EXPLORING THE IMPACTS OF SLUM DWELLING FOR INDIAN WOMEN

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Abstract

Background: Urbanization is increasing around the world, and in India this trend has translated into an increase in the size of slum dwellings. Slum environments may have a negative effect on human health, in particular women's health. The objective of the study is to determine factors associated with Indian women's health in slum environments. **Methods:** The relationship between women's health, measured by BMI, and demographic, behavioural, and socioeconomic factors was statistically modelled. A multiple linear regression was performed, using data from the India National Family Health Survey. **Results:** Increasing BMI is significantly and positively associated with: frequency of watching television, having diabetes, age, wealth index, and residency status in the areas of New Delhi, Andhra Pradesh or Tamil Nadu. **Conclusion:** While belonging to a scheduled tribe was not associated with changes in BMI, unadjusted rates suggest that tribal status may be worthy of deeper investigation. Among slum dwellers, there is a double-burden of under-nutrition and over-nutrition. Therefore a diverse set of interventions will be required to improve the health outcomes of these women.

Keywords: slum dwelling | women's health | Indian women | Tribe in slums

Contexte: L'urbanisation mondiale croissante a contribué à une expansion des taudis en Inde. Les habitants de taudis, plus particulièrement les femmes, sont à risque de développer divers problèmes de santé. L'objectif de cette étude est alors d'identifier les facteurs associés avec la santé des femmes qui habitent dans ces quartiers. **Méthodologie:** Un modèle statistique a été utilisé pour examiner les liens entre l'état de santé des femmes, mesuré par l'IMC (l'Indice de Masse Corporelle), et les facteurs démographiques, comportementaux et socioéconomiques. Une analyse de régression linéaire multiple a été effectuée à partir des donnés de « India National Family Health Survey », un enquête nationale sur la santé des familles. **Résultats:** Il existe une relation positive et significative entre l'IMC et l'écoute fréquente de la télévision, le diabète, l'âge, l'indice de richesse de et le statut de résident au New Delhi, Andhra Pradesh ou Tamil Nadu. **Conclusion:** Bien que l'appartenance à une tribu répertoriée n'était pas associée aux changements d'IMC, les taux non ajustés suggèrent que le statut tribal mérite d'être examiné de plus près. Il y a une double charge de sous-alimentation et de suralimentation chez les habitants de taudis. Conséquemment, une variété d'interventions sera essentielle pour améliorer l'état de santé des femmes.

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Abbreviations

BMI	Body Mass Index
DOHaD	Developmental Origins of Health and Disease
GDP	Gross Domestic Product
JNNURM	Jawaharlal Nehru National Urban Renewal Mission
MDGs	Millennium Development Goals
NCD	Non-communicable disease
NFHS	National Family Health Survey
SPSS	Statistical Package for the Social Sciences, also known as SPSS Statistics
UN	United Nations

Introduction

Anecdotal evidence suggests that the growing trend of global urbanization has seen an increase in the number of people living in slum or slum-like conditions. Slum dwelling is considered to be a predictor of poor social and health outcomes (Sheuya, 2008). Accordingly, slum dwelling has been targeted for intervention by the United Nations (UN) via the Millennium Development Goals (MDGs) as part of their effort to eradicate extreme poverty and hunger by 2015. Slum dwelling has an impact on health via a host of intermediary factors, including access to health and social services and proper nutrition, and exposures to a variety of potentially deleterious environmental factors. This is particularly relevant in population health research conducted in Asia where the largest slum dwelling populations are clustered (Sheuya, 2008).

This project explores the characteristics of women in slums by analyzing the competing factors that have the greatest measurable impact on health outcomes. In slums, maternal health care is of great importance, as stated in MDG 5. While many factors affect the overall health of an individual, slum dwellers seem to experience among the poorest health outcomes due to an urbanized lifestyle which increases risk of non-communicable disease (NCD) development and poverty, which limits their access to health care (Krishnan, 2008). In addition to the direct impact on women's health, the burden of malnutrition has a further health implication for future generations. Child mortality is a widespread issue in slums. Thus, improving maternal health is widely regarded as an effective way to prevent child mortality (Dharmalingam, Navaneetham, & Krishnakumar, 2010).

