^2. In NFHS 4, 3.9 % (n= 1903) mothers had BMI 15.9 kg/m^2 or lower. 22.2 % (n=10736) mothers with BMI ranging from 18.5 - 22.9 kg/m^2. 11.2 % (n= 5429) mothers had BMI ranging from 23.0 - 24.9 kg/m^2 **(Table 4.3)**.

Total children born in a family or household were divided in 3 categories: more than equal to 2 children, three to five children and more than equal to six children. In NFHS 2, Households with more than equal to 2 children were 61% and those with more than equal to six were 6.4%. In NFHS 3, Households with more than equal to 2 children were 48.3% and those with more than equal to six were 11.6 %. Similarly, in NFHS 4, more than equal to 2 children were observed in 58.5 % households and those with more than equal to six were seen in 6.1% families. With time the higher number of children in a family are decreasing **(Table 4.3)**.

As shown in **fig 4.5**, **highest education level** was divided into categories of education- no education, primary education, secondary education and higher education. In NFHS-2, women with no educational qualification were 35.5 % (n= 1887), women who had primary education were 18.4% (n= 976), women with secondary education were 32.6 % (n=1729), and women with higher education were 13.6 % (n= 720). In NFHS 3, no education (45.8%), primary (14.2 %), secondary (35.3%) and higher (6.6%). Similarly, NFHS 4 the women receiving no education, primary, secondary and higher education are 35.1 %, 14.1 %, 40.4 % and 10.4% respectively. There are studies which show mothers' education (Hasan et al., 2013) is important to make informed choices when it comes to nourishment of the child (Das & Hossain et., 2008).

As shown in **fig 4.6**, Anaemia levels depict the Haemoglobin concentration in the blood and is classified as Severe, moderate, mild and non-anaemic. In NFHS 3, mothers who had severe anaemia were 1.5% (n =200), moderate symptoms were 14.3% (n=1849) and 40.3% were non anaemic. In NFHS 4, mothers who were severely, moderately and mildly affected by Anaemia were 0.9%, 12.3% and 42.6% respectively. Maternal anaemia has adverse neonatal outcomes. Infant's length, weight, head circumference and gestational age had significant association with maternal anaemia (Kaur, 2015).

Table 4.2: Mean values for Socio demographic, anthropometric and biochemical variables (Mothers)

Parameter	**NFHS 2** **Mean ± SD** **(N=5,313)**	**NFHS 3** **Mean ± SD** **(N= 12960)**	**NFHS 4** **Mean ± SD** **(N= 48,265)**
Wealth Index factor Score (5 decimal)	----	-28920.65± 94186.37	-14511.17± 99409.095
Number of household members	7.78 + 5313	6.70 ± 3.16	6.64 ± 3.012
Respondents current age	24.75 + 4.97	27.85 ± 5.69	28 + 5.388
Age of respondent at 1st birth	19.48 ± 3.29	19.64 ± 3.64	20.84 ± 3.487
Respondents weight in kilograms	45.66 ± 8.09	46.57 ± 9.12	48.94 + 9.93
Respondents' height in centimetres	151.59 ± 5.61	151.83 ±5.80	151.73 ± 6.08
Body Mass Index	19.84 ± 3.15	20.21 ±4.05	21.21 ± 3.96
Haemoglobin level (g/dl) (1 decimals)	----	11.56 ± 1.71	11.60 ± 1.58
Number of antenatal visits during pregnancy	4.22 ± 3.35	3.54 ± 3.33	4.02 + 4.48

Figure 4.4: Age of mothers (in years)

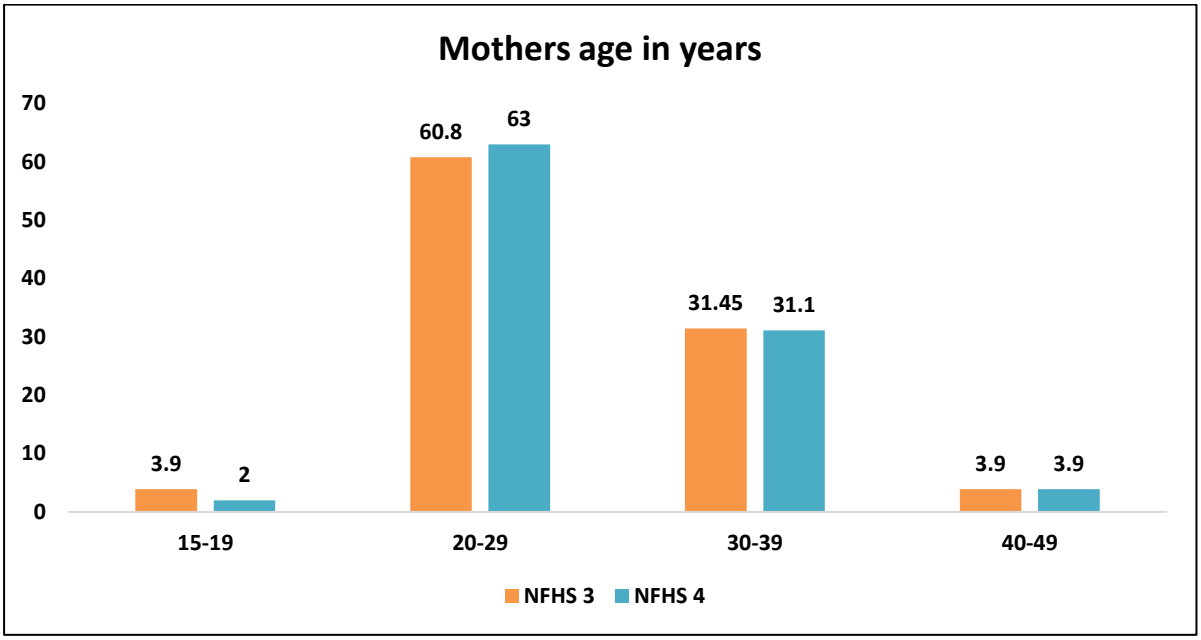


Fig 4.5 - Highest Level of education (Mothers)

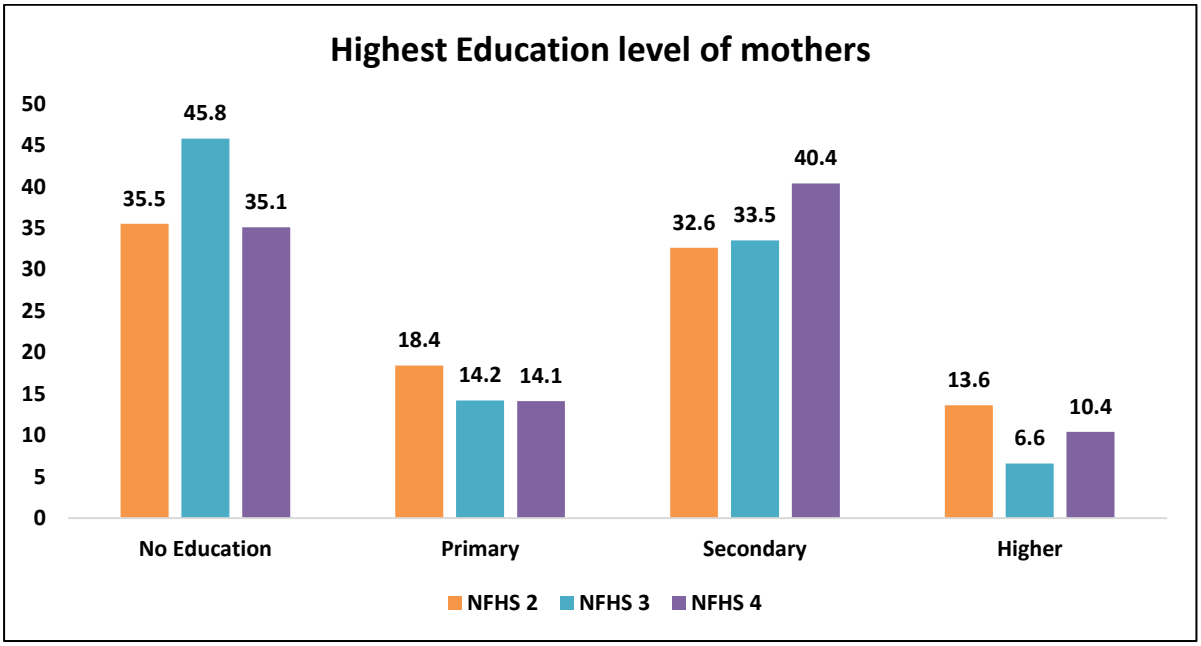
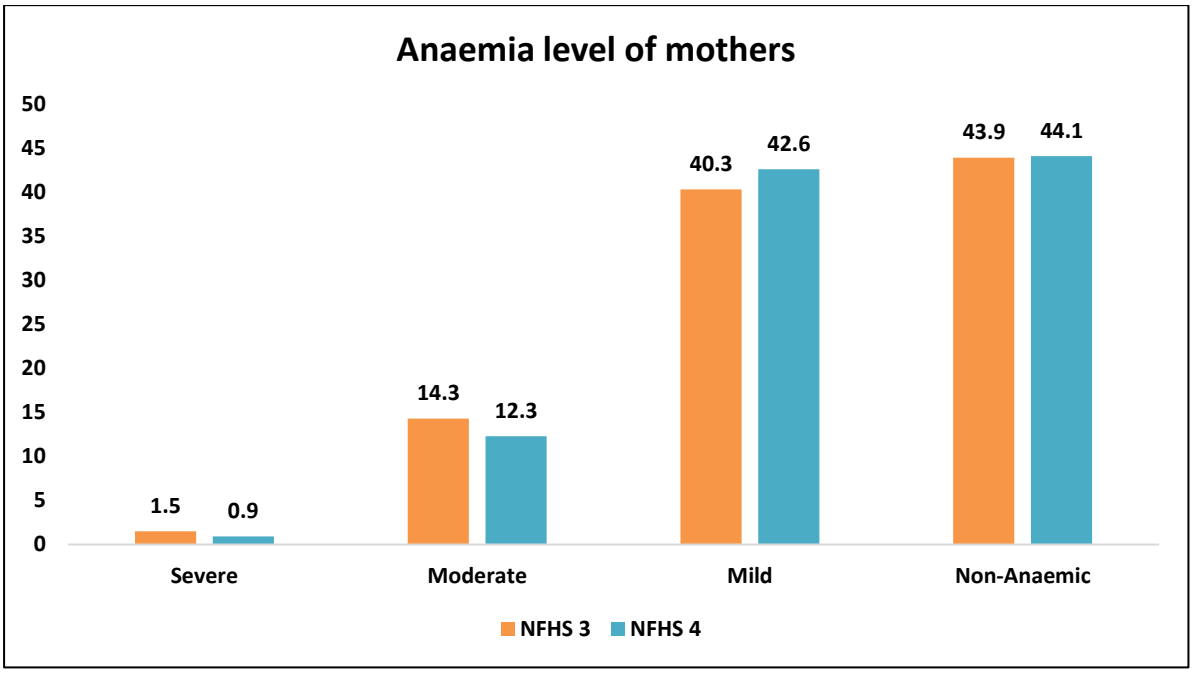


Table 4.3: Frequency distribution of maternal variables

	NFHS 2 **% (n)**	**NFHS 3** **% (n)**	**NFHS 4** **% (n)**
Mother's age at first birth			
15 - 19	51.7 (2747)	52.7 (6550)	39.4 (19017)
20 - 29	43.6 (2317)	45.6 (5668)	58.5 (28203)
30 - 39	0.7 (39)	1.6 (199)	2.1 (1013)
40 - 49	3.9 (210)	.0 (4)	0.1 (32)
Mothers Height (cm)			
Lowest – 144.9 cm	10.5 (559)	37.5 (4864)	11.6(5592)
145 – 149.9	27.7 (1472)	-	26.4 (12737)
150 – 154.9	35.5 (1888)	33.9 (4399)	34.3 (16535)
155 – 159.9	19.6 (1041)	20.3 (2625)	20 (9670)
others	6.6 (353)	8.3 (1072)	7.7 (3730)
Total child born			
≤ 2	61.2 (3252)	48.3 (6255)	58.5 (28257)
3-5	32.4 (1721)	40.1 (5201)	35.3 (17056)
≥ 6	6.4 (340)	11.6 (1504)	6.1 (2952)
Maternal BMI			
Low – 15.9	5.6 (296)	5.8 (756)	3.9 (1903)
18.5	32.0 (1698)	30.8 (3997)	22.2 (10736)
18.5 – 22.9	48.0 (2550)	46.1 (5969)	47.2 (22784)

	NFHS 2 **% (n)**	**NFHS 3** **% (n)**	**NFHS 4** **% (n)**
23.0 – 24.9	6.7 (353)	7.6 (986)	11.2 (5429)
others	7.8 (416)	9.7 (1252)	15.4 (7412)

Fig 4.6 - Prevalence of Anaemia amongst mothers



Assessing nutritional status of the children

Age of the child in months in NFHS 2- 17.4 % children were 6-11 months, 15.7 % were 12-23 months old, 32.3 % were 24-35 months old, 34.6% were 36-47 months old. In NFHS 3- 11.6% children were 6-11 months, 25.4 % were 12-23 months old, 22.9 % were 24-35 months old, 22.0% were 36-47 months old and 19 %b was of 48-59 months. In NFHS 4- 11.3% children were 6-11 months, 23.6% were 12-23 months old, 22.1 % were 24-35 months old, 22.1% were 36-47 months old and 20.9% were of 48-59 months **(Table 4.5)**. The mean age of the children in months is 17.49 $\pm$ 10.48, 30.95 $\pm$ 15.37 and 31.87 $\pm$ 15.58 in NFHS 2, 3 and 4 respectively **(Table 4.4)**.

Sex of the child determines whether the child born is male or female. In NFHS 2- 53 % of the children were male and 47% were female. In NFHS 3, 89.4 % were male and 10.6 % were female. According to NFHS 4 – 57.1 % were male and 42.9 were females **(Table 4.5)**.

Birth order refers to the order in which the child was born in the family. In NFHS 2, there 12.6 % birth order ranged 4 to 5 and 6.1 % were 6th or more in the order. In NFHS 3, 20.4 % were 4th or 5th. According to NFHS 4- 15.6% were ordered 4th or 5th children and 6.1 % were 6th or more **(Table 4.5)**.

Size of the child at birth was divided into 6 categories: Very Large, Larger than average, Average, Smaller than average, very small and don't know. In NFHS 2 - 4.5 % of children were very small. 60.9 % were average, 18.3 % were smaller than average, 12% were larger than average and 6.3% were very large. In NFHS 3 - 5.8 % children were very small, 55.8 % were average, 14.3 % were smaller than average, 18.4 % were larger than average and 6.3% were very large. According to NFHS 4- 3.0% children were very small, 68.6% were average, 8.3% were smaller than average, 12% were larger than average and 6.3% were very large **(Table 4.5)**.

Table 4.4: Mean values for Anthropometric and biochemical variables (Children)

Parameter (Child)	NFHS 2 Mean ± SD (N= 5,313)	NFHS 3 Mean ± SD (N= 12,960)	NFHS 4 Mean ± SD (N= 48,265)
Current age (in months)	17.49 ± 10.48	30.95 ± 15.37	31.87 ± 15.58
Weight in kilograms	8.48 ± 2.56	10.64 + 2.82	10.94 ± 2.85
Height in centimetres	73.49 ± 10.56	84.05 + 11.63	85.60 ± 11.80
Haemoglobin level (g/dl)	---	10.21 + 1.59	10.50 ± 1.523

Table 4.5: Frequency distribution for variables of interest (Children)

	NFHS 2 % (n)	NFHS 3 % (n)	NFHS 4 % (n))
Child age (in months)			
6-11	17.4 (926)	11.6 (1508)	11.3 (5463)
12-23	15.7 (836)	25.4 (3295)	23.6 (11380)
24-35	32.3 (1715)	22.9 (2973)	22.1 (10644)
36-47	34.6 (1836)	21.0 (2722)	22.1 (10687)
48-59	-	19.0 (2462)	20.9 (10091)
Sex of the child			
Male	53.0 (2813)	89.4 (11589)	57.1 (27568)
Female	47.0 (2500)	10.6 (1371)	42.9 (20697)

	NFHS 2 % (n)	NFHS 3 % (n)	NFHS 4 % (n))
Birth order number			
1	35.9 (1908)	19.0 (2466)	24.5 (11821)
2-3	45.4 (2413)	49.0 (6347)	53.8 (25958)
4-5	12.6 (669)	20.4 (2643)	15.6 (7535)
6 and more	6.1 (324)	11.6 (1504)	6.1 (2952)
Size of child at birth			
Very Large	0(0)	3.9 (509)	6.3 (3031)
Larger than average	16.3 (865)	18.4 (2391)	12.0 (5774)
Average	60.9 (3238)	55.8 (7228)	68.6 (33133)
Smaller than average	18.3 (971)	14.3 (1851)	8.3 (4012)
Very small	4.5 (239)	5.8 (756)	3.0 (1460)
Don't know	(0)	1.7 (225)	1.8 (855)

IYCF Practices

Prelacteal feed are the foods given to infants before breastfeeding the child. According to WHO, infants must be exclusively breastfed for the period of first 6 months but it is not followed presenting the results below.

According to NFHS 3 - During the first three days the infants were fed with other source of milk besides breast milk were 26.7%, gave plain water 7.1 %, gave sugar/glucose solution 9.9%, children who were given gripe water 0.3%, sugar/salt solution 1.9%, fruit juices 0.1%, infant formula 0.8%, tea/infusion 3.1%, honey 11.2%, janam ghutti 5.4%, other food items 1.9% and 49.3% didn't feed anything to their infants **(Table 4.6)**. According to NFHS 4 - During the first three days the infants were fed with other source of milk besides breast milk were 14.6 %, gave plain water 3 %, gave sugar/glucose solution 2.2%, children who were given gripe water 0.3%, sugar/salt solution 0.5%, fruit juices 0.2%, infant formula 0.5%, tea/infusion 1.6 %, honey 3.1 %, janam ghutti 1.8%, other food items 0.9% and 77.4 % didn't feed anything to their infants **(Table 4.6)**.

Initiation of breastfeeding within 1 hour of birth is recommended by WHO as it is rich in colostrum which also provides immunoglobulins to the infants which help them to fight with pathogens. In NFHS 2- 35.2 % mothers-initiated breastfeeding within the first hour of delivery. NFHS 3- 41.2% mothers-initiated breastfeeding within the first hour of delivery. In NFHS 4- 66.9 % mothers-initiated breastfeeding within the first hour of delivery **(Table 4.6)**.

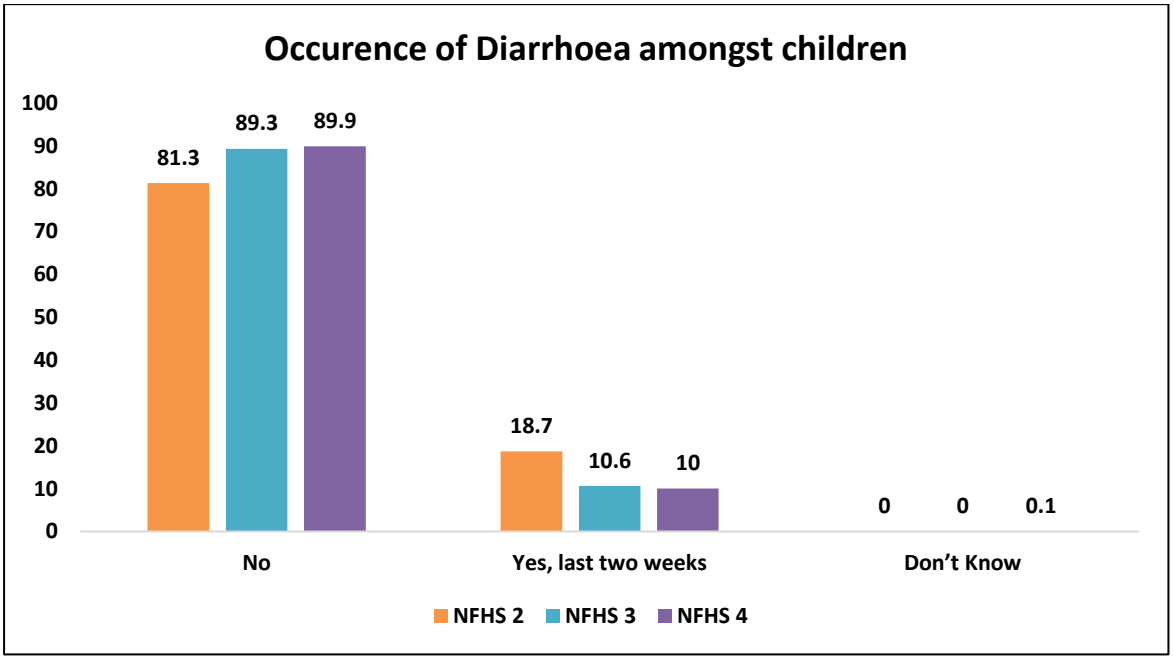
Diarrhoea is one of the most common infections in infants**.** One of the reasons is an unhygienic source of water. In NFHS 2- 18.7 % children were infected with diarrhoea in the past two weeks. In NFHS 3- 10.6 % children were infected with diarrhoea in the past two weeks. In NFHS 4-10 % children were infected with diarrhoea in the past two weeks **(Figure 4.7).**

Table 4.6 - Frequency distribution for variables of IYCF

	NFHS 3 % (n)	NFHS 4 % (n)
First 3 days, given milk (other than mothers milk)		
No	73.3 (9498)	85.4 (41235)
Yes	26.7 (3462)	14.6 (7030)
First 3 days, given plain water		
No	92.9 (12044)	97 (46831)
Yes	7.1 (916)	3.0 (1434)
First 3 days, given sugar/glucose water		
No	90.1 (11674)	97.8 (47211)
Yes	9.9 (1286)	2.2 (1054)
First 3 days, given gripe water		
No	99.7 (12922)	99.7 (48114)
Yes	0.3 (38)	0.3 (151)
First 3 days, given sugar/salt solution		
No	98.1 (12717)	99.5 (48003)
Yes	1.9 (243)	0.5 (262)
First 3 days, given fruit juice		
No	99.9 (12942)	99.8 (48182)
Yes	0.1 (18)	0.2 (83)
First 3 days, given infant formula		

	NFHS 3 % (n)	NFHS 4 % (n)
No	99.2 (12855)	99.5 (48028)
Yes	0.8 (105)	0.5 (237)
First 3 days, given tea/ infusions		
No	96.9 (12563)	98.4 (47503)
Yes	3.1 (397)	1.6 (762)
First 3 days, given honey		
No	88.8 (11504)	96.9 (46756)
Yes	11.2 (1456)	3.1 (1509)
First 3 days, given janam ghutti		
No	94.6 (12266)	98.2 (47417)
Yes	5.4 (694)	1.8 (848)
First 3 days, given other		
No	98.1 (12719)	99.1 (47823)
Yes	1.9 (241)	0.9 (442)
First 3 days, given nothing		
No	50.7 (6566)	22.7 (10945)
Yes	49.3 (6394)	77.4 (37321)
Initiation of Breastfeeding		
Within 1 hour	35.2 (1869)	41.2 (5336)
others	64.8 (3444)	58.8 (7624)

Figure: 4.7 Occurrence of Diarrhoea amongst children in past 2 weeks



Maternal and Child health services

Health card is a card that contains basic information on the mother and the child. NFHS 2 – mothers who had no health card 31.6%, mothers who had a health card but didn't see it were 54.2%. Nearly 4.2% no longer have a card. In NFHS 3- mothers who had no health card 33.9%, mothers who had a health card but didn't see it were 52.7 %. Around 13.4% no longer have a card. According to NFHS 4 data 17.7% had no health card. 57.5% had a health card but not seen and 24.8% no longer had a card **(Table 4.7)**.

