LIST OF ANNEXURES
Clarification to the comments of examiners

This annexure provides detailed clarifications for the comments raised by both the examiners. Specific observation and comments of the examiners and the corresponding clarifications made by the candidate are as follows:

Examiner I

Observation: The thesis is based on secondary data analysis of NFHS – 1, NFHS – 2, and NFHS – 3 in Uttar Pradesh, the largest state in the country and broadly deals with determinants and of nutritional status, morbidity and mortality in under five children.

Thesis is well organized and written clearly and concisely. The thesis is recommended for award of the PhD degree.

One major lacuna in this thesis is poor review of the Indian publications on the nutritional status, morbidity and mortality linkages. It is imperative that Indian data and studies are accessed (even though they are more difficult to access and may lack sophisticated statistical analysis) because only they can provide the perspective and help in interpretation of the data. For instance India shifted to metric system ages ago but low birth-weight is referred to as less than 5.5 pounds. There no mention that even though a third of the Indian infants are low birth-weight, they are mature and they will survive if provided essential new born care.

Very few of the voluminous Indian studies have been accessed on infant and young child feeding practices, factors affecting nutritional status of pre-school children, nutritional status, morbidity and mortality linkages in Indian children. This might
have been one of the reasons for the problems in interpretation of the data from NFHS in terms of clinical or public health implications of the findings.

MDG is referred to but the national five year plan, national policy goals as well as strategies programmes for achieving them which provide the back drop for analysis of the achievements and shortfall are lacking. Interpretation of the results in light of the existing knowledge is critical for designing interventions to improve process and outcome indicators.

In a multi-disciplinary science such as population studies, it is essential that tools of statistical analysis and modelling techniques are used to test the clinical and public health hypothesis on factors responsible for the adverse health and nutrition outcomes, their interactions, so that rational suggestions regarding interventions to improve processes and outcomes within the existing constraints can be made.

**Response:** The examiner’s positive feedback on the thesis is appreciated.

**Comment 1:** For assessment of nutritional status of children, public health professionals and nutritionists use BMI for age instead of wasting irrespective of age – what are the reasons for this preference?

**Response:** The thesis included three anthropometric indices of physical growth that describe the nutritional status of children. Each nutritional index provides different information about growth and body composition. Particularly, wasting (weight-for-height) measures body mass in relation to body length and describes current nutritional status and is an indicator of acute (short-term) malnutrition. While stunting represents the chronic (long-term) effects of malnutrition and underweight is a
A comprehensive measure of malnutrition as it captures elements of both stunting (chronic malnutrition) and wasting (acute malnutrition).

Moreover, WHO recommends these three anthropometric indices for assessment of nutritional status of children under 5 years of age while BMI for age to children of 5-19 years of age as well as these indices are also accepted by the Government of India. In view of WHO recommendation, wasting has been taken as one of the nutritional indicators for children under 5 years of age instead of BMI for age.

**Comment 2:** Stunting and underweight increase with age but wasting declines with age? Why is this happening? What are the implications of these paradoxical findings in terms of using the indices for assessment of interventions to improve nutritional status of children?

**Response:** Stunting (chronic malnutrition) is defined as less height for age and underweight (acute and chronic) as less weight for age. It is obvious that height and weight does not increase in proportion to age due to poor feeding practices as well as genetic factors. On the other hand, wasting represents the current nutritional status and is an indicator of acute (short-term) malnutrition because it represents the less weight for height. It is possible that wasting may decline with ages as children may gain weight proportionately in relation to height.

The implications of these findings are we can improve the weight of children through various programmes and intervention to a greater extent while in case of height we cannot do much after a certain age so it is necessary to give mothers’ proper antenatal and postnatal care and knowledge about child feeding practices so that infants can grow to their natural height.
**Comment 3:** Anaemia is another indicator for assessing nutritional status? Why is that anaemia prevalence rates do not run parallel to stunting, underweight or wasting rates?

**Response:** Anaemia itself is a medical term and it is a condition where the amount of haemoglobin in the blood is below the normal level, or there are fewer red blood cells than normal. Therefore, it is deficiency of a particular nutrient (haemoglobin) in blood. On the other hand, anthropometric indicators (stunting, underweight and wasting) of nutritional status of children present the physical growth of the children and they are determined from the age, height and weight of the children. Therefore anaemia prevalence rates may not run parallel to stunting, underweight and wasting rates.