Thesis Structure

This thesis is written in manuscript format, with a single manuscript sandwiched between traditional thesis components. The thesis begins with an exploration of the slum environment and its definition and classification, the use of BMI as a health measure, maternal health and some factors that influence the health status of women. The methodology of the study is then described to provide further information on the dataset that is used, and the statistical analysis that is conducted using the statistical software package SPSS. The paper that is to be submitted to the Global Journal of Health Sciences contains the results of the statistical analysis, as well as a sub-analysis for the Tribal population. An additional discussion is provided to explore further implications, as well as more deeply comparing results to current literature. This is followed by the conclusion and subsequent tables and appendices that were cited throughout the thesis.

Objectives

- To statistically explore the relationship between demographic, behavioural, and socioeconomic factors and BMI among slum dwelling Indian women
- To determine the extent to which social class as defined by tribal status and caste, is represented in the above relationship

Background

Importance of studying slums

As of 2009, more than half of the world's population lives in urban centres, which is a trend that continues to rise (Bhagat, 2012). India is greatly impacted by this trend; from 2001 to 2011 urbanization increased by 31%, which in absolute terms equates to a total of 377 million people in urban areas (Gupta & Mondal, 2014). Rapid urbanization has also contributed to increases in the number of slum dwellers, which is a result of cities lacking the infrastructure of accessible housing equipped with basic amenities (Gupta & Mondal, 2014). Throughout the years, there have been continued efforts by the UN and various non-governmental organizations to improve the situation of slum dwellers, with one of the more recent efforts being the UN's development of the MDGs. One of the overall UN goals is to improve the living conditions for at least 100 million slum dwellers globally by 2020; however, with the ever increasing number of slum dwellers, many individuals will continue to live without basic necessities, thus causing the UN to fail to achieve their larger goal to eradicate extreme poverty and hunger (Khan, 2012). The constant increase in the number of slum dwellers means that progress towards goals need to be measured regularly in order to eventually achieve success.

There is value to rapid urbanization; currently, urban areas in India contribute to 65% of the nation's Gross Domestic Product(GDP), and play a large role in reaching a healthy annual growth in GDP (Bhagat, 2012). The economic advancement provides incentive for governments in India to invest in better infrastructure in urban centres; the ability to effectively accommodate a larger population would presumably lead to better growth for the country. This was the rationale behind the national Indian Ministry of Urban

Development's creation of the Jawaharlal Nehru National Urban Renewal Mission (JNNURM) in 2005 (Gupta & Mondal, 2014). The goal of the JNNURM was to improve infrastructure within Indian cities and provide housing and basic services for the urban poor (Nandi & Gamkhar, 2013). With regard to infrastructure goals, incomplete municipal projects received a two-year extension from March 2012 to March 2014 because deadlines were not going to be met (Nandi & Gamkhar, 2013). There also remain unused JNNURM funds which have been attributed to the lack of ability to plan and execute projects, this is a cause of poor governance and accountability (Nandi & Gamkhar, 2013). While there is a clearly defined need to improve the living conditions of the urban poor in India, and intention on behalf of various levels of government to do so, projects are not being executed efficiently and in a timely manner to match the continued growth of the urban population.

Current slum definition

The importance of a more comprehensive slum definition became apparent during analysis of the Indian National Family Health Survey data set, which included two different slum variables resulting in discrepant numbers of individuals that were considered slum dwellers. Through a preliminary literature search, it was also evident that the definition of slum varies within the literature, and that the most commonly cited definition provided by UN-Habitat (2006) is not as comprehensive as it was once thought to be (Jankowska, Weeks, & Engstrom, 2011). UN-Habitat defines slum as:

> "a group of individuals living in the same household in an urban area but lacking at least one of the following: (i) durable housing of a permanent nature that protects against extreme climate conditions, (ii) sufficient living space which means not more than three people sharing the same room, (iii) easy access to safe water in

> sufficient amounts at an affordable price, (iv) access to adequate sanitation in the form of a private or public toilet shared by a reasonable number of people, and/or (v) security of tenure that prevents forced evictions" (UN-Habitat, 2006).