Universal **immunization of children** was successful in India. In NFHS 2, almost 86.9% children received vaccination. During 2005, almost 91.1% of children were vaccinated. During 2015, almost 86.6% were vaccinated **(Table 4.7)**.

Place of delivery is to know whether the mother gave birth at home or in a hospital. Institutional delivery in the presence of a medical professional is important. In NFHS 2, Respondents who delivered in Government/ municipal hospitals were 27.4% and 37.1% delivered in a private hospital or maternity clinic. In NFHS 3- 17.1 % mothers gave birth to their children in a government/municipal hospital and 19.1 % delivered in a private hospital/maternity clinic. NFHs 4- Respondents who delivered in Government/ municipal hospitals were 20.3 % and 26.2 % delivered in a private hospital or maternity clinic **(Table 4.7)**.

Antenatal care is important for mothers and their children. It is defined as the percentage of women aged 15-49 attended by any provider at least four times during pregnancy. In NFHS 2- 13.5% had no antenatal visits, 18.5% had 1to 2 visits, 29.5% had 5 to 8 visits and 8.4% had 9 to 12 ANC visits. NFHS 3- 23.1 % had no antenatal visits, 22.3 % had 1to 2 visits, 22.4% had 5 to 8 visits and 8.9% had 9 to 12 ANC visits. NFHS 4- 22.5% had no antenatal visits, 19.7% had 1to 2 visits, 22.4% had 5 to 8 viits and 8.2% had 9 to 12 ANC visits **(Table 4.7)**.

Table 4.7: Frequency distribution for variables of maternal and child health services

	NFHS 2 % (n)	NFHS 3 % (n)	NFHS 4 % (n)
Has Health Card			
No card	31.6 (1679)	33.9 (4383)	17.7 (8534)
Yes, Not seen	54.2 (2879)	52.7 (6825)	57.5 (27770)
No longer has card	14.2 (755)	13.4 (1737)	24.8(11961)
Ever had vaccination			
No	13.0 (690)	8.7 (1123)	12.7 (6111)
Yes	86.9 (4616)	91.1 (11805)	86.6 (41807)
Don't Know	0.1 (6)	0.2 (32)	0.7 (348)
Place of delivery			
Respondent's home	17.4 (925)	51.6 (6690)	21.8 (10525)
Other home	0.3 (18)	0.5 (65)	0.2 (86)
Parent's Home	7.2 (384)	6.8 (885)	2.9 (1397)
Public: Govt./ Municipal Hospital	27.4 (1458)	17.1 (2210)	20.3 (9773)
Public: Govt. Dispensary	0.5 (25)	0.3 (34)	1.4 (686)
Public: UHC/ UHP/ UF WC	0.4 (24)	0.2 (24)	1.6 (779)
Public: CHC/ Rural Hospital/ Block PHC	6.6 (348)	3.2 (415)	16.8 (8105)
Public: PHC/Additional PHC	**0(0)**	0(0)	6.4 (3099)
Public: Sub - Centre	0.5 (27)	0.2 (30)	0.9 (454)
Other Public Health Sector Facility	0.3 (17)	0.2 (21)	0.1 (59)
Private Hospital/Maternity Home / Clinic	37.1 (1972)	19.1 (2470)	26.2 (12661)
Other Private Sector Health Facility	0.3 (15)	0.1 (16)	0.5 (263)
NGO or Trust Hospital/ Clinic	1.7 (89)	0.7 (88)	0.5 (255)
Other	0.2 (12)	0.1 (12)	0.3 (123)
Number of Antenatal Visits during pregnancy			
0	13.5 (716)	23.1 (2988)	22.5 (10879)
1-2	18.5 (985)	22.3 (2888)	19.7 (9528)
3-4	28.7 (1526)	22.4 (2907)	23.9 (11521)
5-8	29.5 (1568)	22.4 (2898)	22.4 (10800)
9-12	8.4 (444)	8.9 (1161)	8.2 (3975)
13-15	0.6 (33)	0.9 (118)	1.2 (570)
16 - highest	0.8 (41)	-	2.1 (992)

Nutritional Status of Children

Prevalence of stunting

As can be observed from (**Table 4.8)** in NFHS 2 - 27.8 % were mildly stunted, followed by 21.5 % which were moderately stunted and 16.7 % were severely stunted. In NFHS 3- 25.1 % were mildly stunted, followed by 24.4 % which were moderately stunted and 23.1 % were severely stunted. In NFHS 4- 27.2 % were mildly stunted, followed by 20.5 % which were moderately stunted and 14.6 % were severely stunted.

Prevalence of underweight

In NFHS 2 - 30.4 % were mildly underweight, followed by 28.2 % were moderately underweight and 12.5 % were severely underweight. NFHS 3- 31.4 % were mildly underweight, followed by 26 % were moderately underweight and 15.2 % were severely underweight. NFHS 4- 32.9 % were mildly underweight, followed by 32.4 % were moderately underweight and 12.6% were severely underweight **(Table 4.8)**.

Prevalence of wasting amongst children

In NFHS 2 - 32.5 % were mildly wasted, followed by 11.6 % which were moderately wasted and 2.5 % were severely wasted. In NFHS 3- 30.2 % were mildly wasted, followed by 12.5% which were moderately wasted and 6.5 % were severely wasted. In NFHS 4- 37.6 % were mildly wasted, followed by 16.3 % which were moderately stunted and 4.7 % were severely wasted **(Table 4.8)**.

Table 4.8: Prevalence of stunting, Underweight and wasting amongst children

Z scores (SD)	NFHS -2 (1988-1999) % (n)	NFHS -3 (2005 -2006) % (n)	NFHS- 4 (2015 – 2016) % (n)
Height for age (z scores SD)			
<-3	16.7 (889)	23.1 (2998)	14.6 (7036)
-3 to -2	21.5 (1145)	24.4 (3157)	20.5 (9872)
-1 to -2	27.8 (1477)	25.1 (3248)	27.2 (13113)
1to -1	28.6 (1519)	22.5 (2922)	30.8 (14854)
1to 2	3.4 (178)	2.9 (376)	4.1 (1985)
2 to 3	1.2 (61)	1.1 (143)	1.7 (828)
>3	0.8 (44)	0.9 (116)	1.2 (576)
Weight for age (z score SD)			
<-3	12.5 (663)	15.2 (1976)	12.6 (6073)
-3 to -2	28.2 (1497)	26.0 (3367)	32.4 (15662)
-1 to -2	30.4 (1616)	31.4 (4067)	32.9 (15870)
1to -1	26.3 (1398)	25.5 (3309)	20.2 (9756)
1to 2	1.8 (97)	1.5 (199)	1.2 (598)
2 to 3	0.4 (22)	0.2 (31)	0.4 (195)
>3	0.4 (20)	0.1 (11)	0.2 (111)
Weight for height (z score SD)			
<-3	2.5 (135)	6.5 (840)	4.7 (2266)
-3 to -2	11.6 (617)	12.5 (1619)	16.3 (7864)
-1 to -2	32.5 (1727)	30.2 (3918)	37.6 (18131)
1to -1	46.8 (2488)	45.6 (5905)	37.7 (18207)
1to 2	4.4 (233)	3.6 (461)	2.4 (1170)
2 to 3	1.4 (77)	1.2 (155)	0.9 (433)
>3	0.7 (36)	.5 (62)	0.4 (195)

Interrelationships between the Variables of interest

Prevalence of stunting (HAZ <- 2sd z scores) and trends based on selected variables - National Family Health Survey 4

The sample size of children was 48265, out of which 17040 i.e., 35.3% were stunted children and 31225 i.e., 64.7% were not stunted. While relating the child's age in months with stunting, 10.1% stunted children belonged to the category of 12 to 23 months. Only 2.4 % were stunted in the age group 6 to 11 months. The highest proportion of non-stunted children were in the age group 24 to 35 months i.e., 15.1%. **(Table 4.9)**.

Percentage of male children who were stunted were 20% and non-stunted children were 37.1 %. In female children 15.3% were stunted and 27.6% were stunted. Male children are more likely to be stunted **(Table 4.9)**.

Nearly one fourth of children whose birth order were 1st, out of which 7% were stunted and 17.5% were non stunted. 2nd and 3rd birth order were seen in 53.8 %, out of which 18.3% were stunted. 6.1% had birth order 6th or more in which 3.0% were stunted and.

When the size of the child was cross analysed with stunting and non-stunting around 68.6% were average sized children, out of which 23.8% were stunted and 44.8% were not stunted. Simultaneously if we look at the very small size of children, out of 3% children, 1.5 % were stunted and 1.5% were non stunted, as given in (**Table 4.9)**.

Out of the 1.7% children who had severe anaemia, 0.8% were stunted and 0.8 % were not stunted too. The highest stunted children were seen in moderate anaemic i.e., 12.7 %. the highest (28.1%) non stunted children were observed in non- anaemic children as given in **table 4.9**.

Majority (71.9%) of the children dwelled in rural areas out of which 27.7% children were stunted and remaining 44.2% weren't stunted. 28.1 % dwelled in urban areas, in which 7.6% were stunted and the remaining 20.5% were not stunted as shown in **table 4.9**.

Out of the 27.7% who were the poorest, 13.1% were stunted and 14.6% were not stunted. 21.5 % were poorer out of which 8.6 % were stunted and 12.9% were not stunted. If we compare it with richest households i.e., 14.3 %, only 2.7% were stunted

and 11.5% were not stunted. Richest the household wealth status lessens the chances of being stunted as given in **table 4.9**.

Nearly half of the households had 6 to 10 members in a family, out of which 17.5 % were stunted and 31.0 % were not stunted. In a family of 11 to 15 members (7.9%), 2.8% were stunted and 5.1 % were not stunted. In a family of 16 to 20 members (1.2%) 0.5% were stunted and 0.8 % were not stunted. It is observed that the larger size of the family gradually the percentage of stunted children are also increasing as given in **table 4.9**.

In households which had 2 or fewer children (58.5%), 17.9% were stunted and 40.6% were not stunted. A household with 6 or more children (6.1%), 3% children were stunted and 3.1% were not stunted. When the number of children in a household increases the stunting prevalence might increase too as shown in **table 4.9**.

Two third of the mothers were categorised under 20 to 29 years old, out of which 19.6% had stunted children and 38.8 % had non stunted children. Out of the 2.0% mothers in the age group 15 to 19 years old, 0.7 % had stunted children and the remaining 1.3 % had non stunted children.3.9% who were 40 - 49 years old 1.8 % were stunted and 2.1 were not stunted out of them. 15 to 19 and 40 - 49-year-old females are less likely to give birth to children who are stunted as given in **table 4.9**.

Around 58.4% of mothers were 20 to 29 years old when they had their first child. Out of which 19.6% were stunted and 38.8% were not stunted. Out of which 15.0% were stunted and 24.4% were not stunted. Children were more likely to be stunted if they are born to mothers who were pregnant at the age of 15 - 19 years old as given in **table 4.9**.

Nearly one fourth of the mother's height ranged from 145 to 149.9 cm, out of which had 11 % had stunted children and 15.4% were not stunted. Mothers whose height was 144.9cm or below that (11.6%), they had 6.4% children who were stunted and 5.2% who were not stunted. If compared with mothers with height ranging from 155 to 159.9cm (20%), only 5% had stunted children and the remaining 15 % were not stunted. It results in mothers with shorter height being more prone to give birth to children who may be stunted later in life as given in **table 4.9**.

Almost half (47.2%) mothers had BMI ranging between 18.51 - 22.9 kg/m^2 out of which 17.9% had stunted children and 8.0% were not stunted. Mothers with BMI 15.9

kg/m^2 below (3.9%) out of these 1.7% had stunted children and 2.2% were not stunted **(Table 4.9)**.

Nearly 42.6 % mothers had mild anaemia, 15.7% of them had stunted children and 27.0% were not stunted. 4.6% children were stunted and 7.7 % were not stunted whose mothers were moderately anaemic (12.3%). 0.9 % were severe anaemic out of which 0.4% were stunted and 0.6% were not stunted. The percentage of stunted children increased with severity of mother's anaemia level **(Table 4.9)**.

Women who had no education were 35.1%, out of which 16.2% were stunted children and 18.9% were not stunted children. Mothers who went to primary school (14.1%), 5.5% children were stunted and 8.6% were not stunted children. Women who had secondary education (40.4%) out of which only 11.8% were stunted children but remaining 28.6% were not stunted children. This shows that mothers' education does play a role in childhood stunting. Children born to educated mothers are less likely to be stunted as given in **table 4.9**.

Out of 66.9% who initiated breastfeeding within one hour of birth, 43.6% were not stunted and 23.3 5 were stunted. Initiation of breastfeeding within one hour of birth proves to be beneficial for the child and reduces the chance of being stunted as given in **table 4.9**.

Children (12.7%) who were not vaccinated, out of them 5 % were stunted and 7.7% were not stunted. 86.6 % were vaccinated out of which 30.1% were stunted and 56.5 % were not stunted revealing that child immunization reduces the chance of being stunted as given in **table 4.9**.

One tenth of the children had diarrhoea in the last two weeks, out of which 3.8% children were stunted and 6.2% were not stunted. 89.9% children did not have diarrhoea in the last two weeks (89.9%), out of which 31.4% were stunted and 58.55 were not stunted. Diarrhoea and recurrent infections can increase the chances of a child to be stunted as given in **table 4.9**.

Mothers who had no Antenatal visits (22.5%), 10.1 % children were stunted and 12.4% were not stunted. Mothers who had 5 to 8 antenatal visits (22.4%) out of which 6.3% were stunted and the remaining 16.1% were not stunted. Higher the number of antenatal visits the chances of child being stunted lowers as given in **table 4.9**.

Table 4.9: Prevalence of stunting (HAZ <- 2sd z scores) and trends based on selected variables - National Family Health Survey 4

Parameter	Stunting % (n)	No stunting % (n)	Chi - Square	Total % (n)
Socio Demographic Variables				
Type of Residence				
Urban	7.6 (3687)	20.5 (9896)	551.17***	28.1 (13583)
Rural	27.7 (13353)	44.2 (21329)		71.9 (34682)
Wealth Index				
Poorest	13.1 (6320)	14.6 (7055)	2071.19***	27.7 (13375)
Poorer	8.6 (4157)	12.9 (6217)		21.5 (10374)
Middle	6.3 (3041)	12,6 (6077)		18.9 (9118)
Richer	4.6 (2201)	13.1 (6302)		17.6 (8503)
Richest	2.7 (1321)	11.5 (5573)		14.3 (6894)
No of Household member				
0-5	14.3 (6925)	27.6 (13330)	33.76***	42.0 (20255)
6-10	17.5 (8443)	31.0 (14960)		48.5 (23403)
11-15	2.8 (1350)	5.1 (2463)		7.9 (3813)
16-20	0.5 (229)	0.8 (374)		1.2 (603)
21-25	0.1 (70)	0.2 (77)		0.3 (147)
others	.0 (23)	0.0 (22)		0.1 (45)
Variables related to the child				
Child's age (in months)				
6 - 11	2.4 (1182)	8.9 (4280)	824.50***	11.3 (5462)
12 -23	10.1 (4880)	13.5 (6500)		23.6 (11380)
24 - 35	6.9 (3344)	15.1 (7300)		22.1 (10644)
36 - 47	8.0 (3869)	14.1 (6818)		22.1 (10687)
48 - 59	7.8 (3765)	13.1 (6327)		20.9 (10092)
Sex of the child				
Male	20.0 (9668)	37.1 (17900)	1.57	57.1 (27568)
Female	15.3 (7373)	27.6 (13325)		42.9 (20698)
Birth Order				
1	7.0 (3389)	17.5 (8431)	772.86***	24.5 (11820)
2-3	18.3 (8854)	35.4 (17103)		53.8 (25957)
4-5	6.9 (3328)	8.7 (4208)		15.6 (7536)
6 and more	3.0 (1469)	3.1 (1483)		6.1 (2952)
Size of child at birth				
Very large	2.0 (982)	4.2 (2049)	277.22***	6.3 (3031)
Larger than average	3.8 (1810)	8.2 (3964)		12.0 (5774)
Average	23.8 (11498)	44.8 (21636)		68.6 (33134)
Smaller than average	3.4 (1649)	4.9 (2363)		8.3 (4012)
Very small	1.5 (728)	1.5 (732)		3.0 (1460)
Don't know	0.8 (374)	1.0 (481)		1.8 (855)
Anaemia level				
Severe	0.8 (402)	0.8 (410)	546.22***	1.7 (812)

Moderate	12.7 (6134)	17.9 (8643)		30.6 (14777)
Mild	9.8 (4708)	17.8 (8612)		27.6 (13320)
Non anaemic	12.0 (5796)	28.1 (13559)		40.1 (19355)
Variables related to the mother				
Mother's age (in Years)				
15-19	0.7 (355)	1.3 (633)	133.11***	2.0 (988)
20-29	21.3 (10297)	41.6 (20097)		63.0 (30394)
30-39	11.5 (5531)	19.6 (9481)		31.1 (15012)
40-49	1.8 (857)	2.1 (1014)		3.9 (1871)
Mothers age at first birth				
15-19	15.0 (7260)	24.4 (11757)	125.43***	39.4 (19017)
20-29	19.6 (9475)	38.8 (18729)		58.4 (28204)
30-39	0.6 (302)	1.5 (711)		2.1 (1013)
40-49	.0 (4)	0.1 (28)		0.1 (32)
Mothers' height (cm)				
144.9 or below	6.4 (3084)	5.2 (2508)	2107.91***	11.6 (5592)
145 – 149.9	11.0 (5308)	15.4 (7429)		26.4 (12737)
150 – 154.9	11.5 (5530)	22.8 (11005)		34.3 (16535)
155 – 159.9	5.0 (2411)	15.0 (7259)		20.0 (9670)
>160	1.5 (707)	6.3 (3024)		7.7 (3731)
Maternal BMI (kg/m^2)				
Lowest-15.9	1.7 (829)	2.2 (1074)	777.88***	3.9 (1903)
16.0-18.50	9.5 (4562)	19.8 (6174)		22.2 (10736)
18.51-22.9	17.1 (8259)	30.1 (14525)		47.2 (22784)
23.0-24.9	3.2 (1563)	8.0 (3866)		11.2 (5429)
>25	3.8 (1827)	11.6 (5585)		15.4 (7412)
Anaemia Level mother				
Severe	0.4 (169)	0.6 (282)	61.39***	0.9 (451)
Moderate	4.6 (2204)	7.7 (3738)		12.3 (5942)
Mild	15.7 (7555)	27.0 (13019)		42.6 (20574)
Not Anaemic	14.7 (7112)	29.4 (14186)		44.1 (21298)
Highest educational level				
No education	16.2 (7835)	18.9 (9105)	1993.14***	35.1 (16940)
Primary	5.5 (2661)	8.6 (4147)		14.1 (6808)
Secondary	11.8 (5700)	28.6 (13814)		40.4 (19514)
Higher	1.7 (844)	8.6 (4159)		10.4 (5003)
Total child born				
≤ 2	17.9 (8660)	40.6 (19598)	742.17***	58.5 (28258)
3-5	14.3 (6912)	21.0 (10144)		35.3 (17056)
≥ 6	3.0 (1469)	3.1 (1483)		6.1 (2952)
Antenatal Visits				
0	10.1 (4882)	12.4 (5997)	1058.79***	22.5 (10879)
1-2	7.9 (3811)	11.8 (5718)		19.7 (9529)
3-4	8.2 (3956)	15.7 (7565)		23.9 (11521)
5-8	6.3 (3024)	16.1 (7776)		22.4 (10800)
9-12	2.0 (988)	6.2 (2987)		8.2 (3975)
13-15	0.3 (149)	0.9 (420)		1.2 (569)
16 or more	0.5 (231)	1.6 (762)		2.1 (993)

Miscellaneous variables				
Initiation of breastfeeding				
Within 1 hour	23.3 (11253)	43.6 (21028)	8.47***	66.9 (32281)
After 1 hour	12.0 (5787)	21.1 (10197)		33.1 (15984)
Ever had vaccination				
No	5.0 (2392)	7.7 (3719)	45.48***	12.7 (6111)
Yes	30.1 (14522)	56.5 (27285)		86.6 (41807)
Don't know	0.3 (126)	0.5 (221)		0.7 (347)
Had Diarrhoea recently				
No	31.4 (15174)	58.5 (28234)	24.15***	89.9 (43408)
Yes, last two weeks	3.8 (1849)	6.2 (2972)		10.0 (4821)
Don't Know	.0 (17)	.0 (19)		0.1 (36)

Prevalence of wasting (WHZ <- 2sd z scores) and trends based on selected variables - National Family Health Survey 4

There were 48265 children, out of which 21.3 % i.e., 10263 children were wasted and 78.7% i.e., 38002 children were not wasted. While relating the child's age in months with wasting, 6.4% wasted children and 17.2 % non-wasted children belonged to the category of 12 to 23 months (23.6%). Only 2.6 % were wasted in the age group 6 to 11 months. The highest proportion of non-wasted children were in the age group months 36 to 47 months i.e., 18.3 % as given in **table 4.10**.

Percentage of male children who were wasted were 12.1% and non-wasted children were 45 %. In female children 9.2 % were wasted and 33.7 % were wasted. Male children are more likely to be wasted as given in **table 4.10**.

Twenty-four-point five percent of children whose birth order were 1st, out of which 5.4% were wasted and 19.1 % were non wasted. 2nd and 3 rd. birth order were seen in 53.8%, out of which 11.3% were wasted and 42.5 % were non wasted. 6.1% had birth order 6th or more in which 1.3 % were wasted and 4.8 % were non wasted as given in **table 4.10**.

When the size of the child is related to wasting and non-wasting. 68.6% were average sized children, out of which 14.4% were wasted and 54.3 % were not wasted. Simultaneously if we look at the very small size of children, out of 3% children, 0.8 % were wasted and 2.2 % were non wasted as given in **table 4.10**.

Out of the 1.7% children who had severe anaemia, 0.4% were wasted and 1.2 % were not wasted. 7.0 percent of wasted children were moderate anaemic out of the total 30.6%. The highest 32.3 % non-wasted children were observed in non- anaemic children as given in **table 4.10**.

Households dwelled in rural areas (71.9%) out of which 15.4 % children were wasted and remaining 56.4 % weren't wasted. 28.1 % dwelled in urban areas, in which 5.8 % were wasted and the remaining 22.3 % were not wasted as shown in **table 4.10**.

Out of the 27.7% who were the poorest, 6.8 % were wasted and 20.9 % were not wasted. 21.5 % were poorer out of which 4.7 % were wasted and 16.8 % were not wasted. If we compare it with richest households i.e., 14.3 %, only 2.6% were wasted and 11.7%

were not wasted. Richest the household wealth status lessen the chances of being wasted as shown in **table 4.10**.

Households had 6 to 10 members in a family (48.5%), out of which 10 % were wasted and 38.5 % were not wasted. In a family of 11 to 15 members (7.9%), 1.6 % were wasted and 6.3 % were not wasted. In a family of 16 to 20 members (1.2%) 0.2 % were wasted and 1.1 % were not wasted. It is observed that the larger size of the family gradually the percentage of wasted children are also increasing as shown in **table 4.10**.

In a household who has 2 or fewer children (58.5%), 12.5 % were wasted and 46 % were not wasted. Households having 3- 5 children (35.3%) 7.4 % were wasted and 27.9% were not wasted. A household with 6 or more children (6.1%), 1.3 % children were wasted and 4.8 % were not wasted. When the number of children in a household increases the wasting prevalence might increase too as shown in **table 4.10**.

Percent of mothers (63) were categorised under 20 to 29 years old, out of which 13.8 % had wasted children and 49.2 % had non wasted children. Out of the 2.0% mothers in the age group 15 to 19 years old, 0.5 % had wasted children and the remaining 1.6 % had non wasted children. 3.9% who were 40 - 49 years old 0.8 % were wasted and 3.1 were not wasted as shown in **table 4.10**.