**Comment 4:** What are the indicators used to assess improvement in nutritional status – at community level (public health) and at individual level (clinical)?

**Response:** In chapter III, multilevel analysis has been done at three levels. At first level we included child level variables and mother level variables have been taken at the second level and finally we have added household level variables at the third level because NFHS does not provide information on the community level variables.

But from the policy point of view, at community level (public health), indicators we can used to assess improvement in nutritional status are child feeding practices, duration of breastfeeding, mother’s education and media exposure, source of drinking water, fuel used for cooking, type of house and toilet facility.

On the other hand, at individual (clinical) level indicators improve nutritional status through antenatal and delivery care.
Comment 5: Cross-sectional data can at best show associations – but do not give clues regarding causality. But ample Indian data are available from clinical and community based studies demonstrating causality and impact of interventions. Based on Indian data which of the following associations are: Sources of drinking water and anaemia, anaemia and poor IYCF, poor growth and wrong IYCF, repeated morbidity, poor IYCF and high morbidity.

Response: This study is based on cross-sectional data which gives only associations so we cannot establish the causal relationship. In this study we have explored determinants of nutritional status of children from socio-economic and demographic point of view rather than clinical perspective. Therefore, this is the limitation of the study and gives further scope to research in this field.

Also, this analysis is based on representative data for India and states; it covers health survey where the scope of supplementing with clinical and community based data was not part of the objectives of this study.

Comment 6: Reported clustering of undernutrition in siblings: which of these two factors are likely to contribute to larger proportion of undernourished siblings: genetic frailties or household food insecurity and poor access to healthcare?

Response: In chapter VII, the results of binary logistic model analysis of sibling (individual) clustering shows that genetic frailties are more likely to contribute to larger proportion of undernourished siblings as compared to access to healthcare. In NFHS information on household food security is not available. Therefore, this is the limitation of the study and gives further scope for research in this field.
Comment 7: In India what is the impact of delayed initiation of breast feeding on breast feeding rates? How is the adverse effect of delay in initiation of breast feeding affect infant growth in the first year mediated?

Response: Due to delayed initiation of breast feeding breast feeding rates may come down and health of the newborn will be adversely affected. If initiation of breastfeeding is delayed than to minimize the adverse effect on infant growth it is mandatory that formula feeding should be started as soon as possible to infant with some other solid and semi-solid foods after six months of age.


Examiner II

Observation: A thesis addressing the issue of child undernourishment in Uttar Pradesh could be a rewarding exercise because Uttar Pradesh has today or will have in the future a disproportionate share of Indian children and children with greater likelihood of being undernourished. This thesis examines child undernourishment in all its four forms under-weight, stunting, wasting and anaemia. It probes the linkage between undernourishment and childhood morbidity and survival to emphasize the bottom line of priority to be accorded to undernourishment in children. With this task at hand, the thesis exploits well the three rounds of NFHS data. Initiating the exercise with an exposition of levels, trends and differentials in under-nourishment, the thesis goes on to explore specific dimensions of the linkage between under-nourishment and child feeding, morbidities and health care seeking, gendered differentials and finally survival among children. It adopts suitable methods to examine the various aspects of under-nourishment in children. Apart from the conventional determinant analysis this thesis brings in two important aspects of disparity i.e. gender discrimination and sibling clustering of under-nourishment. Gender discrimination is examined with respect to components that are supposed to shape under-nourishment like feeding practices, immunization and health care seeking etc. In fact, there is significant sex differential in under-nourishment that has received attention.

Response: The examiner’s positive feedback on the thesis is appreciated.

Comment 1: However, the question of gender has not been adequately examined. An effective gendered analysis of under-nourishment would have probed the gendered attributes of the household that renders children differentially vulnerable to under-nourishment. A first step towards such analysis would have been identifying the
attributes of the households not merely in terms of child sex composition but also roles and functioning of women in them alongside a host of other attributes concerning gender roles that could shape the differential nutrition outcomes between sexes.

**Response:** Examiner’s comment is well taken. The NFHS data does not provide information on role and functioning of women in children alongside a host of other attributes concerning gender roles that could shape the differential nutrition outcomes between sexes. Therefore, this is one of the limitations of the study and gives further opportunities to probe this area.