In India, the lack of consensus around a single national definition has resulted in a smorgasbord of inconsistent, vague, and narrow definitions that vary region to region (Subbaraman, et al., 2012) (Milbert, 2006). The 2001 census definition, which the Indian government recently revised in 2010, states that a slum is "a compact settlement of at least 20 households with a collection of poorly built tenements, mostly of temporary nature, crowded together usually with inadequate sanitary and drinking water facilities in unhygienic conditions" (Arabindoo, 2011). This definition can be characterized as vague due to the subjective nature of "poorly built" or "inadequate," and could allow the government to justify the under-reporting of slums (Milbert, 2006). When it comes to collecting data on urban settlements, there is an effort by the government to keep slum dwelling numbers low. Peri-urban settlements are commonly overlooked when collecting this data, and consequently these slums are not granted slum designation (Milbert, 2006).

This has an impact on the lifestyle of slum dwellers because officially designated slums, either at the national or municipal level, may be eligible to receive municipal resources to improve living conditions, in the form of improved sanitation facilities or access to clean water (Subbaraman, et al., 2012). The problem arises when UN-Habitat defined slums are not designated as slums by the national government definition. This leads to inefficient resource allocation, and consequently a lack of improvement in environment for disadvantaged individuals and families. A paper comparing two areas in India, Kaula Bandar (undesignated slum) to another designated Mumbai slum, found that residents of Kaula Bandar had similar, if not worse, living conditions than the individuals who resided

in the designated slums (Subbaraman et al., 2012). Furthermore, trespassers are prohibited on the vast amounts of private land owned by the central government; individuals who choose to occupy this land will not be acknowledged by the government as slum dwellers, and there is no attempt made to improve their conditions. This is an ongoing issue in India as the central government does not want to provide 'no objection certificates' that would allow municipal water and sanitation services to these areas out of fear that slum dwellers may claim land tenure on the central government's unoccupied land (Subbaraman, et al., 2012).

It is quite easy to generalize the conditions of slums when, in fact, the conditions can vary significantly from slum to slum. This reality further complicates the issue of coming to a singular definition of slum. In addition, slum dwellings do not remain static; they are located in urban centres that are constantly evolving, and thus factors contributing to slum status may evolve over time. Therefore it is important to explore other variables that may characterize slums, including the health impacts of living in a slum.

Body Mass Index as an outcome variable

In this project, Body Mass Index (BMI) is the outcome variable of the multiple linear regression. BMI is calculated as (weight in kilograms / (height in meters)^2) (World Health Organization, 2000). It is a measure of how much the weight of a person differs from the acceptable weight for that particular height (World Health Organization, 2000). A value less than 18.5 kg/m^2 indicates underweight, normal is 18.5-24.99 kg/m^2, 25-30 kg/m^2 is overweight and over 30 kg/m^2 is characterized as obese (World Health Organization, 2000). The use of BMI as an indicator of health has been a contentious issue within the health research community. This is largely in part due to individual body fat compositions,

and the fact that weight due to muscle is not differentiated from weight due to fat, therefore athletes may have an overestimated BMI and seniors with decreased muscle mass may have underestimated BMI values (World Health Organization, 2000). There is literature on the use of a lower cut-off for overweight in South Asians, 22 kg/m^2 instead of 25 kg/m^2, this is suggested because of the body fat distribution mainly in the abdominal region in South Asians and its association with increased risk of cardiovascular disease and type 2 diabetes (WHO Expert Consultation, 2004). BMI is useful in estimating the prevalence of obesity and the associated health risks within a population, but individually it is too simplistic and there may be variations in the severity of the obesity indicated by a BMI value (World Health Organization, 2000). However, for a large scale study, such as the 2005-2006 National Family Health Survey of India where there are over 100,000 women surveyed, BMI measurement is both non-invasive and relatively quick and cost effective which is why it is acceptable for population health studies (Barao & Forones, 2012).