Fifty-eight-point four percent of mothers were 20 to 29 years old when they had their first child. Out of which 12.5 % were wasted and 45.9 % were not wasted. Mothers who gave birth at the age of 15 to 19 years were 39.4%. Out of which 8.3 % were stunted and 31.1 % were not wasted. Children are more likely to be wasted if they are born to mothers who were pregnant at the age of 15 - 19 years old as shown in **table 4.10**.

Mother's height (26.4%) ranged from 145 to 149.9 cm, out of which 6 % were wasted and 20.4% were not wasted. If we see mothers whose height is 144.9cm or below that (11.6%), they had 2.6 % children who were wasted and 9.0 % who were not wasted. If compared with mothers with height ranging from 155 to 159.9cm (20%), only 4% had wasted children and the remaining 16 % were not wasted. It results in mothers with shorter height being more prone to give birth to children who may be wasted as shown in **table 4.10**.

Forty- seven- point two percent mothers had BMI ranging from 18.51 - 22.9 kg/m^2 out of which 10 % were wasted and 37.2 % were not wasted. Mothers with BMI 15.9 kg/m^2

below (3.9%) out of which 1.4 were wasted and 2.6 % were not wasted as shown in **table 4.10**.

Mothers (42.6 %) had mild anaemia, 9.4 % of them were wasted and 33.2 % were not wasted. 2.6% children were wasted and 9.8 % were not wasted, mothers who were moderately anaemic (12.3%). 0.9 % mothers were severe anaemic out of which 0.2 % were wasted and 0.7% were not wasted. The percentage of wasted children increased with severity of mother's anaemia level as shown in **table 4.10**.

Women who had no education were 35.1%, out of which 8.1 % were wasted children and 27 % were not wasted children. Mothers who went to primary school (14.1%), 2.9 % children were wasted and 11.2% were not wasted children. This shows that mothers' education does play a role in childhood stunting. Children born to educated mothers are less likely to be stunted as shown in **table 4.10**.

Out of 66.9% who initiated breastfeeding within one hour of birth, 52.4 % were not wasted and 14.5 % were wasted. Initiation of breastfeeding within one hour of birth proves to be beneficial for the child and reduces the chance of being stunted as shown in **table 4.10**.

Children (12.7%) who were not vaccinated, out of them 2.8% were wasted and 9.9 % were not wasted. 86.6 % were vaccinated out of which 18.3 % were wasted and 68.3 % were not wasted, revealing that child immunization reduces the chance of being stunted as shown in **table 4.10**.

Children (10.0 %) had diarrhoea in the last two weeks, out of which 2.3 % children were wasted and 7.6 % were not wasted. 89.9% of children did not have diarrhoea in the last two weeks, out of which 18.9 % were wasted and 71 % were not wasted. Diarrhoea and recurrent infections can increase the chances of a child to be stunted as shown in **table 4.10**.

Mothers who had no Antenatal visits (22.5%), 4.8 % children were wasted and 17.7 % were not wasted. Mothers who had 5 to 8 antenatal visits (22.4%) out of which 4.8 % were wasted and the remaining 17.6 % were not wasted. Higher the Antenatal visits the chances of child being wasted lowers as shown in **table 4.10**.

Table 4.10: Prevalence of wasting (HAZ <- 2sd z scores) and trends based on selected variables - National Family Health Survey 4

Parameter	Wasting % (n)	Not Wasting % (n)	Chi-square	Total % (n)
Socio Demographic variables				
Type of Residence				
Urban	5.8 (2812)	22.3 (10771)	3.56*	28.1 (13583)
Rural	15.4 (7451)	56.4 (27231)		71.9 (34682)
Wealth Index				
Poorest	6.8 (3281)	20.9 (10094)	150.88***	27.7 (13375)
Poorer	4.7 (2260)	16.8 (8114)		21.5 (10374)
Middle	3.8 (1814)	15.1 (7304)		18.9 (9118)
Richer	3.4 (1636)	14.2 (6867)		17.6 (8503)
Richest	2.6 (1271)	11.7 (5623)		14.3 (6894)
No of Household member				
0-5	9.4 (4529)	32.6 (15726)		42.0 (20255)
6-10	10.0 (4831)	38.5 (18572)		48.5 (23403)
11-15	1.6 (775)	6.3 (3037)	40.19***	7.9 (3812)
16-20	0.2 (95)	1.1 (508)		1.2 (603)
21-25	0.1 (31)	0.2 (117)		0.3 (148)
>25	0.0 (2)	0.1 (42)		0.1 (44)
Variables related to the child				
Child's age (months)				
6 - 11	2.6 (1234)	8.8 (4229)	425.25***	11.3 (5463)
12 -23	6.4 (3076)	17.2 (8304)		23.6 (11380)
24 - 35	4.9 (2346)	17.2 (8298)		22.1 (10644)
36 - 47	3.9 (1875)	18.3 (8812)		22.1 (10667)
48 - 59	3.6 (1732)	17.3 (8360)		20.9 (10092)
Sex of the child				
Male	12.1 (5830)	45.0 (21738)	0.518	57.1 (27568)
Female	9.2 (4433)	33.7 (16264)		42.9 (20697)
Birth Order				
1	5.4 (2592)	19.1 (9229)	4.32	24.5 (11821)
2-3	11.3 (5456)	42.5 (20502)		53.8 (25958)
4-5	3.3 (1584)	12.3 (5951)		15.6 (7535)
6 and more	1.3 (631)	4.8 (2321)		6.1 (2952)
Size of child at birth				
Very large	1.1 (514)	5.2 (2517)	102.61***	6.3 (3031)
Larger than average	2.5 (1219)	9.4 (4555)		12.0 (5774)
Average	14.4 (6935)	54.3 (26198)		68.6 (33133)
Smaller than average	2.0 (986)	6.3 (3026)		8.3 (4012)
Very small	0.8 (406)	2.2 (1054)		3.0 (1460)
Don't know	0.4 (203)	1.4 (652)		1.8 (855)
Anaemia level				
Severe	0.4 (212)	1.2 (600)	77.34***	1.7(812)

Moderate	7.0 (3379)	23.6(11399)		30.6(14778)
Mild	6.0 (2917)	21.6 (10404)		27.6 (13321)
Non anaemic	7.8 (3755)	32.3 (15600)		40.1 (19355)
Variables related to the mother				
Mother's age				
15-19	0.5 (219)	1.6 (769)	24.89***	2.0 (988)
20-29	13.8 (6667)	49.2 (23727)		63.0 (30394)
30-39	6.2 (3010)	24.9 (12002)		31.1 (15012)
40-49	0.8 (367)	3.1 (1504)		3.9 (1871)
Mothers age at first birth				
15-19	8.3 (4008)	31.1 (15009)	4.46	39.4 (19017)
20-29	12.5 (6049)	45.9 (22154)		58.4 (28203)
30-39	0.4 (204)	1.7 (810)		2.1 (1014)
40-49	0.0 (3)	0.1 (29)		0.1 (32)
Mothers' height (cm)				
144.9 or less	2.6 (1242)	9.0 (4350)	45.0***	11.6 (5592)
145 – 149.9	6.0 (2915)	20.4 (9822)		26.4 (12737)
150 – 154.9	7.2 (3456)	27.1 (13078)		34.3 (16534)
155 – 159.9	4.0 (1947)	16.0 (7724)		20.0 (9671)
160 or more	1.5 (702)	6.3 (3028)		7.7 (3730)
Maternal BMI (kg/m^2)				
Lowest-15.9	1.4 (665)	2.6 (1238)	642.06***	3.9 (1903)
16.0-18.50	5.7 (2770)	16.5 (7967)		22.2 (10737)
18.51-22.9	10.0 (4846)	37.2 (17938)		47.2 (22748)
23.0-24.9	2.0 (977)	9.2 (4452)		11.2 (5429)
>25	2.1 (1005)	13.3 (6407)		15.4 (7412)
Anaemia Level mother				
Severe	0.2 (109)	0.7 (342)		0.9 (451)
Moderate	2.6 (1231)	9.8 (4712)	17.42***	12.3 (5943)
Mild	9.4 (4541)	33.2 (16032)		42.6 (20573)
Not Anaemic	9.1 (4382)	35.0 (16916)		44.1 (21298)
Highest educational level				
No education	8.1 (3888)	27.0 (13052)	71.68***	35.1 (16940)
Primary	2.9 (1398)	11.2 (5410)		14.1 (6808)
Secondary	8.5 (4096)	31.9 (15419)		40.4 (19515)
Higher	1.8 (881)	8.5 (4121)		10.4 (5002)
Total child born				
≤ 2	12.5 (6045)	46.0 (22213)	0.85	58.5 (28258)
3-5	7.4 (3587)	27.9 (13469)		35.3 (17056)
≥ 6	1.3 (631)	4.8 (2321)		6.1 (2952)
Antenatal Visits				
0	4.8 (2340)	17.7 (8539)	16.59**	22.5 (10879)
1-2	4.2 (2013)	15.6 (7515)		19.7 (9528)
3-4	5.0 (2399)	18.9 (9122)		23.9 (11521)
5-8	4.8 (2304)	17.6 (8496)		22.4 (10800)

9-12	1.9 (913)	6.3 (3062)		8.2 (3975)
13-15	0.2 (199)	0.9 (451)		1.2 (570)
16-or more	0.4 (175)	1.7 (817)		2.1 (992)
Miscellaneous Variables				
Initiation of breastfeeding				
Within 1 hour	14.5 (6989)	52.4 (25292)	8.70***	66.9 (32281)
After 1 hour	6.8 (3274)	26.3 (12710)		33.1 (15984)
Ever had vaccination				
No	2.8 (1342)	9.9 (4769)	2.40***	12.7 (6111)
Yes	18.3 (8852)	68.3 (32955)		86.6 (41807)
Don't know	0.1 (69)	0.6 (279)		0.7 (348)
Had Diarrhoea recently				
No	18.9 (9126)	71.0 (34282)	16.75***	89.9 (43408)
Yes, last two weeks	2.3 (1132)	7.6 (3690)		10.0 (4822)
Don't Know	0.0 (5)	0.1 (31)		0.1 (36)

Prevalence of underweight (WAZ <- 2sd z scores) and trends based on selected variables - National Family Health Survey 4

There were 48265 children out of which 21940 children (45.5%) were underweight and 26325 children were not underweight (54.5%).

While relating the child's age in months with underweight, 12.1% underweight children and 11.5% non-underweight children belonged to the category of 12 to 23 months. Only 3.8 % were underweight in the age group 6 to 11 months (11.3 %). The highest underweight children were 24 to 35 months old i.e., 10.8 %. The highest proportion of not underweight children were in the age group 12 to 23 months i.e., 11.5 % and lowest in 6 to 11 months i.e., 7.5 % **(Table 4.11)**.

Percentage of male children who were underweight was 25.4 % and children who were not underweight 31.7 %. In female children 20 % were underweight and 22.9 % were not underweight. Male children are more likely to be underweight **(Table 4.11)**.

Around 24.5 percent of children whose birth order were 1st, out of which 9.8 % were underweight and 14.7 % were non-underweight. The 2nd and 3rd birth order were seen in 53.8%, out of which 24.1% were underweight and 29.7 % were non-underweight. 6.1% had birth order 6th or more in which 3.5% were underweight and 2.6 % were non underweight **(Table 4.11)**..

When the size of the child is related to underweight and non-underweight. 68.7% were average sized children, out of which 30.5 % were underweight and 38.1% were not underweight. Simultaneously if we look at the very small size of children, out of 3% children, 1.9 % were underweight and 1.1% were non-underweight **(Table 4.11)**.

Out of the 1.7% children who had severe anaemia, 1 % were underweight and 0.7 % were non underweight. The highest percent of children (30.6%) were seen in moderate anaemic, out of which 15.8 % were underweight. The highest non-underweight i.e., 24% children were observed in non- anaemic children.

More than half i.e., 71.9% households dwelled in rural areas out of which 34.8 % children were underweight and remaining 37 % weren't underweight. 28.1 % dwelled in urban areas, in which 10.6% were underweight and the remaining 17.5 % were not underweight **(Table 4.11)**.

Out of the 27.7% who were the poorest, 16.1% were underweight and 11.6% were not underweight. 21.5 % were poorer out of which 10.7 % were underweight and 10.8 % were not underweight. If we compare it with richest households i.e. 14.3 % , only 4.0 % were underweight and 10.3 % were not underweight. Richest the household wealth status lessens the chances of being underweight **(Table 4.11)**.

Almost half i.e., 48.5% households had 6 to 10 members in a family, out of which 22.4 % were underweight and 26.1 % were not underweight. In a family of 11 to 15 members (7.9%), 3.5 % were underweight and 4.4 % were not underweight. In a family of 16 to 20 members (1.2%) 0.5% were underweight and 0.7 % were not underweight. It is observed that the larger size of the family gradually the percentage of underweight children are also increasing **(Table 4.11)**.

In a household who has 2 or fewer children (58.5%), 24.4 % were underweight and 34.1 % were not underweight. A household with 6 or more children (6.1%), 3.5 % children were underweight and 2.6 % were not underweight. When the number of children in a household increases the underweight prevalence might increase too **(Table 4.11)**.

Around 63 percent mothers were categorised under 20 to 29 years old, out of which 28.2 % had underweight children and 34.7 % had non underweight children. Out of the 2.0% mothers in the age group 15 to 19 years old, 1 % had underweight children and the remaining 1.1 % had non underweight children.3.9% who were 40 - 49 years old 2.1 % were underweight and 1.8 were not underweight out of them **(Table 4.11)**.

Nearly, 63 % of mothers were 20 to 29 years old when they had their first child. Out of which 28.2% were underweight and 34.7 % were not underweight. Mothers who gave birth at the age of 15 to 19 years were 39.4%. Out of which 18.9 % were underweight and 20.5 % were non underweight. Children are more likely to be underweight if they are born to mothers who were pregnant at the age of 15 - 19 years old **(Table 4.11)**.

Around 26.4% mother's height ranged from 145 to 149.9 cm, out of which 13.9 % were underweight and 12.5 % were not underweight. If we see mothers whose height is 144.9cm or below that (11.6%), they had 7.3 % children who were underweight and 4.3 % who were non underweight. If compared with mothers with height ranging from 155 to 159.9cm (20%), 7.2 % were underweight children and the remaining 12.9 % were

non underweight. It results in mothers with shorter height being more prone to give birth to children who were underweight **(Table 4.11)**.

Nearly half i.e., 47.2% mothers had BMI ranging from 18.51 - 22.9 kg/m^2 out of which 21.4 % were underweight and 25.8 % were non-underweight. Mothers with BMI 15.9 kg/m^2 below (3.9%) out of which 2.6 % were underweight and 1.4 % were not underweight **(Table 4.11)**.

Around, 42.6 % mothers had mild anaemia, 20.1 % of them were underweight and 22.5 % were not underweight. 6 % children were underweight and 7.7 % were not underweight, mothers who were moderately anaemic (12.3%). 0.9 % were severe anaemic out of which 0.5% were underweight and 0.5 % were not underweight. The percentage of underweight children increased with severity of mother's anaemia level **(Table 4.11)**.

Women who had no education were 35.1%, out of which 19.6 % were underweight children and 15.5 % were not underweight children. Mothers who went to primary school (14.1%), 6.8 % children were underweight and 7.3 % were not underweight children. Women who had secondary education (40.4%) out of which only 16.2 % were underweight children but remaining 24.2 % were not underweight children. This shows that mothers' education does play a role in childhood underweight. Children born to educated mothers are less likely to be underweight **(Table 4.11)**.

Out of 66.9% who initiated breastfeeding within one hour of birth, 36.6 % were not underweight and 30.3 were underweight. Initiation of breastfeeding within one hour of birth proves to be beneficial for the child and reduces the chance of being underweight **(Table 4.11)**.

Around, 12.7% children who were not vaccinated, out of them 6.1 % were underweight and 6.6 % were not underweight. 86.6 % were vaccinated out of which 39.0 % were underweight and 47.6 % were not underweight, revealing that child immunization reduces the chance of being underweight **(Table 4.11)**.

Ten percent children had diarrhoea in the last two weeks, out of which 5 % children were underweight and 5 % were not underweight. 89.9% children did not have diarrhoea in the last two weeks out of which 40.4% were underweight and 49.5 % were

not underweight. Diarrhoea and recurrent infections can increase the chances of a child to be underweight **(Table 4.11)**.

Mothers who had no Antenatal visits (22.5%), 12 % children were underweight and 10.5 % were not underweight. Mothers who had 5 to 8 antenatal visits (22.4%) out of which 8.8 % were underweight and the remaining 13.5 % were not underweight. Higher the Antenatal visits the chances of the child being underweight lowers**(Table 4.11)**.

Table 4.11: Prevalence of underweight (WAZ <- 2sd z scores) and trends based on selected variables - National Family Health Survey 4

Parameter	Underweight % (n)	Not Underweight % (n)	Chi - square	Total % (n)
Socio Demographic variables				
Type of Residence				
Urban	10.6 (5121)	17.5 (8462)	458.60***	28.1 (13583)
Rural	34.8 (16819)	37.0 (17863)		71.9 934682)
Wealth Index				
Poorest	16.1 (7782)	11.6 (5593)	2067.89***	27.7 (13375)
Poorer	10.7 (5147)	10.8 (5228)		21.5 (10375)
Middle	8.2 (3945)	10.7 (5173)		18.9 (9118)
Richer	6.5 (3144)	11.1 (5359)		17.6 (8503)
Richest	4.0 (1923)	10.3 (4971)		14.3 (6894)
No of Household member				
0-5	18.8 (9084)	23.1 (11170)	17.09***	42.0 (20254)
6-10	22.4 (10810)	26.1 (12593)		48.5 (23403)
11-15	3.5 (1696)	4.4 (2116)		7.9 (3812)
16-20	0.5 (250)	0.7 (353)		1.2 (603)
21-25	0.2 (75)	0.1 (72)		0.3 (147)
others	0.1 (25)	0.0 (20)		0.1 (45)
Variables related to the child				
Child's age				
6 - 11	3.8 (1846)	7.5 (3616)	546.44***	11.3 (5462)
12 -23	12.1 (5845)	11.5 (5535)		23.6 (11380)
24 - 35	10.8 (5214)	11.3 (5430)		22.1 (10644)
36 - 47	9.7 (4679)	12.4 (6007)		22.1 (10686)
48 - 59	9.0 (4356)	11.9 (5736)		20.9 (10092)
Sex of the child				
Male	25.4 (12278)	31.7 (15290)	22.05***	57.1 (27568)
Female	20.0 (9663)	22.9 (11034)		42.9 (20697)
Birth Order				
1	9.8 (4731)	14.7 (7089)	441.0***	24.5 (11820)
2-3	24.1 (11612)	29.7 (14346)		53.8 (25958)
4-5	8.1 (3897)	7.5 (3638)		15.6 (7535)
6 and more	3.5 (1700)	2.6 (1251)		6.1 (2951)
Size of child at birth				
Very large	2.5 (1222)	3.7 (1809)	395.236***	6.3 (3131)
Larger than average	5.1 (2440)	6.9 (3334)		12.0 (5774)
Average	30.5 (14734)	38.1 (18400)		68.7 (33134)
Smaller than average	4.5 (2157)	3.8 (1855)		8.3 (4012)
Very small	1.9 (925)	1.1 (535)		3.0 (1460)
Don't know	1.0 (462)	0.8 (392)		1.8 (854)
Anaemia level				

Severe	1.0 (482)	0.7 (330)	504.96***	1.7 (812)
Moderate	15.8 (7619)	14.8 (7159)		30.6 (14778)
Mild	12.6 (6068)	15 (7253)		27.6 (13321)
Non anaemic	16.1 (7771)	24 (11584)		40.1 (19355)
Variables related to the mother				
Mother's age				
15-19	1.0 (464)	1.1 (523)	55.78***	2.0 (987)
20-29	28.2 (13630)	34.7 (16764)		63.0 (30394)
30-39	14.2 (6843)	16.9 (8170)		31.1 (15013)
40-49	2.1 (1003)	1.8 (868)		3.9 (1871)
Mothers age at first birth				
15-19	18.9 (9138)	20.5 (9879)	104.47***	39.4 (19017)
20-29	25.7 (12406)	32.7 (15797)		58.4 (28203)
30-39	0.8 (390)	1.3 (623)		2.1 (1013)
40-49	0.0 (6)	0.1 (25)		0.1 (31)
Mothers' height				
Lowest – 144.9 cm	7.3 (3519)	4.3 (2073)	1774.57***	11.6 (5592)
145 – 149.9	13.9 (6692)	12.5 (6045)		26.4 (12737)
150 – 154.9	14.9 (7215)	19.3 (9319)		34.3 (16534)
155 – 159.9	7.2 (3451)	12.9 (6219)		20.0 (9670)
others	2.2 (1062)	5.5 (2668)		7.7 (3730)
Maternal BMI				
Lowest-15.9	2.6 (1237)	1.4 (666)	1656.58***	3.9 (1903)
16.0-18.50	12.6 (6093)	9.6 (4643)		22.2 (10736)
18.51-22.9	21.4 (10342)	25.8 (12442)		47.2 (22748)
23.0-24.9	4.1 (1974)	7.2 (3455)		11.2 (5429)
others	4.8 (2294)	10.6 (5119)		15.4 (7413)
Anaemia Level mother				
Severe	0.5 (229)	0.5 (222)	114.42***	0.9 (451)
Moderate	6.0 (2877)	6.4 (3065)		12.3 (5942)
Mild	20.1 (9722)	22.5 (10851)		42.6 (20573)
Not Anaemic	18.9 (9112)	25.2 (12186)		44.1 (21298)
Highest educational level				
No education	19.6 (9461)	15.5 (7479)	1665.93***	35.1 (16940)
Primary	6.8 (3294)	7.3 (3514)		14.1 (6808)
Secondary	16.2 (7830)	24.2 (11684)		40.4 (19514)
Higher	2.8 (1355)	7.6 (3647)		10.4 (5002)
Total child born				
≤ 2	24.4 (11794)	34.1 (16463)	446.83	58.5 (28257)
3-5	17.5 (8446)	17.8 (8610)		35.3 (17056)
≥ 6	3.5 (1700)	2.6 (1251)		6.1 (2951)
Antenatal Visits				
0	12.0 (5802)	10.5 (5077)	674.90***	22.5 (10879)
1-2	9.7 (4670)	10.1 (4858)		19.7 (9528)
3-4	10.8 (5192)	13.1 (6329)		23.9 (11521)
5-8	8.8 (4260)	13.5 (6539)		22.4 (10799)
9-12	3.1 (1501)	5.1 (2474)		8.2 (3975)
13-15	0.4 (201)	0.8 (369)		1.2 (570)

16-highest	0.6 (313)	1.4 (679)		2.1 (992)
Miscellaneous Variables				
Initiation of breastfeeding				
Within 1 hour	30.3 (14634)	36.6 (17647)	0.60	66.9 (32281)
others	15.1 (7306)	18.0 (8678)		33.1 (15984)
Ever had vaccination				
No	6.1 (2936)	6.6 (3174)	18.84***	12.7 (6110)
Yes	39.0 (18847)	47.6 (22960)		86.6 (41807)
Don't know	0.3 (158)	0.4 (190)		0.7 (348)
Had Diarrhoea recently				
No	40.4 (19507)	49.5 (23901)	47.08***	89.9 (43408)
Yes, last two weeks	5.0 (2417)	5.0 (2405)		10.0 (4822)
Don't Know	0.0 (16)	0.0 (20)		0.1 (36)

Prevalence of stunting (HAZ <- 2sd z scores) and trends based on selected variables - National Family Health Survey 3

There were 12960 children in total. Out of which 47.5% i.e., 6155 were stunted and 52.5 % i.e., 6805 were not stunted.

While relating the child's age in months with stunting, 13.2 % stunted children and 12.2 % non-stunted children belonged to the category of 12 to 23 months. Only 3.41 % were stunted in the age group 6 to 11 months. The highest proportion of non-stunted children were in the age group 12 to 13 months i.e., 12.2 % and lowest in 6 to 11 months i.e., 8.3 % **(Table 4.12)**.