**Comment 2:** When we consider variables like feeding, rearing practices as well as health care seeking, they are greatly influenced by gender roles within the household. Another concern is a fascination with interpreting gender differential conditioned by sons. In fact I am reminded of some work which evaluates inequality within inequality (i.e. the manner in which sibling composition itself is guided by the principle of differential stopping behaviour and it’s result in inequality favouring male children eventually).

**Response:** The interpretation of results present evidence that discrimination against girls is not universal and that it depends greatly on the birth order of the index child and the sex composition of older living siblings, which is measured as mother's number of living sons at each birth order.

This argument is consistent with previous research in South Asia which has shown that mortality tends to be higher among girls in families with a larger number of older female siblings. Studies have established that differential stopping behaviour leads to
skewed sex ratio, which may also compound the effects of discrimination in nutritional status.


**Comment 3:** An enquiry into sibling and family level clustering of under-nourishment attempted here offers insights regarding the phenomenon on under-nourishment which is self perpetuating. The kind of clustering with specific attributes offers a clue for identification for intervention. However, clustering linked homogeneity needs to be highlighted against the absence of clustering. Opposed to clustering, the coexistence of ill-nourished and the well-nourished too can offer interesting insights in the sense that such co-existence could be gendered on the one
hand and could also be influenced by household conditioning (i.e. intra-familial relational structure) on the other.

**Response:** Examiner’s comment is appreciated. This is an area for further exploration.

**Comment 4:** This thesis is an example of excellent data exploration on a topic of contemporary significance. However, given the expertise at hand, the candidate could have attempted a determinant analysis over time too to comment on change if any in the dynamics of factors shaping nutritional outcome in children. Given the fact that unlike any other deprivation ill-nourishment too has common and similar correlates, it would have been rewarding to analyze this phenomenon with these correlates rather than across them. This suggestion is in keeping with the sample size advantage of the state of Uttar Pradesh hinting at carrying out analysis among the poor (wealth quintile based), the SC/ST and the like.

**Response:** For keeping study comprehensive and concise and focussed on the objectives of determinants such analysis has not been done over time. However, trend analysis of nutritional status of children has been done by bio-demographic, health care, socio-economic and household environment variables. However, the suggestion gives us scope to undertake such research.

**Comment 5:** While the application of method has been suitably chosen by the candidate to address separate issues, it gives a feeling that these methods are pre-fixed rather than being adopted in the process of inquiry. Often an investigation would begin with simple and preliminary approach of verification and lead to a method of exploration that will explain the dynamics in completeness. This impression arises
because of the absence of methodological reviews that would have engaged with the exercise carried out in the past and thereby justified the methods used here.

**Response:** The methodological reviews have been done alongside the review of literature for the conceptualization of the study and they have been adopted at the time of literature review and not necessarily searched as standalone method for the chapters and in accordance with the objectives of the study. However, the scope of additional methodological reviews will be taken care for publication of thesis.

**Comment 6:** Besides the issues raised with respect to the taxonomy of the thesis, let me also point out some other related concerns to be addressed while converting the manuscript into plausible form. An initiative must show sufficient provocation in terms of why it is attempted and the contribution it seeks to make to the existing stock of knowledge. This requires a competent review that highlights the contributions, differences and disagreements in the literature.

**Response:** Examiner’s comment is well taken. The nutritional problems among children in Uttar Pradesh, with one of the highest levels of stunting, wasting, underweight and anaemia, therefore, it is critical to study in details, the extent of nutritional problems in Uttar Pradesh, inequalities by socio-economic, rural-urban and linkage with child health and mortality.

Past researches on child nutrition in India have mainly dealt with the role of various socio-economic, maternal and environmental factors in determining the levels and pace of child nutrition transition. Despite the recent attention on the subject, two major gaps in child nutrition analysis that are important to be dealt with are: 1) assessing the influence of health care services impact on child nutrition and 2) analyzing clustering of undernourished children. this study has attempted to fulfill this
gap. The results of the study add considerable new insights on the subject of nutritional status of children in Uttar Pradesh.