Percentage of male children who were stunted were 26.8% and non-stunted children were 29 %. In female children 20.7% were stunted and 23.5 % were stunted. Male children are more likely to be stunted. Nineteen percent of children whose birth order were 1st, out of which 7.7% were stunted and 11.4 % were non stunted. 2nd and 3 rd birth order were seen in 49 %, out of which 21.9 % were stunted and 27 % were non stunted. 11.6% had birth order 6th or more in which 7.2 % were stunted and 4.5 % were non stunted. Higher the birth orders the stunting rates increase **(Table 4.12)**.

When the size of the child is related to stunting and non-stunting. 55.8% were average sized children, out of which 25.7 % were stunted and 30.1 % were not stunted. Simultaneously if we look at the very small size of children, out of 5.8 % children, 3.2 % were stunted and 2.7 % were non stunted **(Table 4.12)**.

Out of the 2.8 % children who had severe anaemia, 1.9 % were stunted and 0.9 % were not stunted. The highest stunted children were seen in moderate anaemic i.e., 21.2 %. 20.5 % were not stunted and non-anaemic too **(Table 4.12)**.

Sixty five percent households dwelled in rural areas out of which 33.6 % children were stunted and remaining 31.9 % weren't stunted. 34.4 % dwelled in urban areas, in which 13.9 % were stunted and the remaining 20.6% were not stunted **(Table 4.12)**.

Out of the 20.4 % who were the poorest, 12.2 % were stunted and 8.2 % were not stunted. 19 % were poorer out of which 10.6 % were stunted and 8.4 % were not stunted. If we compare it with richest households i.e., 19 %, only 5.3 % were stunted and 13.7

% were not stunted. Richest the household wealth status lessens the chances of being stunted **(Table 4.12)**.

Almost 48.4 % households had 6 to 10 members in a family, out of which 24 % were stunted and 24.5 % were not stunted. In a family of 11 to 15 members (7.9%), 4.0 % were stunted and 4 % were not stunted. In a family of 16 to 20 members (1.2%) 0.7 % were stunted and 0.5 % were not stunted. It is observed that the larger size of the family gradually the number of stunted children is also increasing **(Table 4.12)**.

In a household who has 2 or fewer children (48.3 %), 20.1 % were stunted and 28.1 % were not stunted. A household with 6 or more children (11.6%), 7.2 % children were stunted and 4.5 % were not stunted. When the number of children in a household increases the stunting prevalence might increase too **(Table 4.12)**.

Around 60.8 percent mothers were categorised under 20 to 29 years old, out of which 28.2 % had stunted children and 32.5 % had non stunted children. Out of the 3.9 % mothers in the age group 15 to 19 years old, 2.1 % had stunted children and the remaining 1.8 % had non stunted children.3.9% who were 40 - 49 years old 2.2 % were stunted and 1.7% were not stunted **(Table 4.12)**.

Around 60.8 % of mothers were 20 to 29 years old when they had their first child. Out of which 28.2 % were stunted and 32.5 % were not stunted. Mothers who gave birth at the age of 15 to 19 years were 3.9 %. Out of which 2.1 % were stunted and 1.8 % were not stunted **(Table 4.12)**.

One third mother's height ranged from 145 to 149.9 cm, out of which 15.7 % were stunted and 18.2 % were not stunted. If we see mothers whose height is 144.9cm or below that (37.5 %), they had 20 % children who were stunted and 15.6% who were not stunted. If compared with mothers with height ranging from 155 to 159.9cm (20.3%), only 7.3 % had stunted children and the remaining 12.9 % were not stunted. It results in mothers with shorter height being more prone to give birth to children who may be stunted later in life **(Table 4.12)**.

About 46.1 % mothers had BMI ranging from 18.51 - 22.9 kg/m^2 out of which 21.4 % were stunted and 24.6 % were not stunted. Mothers with BMI 15.9 kg/m^2 below (5.8 %) out of which 3.2 % were stunted and 2.6 % were not stunted **(Table 4.12)**.

Almost 40.3 % mothers had mild anaemia, 19.4 % of them were stunted and 20.9 % were not stunted. 7.1 % children were stunted and 7.2 % were not stunted, mothers who were moderately anaemic (14.3 %). 1.5 % were severe anaemic out of which 0.9 % were stunted and 0.7% were not stunted. The percentage of stunted children increased with severity of mother's anaemia level **(Table 4.12)**.

Women who had no education were 45.8 %, out of which 25.8 % were stunted children and 20.0 % were not stunted children. Mothers who went to primary school (14.2 %), 7.1 % children were stunted and 7.1 % were not stunted children. Women who had secondary education (33.5 %) out of which only 13.3 % were stunted children but remaining 20.2 % were not stunted children. This shows that mothers' education does play a role in childhood stunting. Children born to educated mothers are less likely to be stunted **(Table 4.12)**.

Out of 41.2 % who initiated breastfeeding within one hour of birth, 18.3 % were not stunted and 22.9 % were stunted. Initiation of breastfeeding within one hour of birth proves to be beneficial for the child and reduces the chance of being stunted **(Table 4.12)**.

Around 8.7% children who were not vaccinated, out of them 4.5 % were stunted and 4.2% were not stunted. 91.1 % were vaccinated out of which 42.8 % were stunted and 48.3 % were not stunted revealing that child immunization reduces the chance of being stunted **(Table 4.12)**.

Nearly 10.6 % children had diarrhoea in the last two weeks, out of which 5.2 % children were stunted and 5.4 % were not stunted. 89.3 % children did not have diarrhoea in the last two weeks, out of which 42.3 % were stunted and 47 were not stunted. Diarrhoea and recurrent infections can increase the chances of a child to be stunted **(Table 4.12)**.

Mothers who had no Antenatal visits (23.4), 13.7 % children were stunted and 9.7 % were not stunted. Mothers who had 5 to 8 antenatal visits (22.8%) out of which 11 % were stunted and the remaining 11.8 % were not stunted. Higher the Antenatal visits the chances of child being stunted lowers **(Table 4.12)**.

Table 4.12: Prevalence of stunting (HAZ <- 2sd z scores) and trends based on selected variables - National Family Health Survey 3

Parameter	Stunting % (n)	No stunting % (n)	Chi - Square	Total % (n)
Socio Demographic Variables				
Type of Residence				
Urban	13.9 (1796)	20.6 (2667)	143.49***	34.4 (4463)
Rural	33.6 (4359)	31.9 (4138)		65.6 (8497)
Wealth Index				
Poorest	12.2 (1580)	8.2 (1066)	630.22***	20.4 (2646)
Poorer	10.6 (1370)	8.4 (1094)		19.0 (2464)
Middle	10.3 (1336)	10.3 (1329)		20.6 (2665)
Richer	9.2 (1186)	11.9 (1543)		21.1 (2729)
Richest	5.3 (683)	13.7 (1773)		19.0 (2456)
No of Household member				
0-5	18.6 (2408)	23.2 (3010)	41.83***	41.8 (4518)
6-10	24.0 (3107)	24.5 (3169)		48.4 (6276)
11-15	4.0 (512)	4.0 (518)		7.9 (1030)
16-20	0.7 (92)	0.5 (65)		1.2 (157)
21-25	0.2 (24)	0.3 (34)		0.4 (58)
others	0.1 (12)	0.1 (9)		0.2 (21)
Variables related to the child				
Child's age (in months)				
6 - 11	3.41 (435)	8.3 (1073)	283.73***	11.6 (1508)
12 -23	13.2 (1715)	12.2 (1580)		25.4 (3295)
24 - 35	12.2 (1576)	10.8 (1397)		22.9 (2973)
36 - 47	10.3 (1329)	10.7 (1393)		21.0 (2722)
48 - 59	8.5 (1100)	10.5 (1362)		19.0 (2462)
Sex of the child				
Male	26.8 (3471)	29.0 (3759)	1.746	55.8 (7230)
Female	20.7 (2684)	23.5 (3046)		44.2 (5730)
Birth Order				
1	7.7 (995)	11.4 (1479)	217.84***	19.0 (2466)
2-3	21.9 (2842)	27.0 (3505)		49.0 (6347)
4-5	10.7 (1391)	9.7 (1252)		20.4 (2643)
6 and more	7.2 (927)	4.5 (577)		11.6 (1504)
Size of child at birth				
Very large	1.6 (208)	2.3 (301)	87.13***	3.9 (509)
Larger than average	8.2 (1066)	10.2 (1325)		18.4 (2391)
Average	25.7 (3325)	30.1 (3903)		55.8 (7228)
Smaller than average	7.9 (1026)	6.4 (825)		14.3 (1851)
Very small	3.2 (410)	2.7 (346)		5.8 (756)
Don't know	0.9 (120)	0.8 (105)		1.7 (225)
Anaemia level				

Severe	1.9 (250)	0.9 (118)	346.58***	2.8 (368)
Moderate	21.1 (2733)	17.0 (2200)		38.1 (4933)
Mild	12.0 (1551)	14.1 (1832)		26.1 (3383)
Non anaemic	12.5 (1621)	20.5 (2655)		33.0 (4276)
Variables related to the mother				
Mother's age (in Years)				
15-19	2.1 (268)	1.8 (231)	26.22***	3.9 (499)
20-29	28.2 (3661)	32.5 (4218)		60.8 (7879)
30-39	15.0 (1942)	16.5 (2134)		31.5 (4076)
40-49	2.2 (284)	1.7 (222)		3.9 (506)
Mothers age at first birth				
15-19	27.5 (3419)	25.2 (3131)	161.23	52.7 (6550)
20-29	19.1 (2376)	26.5 (3292)		45.6 (5668)
30-39	0.4 (54)	1.2 (145)		1.6 (199)
40-49	0.0 (2)	0.0 (2)		0.0 (4)
Mothers' height (cm)				
144.9 or below	20.0 (2847)	15.6 (2017)	511.32***	37.5 (4864)
145 – 149.9	15.7 (2041)	18.2 (2358)		33.9 (4399)
150 – 154.9	7.3 (948)	12.9 (1677)		20.3 (2625)
155 – 159.9	2.5 (319)	5.8 (753)		8.3 (1072)
>160				
Maternal BMI (kg/m^2)				
Lowest-15.9	3.2 (421)	2.6 (335)	278.46***	5.8 (756)
16.0-18.50	16.9 (2196)	13.9 (1801)		30.8 (3997)
18.51-22.9	21.4 (2775)	24.6 (3194)		46.1 (5969)
23.0-24.9	2.8 (364)	4.8 (622)		7.6 (986)
>25	3.1 (399)	6.6 (853)		9.7 (1252)
Anaemia Level mother				
Severe	0.9 (111)	0.7 (89)	14.96***	1.5 (200)
Moderate	7.1 (919)	7.2 (930)		14.3 (1849)
Mild	19.4 (2513)	20.9 (2713)		40.3 (5226)
Not Anaemic	20.2 (2612)	23.7 (3073)		43.9 (5685)
Highest educational level				
No education	25.8 (3340)	20.0 (2590)	540.83***	45.8 (5930)
Primary	7.1 (918)	7.1 (921)		14.2 (1839)
Secondary	13.3 (1719)	20.2 (2617)		33.5 (4336)
Higher	1.4 (178)	5.2 (677)		6.6 (855)
Total child born				
≤ 2	20.1 (2610)	28.1 (3645)	220.89	48.3 (6255)
3-5	22.2 (2618)	19.9 (2583)		40.1 (5201)
≥ 6	7.2 (927)	4.5 (577)		11.6 (1504)
Antenatal Visits				
0			427.24***	
1-2	13.7 (1750)	9.7 (1238)		23.4 (2988)
3-4	11.9 (1514)	10.8 (1375)		22.6 (2888)
5-8	11.0 (1406)	11.8 (1501)		22.8 (2907)
9-12	8.5 (1085)	14.2 (1813)		22.7 (2898)
13-15	2.3 (294)	5.2 (666)		7.5 (960)

16 or more	0.2 (29)	0.7 (89)		0.9 (118)
Miscellaneous variables				
Initiation of breastfeeding				
Within 1 hour	18.3 (2371)	22.9 (2965)	34.02***	41.2 (5336)
After 1 hour	29.2 (3784)	29.6 (3840)		58.8 (7624)
Ever had vaccination				
No	4.5 (585)	4.2 (538)	12.38***	8.7 (1123)
Yes	42.8 (5551)	48.3 (6254)		91.1 (11805)
Don’t know	0.1 (19)	0.1 (13)		0.2 (32)
Had Diarrhoea recently				
No	42.3 (5479)	47.0 (6096)	3.57	89.3 (11575)
Yes, last two weeks	5.2 (675)	5.4 (704)		10.6 (1379)
Don’t Know	0.0 (1)	0.0 (5)		0.0 (6)

Prevalence of wasting (WHZ <- 2sd z scores) and trends based on selected variables - National Family Health Survey 3

There were 12960 children in total. Out of which 19%% i.e., 2459 were wasted and 81.9% % i.e., 10501 were not wasted.

While relating the child's age in months with wasting, 5.6 % wasted children and 19.8 % non-wasted children belonged to the category of 12 to 23 months (25.4 %). Only 3.4 % were wasted in the age group 6 to 11 months. The highest proportion of non-wasted children were in the age group months 12 to 23 months i.e., 19.8 % **(Table 4.13)**.

Percentage of male children who were wasted were 10.8 % and non-wasted children were 44.9 %. In female children 8.1 % were wasted and 36.1 % were wasted. Male children are more likely to be wasted **(Table 4.13)**.

Nineteen percent of children whose birth order were 1st, out of which 3.4% were wasted and 15.6 % were non wasted. 2nd and 3 rd birth order were seen in 49 %, out of which 8.9 % were wasted and 40.1 % were non wasted. 11.6 % had birth order 6th or more in which 2.7 % were wasted and 8.9 % were non-wasted **(Table 4.13)**.

When the size of the child is related to wasting and non-wasting. 55.8 % were average sized children, out of which 9.9 % were wasted and 45.9 % were not wasted. Simultaneously if we look at the very small size of children, out of 5.8 % children, 1.7 % were wasted and 4.2 % were non-wasted **(Table 4.13)**.

Out of the 2.8 % children who had severe anaemia, 0.7 % were wasted and 2.1 % were not wasted. 8 percent of wasted children were moderate anaemic out of the total 38.1 %. Out of 33% of non-anaemic mothers, 5.3 % were wasted and 27.7 % were not stunted **(Table 4.13)**.

Around 65.5 % households dwelled in rural areas out of which 13.3 % children were wasted and remaining 52.2 % weren't wasted. 34.4 % dwelled in urban areas, in which 5.6 % were wasted and the remaining 28.8 % were not wasted **(Table 4.13)**.

Out of the 20.4 % who were the poorest, 5.6 % were wasted and 14.8 % were not wasted. 19 % were poorer out of which 4.2 % were wasted and 14.9 % were not wasted. If we compare it with richest households i.e., 19 %, only 2.3% were wasted and 16.6 %

were not wasted. Richest the household wealth status lessens the chances of being wasted **(Table 4.13)**.

Nearly 48.4% households had 6 to 10 members in a family, out of which 9.7 % were wasted and 38.8 % were not wasted. In a family of 11 to 15 members (7.9%), 1.4 % were wasted and 6.6 % were not wasted. In a family of 16 to 20 members (1.2%) 0.2 % were wasted and 1 % were not wasted.

In a household who has 2 or fewer children (48.3 %), 8.6 % were wasted and 39.7 % were not wasted. Households having 3- 5 children (40.1 %) 7.7 % were wasted and 32.4 % were not wasted. A household with 6 or more children (11.6 %), 2.7 % children were wasted and 8.9 % were not wasted. When the number of children in a household increases the wasting prevalence might increase too **(Table 4.13)**.

About 60.8 percent of mothers were categorised under 20 to 29 years old, out of which 11.5 % had wasted children and 49.3 % had non wasted children. Out of the 3.9% mothers in the age group 15 to 19 years old, 0.9 % had wasted children and the remaining 2.9 % had non wasted children. 3.9% who were 40 - 49 years old 0.7 % were wasted and 3.2 were not wasted **(Table 4.13)**.

Nearly 45.6 % of mothers were 20 to 29 years old when they had their first child. Out of which 7.9 % were wasted and 37.7 % were not wasted. Mothers who gave birth at the age of 15 to 19 years were 52.7 %. Out of which 10.7 % were stunted and 42 % were not wasted. Children are more likely to be wasted if they are born to mothers who were pregnant at the age of 15 - 19 years old **(Table 4.13)**.

If we see mothers whose height is 144.9cm or below that (37.5 %), they had 8 % children who were wasted and 29.5 % who were not wasted. If compared with mothers with height ranging from 155 to 159.9cm (20.3 %), only 3.1 % had wasted children and the remaining 17.1 % were not wasted. It results in mothers with shorter height being more prone to give birth to children who may be wasted **(Table 4.13)**.

Almost 46.1 % mothers had BMI ranging from 18.51 - 22.9 kg/m^2 out of which 7.9 % were wasted and 38.2 % were not wasted. Mothers with BMI 15.9 kg/m^2 below (5.8 %) out of which 1.9 % were wasted and 3.9 % were not wasted **(Table 4.13)**.

Nearly 40.3 % mothers had mild anaemia, 8.3 % of them were wasted and 32 % were not wasted. 2.9% children were wasted and 11.3 % were not wasted, mothers who were

moderately anaemic (14.3 %). 1.5 % mothers were severe anaemic out of which 0.3 % were wasted and 1.2 % were not wasted. The percentage of wasted children increased with severity of mother's anaemia level **(Table 4.13)**.

Women who had no education were 45.8 %, out of which 10.3 % were wasted children and 35.4 % were not wasted children. Mothers who went to primary school (14.2%), 2.8 % children were wasted and 114 2% were not wasted children. Women who had secondary education (33.5 %) out of which only 5.1 % were wasted children but remaining 28.4 % were not wasted children. This shows that mothers' education does play a role in childhood stunting. Children born to educated mothers are less likely to be stunted **(Table 4.13)**.

Out of 41.2 % who initiated breastfeeding within one hour of birth, 34 % were not wasted and 7.2 % were wasted. Initiation of breastfeeding within one hour of birth proves to be beneficial for the child and reduces the chance of being stunted **(Table 4.13)**.

Nearly 8.7 % children who were not vaccinated, out of them 2.2 % were wasted and 6.5 % were not wasted. 91.1 % were vaccinated out of which 16.7 % were wasted and 74.3 % were not wasted, revealing that child immunization reduces the chance of being wasted **(Table 4.13)**.

One tenth children had diarrhoea in the last two weeks, out of which 2.5 % children were wasted and 8.1 % were not wasted. 89.3 % of children did not have diarrhoea in the last two weeks, out of which 16.4 % were wasted and 72.9 % were not wasted. Diarrhoea and recurrent infections can increase the chances of a child to be wasted **(Table 4.13)**.

Mothers who had no Antenatal visits (23.4 %), 5.6 % children were wasted and 17.9 % were not wasted. Mothers who had 5 to 8 antenatal visits (22.7%) out of which 4.2 % were wasted and the remaining 18.6 % were not wasted. Higher the Antenatal visits the chances of child being wasted lowers **(Table 4.13)**.

Table 4.13: Prevalence of wasting (WHZ <- 2sd z scores) and trends based on selected variables - National Family Health Survey 3

Parameter	Wasting % (n)	No wasting % (n)	Chi - Square	Total % (n)
Socio Demographic Variables				
Type of Residence				
Urban	5.6 (730)	28.8 (3733)	30.32***	34.4 (4463)
Rural	13.3 (1729)	52.2 (6768)		65.6 (8497)
Wealth Index				
Poorest	5.6 (726)	14.8 (1920)	232.02***	20.4 (2646)
Poorer	4.2 (539)	14.9 (1925)		19.0 (2464)
Middle	3.6 (468)	17.0 (2197)		20.6 (2665)
Richer	3.3 (423)	17.8 (2306)		21.1 (2729)
Richest	2.3 (303)	16.6 (2153)		19.0 (2456)
No of Household member				
0-5	7.7 (999)	34.1 (4419)	12.95*	41.8 (5418)
6-10	9.7 (1252)	38.8 (5024)		48.4 (6276)
11-15	1.4 (176)	6.6 (854)		7.9 (1030)
16-20	0.2 (23)	1.0 (134)		1.2 (157)
21-25	0.1 (8)	0.4 (50)		0.4 (58)
others	0.0 (1)	0.2 (20)		0.2 (21)
Variables related to the child				
Child's age (in months)				
6 - 11	3.4 (438)	8.3 (1070)	177.57***	11.6 (1508)
12 -23	5.6 (732)	19.8 (2563)		25.4 (3295)
24 - 35	3.8 (495)	19.1 (2478)		22.9 (2973)
36 - 47	3.2 (418)	17.8 (2304)		21.0 (2722)
48 - 59	2.9 (376)	16.1 (2086)		19.0 (2462)
Sex of the child				
Male	10.8 (1405)	44.9 (5825)	2.24	55.8 (7230)
Female	8.1 (1054)	36.1 (4676)		44.2 (5730)
Birth Order				
1	3.4 (445)	15.6 (2021)	20.25***	19.0 (2466)
2-3	8.9 (1154)	40.1 (5193)		49.0 (6347)
4-5	4.0 (514)	16.4 (2129)		20.4 (2643)
6 and more	2.7 (346)	8.9 (1158)		11.6 (1504)
Size of child at birth				
Very large	0.6 (76)	3.3 (433)	109.13***	3.9 (509)
Larger than average	3.0 (385)	15.5 (2006)		18.4 (2381)
Average	9.9 (1281)	45.9 (5947)		55.8 (7228)
Smaller than average	3.5 (457)	10.8 (1394)		14.3 (1851)
Very small	1.7 (215)	4.2 (541)		5.8 (756)
Don't know	0.3 (45)	1.4 (180)		1.7 (225)
Anaemia level				
Severe	0.7 (97)	2.1 (271)	49.25***	2.8 (368)

Moderate	8.0 (1040)	30.0 (3893)		38.1 (4933)
Mild	4.9 (630)	21.2 (2753)		26.1 (3383)
Non anaemic	5.3 (692)	27.7 (3584)		33.0 (4276)
Variables related to the mother				
Mother's age (in Years)				
15-19	0.9 (121)	2.9 (378)	9.66*	3.9 (499)
20-29	11.5 (1488)	49.3 (6391)		60.8 (7879)
30-39	5.8 (754)	25.6 (3322)		31.5 (4076)
40-49	0.7 (96)	3.2 (410)		3.9 (506)
Mothers age at first birth				
15-19	10.7 (1328)	42.0 (5222)	19.22***	52.7 (6550)
20-29	7.9 (982)	37.7 (4686)		45.6 (5668)
30-39	0.3 (32)	1.3 (167)		1.6 (199)
40-49	0.0 (0)	0.0 (4)		0.0 (4)
Mothers' height (cm)				
144.9 or below	8.0 (1040)	29.5 (3824)	41.08***	37.5 (4864)
145 – 149.9				
150 – 154.9	6.4 (826)	27.6 (3573)		33.9 (4399)
155 – 159.9	3.1 (406)	17.1 (2219)		20.3 (2625)
>160	1.4 (187)	6.8 (885)		8.3 (1072)
Maternal BMI (kg/m^2)				
Lowest-15.9	1.9 (249)	3.9 (507)	315.31***	5.8 (756)
16.0-18.50	7.5 (974)	23.3 (3023)		30.8 (3997)
18.51-22.9	7.9 (1019)	38.2 (4950)		46.1 (5969)
23.0-24.9	0.9 (115)	6.7 (871)		7.6 (986)
>25	0.8 (102)	8.9 (1150)		9.7 (1452)
Anaemia Level mother				
Severe	0.3 (44)	1.2 (156)	28.01***	1.5 (200)
Moderate	2.9 (379)	11.3 (1470)		14.3 (1849)
Mild	8.3 (1074)	32.0 (4152)		40.3 (5226)
Not Anaemic	7.4 (962)	36.4 (4723)		43.9 (5685)
Highest educational level				
No education	10.3 (1339)	35.4 (4591)	116.39***	45.8 (5930)
Primary	2.8 (357)	11.4 (1482)		14.2 (1839)
Secondary	5.1 (659)	28.4 (3677)		33.5 (4336)
Higher	0.8 (104)	5.8 (751)		6.6 (855)
Total child born				
≤ 2	8.6 (1109)	39.7 (5146)	22.56***	48.3 (6255)
3-5	7.7 (1004)	32.4 (4197)		40.1 (5201)
≥ 6	2.7 (346)	8.9 (1158)		11.6 (1504)
Antenatal Visits				
0	5.6 (709)	17.9 (2279)	96.24***	23.4 (2988)
1-2	4.7 (597)	18.0 (2291)		22.6 (2888)
3-4	4.2 (534)	18.6 (2373)		22.8 (2907)
5-8	3.4 (438)	19.3 (2460)		22.7 (2898)
9-12	1.0 (130)	6.5 (830)		7.5 (960)
13-15	0.2 (22)	0.8 (96)		0.9 (118)
16 or more				

Miscellaneous variables				
Initiation of breastfeeding				
Within 1 hour	7.2 (927)	34.0 (4409)	15.12***	41.2 (5336)
After 1 hour	11.8 (1532)	47.0 (6092)		58.8 (7624)
Ever had vaccination				
No	2.2 (285)	6.5 (838)	33.52***	8.7 (1123)
Yes	16.7 (2170)	74.3 (9635)		91.1 (11805)
Don't know	0.0 (4)	0.2 (28)		0.2 (32)
Had Diarrhoea recently				
No	16.4 (2128)	72.9 (9447)	31.63***	89.3 (11575)
Yes, last two weeks	2.5 (327)	8.1 (1052)		10.6 (1379)
Don't Know	0.0 (4)	0.0 (2)		0.0 (6)

Prevalence of Underweight (WAZ <- 2sd z scores) and trends based on selected variables - National Family Health Survey 3

There were 12960 children in total. Out of which 47.5 % i.e., 6155 were underweight and 52.5% % i.e., 6805 were not underweight.

While relating the child's age in months with underweight, 13.2 % underweight children and 12.2 % non-underweight children belonged to the category of 12 to 23 months. Only 3.4 % were underweight in the age group 6 to 11 months (11.6 %). The highest underweight children were 12 to 23 months old i.e., 13.2 %. The highest proportion of not underweight children were in the age group 12 to 23 months i.e., 12.2 % and lowest in 6 to 11 months i.e., 7.5 % as shown in **table 4.14**.

Percentage of male children who were underweight was 26.8 % and children who were not underweight 29 %. In female children 20.7 % were underweight and 23.5 % were not underweight. Male children are more likely to be underweight as given in **table 4.14**.

Nineteen percent of children whose birth order were 1st, out of which 7.7% were underweight and 11.4 % were non-underweight. The 2nd and 3rd birth order were seen in 49 %, out of which 21.9 % were underweight and 27 % were non-underweight. 11.6 % had birth order 6th or more in which 7.2 % were underweight and 4.5 % were non underweight as shown in **table 4.14**.

When the size of the child is related to underweight and non-underweight. 55.8 % were average sized children, out of which 25.7 % were underweight and 30.1% were not underweight. Simultaneously if we look at the very small size of children, out of 5.8 % children, 3.2 % were underweight and 2.7 % were non underweight as shown in **table 4.14**.

Out of the 2.8 % children who had severe anaemia, 1.9 % were underweight and 0.9 % were non underweight. The highest percent of children (38.1) were seen in moderate anaemic, out of which 21.1 % were underweight. The highest non-underweight i.e., 20.5 % children were observed in non- anaemic children as shown in **table 4.14**.

Nearly 65.6 % households dwelled in rural areas out of which 33.6 % children were underweight and remaining 31.9 % weren't underweight. 34.4 % dwelled in urban

areas, in which 13.9 % were underweight and the remaining 20.7 % were not underweight. Larger proportion of children were underweight who lived in rural areas as shown in **table 4.14**.

Out of the 20.4 % who were the poorest, 12.2 % were underweight and 8.2 % were not underweight. 19 % were poorer out of which 10.6 % were underweight and 8.4 % were not underweight. If we compare it with richest households i.e., 19 %, only 5.3 % were underweight and 13.7 % were not underweight. Richest the household wealth status lessens the chances of being underweight as shown in **table 4.14**.

Around 48.4% households had 6 to 10 members in a family, out of which 24 % were underweight and 24.5 % were not underweight. In a family of 11 to 15 members (7.9%), 4 % were underweight and 4.0 % were not underweight. In a family of 16 to 20 members (1.2%) 0.7% were underweight and 0.5 % were not underweight. It is observed that the larger size of the family gradually the percentage of underweight children are also increasing as shown in **table 4.14**.

In a household who has 2 or fewer children (48.3%), 20.1 % were underweight and 28.1 % were not underweight. A household with 6 or more children (11.6 %), 7.2 % children were underweight and 4.5 % were not underweight. When the number of children in a household increases the underweight prevalence might increase too as shown in **Table 4.14**.

About 60.8 percent mothers were categorised under 20 to 29 years old, out of which 28.2 % had underweight children and 32.5 % had non underweight children. Out of the 3.9 % mothers in the age group 15 to 19 years old, 2.1 % had underweight children and the remaining 1.8 % had non underweight children. 3.9 % who were 40 - 49 years old 2.2 % were underweight and 1.7 were not underweight out of them as shown in **table 4.14**.

Almost 45.6 % of mothers were 20 to 29 years old when they had their first child. Out of which 19.1 % were underweight and 26.5 % were not underweight. Mothers who gave birth at the age of 15 to 19 years were 52.7 %. Out of which 27.5 % were underweight and 25.2 % were non underweight. Children are more likely to be underweight if they are born to mothers who were pregnant at the age of 15 - 19 years old as shown in **table 4.14**.

Mothers whose height is 144.9cm or below that (37.5 %), they had 20 % children who were underweight and 15.6 % who were non underweight. If compared with mothers with height ranging from 155 to 159.9cm (20%), 7.3 % were underweight children and the remaining 12.9 % were non underweight. It results in mothers with shorter height being more prone to give birth to children who were underweight as shown in **table 4.14**.

Almost 46.1 % mothers had BMI ranging from 18.51 - 22.9 kg/m^2 out of which 21.4 % were underweight and 24.6 % were non-underweight. Mothers with BMI 15.9 kg/m^2 below (5.8 %) out of which 3.2 % were underweight and 2.6 % were not underweight as shown in **table 4.14**.

Nearly 40.3 % mothers had mild anaemia, 19.4 % of them were underweight and 20.9 % were not underweight. 7.1 % children were underweighting and 7.2 % were not underweight, mothers who were moderately anaemic (14.3%). 1.5 % were severe anaemic out of which 0.9% were underweight and 0.7 % were not underweight. The percentage of underweight children increased with severity of mother's anaemia level as shown in **table 4.14**.

Women who had no education were 45.8 %, out of which 25.8 % were underweight children and 20 % were not underweight children. Mothers who went to primary school (14.2%), 7.1 % children were underweight and 7.1 % were not underweight children. Women who had secondary education (33.5 %) out of which only 13.3 % were underweight children but remaining 20.2 % were not underweight children. This shows that mothers' education does play a role in childhood underweight. Children born to educated mothers are less likely to be underweight as shown in **table 4.14**.

Out of 41.2 % who initiated breastfeeding within one hour of birth, 22.9 % were not underweight and 18.3 were underweight. Initiation of breastfeeding within one hour of birth proves to be beneficial for the child and reduces the chance of being underweight as shown in **table 4.14**.

Almost 8.7% children who were not vaccinated, out of them 4.5 % were underweight and 4.2 % were not underweight. 91.1 % were vaccinated out of which 42.8 % were underweight and 48.3 % were not underweight, revealing that child immunization reduces the chance of being underweight as shown in **table 4.14**.

Nearly 10.6 % children had diarrhoea in the last two weeks, out of which 5.2 % children were underweight and 5.4 % were not underweight. 89.3 % children did not have diarrhoea in the last two weeks out of which 42.3 % were underweight and 47 % were not underweight. Diarrhoea and recurrent infections can increase the chances of a child to be underweight as shown in **table 4.14**.

Amongst mothers who had no Antenatal visits (23.4%), 13.7 % their children were underweight and 9.7 % were not underweight. Mothers who had 5 to 8 antenatal visits (22.7%) out of which 8.5 % were underweight and the remaining 14.2 % were not underweight. Higher the Antenatal visits the chances of the child being underweight lowers.

Underweight when related with stunting, out of 47.5 % children who were stunted, 32.7 % were underweight and 14.8 % were not underweight. Out of 52.5 % children who were not stunted, 8.5 % children were underweight and 44 % children weren't underweight as shown in **table 4.14**.

Table 4.14: Prevalence of Underweight (WAZ <- 2sd z scores) and trends based on selected variables - National Family Health Survey 3

Parameter	Underweight % (n)	No underweight % (n)	Chi - Square	Total % (n)
Socio Demographic Variables				
Type of Residence				
Urban	13.9 (1796)	20.6 (2667)	143.49***	34.4 (4463)
Rural	33.6 (4359)	31.9 (4138)		65.6 (8497)
Wealth Index				
Poorest	12.2 (1580)	8.2 (1066)	630.22***	20.4 (2646)
Poorer	10.6 (1370)	8.4 (1094)		19.0 (2464)
Middle	10.3 (1336)	10.3 (1329)		20.6 (2665)
Richer	9.2 (1186)	11.9 (1543)		21.1 (2729)
Richest	5.3 (683)	13.7 (1773)		19.0 (2456)
No of Household member				
0-5	18.6 (2408)	23.2 (3010)	41.83***	41.8 (5418)
6-10	24.0 (3107)	24.5 (3169)		48.4 (6276)
11-15	4.0 (512)	4.0 (518)		7.9 (1030)
16-20	0.7 (92)	0.5 (65)		1.2 (157)
21-25	0.2 (24)	0.3 (34)		0.4 (58)
others	0.1 (12)	0.1 (9)		0.2 (21)
Variables related to the child				
Child's age (in months)				
6 - 11	3.4 (435)	8.3 (1073)	283.73***	11.6 (1508)
12 -23	13.2 (1715)	12.2 (1580)		25.4 (3295)
24 - 35	12.2 (1576)	10.8 (1397)		22.9 (2973)
36 - 47	10.3 (1329)	10.7 (1393)		21.0 (2722)
48 - 59	8.5 (1100)	10.5 (1362)		19.0 (2462)
Sex of the child				
Male	26.8 (3471)	29.0 (3759)	1.74	55.8 (7230)
Female	20.7 (2684)	23.5 (3046)		44.2 (5730)
Birth Order				
1	7.7 (995)	11.4 (1471)	217.84***	19.0 (2466)
2-3	21.9 (2842)	27.0 (3505)		49.0 (6347)
4-5	10.7 (1391)	9.7 (1252)		20.4 (2643)
6 and more	7.2 (97)	4.5 (577)		11.6 (1504)
Size of child at birth				
Very large	1.6 (208)	2.3 (301)	87.13	3.9 (509)
Larger than average	8.2 (1066)	10.2 (1325)		18.4 (2391)
Average	25.7 (3325)	30.1 (3903)		55.8 (7228)
Smaller than average	7.9 (1026)	6.4 (825)		14.3 (1851)
Very small	3.2 (410)	2.7 (346)		5.8 (756)
Don't know	0.9 (120)	0.8 (105)		1.7 (225)
Anaemia level				
Severe	1.9 (250)	0.9 (118)	346.58***	2.8 (368)

Moderate	21.1 (2733)	17.0 (2200)		38.1 (4933)
Mild	12.0 (1551)	14.1 (1832)		26.1 (3383)
Non anaemic	12.5 (1621)	20.5 (2655)		33.0 (4276)
Variables related to the mother				
Mother's age (in Years)				
15-19	2.1 (268)	1.8 (231)	26.22***	3.9 (499)
20-29	28.2 (3661)	32.5 (4218)		60.8 (7879)
30-39	15.0 (1942)	16.5 (2134)		31.5 (4076)
40-49	2.2 (284)	1.7 (222)		3.9 (506)
Mothers age at first birth				
15-19	27.5 (3419)	25.2 (3131)	161.23***	52.7 (6550)
20-29	19.1 (2376)	26.5 (3292)		45.6 (5668)
30-39	0.4 (54)	1.2 (145)		1.6 (199)
40-49	0.0 (2)	0.0 (2)		0.0 (4)
Mothers' height (cm)				
144.9 or below	20.0 (2847)	15.6 (2017)	511.32***	37.5 (4864)
145 – 149.9				
150 – 154.9	15.7 (2041)	18.2 (2358)		33.9 (4399)
155 – 159.9	7.3 (948)	12.9 (1677)		20.3 (2625)
>160	2.5 (319)	5.8 (753)		8.3 (1072)
Maternal BMI (kg/m^2)				
Lowest-15.9	3.2 (421)	2.6 (335)	278.46***	5.8 (756)
16.0-18.50	16.9 (2196)	13.9 (1801)		30.8 (3997)
18.51-22.9	21.4 (2775)	24.6 (3194)		46.1 (5969)
23.0-24.9	2.8 (364)	4.8 (622)		7.6 (986)
>25	3.1 (399)	6.6 (853)		9.7 (1252)
Anaemia Level mother				
Severe	0.9 (111)	0.7 (89)	14.96***	1.5 (200)
Moderate	7.1 (919)	7.2 (930)		14.3 (1849)
Mild	19.4 (2513)	20.9 (2713)		40.3 (5226)
Not Anaemic	20.2 (2612)	23.7 (3073)		43.9 (5685)
Highest educational level				
No education	25.8 (3340)	20.0 (2590)	540.83***	45.8 (5930)
Primary	7.1 (918)	7.1 (921)		14.2 (1839)
Secondary	13.3 (1719)	20.2 (2617)		33.5 (4336)
Higher	1.4 (178)	5.2 (677)		6.6 (855)
Total child born				
≤ 2	20.1 (2610)	28.1 (3645)	220.89***	48.3 (6255)
3-5	20.2 (2618)	19.9 (2583)		40.1 (5201)
≥ 6	7.2 (927)	4.5 (577)		11.6 (1504)
Antenatal Visits				
0	13.7 (1750)	9.7 (1238)	427.24***	23.4 (2988)
1-2	11.9 (1513)	10.8 (1375)		22.6 (2888)
3-4	11.0 (1406)	11.8 (1501)		22.8 (2907)
5-8	8.5 (1085)	14.2 (1813)		22.7 (2898)
9-12	2.3 (294)	5.2 (666)		7.5 (960)
13-15	0.2 (29)	0.7 (89)		0.9 (118)

16 or more	-	-		-
Miscellaneous variables				
Initiation of breastfeeding				
Within 1 hour	18.3 (2371)	22.9 (2865)	34.02***	41.2 (5336)
After 1 hour	29.2 (3784)	29.6 (3840)		58.8 (7624)
Ever had vaccination				
No	4.5 (585)	4.2 (538)	12.38***	8.7 (1123)
Yes	42.8 (5551)	48.3 (6254)		91.1 (11805)
Don't know	0.1 (19)	0.1 (13)		0.2 (32)
Had Diarrhoea recently				
No	42.3 (5479)	47.0 (6096)	3.57	89.3 (11575)
Yes, last two weeks	5.2 (675)	5.4 (704)		10.6 (1379)
Don't Know	0.0 (1)	0.0 (5)		0.0 (6)

Prevalence of Stunting (HAZ <- 2sd z scores) and trends based on selected variables - National Family Health Survey 2

The total children were 5,313 out of which 38.3 % i.e., 2033 were stunted and 61.7 % i.e., 61.7 5 were not stunted.

While relating the child's age in months with stunting, 4.4 % stunted children and 11.3 % non-stunted children belonged to the category of 12 to 23 months. Only 2.4 % were stunted in the age group 6 to 11 months. The highest proportion of non-stunted children were in the age group 36 to 47 months i.e., 18.9 % and lowest in 12 to 23 months i.e., 11.3 % **(Table 4.15)**.

Percentage of male children who were stunted were 19.4 % and non-stunted children were 33.6 %. In female children 18.9 % were stunted and 28.1 % were stunted. Male children are more likely to be stunted **(Table 4.15)**.

Nearly 35.9 percent of children whose birth order were 1st, out of which 12.9 % were stunted and 23 % were non stunted. 2nd and 3 rd birth order were seen in 45.4 % , out of which 16.1 % were stunted and 29.3 % were non stunted. 6.1 % had birth order 6th or more in which 3.3 % were stunted and 2.7 % were non stunted. Higher the birth orders the stunting rates increase **(Table 4.15)**.

When the size of the child is related to stunting. 60.9 % were average sized children, out of which 22.8 % were stunted and 38.1 % were not stunted. Simultaneously if we look at the very small size of children, out of 4.5 % children, 2.1 % were stunted and 2.4 % were non stunted **(Table 4.15)**.

Nearly, 64.4 % households dwelled in rural areas out of which 26.2 % children were stunted and remaining 38.3 % weren't stunted. 35.6 % dwelled in urban areas, in which 12.1 % were stunted and the remaining 23.5% were not stunted **(Table 4.15)**.

Around, 49 % households had 6 to 10 members in a family, out of which 19.4 % were stunted and 29.6 % were not stunted. In a family of 11 to 15 members (13.5 %), 5% were stunted and 8.5 % were not stunted. In a family of 16 to 20 members (3.9 %), 1.5 % were stunted and 2.4 % were not stunted. It is observed that the larger size of the family gradually the number of stunted children is also increasing **(Table 4.15)**.

Almost, 92.4 % were males who were the household head, in such families where the males were head of the household 35.5 % children were stunted and 56.8 % were not

stunted. Out of 7.6 % families run by a female. 2.8 % children were stunted and 4.9 % were not stunted **(Table 4.15)**.

In a household who has 2 or fewer children (61.2 %), 21% were stunted and 40.2 % were not stunted. A household with 6 or more children (6.4 %), 3.6 % children were stunted and 2.8 % were not stunted. When the number of children in a household increases the stunting prevalence might increase too **(Table 4.15)**.

Almost, 43.6 % of mothers were 20 to 29 years old when they had their first child. Out of which 13.8 % were stunted and 29.8 % were not stunted. Mothers who gave birth at the age of 15 to 19 years were 51.7 %. Out of which 21.8 % were stunted and 29.9 % were not stunted. Mothers who were as young as 15 to 19 years old were more likely to bear a child who is stunted later in life **(Table 4.15)**.

Around, 27.7 % mother's height ranged from 145 to 149.9 cm, out of which 12.1 % were stunted and 15.6 % were not stunted. If we see mothers whose height is 144.9cm or below that (10.5 %), they had 5.8 % children who were stunted and 4.7 % who were not stunted. If compared with mothers with height ranging from 155 to 159.9cm (19.6 %), only 5.6 % had stunted children and the remaining 13.9 % were not stunted. It results in mothers with shorter height being more prone to give birth to children who may be stunted later in life **(Table 4.15)**.

Forty eight percent mothers had BMI ranging from 18.51 - 22.9 kg/m^2 out of which 17.8 % were stunted and 30.2 % were not stunted. Mothers with BMI 15.9 kg/m^2 below (5.6 %) out of which 2.6 % were stunted and 2.9 % were not stunted **(Table 4.15)**.

Out of 35.2 % who initiated breastfeeding within one hour of birth, 12.5 % were not stunted and 20.7 % were stunted. Initiation of breastfeeding within one hour of birth proves to be beneficial for the child and reduces the chance of being stunted **(Table 4.15)**.

Thirteen percent children who were not vaccinated, out of them 4.5 % were stunted and 8.5 % were not stunted. 86.9 % were vaccinated out of which 33.7 % were stunted and 53.1 % were not stunted revealing that child immunization reduces the chance of being stunted **(Table 4.15)**.

Around, 18.7 % children had diarrhoea in the last two weeks, out of which 7.8 % children were stunted and 10.8 % were not stunted. 81.3 % children did not have diarrhoea in the last two weeks, out of which 30.5 % were stunted and 50.9 % were not stunted. Diarrhoea and recurrent infections can increase the chances of a child to be stunted **(Table 4.15)**.

Mothers who had no Antenatal visits (13.5), 7% children were stunted and 6.5 % were not stunted. Mothers who had 5 to 8 antenatal visits (29.5 %) out of which 8.1 % were stunted and the remaining 21.4 % were not stunted. Higher the Antenatal visits the chances of child being stunted lowers **(Table 4.15)**.

Table 4.15: Prevalence of Stunting (HAZ <- 2sd z scores) and trends based on selected variables - National Family Health Survey 2

Parameter	Stunting % (n)	No stunting % (n)	Chi - Square	Total % (n)
Socio Demographic Variables				
Type of Residence				
Urban	12.10 (643)	23.50 (1246)	22.15***	35.60 (1889)
Rural	26.20 (1390)	38.30 (2034)		64.40 (3424)
No of Household member				
0-5	11.7 (623)	20.6 (1094)	7.91	32.3 (1717)
6-10	19.4 (1033)	29.6 (1571)		49.0 (2604)
11-15	5.0 (263)	8.5 (453)		13.5 (716)
16-20	1.5 (82)	2.4 (125)		3.9 (207)
21-25	0.5 (25)	0.6 (30)		1.0 (55)
others	0.1 (7)	0.1 (7)		0.3 (14)
Variables related to the child				
Child's age (in months)				
6 - 11	2.4 (128)	15.0 (798)	393.3***	17.4 (926)
12 -23	4.4 (234)	11.3 (602)		15.7 (836)
24 - 35	15.8 (840)	16.5 (874)		32.3 (1714)
36 - 47	15.6 (831)	18.9 (1005)		34.6 (1836)
48 - 59				
Sex of the child				
Male	19.4 (1028)	33.6 (1785)	7.55**	53.0 (2813)
Female	18.9 (1005)	28.10 (1494)		47.0 (2499)
Birth Order				
1	12.9 (686)	23.0 (1222)	70.68***	35.9 (1908)
2-3	16.1 (857)	29.3 (1556)		45.4 (2413)
4-5	5.9 (314)	6.7 (355)		12.6 (669)
6 and more	3.3 (117)	2.7 (146)		6.1 (323)
Size of child at birth				
Very large			53.98***	
Larger than average	5.0 (264)	11.3 (600)		16.3 (864)
Average	22.8 (1212)	38.1 (2026)		60.9 (3238)
Smaller than average	8.4 (447)	9.9 (525)		18.3 (972)
Very small	2.1 (111)	2.4 (128)		4.5 (239)
Don't know				
Variables related to the mother				
Mothers age at first birth				
15-19	21.8 (1160)	29.9 (1588)	110.4***	51.7 (2748)
20-29	13.8 (377)	29.8 (1583)		43.6 (2316)
30-39	0.2 (11)	0.5 (28)		0.7 (39)
40-49	2.4 (129)	1.5 (81)		4.0 (210)
Mothers' height (cm)				

144.9 or below	5,8 (307)	4.7 (252)	155.6***	10.5 (559)
145 – 149.9	12.1 (641)	15.6 (831)		27.7 (1472)
150 – 154.9	13.2 (704)	22.3 (1185)		35.5 (1889)
155 – 159.9	5.6 (300)	13.9 (741)		19.6 (1041)
>160	1.6 (83)	5.1 (270)		6.6 (353)
Maternal BMI (kg/m^2)				
Lowest-15.9	2.6 (140)	2.9 (156)	102.1***	5.6 (296)
16.0-18.50	14.3 (757)	17.7 (941)		32.0 (1698)
18.51-22.9	17.8 (946)	30.2 (1604)		48.0 (2550)
23.0-24.9	1.8 (94)	4.9 (259)		6.6 (353)
>25	1.8 (95)	6.0 (320)		7.8 (415)
Total child born				
≤ 2	21.0 (1114)	40.2 (2138)	80.49***	61.2 (3252)
3-5	13.7 (729)	18.7 (992)		32.4 (1721)
≥ 6	3.6 (191)	2.8 (149)		6.4 (340)
Antenatal Visits				
0	7.0 (327)	6.5 (344)	191.62***	13.5 (716)
1-2	8.5 (452)	10.0 (533)		18.5 (985)
3-4	11.9 (634)	16.8 (892)		28.7 (1526)
5-8	8.1 (5433)	21.4 (1136)		29.5 (1569)
9-12	2.3 (122)	6.1 (322)		8.4 (444)
13-15	0.2 (12)	0.4 (21)		0.6 (33)
16 or more	0.2 (8)	0.6 (33)		0.8 (41)
Miscellaneous variables				
Initiation of breastfeeding				
Within 1 hour	12.5 (663)	20.7 (1206)	9.63***	35.2 (1869)
After 1 hour	25.8 (1371)	39.0 (2073)		64.8 (3444)
Ever had vaccination				
No	4.5 (239)	8.5 (451)	4.75*	13.0 (690)
Yes	33.7 (1793)	53.1 (2824)		86.9 (4617)
Don’t know	0.0 (2)	0.1 (5)		0.1 (7)
Had Diarrhoea recently				
No	30.5 (1618)	50.9 (2702)	7.29*	81.3 (4320)
Yes, last two weeks	7.8 (415)	10.8 (576)		18.7 (991)
Don’t Know	0.0 (0)	0.0 (1)		0.0 (1)

Prevalence of wasting (WHZ <- 2sd z scores) and trends based on selected variables - National Family Health Survey 2

There was total 5,313 children, out of which 14.2% i.e., 753 were wasted and 85.8% i.e., 4560 were not wasted.