**Observation:** Despite these critical observations, I find the quantum and quality of work satisfactory. It undoubtedly explores the possible pathways resulting in under-nourishment outcomes in children and adequately exploits the available data sets. Considering the exercise as comprehensive, wide-ranging and holistic in content, I have no hesitation in awarding the degree of doctor of philosophy in population studies to the candidate.
Ph.D Thesis Abstract

Introduction: The prevalence of child undernutrition in India is among the highest in the world; nearly double that of sub-Saharan Africa, with dire consequences for morbidity, mortality, productivity and economic growth. Moreover, inequalities in undernutrition between demographic, socio-economic and geographic groups have persistently high and increased during the last decade (World Bank, 2005). Malnutrition in general and undernutrition and anaemia in particular remain major health problems in India (Rajaretanam et al., 2000). Moreover, nutritional problems among children in Uttar Pradesh, with one of the highest levels of stunting, wasting, underweight and anaemia, therefore, this study provides in details, the extent of nutritional problems in Uttar Pradesh, inequalities by socio-economic, rural-urban and linkage with child health and mortality.

Objectives: The objectives of this research are: First, to assess the levels, trends and differentials in nutritional status of children (stunting, wasting, underweight and anaemia); second, to study the linkages of child feeding practices on nutritional status of children; third, to examine sex differentials in childhood feeding, health care and nutritional status of children; fourth, to examine the linkages between nutritional status of children, childhood morbidities and treatment seeking behaviour; fifth, to study sibling and family level clustering effects on nutritional status of children; sixth, to study the impact of nutritional status of child and mother vis-à-vis socio-economic and demographic factors on child survival.

Data: In this thesis, data from three rounds of National Family Health Survey (NFHS), NFHS-1, NFHS-2 and NFHS-3 conducted in the years 1992-93, 1998-99 and 2005-06 respectively, for Uttar Pradesh have been used to study the levels and trends in nutritional status of children over the period. The third National Family Health Survey of 2005-06 data for Uttar Pradesh is used for more in-depth analysis, to study the determinants of nutritional status of children and linkages with child feeding practices, childhood morbidities, treatment seeking, clustering effects and child survival.

Methodology: A range of cross-sectional and multivariate analysis has been used to examine the objectives and hypotheses of the study. Multivariate (multinomial and multilevel) regression models have been used for studying the following aspects: 1. bio-demographic, health care, socio-economic and household specific determinants of nutritional status of children; 2. linkages between child feeding practices and nutritional status indicators of children; 3. gender discrimination in childhood feeding, health care and children nutritional status; 4. linkages between nutritional status of children, childhood morbidities and treatment seeking; 5. sibling and family level clustering of child nutrition; and 6. relationship between nutritional status of children and child survival.

Findings: This study has brought out ample insights on nutritional status of children in Uttar Pradesh, filling a critical gap. The assessment of levels, trends and differentials in nutritional status of children by various new combinations of health care, demographic, socioeconomic and household environmental variables provide considerable fresh insights. Children delivered at home but whose mothers received ANC and delivery assistance better than children who delivered at home, mothers who received no ANC and assistance during delivery. Result demonstrates that
antenatal care (ANC) check-ups during pregnancy and assistance during the birth of the child are necessary for the healthy child. Similarly, result confirms that children of low birth order and longer birth interval are nutritionally well-off; therefore, knowledge about the importance of small family size and birth interval should be given to women through programmes and mass media. This study also reveals that initiation of breastfeeding, intake of prelacteal food have marginal influence on nutritional status of children, while, exclusive breastfeeding for 6 months, provision of solid or semi-solid food and provision of liquid have a much greater impact on nutritional status of children. This study also displayed evidence of gender discrimination in childhood feeding, immunization, treatment seeking and nutritional status of children by the specific birth orders and sex composition. This study foster clear linkages between morbidities of children and health seeking behaviour of mothers on all the anthropometric indicators of nutritional status of children, as well as anaemia. Until, clustering concept was widely used in mortalities only, while, for the first time, family and sibling level clustering of child nutrition have been analysed. Results reveal that, despite children of underweight mothers belonging to high wealth index and have high education (high school and above) are remained underweight. Result suggests that family genetic frailty as an important cause of child undernutrition clustering. Most of the previous studies documented that significant impact of bio-demographic, socio-economic and health care variables on infant and under 5 mortality. This study focussed beyond and assessed the impact of child and mother’s nutritional status on the survival of infants and under 5 children. Results show that the children of large birth weight as well as children of normal BMI mothers have a greater chance of survival.