While relating the child's age in months with wasting, 2.3 % wasted children and 13.4 % non-wasted children belonged to the category of 12 to 23 months (25.4 %). Only 1.3 % were wasted in the age group 6 to 11 months. The highest proportion of non-wasted children were in the age group months 36 to 47 months i.e., 30.7 % **(Table 4.16)**.

Percentage of male children who were wasted were 7.8 % and non-wasted children were 45.1 %. In female children 6.3 % were wasted and 40.7 % were wasted. Male children are more likely to be wasted **(Table 4.16)**.

Around 35.9 percent of children whose birth order were 1st, out of which 4.5% were wasted and 31.4 % were non wasted. 2nd and 3 rd birth order were seen in 45.4 %, out of which 6.7 % were wasted and 38.7 % were non wasted. 6.1 % had birth order 6th or more in which 1 % were wasted and 5 % were non wasted **(Table 4.16)**.

When the size of the child is related to wasting and non-wasting. 60.9 % were average sized children, out of which 8.3 % were wasted and 52.6 % were not wasted. Simultaneously if we look at the very small size of children, out of 4.5 % children, 0.7 % were wasted and 3.8 % were non-wasted **(Table 4.16)**.

Almost 64.4 % households dwelled in rural areas out of which 9.7% children were wasted and remaining 54.7 % weren't wasted. 35.6 % dwelled in urban areas, in which 4.4 % were wasted and the remaining 31.1 % were not wasted **(Table 4.16)**.

Forty nine percent households had 6 to 10 members in a family, out of which 7.1 % were wasted and 41.9 % were not wasted. In a family of 11 to 15 members (13.5 %), 2.2 % were wasted and 11.3 % were not wasted. In a family of 16 to 20 members (3.9%) 0.5 % were wasted and 3.4 % were not wasted **(Table 4.16)**.

Nearly, 92.4 % families were headed by male member, 13.1 % were wasted and 79.3 were not wasted. 7.6 % families were headed by female members, 1.1 were wasted and 6.6 weren't wasted **(Table 4.16)**

In a household who has 2 or fewer children (61.2 %), 8.2 % were wasted and 53 % were not wasted. Households having 3- 5 children (32.4 %) 4.9 % were wasted and 27.5 % were not wasted. A household with 6 or more children (6.4 %), 1.1 % children were wasted and 5.3 % were not wasted. When the number of children in a household increases the wasting prevalence might increase too **(Table 4.16)**.

Around 43.6 % of mothers were 20 to 29 years old when they had their first child. Out of which 6 % were wasted and 37.6 % were not wasted. Mothers who gave birth at the age of 15 to 19 years were 51.7 %. Out of which 7.4 % were stunted and 44.3 % were not wasted. Children are more likely to be wasted if they are born to mothers who were pregnant at the age of 15 - 19 years old **(Table 4.16)**.

If we see mothers whose height is 144.9cm or below that (10.5 %), they had 1.8 % children who were wasted and 8.7 % who were not wasted. If compared with mothers with height ranging from 155 to 159.9cm (19.6 %), only 2.4 % had wasted children and the remaining 17.2 % were not wasted. It results in mothers with shorter height being more prone to give birth to children who may be wasted **(Table 4.16)**.

Nearly, 48 % mothers had BMI ranging from 18.51 - 22.9 kg/m^2 out of which 5.8 % were wasted and 42.2 % were not wasted. Mothers with BMI 15.9 kg/m^2 below (5.6 %) out of which 1.4 % were wasted and 4.2 % were not wasted **(Table 4.16)**.

Out of 35.2 % who initiated breastfeeding within one hour of birth, 30.2 % were not wasted and 5 % were wasted. Initiation of breastfeeding within one hour of birth proves to be beneficial for the child and reduces the chance of being stunted **(Table 4.16)**.

Thirteen percent children who were not vaccinated, out of them 1.5 % were wasted and 11.4 % were not wasted. 86.9 % were vaccinated out of which 12.6 % were wasted and 74.3 % were not wasted, revealing that child immunization reduces the chance of being wasted **(Table 4.16)**.

Around 18.7 % children had diarrhoea in the last two weeks, out of which 3.3 % children were wasted and 15.4 % were not wasted. 81.3 % of children did not have diarrhoea in the last two weeks, out of which 10.9 % were wasted and 70.4 % were not wasted. Diarrhoea and recurrent infections can increase the chances of a child to be wasted **(Table 4.16)**.

Mothers who had no Antenatal visits (13.5 %), 1.8 % children were wasted and 11.7 % were not wasted. Mothers who had 5 to 8 antenatal visits (29.5 %) out of which 3.7 % were wasted and the remaining 25.8 % were not wasted. Higher the Antenatal visits the chances of child being wasted lowers **(Table 4.16)**.

Wasting when related with stunting, out of 38.3 % children who were stunted, 5.3 % were wasted and 32,9 % were not wasted. Out of 61.7 % children who were not stunted, 8.8 % children were wasted and 52.9 % children weren't wasted **(Table 4.16)**.

Underweight when related with wasting. Out of 40.7 % underweight children, 11.3 % were wasted and 29.3 % were not wasted. Out of 59.3 % children who were not underweight, 2.8 % were wasted and 56.5 % were not wasted **(Table 4.16)**.

Table 4.16: Prevalence of Wasting (WHZ <- 2sd z scores) and trends based on selected variables - National Family Health Survey 2

Parameter	Wasting % (n)	No wasting % (n)	Chi - Square	Total % (n)
Socio Demographic Variables				
Type of Residence				
Urban	4.4 (236)	31.1 (1653)	6.79**	35.6 (1889)
Rural	9.7 (517)	54.7 (2907)		64.4 (3424)
No of Household member				
0-5	4.3 (227)	28.1 (1491)	4.76	32.3 (1718)
6-10	7.1 (375)	41.9 (2228)		49.0 (2603)
11-15	2.2 (116)	11.3 (600)		13.5 (716)
16-20	0.5 (26)	3.4 (181)		3.9 (207)
21-25	0.1 (6)	0.9 (49)		1.0 (55)
others	0.0 (2)	0.2 (12)		0.3 (14)
Variables related to the child				
Child's age (in months)				
6 - 11	1.3 (71)	16.1 (855)	102.74***	17.4 (926)
12 -23	2.3 (123)	13.4 (713)		15.7 (836)
24 - 35	6.6 (352)	2.6 (1362)		32.3 (1714)
36 - 47	3.9 (206)	30.7 (1630)		34.6 (1836)
48 - 59	-	-		-
Sex of the child				
Male	7.8 (417)	45.1 (2396)	2.20	52.9 (2813)
Female	6.3 (335)	40.7 (2165)		47.1 (2500)
Birth Order				
1	4.5 (239)	31.4 (1669)	7.82*	35.9 (1908)
2-3	6.7 (355)	38.7 (2058)		45.4 (2413)
4-5	1.9 (103)	10.7 (566)		12.6 (669)
6 and more	1.0 (55)	5.0 (268)		6.1 (323)
Size of child at birth				
Very large			33.48***	
Larger than average	1.6 (87)	14.6 (778)		16.3 (865)
Average	8.3 (442)	52.6 (2796)		60.9 (3238)
Smaller than average	3.5 (187)	14.8 (785)		18.3 (972)
Very small	0.7 (36)	3.8 (202)		4.5 (238)
Don't know	-	-		-
Variables related to the mother				
Mothers age at first birth				
15-19	7.4 (394)	44.3 (2354)	0.47	51.7 (2748)
20-29	6.0 (321)	37.6 (1996)		43.6 (2317)
30-39	0.1 (6)	0.6 (34)		0.8 (40)
40-49	0.6 (32)	3.3 (178)		4.0 (210)

Mothers' height (cm)				
144.9 or below	1.8 (95)	8.7 (464)	7.53	10.5 (559)
145 – 149.9	4.0 (211)	23.7 (1261)		27.7 (1472)
150 – 154.9	5.1 (273)	30.4 (1615)		35.5 (1888)
155 – 159.9	2.4 (127)	17.2 (914)		19.6 (1041)
>160	0.9 (46)	5.8 (307)		6.6 (353)
Maternal BMI (kg/m^2)				
Lowest-15.9	1.4 (75)	4.2 (221)	67.96***	5.6 (296)
16.0-18.50	5.6 (297)	26.4 (1402)		32.0 (1699)
18.51-22.9	5.8 (306)	42.2 (2244)		48.0 (2550)
23.0-24.9	0.6 (33)	6.0 (320)		6.6 (353)
>25	0.8 (42)	7.0 (374)		7.8 (416)
Total child born				
≤ 2	8.2 (437)	53.0 (2816)	4.73*	61.2 (3253)
3-5	4.9 (258)	27.5 (1463)		32.4 (1721)
≥ 6	1.1 (58)	5.3 (282)		6.4 (340)
Antenatal Visits				
0	1.8 (93)	11.7 (623)	15.81**	13.5 (716)
1-2	3.0 (158)	15.6 (827)		18.5 (985)
3-4	4.6 (243)	24.1 (1283)		28.7 (1526)
5-8	3.7 (198)	25.8 (1370)		29.5 (1565)
9-12	1.0 (51)	7.4 (393)		8.4 (444)
13-15	0.0 (2)	0.6 (31)		0.6 (33)
16 or more	0.2 (8)	0.6 (34)		0.8 (42)
Miscellaneous variables				
Initiation of breastfeeding				
Within 1 hour	5.0 (226)	30.2 (1603)	0.015	35.2 (1869)
After 1 hour	9.1 (486)	55.7 (2958)		64.8 (3444)
Ever had vaccination				
No	1.5 (82)	11.4 (608)	3.40	13.0 (690)
Yes	12.6 (670)	74.3 (3947)		86.9 (4617)
Don't know	0.0 (1)	0.1 (6)		0.1 (7)
Had Diarrhoea recently				
No	10.9 (578)	70.4 (3743)	12.31**	81.3 (4321)
Yes, last two weeks	3.3 (175)	15.4 (816)		18.7 (991)
Don't Know	0.0 (0)	0.0 (1)		0.0 (1)

Prevalence of Underweight (WAZ <- 2sd z scores) and trends based on selected variables - National Family Health Survey 2

There was a total of 5,313 children, out of which 40.7 % i.e., 2160 were underweight and 59.3% i.e., 3153 were not underweight.

While relating the child's age in months with underweight, 5.6 % underweight children and 15.6 % non-underweight children belonged to the category of 12 to 23 months. Only 1.8 % were underweight in the age group 6 to 11 months (11.6 %). The highest underweight children were 36 to 47 months old i.e., 17 %. The highest proportion of not underweight children were in the age group 36 to 47 months i.e., 17.5 % **(Table 4.17)**.

Percentage of male children who were underweight was 20.8 % and children who were not underweight 32.2 %. In female children 19.9 % were underweight and 27.2 % were not underweight. Male children are more likely to be underweight **(Table 4.17)**.

Around 35.9 percent of children whose birth order were 1st, out of which 13 % were underweight and 22.9 % were non-underweight. The 2nd and 3rd birth order were seen in 45.4 %, out of which 18.4 % were underweight and 27 % were non-underweight. 6.1 % had birth order 6th or more in which 3.4 % were underweight and 2.7 % were non underweight **(Table 4.17)**.

When the size of the child is related to underweight and non-underweight. 60.9 % were average sized children, out of which 23.8 % were underweight and 37.2% were not underweight. Simultaneously if we look at the very small size of children, out of 4.5 % children, 2.5 % were underweight and 4.5 % were non underweight **(Table 4.17)**.

Around 64.6 % households dwelled in rural areas out of which 27.7 % children were underweight and remaining 36.8 % weren't underweight. 35.6 % dwelled in urban areas, in which 13 % were underweight and the remaining 22.6 % were not underweight. Larger proportion of children were underweight who lived in rural areas. 49 % households had 6 to 10 members in a family, out of which 19.9 % were underweight and 29.1 % were not underweight. In a family of 11 to 15 members (13.5 %), 5.6 % were underweight and 7.9 % were not underweight. In a family of 16 to 20 members (3.9 %) 1.6 % were underweight and 2.3 % were not underweight. It is observed that the larger size of the family gradually the percentage of underweight children are also increasing **(Table 4.17)**.

In a household who has 2 or fewer children (48.3%), 20.1 % were underweight and 28.1 % were not underweight. A household with 6 or more children (11.6 %), 7.2 % children were underweight and 4.5 % were not underweight. When the number of children in a household increases the underweight prevalence might increase too **(Table 4.17)**.

Nearly 92.4 % households were male headed, 37.7 % children were underweight and 54.6 % were not underweight. 7.6 % families were female headed, 2.9 % were underweight and the remaining 4.7 5 were underweight **(Table 4.17)**.

Almost 43.6 % of mothers were 20 to 29 years old when they had their first child. Out of which 14.9 % were underweight and 28.7 % were not underweight. Mothers who gave birth at the age of 15 to 19 years were 51.7 %. Out of which 23.2 % were underweight and 28.5 % were non underweight. Children are more likely to be underweight if they are born to mothers who were pregnant at the age of 15 - 19 years old **(Table 4.17)**.

If we see mothers whose height is 144.9cm or below that (5.6 %), they had 3.4 % children who were underweight and 2.1 % who were non underweight. If compared with mothers with height ranging from 155 to 159.9cm (19.6 %), 6 % were underweight children and the remaining 13.6 % were non underweight. It results in mothers with shorter height being more prone to give birth to children who were underweight **(Table 4.17)**.

Around 48 % mothers had BMI ranging from 18.51 - 22.9 kg/m^2 out of which 16.7 % were underweight and 31.3 % were non-underweight. Mothers with BMI 15.9 kg/m^2 below (5.6 %) out of which 3.4 % were underweight and 2.1 % were not underweight **(Table 4.17)**.

Out of 35.2 % who initiated breastfeeding within one hour of birth, 13.8 % were not underweight and 21.4 were underweight. Initiation of breastfeeding within one hour of birth proves to be beneficial for the child and reduces the chance of being underweight **(Table 4.17)**.

Thirteen percent children who were not vaccinated, out of them 4.6 % were underweight and 8.4 % were not underweight. 86.9 % were vaccinated out of which 36.1 % were underweight and 50.8 % were not underweight, revealing that child immunization reduces the chance of being underweight **(Table 4.17)**.

Around 18.7 % children had diarrhoea in the last two weeks, out of which 8.5 % children were underweight and 10.1 % were not underweight. 81.3 % children did not have diarrhoea in the last two weeks out of which 32.1 % were underweight and 49.2 % were not underweight. Diarrhoea and recurrent infections can increase the chances of a child to be underweight **(Table 4.17)**.

Mothers who had no Antenatal visits (13.5 %), 6.7 % children were underweight and 6.8 % were not underweight. Mothers who had 5 to 8 antenatal visits (29.5 %) out of which 9.8 % were underweight and the remaining 19.7 % were not underweight. Higher the Antenatal visits the chances of the child being underweight lowers **(Table 4.17)**.

Table 4.17: Prevalence of Underweight (WHZ <- 2sd z scores) and trends based on selected variables - National Family Health Survey 2

Parameter	Underweight % (n)	No Underweight % (n)	Chi - Square	Total % (n)
Socio Demographic Variables				
Type of Residence				
Urban	13.0 (690)	22.6 (1199)	20.70***	35.6 (1889)
Rural	27.7 (1470)	36.8 (1954)		64.4 (3424)
No of Household member				
0-5	13.1 (695)	19.2 (1022)	0.79	32.3 (1717)
6-10	19.9 (1055)	29.1 (1548)		49.0 (2603)
11-15	5.6 (296)	7.9 (420)		13.5 (716)
16-20	1.6 (84)	2.3 (123)		3.9 (207)
21-25	0.5 (24)	0.6 (32)		1.1 (56)
others	0.1 (7)	0.1 (7)		0.3 (14)
Variables related to the child				
Child's age (in months)				
6 - 11	1.8 (95)	15.6 (831)	483.28***	17.4 (926)
12 -23	5.6 (300)	10.1 (536)		15.7 (836)
24 - 35	16.2 (860)	16.1 (855)		32.3 (1715)
36 - 47	17.0 (905)	17.5 (931)		34.6 (1836)
48 - 59				
Sex of the child				
Male	20.8 (1104)	32.2 (1709)	4.91*	52.9 (2813)
Female	19.9 (1056)	27.2 (1444)		47.1 (2500)
Birth Order				
1	13.0 (689)	22.9 (1219)	59.12***	35.9 (1908)
2-3	18.4 (976)	27.0 (1436)		45.4 (2412)
4-5	5.9 (313)	6.7 (356)		12.6 (669)
6 and more	3.4 (182)	2.7 (142)		6.1 (324)
Size of child at birth				
Very large			93.39***	
Larger than average	5.2 (275)	11.1 (590)		16.3 (865)
Average	23.8 (1262)	37.2 (1976)		60.9 (3238)
Smaller than average	9.2 (489)	9.1 (482)		18.3 (971)
Very small	2.5 (134)	2.0 (105)		4.5 (239)
Don't know				
Variables related to the mother				
Mothers age at first birth				
15-19	23.2 (1231)	28.5 (1516)	92.70***	51.7 (2747)
20-29	14.9 (794)	28.7 (1523)		43.6 (2317)
30-39	0.2 (11)	0.5 (29)		0.8 (40)
40-49	2.4 (125)	1.6 (85)		4.0 (210)
Mothers' height (cm)				
144.9 or below	5.6 (297)	4.9 (262)	122.47***	10.5 (559)

145 – 149.9	12.6 (667)	15.1 (805)		27.7 (1472)
150 – 154.9	14.8 (785)	20.8 (1104)		35.5 (1889)
155 – 159.9	6.0 (317)	13.6 (724)		19.6 (1041)
>160	1.8 (95)	4.9 (258)		6.6 (353)
Maternal BMI (kg/m^2)				
Lowest-15.9	3.4 (182)	2.1 (114)	264.10***	5.6 (296)
16.0-18.50	16.8 (894)	15.1 (805)		32.0 (1699)
18.51-22.9	16.7 (889)	31.3 (1661)		48.0 (2550)
23.0-24.9	1.7 (90)	5.0 (264)		6.7 (354)
>25	2.0 (105)	5.8 (310)		7.8 (415)
Total child born				
≤ 2	22.3 (1187)	38.9 (2065)	74.44***	61.2 (3252)
3-5	14.7 (781)	17.7 (940)		32.4 (1721)
≥ 6	3.6 (192)	2.8 (148)		6.4 (340)
Antenatal Visits				
0	6.7 (354)	6.8 (361)	135.45***	13.5 (715)
1-2	9.0 (477)	9.6 (508)		18.5 (985)
3-4	12.6 (670)	16.1 (856)		28.7 (1526)
5-8	9.8 (522)	19.7 (1046)		29.5 (1568)
9-12	2.1 (113)	6.2 (330)		8.3 (443)
13-15	0.2 (12)	0.7 (21)		0.6 (33)
16 or more	0.2 (11)	0.6 (30)		0.8 (41)
Miscellaneous variables				
Initiation of breastfeeding				
Within 1 hour	13.8 (732)	21.4 (1137)	2.65	35.2 (1869)
After 1 hour	26.9 (1428)	37.9 (2016)		64.8 (3444)
Ever had vaccination				
No	4.6 (243)	8.4 (447)	10.24**	13.0 (690)
Yes	36.1 (1916)	50.8 (2701)		86.9 (4617)
Don’t know	0.0 (2)	0.1 (5)		0.1 (7)
Had Diarrhoea recently				
No	32.1 (1707)	49.2 (2614)	13.55***	81.3 (4321)
Yes, last two weeks	8.5 (453)	10.1 (538)		18.7 (991)
Don’t Know	0.0 (0)	0.0 (1)		0.0 (1)

Assessment of the determinants of Stunting, Underweight and Wasting amongst children (6-59 months)

National Family Health Survey 4

A binary logistic regression analysis was performed to ascertain the effects of selected characteristics on the likelihood that Children were stunted (Height for age z scores <-2sd). The binary logistic regression model was found to be statistically significant, Chi square = 65.20, p <0.000. The model explained 68.5% (Nagelkerke R^2) of the variance in stunting amongst children and correctly classified 85% of cases.

On carrying out binary logistic regression to see the effect of the selected characteristics on underweight (Weight for age z scores <-2sd), the model explained 81.5% (Nagelkerke R^2) of the variance in underweight amongst children and correctly classified 89.4% of cases. The binary logistic regression model was found to be statistically significant, Chi square = 23.53, p <0.003.

Binary logistic regression analysis between the selected characteristics and wasting (Weight for height <-2 SD) was conducted and it was observed that the model explained 64.6% (Nagelkerke R^2) of the variance in wasting amongst children and correctly classified 89.1% of cases. The binary logistic regression model was found to be statistically significant, Chi square = 94.66, p <0.000.

Odds of Stunting, Underweight and Wasting amongst children (06-59 months) by selected characteristics- India NFHS 4

Odds for wasting were significantly lower in children residing in urban areas. However, Stunting and underweight status were not affected by the type of residence. Children falling under richer and richest quintile for wealth index had significantly lower odds for stunting and underweight. Significantly lower odds were observed for stunting in children belonging to households having less than 6 members. Male children had higher has significantly higher odds for underweight and lower odds for stunting and wasting as compared to female children. Highest odds for stunting and wasting were observed in children between 12-23 months followed by 48-59 months of age while for underweight highest odds were observed in 24-35 months age. Fourth or the fifth birth order children had highest odds for stunting and underweight. Child's size at birth did

not show any significant association with stunting and underweight however, highest odds for wasting were observed in children who were smaller than average at the time of birth. Children breastfed within 1 hour of birth showed significantly lower odds for underweight. Reduction in severity of anaemia led to reduction in odds of getting stunted.

Mothers current age showed no significant association. Stunting and wasting odds were higher in children whose mothers belonged to the age group of 20-29 years. Lowest odds for underweight were observed in children whose mothers went for 16 or more antenatal visits. As the mother's education level increased odds for stunting and wasting reduced. Lowest odds for underweight and wasting were observed in children whose mothers had BMI >25. Prevalence of anaemia amongst mothers was not found to be associated significantly with any of the three forms of malnutrition **(Table 4.18).**

Table 4.18: Odds of Stunting, Underweight and Wasting amongst children (06-59 months) by selected characteristics- India NFHS 4 (N=48,265)

Parameters		95% CI							
	Stunting			Underweight			Wasting		
	Odds ratio	Lower	Upper	Odds ratio	Lower	Upper	Odds ratio	Lower	Upper
Place of Residence									
Urban									
Rural	.999	.924	1.080	.923	.843	1.011	.895**	.819	.979
Wealth Index									
Poorest									
Poor	1.043	.961	1.132	.920	.832	1.016	1.020	.929	1.120
Middle	.956	.870	1.049	.856**	.766	.958	1.003	.901	1.117
Richer	.766***	.688	.854	.862*	.760	.979	.905	.799	1.025
Richest	.772***	.675	.883	.662***	.566	.775	1.179*	1.014	1.372
Number of Household members									
0-5									
6-10	.927*	.870	.989	1.059	.981	1.143	.887**	.825	.954
11-15	.956	.853	1.071	1.081	.945	1.238	.815**	.715	.928
16-20	1.042	.805	1.348	1.199	.887	1.621	.754	.548	1.038
21-25	1.624	.946	2.785	.336***	.183	.618	1.115	.670	1.853
>25	1.913	.818	4.472	.448	.128	1.568	.433	.108	1.736
Gender									
Male									
Female	.846***	.799	.897	1.443***	1.347	1.546	.714***	.668	.762
Age (in months)									
0-5									
6-11									
12-23	5.312***	4.670	6.043	.514***	.454	.582	1.624***	1.442	1.830
24-35	2.102***	1.844	2.397	1.292***	1.136	1.469	.579***	.510	.656
36-47	3.898***	3.417	4.446	.611***	.536	.697	.933	.821	1.060
48-59	4.658***	4.072	5.328	.499***	.436	.571	1.190*	1.043	1.357
Birth Order									
First									
Second or Third	1.090*	1.004	1.184	.924	.840	1.016	.977	.892	1.071
Fourth or Fifth	1.429***	1.251	1.632	.749***	.639	.877	.997	.857	1.159
Sixth or more	1.407***	1.191	1.661	.826	.675	1.011	.991	.819	1.200
Size at birth									
Very large	.906	.785	1.047	.950	.802	1.125	1.474***	1.245	1.746
Larger than average	.957	.848	1.080	.868	.752	1.001	1.334***	1.152	1.544
Average	1.090	.938	1.267	1.083	.903	1.298	1.525***	1.280	1.819
Smaller than average	1.087	.892	1.325	1.335*	1.042	1.711	1.586***	1.277	1.970
Very small	.967	.761	1.227	1.063	.792	1.427	1.372*	1.045	1.802
Breastfeeding initiation within 1 hour									
Yes									
No	1.004	.945	1.068	.918*	.853	.987	.973	.907	1.044
Ever Vaccinated									
No									
Yes	1.000	.958	1.044	.992	.943	1.045	.965	.920	1.013

Prevalence of Anaemia									
Severe									
Moderate	.829	.668	1.029	1.016	.779	1.324	.858	.677	1.087
Mild	.721***	.580	.896	1.021	.782	1.333	.847	.667	1.076
No Anaemia	.625***	.504	.775	1.037	.795	1.354	.819	.646	1.039
Mother's Age in Years									
15-19									
20-29	1.003	.803	1.253	1.025	.793	1.326	1.254	.976	1.611
30-39	.949	.745	1.208	1.063	.803	1.409	1.298	.989	1.704
40-49	.810	.603	1.088	1.356	.955	1.925	1.159	.828	1.621
Mother's Age at first birth (in Years)									
15-19									
20-29	1.069*	1.001	1.141	.979	.905	1.060	1.089*	1.010	1.174
30-39	1.183	.932	1.502	.983	.749	1.291	.989	.754	1.297
40-49	.696	.180	2.694	2.132	.288	15.780	.186*	.036	.971
Number of Antenatal visits									
0									
1-2	.905*	.831	.987	.910	.821	1.009	1.048	.948	1.158
3-4	.859***	.788	.936	.924	.834	1.023	1.032	.935	1.140
5-8	.839***	.765	.921	.930	.832	1.039	1.280***	1.152	1.423
9-12	.809***	.712	.920	1.032	.886	1.203	1.463***	1.271	1.683
13-15	.749*	.565	.993	1.012	.700	1.463	1.461*	1.063	2.009
≥ 16	.828	.664	1.034	.531***	.405	.695	1.079	.827	1.407
Educational attainment									
No education									
Primary	.983	.899	1.076	.879*	.789	.980	.896*	.806	.995
Secondary	.870***	.805	.941	.899*	.818	.989	1.026	.938	1.123
Higher	.626***	.545	.718	.928	.796	1.081	.789**	.677	.920
Body Mass Index (Kg/m)									
<16.0									
16.0-18.5	1.037	.891	1.206	.780**	.643	.945	.668***	.578	.771
18.5-22.9	1.075	.928	1.244	.665***	.553	.801	.603***	.525	.693
23- 25	.976	.826	1.154	.666***	.542	.820	.565***	.477	.669
>25	.922	.783	1.086	.626***	.511	.768	.439***	.372	.520
Prevalence of anaemia (Mothers)									
Severe									
Moderate	1.136	.836	1.544	1.104	.759	1.608	.814	.582	1.138
Mild	1.253	.929	1.691	1.133	.785	1.635	.889	.641	1.233
No Anaemia	1.199	.888	1.618	1.103	.764	1.592	.893	.644	1.240

National Family Health Survey 3

A binary logistic regression analysis was performed to ascertain the effects of selected characteristics on the likelihood that Children were stunted (Height for age z scores <-2sd). The model explained 70.8% (Nagelkerke R^2) of the variance in stunting amongst children and correctly classified 85.1% of cases.

On carrying out binary logistic regression to see the effect of the selected characteristics on underweight (Weight for age z scores <-2sd), the model explained 83.6% (Nagelkerke R^2) of the variance in underweight amongst children and correctly classified 92% of cases.

Binary logistic regression analysis between the selected characteristics and wasting (Weight for height <-2 SD) was conducted and it was observed that the model explained 67.7% (Nagelkerke R^2) of the variance in wasting amongst children and correctly classified 89.7% of cases.

Odds of Stunting, Underweight and Wasting amongst children (06-59 months) by selected characteristics- India NFHS 3 (N= 12,960)

Table (4.19) shows that type of residence had no significant association with any form of malnutrition in children. Children falling under richest quintile for wealth index had lowest odds for underweight. Male children had significantly higher odds for underweight and lower odds for stunting and wasting as compared to female children. Highest odds for stunting and wasting were observed in children between 12-23 months while for underweight lowest odds were observed in 12-23 months age. Highest odds for wasting and underweight were observed in children who were smaller than average at the time of birth. Reduction in severity of anaemia led to reduction in odds of getting stunted. Children of women whose current age was between 40-49 years has highest odds for underweight. Wasting odds were higher in children whose mothers belonged to the age group of 30-39 years. Significantly lower odds for stunting were observed in children whose mothers went for 9-12 antenatal visits. As the mother's education level increased odds for stunting reduced. Lowest odds for underweight and wasting were observed in children whose mothers had BMI >25. Prevalence of anaemia amongst mothers was not found to be associated significantly with any of the three forms of malnutrition.

Table 4.19: Odds of Stunting, Underweight and Wasting amongst children (06-59 months) by selected characteristics- India NFHS 3 (N= 12960)

Parameters		95% CI							
	Stunting			Underweight			Wasting		
	Odds ratio	Lower	Upper	Odds ratio	Lower	Upper	Odds ratio	Lower	Upper
Place of Residence									
Urban									
Rural	1.019	.885	1.173	.876	.727	1.056	.841	.705	1.003
Wealth Index									
Poorest									
Poor	1.122	.931	1.352	.876	.697	1.101	.917	.751	1.120
Middle	1.152	.952	1.393	.680**	.537	.861	.809	.652	1.005
Richer	1.012	.820	1.250	.662**	.507	.864	.831	.645	1.070
Richest	.781	.603	1.011	.520***	.370	.731	.767	.555	1.062
Number of Household members									
0-5									
6-10	1.061	.932	1.208	1.113	.940	1.318	1.074	.919	1.255
11-15	1.148	.917	1.438	1.073	.808	1.424	.930	.708	1.221
16-20	1.447	.887	2.361	.554	.291	1.054	.969	.496	1.892
21-25	.710	.314	1.607	1.527	.514	4.534	.420	.118	1.494
>25	.831	.249	2.770	.597	.089	3.991	.742	.077	7.166
Gender									
Male									
Female	.776***	.692	.870	1.397***	1.204	1.619	.651***	.567	.747
Age (in months)									
0-5									
6-11									
12-23	3.273***	2.658	4.030	.421***	.317	.559	1.622***	1.273	2.068
24-35	2.962***	2.381	3.684	.673**	.505	.897	.913	.710	1.173
36-47	2.376***	1.894	2.980	.911	.677	1.225	.820	.631	1.067
48-59	1.967***	1.555	2.489	1.014	.746	1.377	.794	.603	1.045
Birth Order									
First									
Second or Third	.933	.792	1.099	1.073	.858	1.342	.924	.752	1.134

Fourth or fifth	.872	.695	1.095	1.188	.883	1.597	.798	.608	1.048
Sixth or more	1.142	.843	1.548	1.081	.733	1.594	.878	.621	1.241
Size at birth									
Very large	.856	.621	1.180	1.701*	1.110	2.605	.911	.600	1.381
Larger than average	.904	.668	1.223	1.491	.996	2.230	1.082	.730	1.603
Average	1.099	.791	1.527	1.694*	1.097	2.617	1.348	.891	2.040
Smaller than average	1.143	.782	1.671	1.737*	1.061	2.843	1.693*	1.072	2.674
Very small	.713	.427	1.191	1.674	.821	3.411	1.236	.643	2.374
Breastfeeding initiation within 1 hour									
Yes									
No	.987	.877	1.112	1.023	.876	1.194	1.134	.982	1.310
Ever Vaccinated									
No									
Yes	1.037	.907	1.185	.947	.809	1.109	.873	.731	1.042
Prevalence of Anemia									
Severe									
Moderate	.792	.545	1.151	.826	.526	1.297	.821	.576	1.170
Mild	.722	.494	1.056	.573*	.361	.910	.918	.634	1.329
No Anemia	.553**	.378	.809	.671	.423	1.065	.958	.660	1.390
Mother's Age in Years									
15-19									
20-29	.833	.597	1.161	1.692*	1.089	2.629	1.002	.675	1.487
30-39	.852	.582	1.247	1.605	.972	2.649	.989	.628	1.559
40-49	1.031	.616	1.728	2.135*	1.109	4.110	1.043	.584	1.864
Mother's Age at first birth (in Years)									
15-19									
20-29	.888	.778	1.014	1.134	.954	1.347	.947	.808	1.110
30-39	.827	.495	1.382	.705	.342	1.452	1.880*	1.021	3.463
40-49	1.612	.006	400.861	1.342	.041	43.865	-	-	-
Number of Antenatal visits									
0									
1-2	.932	.784	1.106	1.014	.818	1.257	.946	.780	1.147
3-4	.897	.752	1.070	1.017	.812	1.273	.934	.760	1.147
5-8	.824	.678	1.002	1.052	.820	1.350	.957	.756	1.213
9-12	.624***	.481	.811	1.154	.808	1.647	.804	.569	1.136
13-15	.696	.377	1.286	.720	.291	1.779	1.963	.921	4.185
≥ 16	.932	.784	1.106	1.014	.818	1.257	.946	.780	1.147
Educational attainment									
No education									
Primary	1.142	.957	1.363	.841	.674	1.049	1.307**	1.054	1.619
Secondary	.941	.802	1.104	.988	.805	1.213	1.115	.915	1.359
Higher	.795	.585	1.080	1.110	.721	1.709	1.407	.938	2.109
Body Mass Index (Kg/m)									
<16.0									
16.0-18.5	1.150	.892	1.481	.804	.581	1.112	.760*	.589	.979

18.5-22.9	1.059	.827	1.357	.689*	.502	.948	.619***	.480	.797
23- 25	1.210	.881	1.663	.656*	.434	.991	.561**	.382	.825
>25	1.166	.855	1.590	.565**	.375	.854	.427***	.287	.636
Prevalence of anaemia (Mothers)									
Severe									
Moderate	.819	.497	1.350	.945	.547	1.634	1.009	.575	1.769
Mild	.983	.605	1.597	.814	.481	1.378	1.151	.667	1.988
No Anemia	1.141	.702	1.857	.800	.472	1.355	1.049	.607	1.815

National Family Health Survey 2

A binary logistic regression analysis was performed to ascertain the effects of selected characteristics on the likelihood that Children were stunted (Height for age z scores <-2sd). The binary logistic regression model was found to be statistically significant, Chi square = 29.26, p <0.000. The model explained 69.9% (Nagelkerke R^2) of the variance in stunting amongst children and correctly classified 85.6% of cases.

On carrying out binary logistic regression to see the effect of the selected characteristics on underweight (Weight for age z scores <-2sd), the model explained 82.7% (Nagelkerke R^2) of the variance in underweight amongst children and correctly classified 90.6% of cases. The binary logistic regression model was found to be statistically significant, Chi square = 15.61, p <0.048.

Binary logistic regression analysis between the selected characteristics and wasting (Weight for height <-2 sd) was conducted and it was observed that the model explained 63.4% (Nagelkerke R^2) of the variance in wasting amongst children and correctly classified 91.9% of cases.

Odds of Stunting, Underweight and Wasting amongst children (06-59 months) by selected characteristics- India NFHS 2 (N= 5,313)

No significant association was observed between the three forms of malnutrition and type of residence. Higher odds for underweight and wasting were observed in families with a size of 25 members or more. However, the association was not significant. Male children had higher has significantly higher odds for underweight and lower odds for wasting as compared to female children. Highest odds for stunting and wasting were observed in children between 12-23 months while for underweight highest odds were observed in 6-11 months age. Children on birth order 6 or above had highest odds for wasting

Lowest odds for stunting and wasting were observed in children whose mothers belonged to the age group of 30-39 years. Highest odds for wasting were observed in children whose mothers belonged to 20-29 years of age at the time of first birth. Lowest odds for underweight were observed in children whose mothers went for 9-12 antenatal

visits while lowest odds for stunting were observed with 5-8 antenatal visits. As the mother's education level increased odds for malnutrition reduced however, no significant association was observed. Lowest odds for underweight were observed in children whose mothers had BMI between 18.5-22.9 kg/m^2 (**Table 4.20**).

Table 4.20 Odds of Stunting, Underweight and Wasting amongst children (06-59 months) by selected characteristics- India NFHS 2 (N= 5,313)

Parameters	95% CI								
	Stunting			Underweight			Wasting		
	Odds ratio	Lower	Upper	Odds ratio	Lower	Upper	Odds ratio	Lower	Upper
Place of Residence									
Urban									
Rural	.859	.709	1.040	.958	.753	1.220	1.280	.988	1.658
Number of Household members									
0-5									
6-10	1.011	.825	1.239	1.153	.892	1.491	1.089	.830	1.429
11-15	.991	.746	1.318	1.315	.923	1.874	1.212	.845	1.736
16-20	1.078	.661	1.757	1.069	.618	1.849	.708	.354	1.417
21-25	1.598	.719	3.552	1.315	.450	3.839	1.058	.329	3.396
>25	.510	.080	3.237	4.919	.843	28.691	2.020	.184	22.162
Gender									
Male									
Female	1.067	.896	1.271	1.259*	1.013	1.566	.672**	.534	.846
Age (in months)									
0-5									
6-11	1.253	.854	1.839	3.134***	2.021	4.860	.545*	.337	.880
12-23	6.868	4.864	9.698	1.017	.678	1.526	1.617*	1.059	2.469
24-35	3.545	2.512	5.002	2.241***	1.483	3.387	.412***	.261	.649
Birth Order									
First									
Second or Third	1.002	.793	1.264	1.042	.777	1.396	1.386*	1.013	1.895
Fourth or Fifth	1.560	1.054	2.309	.669	.410	1.092	1.411	.841	2.365
Sixth or more	1.888	1.055	3.378	.889	.434	1.821	2.942**	1.437	6.020
Breastfeeding initiation within 1 hour									
Yes									
No	1.142	.947	1.377	.850	.672	1.074	1.101	.862	1.406
Ever Vaccinated									
No									
Yes	1.012	.768	1.333	.708	.507	.989	1.093	.866	1.381
Mother's Age in Years									
15-19									
20-24	.885	.635	1.232	.822	.538	1.256	.855	.554	1.319
25-29	.636**	.419	.965	1.276	.745	2.186	.670	.389	1.156
30-34	.756	.449	1.273	1.120	.582	2.156	.507	.254	1.012
35-39	.365***	.179	.742	1.518	.581	3.968**	.282	.112	.709
40-44	.553	.156	1.963	1.391	.294	6.594	.355	.087	1.443
45-49	.161*	.032	.795	6.681	.902	49.497	.079*	.009	.728
Mother's Age at first birth (in Years)									
15-19									
20-29	1.217	.968	1.530	.655**	.487	.880	1.611	1.187**	2.186
30-39	1.405	.450	4.391	.470	.131	1.682	3.864	1.031*	14.488
40-49	1.339	.849	2.110	.900	.530	1.529	.874	.482	1.585
Number of Antenatal visits									
0									
1-2	.837	.612	1.145	1.102	.751	1.619	1.025	.685	1.533

3-4	.961	.713	1.297	.803	.555	1.164	1.245	.843	1.841
5-8	.565***	.414	.771	1.137	.772	1.673	.937	.617	1.423
9-12	.967	.640	1.461	.493**	.286	.847	1.391	.783	2.469
13-15	.909	.198	4.170	3.004	.660	13.682	.373	.053	2.607
≥ 16	.489	.176	1.359	.529	.142	1.966	1.507	.454	5.005
Educational attainment									
No education									
Primary	.813	.633	1.045	.904	.660	1.237	.980	.708	1.355
Secondary	.675	.536	.849	.784	.586	1.048	.925	.678	1.261
Higher	.575	.411	.805	.750	.497	1.132	.883	.569	1.370
Body Mass Index (Kg/m)									
<16.0									
16.0-18.5	1.002	.685	1.467	.736	.452	1.198	.737	.478	1.136
18.5-22.9	1.274	.874	1.856	.423***	.262	.685	.770	.500	1.187
23- 25	.931	.559	1.550	.468*	.246	.888	.509	.252	1.026
>25	.694	.419	1.150	.594	.320	1.103	.829	.444	1.548

Assessing transition in determinants of Stunting, wasting and Underweight

The results indicate the factors with significant odds of Stunting during the time period 1998- 1999 were Number of antenatal visits (OR: 0.565, $p \leq 0.001$) and mothers age (OR: .365, $p \leq 0.001$).

In 2005 and 2006 the factors that were significantly associated with Stunting were child's age in months (OR: 3.273, $p \leq 0.001$), Gender of the child (OR: 0.776, $p \leq 0.001$), Number of Antenatal visits (OR: .624, $p \leq 0.001$) and prevalence of anaemia amongst children (OR: 0.553, $p \leq 0.001$).

During 2015 – 2016 it was observed that child's age in months (OR: 5321, $p \leq 0.001$) showed the highest odds of stunting amongst 12 -23 months old children and followed by 48 – 59 months old child (OR: 4.658, $p \leq 0.001$). Birth order (OR; 1.429, $p \leq 0.001$) higher odds of stunting were seen in birth order 4^{th} and 5^{th}. Mothers' education (OR:0.87, $p \leq 0.001$) as the education level of mothers increases the risk of stunting reduces. Number of Antenatal visits (OR: 0.859, $p \leq 0.001$) depicted the lower odds of stunting among mothers who had 9-12 ANC visits. Gender of the child (OR: 0.846, $p \leq 0.001$) male were more likely to be stunted as compared to girls. Wealth index (OR: 0.772, $p \leq 0.001$) richest household were less likely to have children who were stunted. Prevalence of anaemia amongst children (OR: 0.721, $p \leq 0.001$) the likeliness of the children being stunted reduces when the child is either mild or not anaemic.

In order to analyse the transition in the determinants **(Fig 5.1)** during the three different time periods from NFHS 2 to NFHS 3 the most common predictor was number of antenatal visits which was common in all the surveys. Childs age in months, gender of the child and prevalence of anaemia were common in NFHS 3 and NFHS 4. A strong focus must be laid on improving the antenatal care of the mothers as it occurred in all the three surveys. Gender of the child, child's age in months and prevalence of anaemia was observed in NFHS 3 and 4. Mother's education and wealth index was determined as an important predictor in NFHS 4.

The results indicate the significant factors associated with underweight in NFHS 2, were child's age in months (OR: 3.134, $p \leq 0.001$), maternal BMI (OR: 0.423, $p \leq 0.001$), Mothers age at first birth (OR:0.655 $p \leq 0.01$) and number of antenatal visits (OR: 0.493, $p \leq 0.01$).

In NFHS 3, the factors significantly associated with underweight were gender of the child (1.397, $p \leq 0.001$), maternal BMI (OR: 0.565, $p \leq 0.001$), wealth index (OR: 0.520, $p \leq 0.001$) richest had less odds of underweight and child's age in months (OR: 0.421, $p \leq 0.001$) 12 – 23 age group were more prone to being underweight.

In NFHS 4, Gender of the child (1.443, $p \leq 0.001$) male children were more prone to underweight than their female counterparts. Age in months (OR: 1.292, $p \leq 0.001$), Birth order (OR: 0.749, $p \leq 0.001$) fourth and fifth child were more likely to be underweight. Maternal BMI (OR: 0.666, $p \leq 0.001$), wealth index (OR: 0.662, $p \leq 0.001$) and number of ANC (OR: 0.531, $p \leq 0.001$) were the significant factors associated with underweight. Here, low Maternal BMI and child's age in months were common in all the surveys, there is strong need to improve the factors followed by gender of the child, wealth index, number of ANC were common in two surveys NFHS 3 and 4**(Fig 5.2)**.

The results depicted the factors significantly associated with wasting in NFHS 2 were, child's age in months (OR: 0.412, $p \leq 0.001$), gender of the child (OR: 0.672, $p \leq 0.01$) and birth order (OR: 2.942, $p \leq 0.01$).

In NFHS 3, the factors were Age in months (OR: 1.622, $p \leq 0.01$), Gender of the child (OR: 0.651, $p \leq 0.001$), Maternal BMI (OR: 0.619, $p \leq 0.001$), Mother's education (OR: 1.307, $p \leq 0.01$) and size at birth (OR: 1.693, $p \leq 0.05$).

In NFHS 4, the factors which were significantly associated with wasting were child's age in months (OR: 1.624, $p \leq 0.001$), size of the child at birth (OR: 1.586, $p \leq 0.001$) smaller than average children were more likely to be wasted, number of antenatal visits (OR: 1.463, $p \leq 0.001$), Gender of the child (OR: 0.714, $p \leq 0.001$), Maternal BMI (OR: 0.668, $p \leq 0.001$), place of residence (OR: 0.895, $p \leq 0.01$). Weaker associations were observed in wealth index and mother's education. Child's age in months and gender were common in all the surveys hence emphasis must be laid to improve it. Maternal BMI and size at birth were common for two surveys NFHS 3 and 4 **(Fig 5.3)**.

Fig 5.1 – Transition in Determinants of Stunting

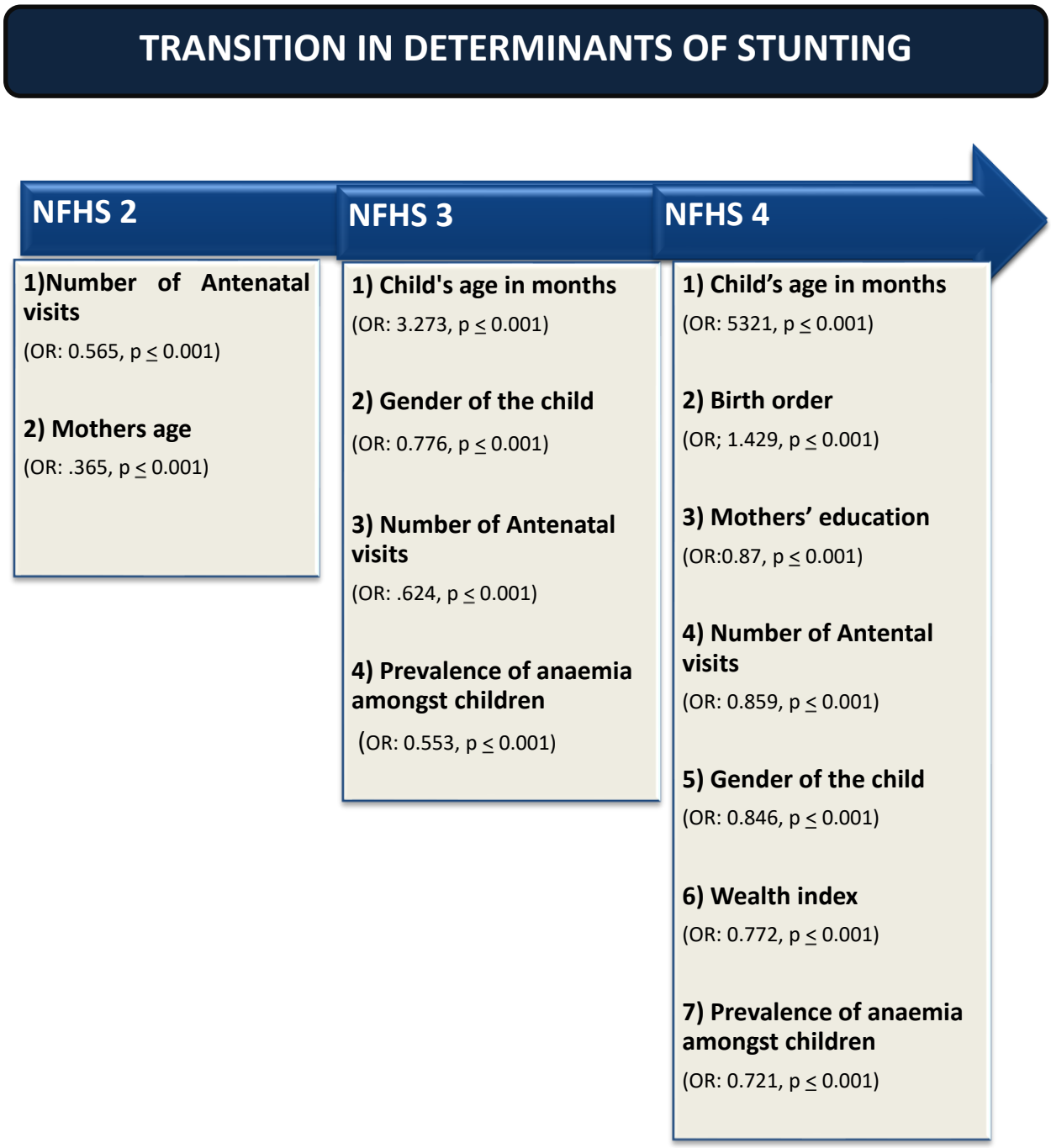


Fig 5.2 – Transition in Determinants of Underweight

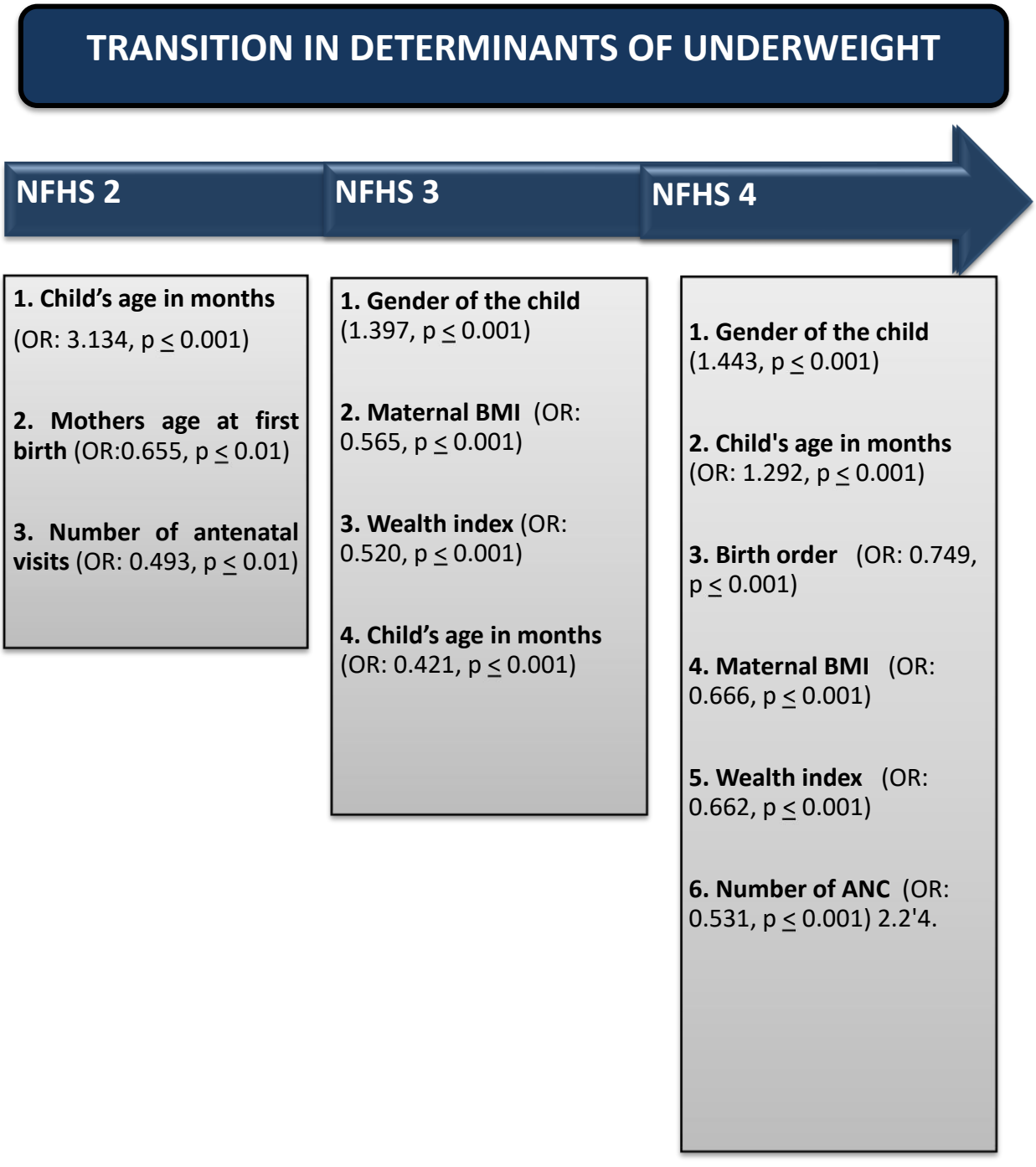
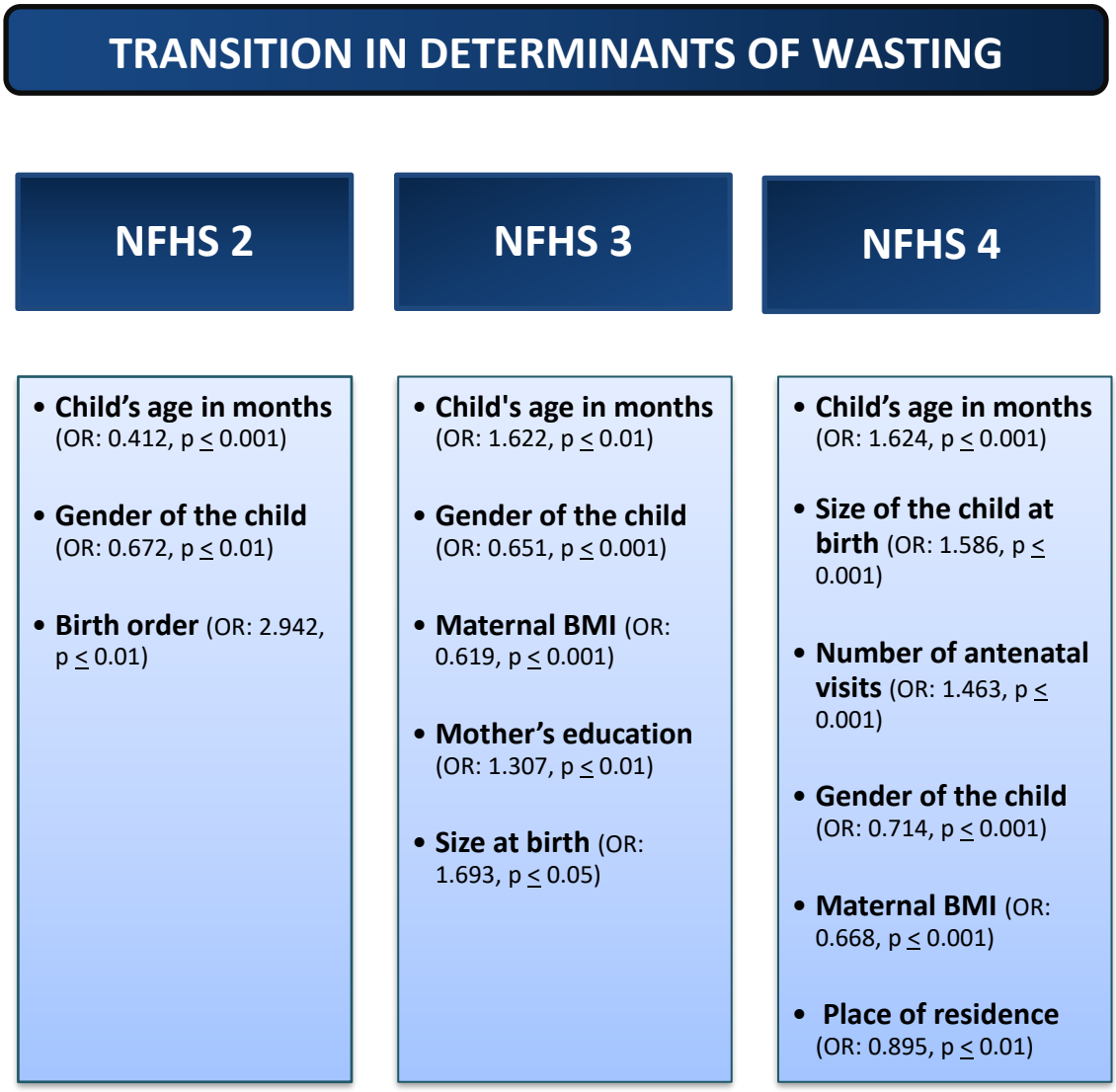


Fig 5.3 – Transition in Determinants of Wasting



DISCUSSION

The present study strongly recommends to lay emphasis on the antenatal care of mothers as it was one of the significant predictors of undernutrition. Antenatal care (ANC) is an opportunity to improve mother and child survival by promoting a positive pregnancy experience. As part of the vital "1000 days" window, prenatal care is also critical for supporting the child's long-term growth and development. If Antenatal care is taken care of many factors such as maternal BMI, and maternal Anaemia can be prevented. In India, The Ministry of health and family welfare has provided guidelines for the optimal care during pregnancy where the expectant mothers are registered, their blood pressure is monitored, Tetanus toxoid is given, IFA tablets are supplied to the mothers. The frontline workers counsel the mothers on dietary diversity and intake of balanced diet, importance of exclusive breastfeeding, immunisation of child and how family support boosts the pregnancy. Along with the counselling institutional delivery is promoted by the cash incentives. The Pradhan Mantri Matru Vandana Yojana (PMMVY), formerly known as the Indira Gandhi Matritva Sahyog Yojana, is a government-run maternity benefit programme. The Ministry of Women and Child Development is in charge of implementing the programme. It is a conditional cash transfer programme for pregnant and lactating mothers aged 19 or older who give birth to their first child. The eligible beneficiaries would get the Janani Suraksha Yojana (JSY) incentive for institutional delivery, and the JSY incentive would be applied to maternity benefits, resulting in an average of 6,000 rupees per woman. Despite the benefits provided number of ANC is still one of the strongest predictors. The conditionalities of the scheme might be one of the possible reasons. First of all, the amount is already less and it’s given in three instalments that too provided, certain conditions related to completion of registration of pregnancy and birth, antenatal care and immunisation are met. The Maternity Benefits Act (1961) only covered women who were employed for at least 80 days during 12 months immediately preceding the date of delivery of child in that particular establishment, leaving out more than 90% of the women in the country [13,14]. It’s provided to first child in the family. Not only has this made institutional delivery a criterion for receiving pay compensation for pregnancy and childbirth, but it also appears that the Janani Surakhsa Yojana (JSY), which provides a cash-based incentive of Rs 1,400 for institutional deliveries, has been absorbed into this plan. The JSY is an older programme that was launched

for a different reason and should not be confused with maternity benefits for wage replacement. According to the NFHS-4 statistics, the average out-of-pocket expenditure per delivery in a public health facility in 2015-16 was Rs 3,198. As a result, the JSY is only just succeeding in decreasing the burden of out-of-pocket expenses during birth [14]. Recently, the government has launched the 'Pradhan Mantri Surakshit Matritva Abhiyan' (PMSMA), a new scheme to provide comprehensive and quality antenatal care to pregnant women on the ninth of every month.

Child's age in months is another significant predictor of malnutrition. It was observed that 12 -23 months the children were more prone to being stunted and wasted. Prevalence of Anaemia amongst the under 5 population had a significant affect too. For the welfare and development of the children, the Integrated Child Development Services (ICDS) scheme aims to provide an integral package of services of health check up, immunisation, supplementary nutrition, referral services, pre-school education, and nutrition health education to children, pregnant women and nursing mothers.

Apart from ICDS the other programmes for child development are day-care centers for children below five years belonging to weaker sections of the society, Supplementary Nutrition Programme, applied Nutrition Programme, Balwadi Nutrition Programme, National Nutritional Anaemia prophylaxis programme, Early Childhood Education and National Institute of Public Cooperation and Child Development. Timely interventions and programmes that run in India such as ICDS since the last 40 years are unable to meet India's target of achieving malnutrition free India. It is said that if we scale up the interventions under five, undernutrition can be avoided (Alderman et al., 2019). Despite this programme undernutrition was higher amongst children under 5 years of age. The possible reasons could be problems in implementation of the programme, Anganwadi workers are inadequately trained, supervised and supported, while their duties require considerable understanding of nutrition, pre-school education, and maternal and child health issues. Erratic provision of supply of supplementary food, leakage in food procurement, Poor coverage and compliance to name a few.

Beneficiaries do not make the best use of the services provided to them. They do not go for health check-ups. Antenatal care and the IFA provided to them remains

unconsumed. The number of beneficiaries receiving take home ration also varies. Despite improvement in institutional deliveries the exclusive breastfeeding rates haven't reached 50 %. Timely introduction of complementary feeding has declined over a decade from 52.6 % to 42.7%.

Children are most vulnerable to exploitation and abuse. The girls in particular face debilitating discrimination at all stages. The National Policy for children was adopted on 22 August, 1974 for the development and welfare of children. Under this policy, the States and UTs are required to provide adequate services before and after birth as well as during growing stages of children for their full physical, mental and social development. A specific concentration is being given to efforts to improve opportunities and life of Girl Child. There are ample of programmes in India to provide for the girl child as discrimination and female foeticide was on rise. It is now notice that sex of the child is an important determinant but surprisingly the male child is more prone to undernutrition as compared to girl child.

Wealth index is also one of the significant predictors. Eradication of poverty remains a major challenge of planned economic development. Development of women and child in rural areas was launched in 1982- 83 as a sub scheme of Integrated rural development programme. This programme uplifted the status of women by empowering them and creche services were provide for their children. It is now commonly known as Self-help groups which microfinances the women organisation and support their start-up. One of the reason might be there are less poverty alleviation programmes which help urban women, all programmes focuses on the rural poor.

Mahila Samakhya Programme was launched in 1998 acknowledged that the empowerment of women could be done by the participation of girls and women in the education process. After, Sarv Siksha Abhiyaan or universalisation of primary education is a flagship programme of the government of India, that was started in 2001, to achieve the Universalisation of Elementary Education (UEE). The legal backing to SSA was provided when free and compulsory education for the children in the age group of 6-14 was made a fundamental right in the Indian Constitution under Article 21 A. Padhe Bharat Badhe Bharat was a sub programme. Since mother's education was an important factor. Despite the programme mother's education still hinders nutritional status of children.

Poshan Abhiyaan or National Nutrition mission is India's flagship programme which holistically addresses the conglomerate determinants of malnutrition for children, pregnant women and lactating mothers. It aims to improve the nutritional status of the beneficiary by technology driven service delivery, behavioural change and through multi ministerial convergence. It is unique as it aims to eradicate undernutrition in the grassroot level.

Programmes have evolved since and one such good feature of the Poshan Abhiyaan is Jan Andolan or people's movement is one of its unique features which aims to build the knowledge gap and reduce undernutrition by providing information, supplements and vaccines and break the intergenerational cycle. For better reach of the people initiatives have been taken to inform individuals about healthy and balanced meals under the Eat Right movement. The Food Fortification centre was set up to fortify staples rice, wheat, milk, oil and salt and distributed through public distribution system, mid-day meals, Aganwadis (MHFW,2018). Anaemia mukt Bharat initiative focuses on supply chain and monitors the nutritive and non-nutritive causes of anaemia.

SUMMARY AND CONCLUSION

SUMMARY AND CONCLUSION

Despite the decline in the stunting rates over the decade. India is home to World's highest number of children under five years of age who are stunted and wasted. Nutrition and health programmes have existed in India since the last 45 years, still India is not free from malnutrition.

An in-depth understanding of the determinants of stunting, wasting and underweight amongst children and their transition over a period of time can help in evaluating the existing policies and programmes. Therefore the present study was planned with the major objective of assessing the determinants of child malnutrition amongst children under 5 years of age in India over a period of two decades by conducting secondary analysis of data obtained from National Family and Health Surveys

The present study was divided into two phases:

Phase I A – Selection of survey for analysis i.e., NFHS 1, 2, 3, and 4

- Questionnaires were reviewed
- Registered for accessing data
- Downloading the datasets from The DHS program
- Identification of indicators of child health and Nutrition

Phase I B – Conducting descriptive Statistical analysis for identifying determinants in individual datasets

Phase II- Identify Transition in determinants over a period of two decades comparing the 4 datasets

In order to understand the determinants which, cause malnutrition and the transition in the major determinants over a period of two decades was necessary to highlight the key areas where the focus is required. It aims to find the gap in the programmes and policy and recommend suggestions to the practitioners which might aid in reducing the overburden of undernutrition in India.

The significant transition in factors associated with stunting were antenatal care which appeared in NFHS 2, 3 and 4. Child's age in months, gender of the child was observed in NFHS 3 and 4. Mother's education and wealth index appeared in NFHS 4 indicating there is a need to relook the programmes.

The transition observed in wasting were Child's age in months and gender of the child were common in all the NFHS surveys. Maternal BMI and size of the child at birth were observed in NFHS 3 and 4 as predictors of wasting. The transition observed in underweight were from 1998 to 2015 child's age in months and low Maternal BMI were a constant predictor. Wealth index and gender of the child was noticed in NFHS 3 and 4.

According to the transitions determined, there were few recommendations for the policy makers that instead of a standardized policy for a nation, as the geography and socio demographic profile varies in different states the norms should be made flexible.

Best practices from each state must be recognised and appreciated and adopted too. Synergy or convergence is the key, alone without the contribution of each ministry and sector the dream of malnutrition free India will remain a dream. Along with the Nutrition specific intervention importance should be given to nutrition sensitive interventions. Most of all People of India must be aware about the intergenerational cycle of malnutrition and change must come from within, the dire need to combat malnutrition.

RECOMMENDATIONS

In order to make these programmes more successful the approach shouldn't be from top to bottom but vice versa. Instead of standardising nationwide policy rules, it should be made area or region specific. Researches have shown that the states are performing better through small innovations. Best practices should be adopted.

Better reach, service delivery and connectivity. The convergence must be strengthened between different ministries, centre and state. It was observed that there was a shortage of growth monitoring tools in AGWCs and ICDS- CAS must be strictly applied in all AGWCs. The field functionaries must be trained and updated. Most of all behaviour change people must understand the repercussions of intergenerational cycle if undernutrition a change should come from within each individual to eradication malnutrition from India.

LIMITATIONS

The findings are not causal inferences.

Though it was large data set there were lots of missing data and other factors due to which a large sample size was eliminated from the study.

Further research is required where recent data on dietary factors such as dietary diversity is easily available and accessible.

Due to unavailability of recent data (NFHS 5) determinants for the same could not be identified. Whenever, recent data is available practitioners and policy makers may use this method to find out the factors involved and changes required to combat undernutrition.

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APPENDICES

Appendix 1 – Permission letter

Sep 30, 2020

Vijayata Sengar
Dept of Foods and Nutrition
India
Phone: +919879540227
Email: vijayata.sengar-fn@msubaroda.ac.in
Request Date: 09/30/2020

Dear Vijayata Sengar:

This is to confirm that you are approved to use the following Survey Datasets for your registered research paper titled: "Dterminants of malnutrition amongst children":

India

To access the datasets, please login at: https://www.dhsprogram.com/data/dataset_admin/login_main.cfm. The user name is the registered email address, and the password is the one selected during registration.

The IRB-approved procedures for DHS public-use datasets do not in any way allow respondents, households, or sample communities to be identified. There are no names of individuals or household addresses in the data files. The geographic identifiers only go down to the regional level (where regions are typically very large geographical areas encompassing several states/provinces). Each enumeration area (Primary Sampling Unit) has a PSU number in the data file, but the PSU numbers do not have any labels to indicate their names or locations. In surveys that collect GIS coordinates in the field, the coordinates are only for the enumeration area (EA) as a whole, and not for individual households, and the measured coordinates are randomly displaced within a large geographic area so that specific enumeration areas cannot be identified.

The DHS Data may be used only for the purpose of statistical reporting and analysis, and only for your registered research. To use the data for another purpose, a new research project must be registered. All DHS data should be treated as confidential, and no effort should be made to identify any household or individual respondent interviewed in the survey. Please reference the complete terms of use at: https://dhsprogram.com/Data/terms-of-use.cfm.

The data must not be passed on to other researchers without the written consent of DHS. However, if you have coresearchers registered in your account for this research paper, you are authorized to share the data with them. All data users are required to submit an electronic copy (pdf) of any reports/publications resulting from using the DHS data files to: references@dhsprogram.com.

Sincerely,

Bridgette Wellington

Bridgette Wellington
Data Archivist
The Demographic and Health Surveys (DHS) Program

530 Gaither Road, Suite 500, Rockville, MD 20850 USA +1.301.407.6500 +1.301.407.6501 fax icf.com

Appendix 2 - Ethical compliance Certificate

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Institutional Ethics Committee for Human Research (IECHR)

FACULTY OF FAMILY AND COMMUNITY SCIENCES
THE MAHARAJA SAYAJIRAO UNIVERSITY OF BARODA

Ethical Compliance Certificate 2020 – 2021

This is to certify that **Ms. Pranatusmi Sharma**'s study titled, "**Assessing transition in determinants of Child malnutrition amongst children under five years of age in India over a period of two decades: Secondary analysis using National Family Health Surveys (NHFs)**" has been approved by the Institutional Ethics Committee for Human Research (IECHR), Faculty of Family and Community Science, The Maharaja Sayajirao University of Baroda. The study has been allotted the ethical approval number **IECHR/FCSc/2020/60.**

Prof Mini Sheth
Member Secretary
IECHR

Prof Shagufa Kapadia
Chairperson
IECHR