Most of the literature uses BMI as a measure of health status. Previous analysis by Bharati et al. (2007) used the National Family Health Survey in India data set from 1998-1999. In their multiple linear regression, they found that health status, determined through BMI, had a strong correlation with the state that the women lived in. More economically developed states and territories, such as Punjab and New Delhi, had a higher prevalence of obesity, whereas less developed states, such as Bihar and Orissa had a higher prevalence of chronic energy deficiency (Bharati, Pal, Bhattacharya, & Bharati, 2007) It was also interesting to note that there was coexistence between large rates of obesity and chronic energy deficiency in states such as Gujarat and Maharashtra (Bharati, Pal, Bhattacharya, & Bharati, 2007). It is logical to assume that if individuals are residing in slums, they

probably do not have access to proper nutrition and would therefore suffer from chronic energy deficiency. However, average BMI is higher in urban areas, including slums, compared with rural areas (Krishnan, 2008). This is mainly due to unhealthy dietary practices and the sedentary lifestyle associated with rapid urbanization, which are major issues as risk factors of NCD development (Krishnan, 2008).

Non-Communicable Disease prevalence

Globally slum environments have proven to be problematic due to the unsanitary conditions created by poor access to safe water and sanitation, ultimately creating an environment that facilitates the spread of infectious diseases. This remains an issue in many slums; however, similar to the global trend, there is a need to address the rise in non-infectious diseases. Slum environments have recently been shown to increase the risk for morbidities such as diabetes or obesity (Subbaraman, et al., 2012) (Alves, Gale, Mutrie, Correia, & Batty, 2009). These morbidities are characteristic risk factors of developing non-infectious diseases (NCDs). Non-infectious diseases can be slow to develop but they typically require long-term care which creates a large health care burden.

Maternal Health

Maternal health is explored briefly because much of women's health in slum dwelling population is gated by their reproductive experiences, and both BMI and nutritional status are known to vary depending on women's reproductive histories. Of the globally reported maternal deaths, a quarter of them occur in India alone (Vora, et al., 2009). The Maternal Mortality Ratio (MMR) is estimated to be 300-450 per 100 000 live births and there has been little improvement over the past couple of decades (Vora, et al., 2009).

Globally, the health of infants is a critical priority, which coincides with maternal health. It has been determined that the maternal environment plays a large role in the long term health of the child, this is apparent through the Developmental Origins of Health and Disease (DOHaD) theory (Wang, Chen, Shaikh, & Mathur, 2009). The theory suggests that under-nutrition in women at time of pregnancy leads to increased risk of development of obesity, type 2 diabetes, cardiovascular disease, and other metabolic diseases when the child is older and in better living conditions (Wang, Chen, Shaikh, & Mathur, 2009). In order for women to live healthier lives and avoid pregnancy and childbirth complications, as well as to improve the health of future generations, it is important to improve maternal health; this has become a global priority as indicated in MDG 5.

Micronutrient deficiencies, which are commonly found in areas of poverty globally, can have negative fetal health outcomes (Mahanta, Deb Roy, Dutta, & Devi, 2012). Zinc, calcium and magnesium deficiencies have been associated with unwanted health outcomes in women such as infertility, pregnancy wastage, congenital anomalies, pregnancy-induced hypertension, placental abruption, premature rupture of membranes, still births, and low birth weight (Mahanta, Deb Roy, Dutta, & Devi, 2012). Iron deficiency anemia also remains an issue in India with a high prevalence in pregnant women, which has resulted in increased maternal and perinatal mortality (Mahanta, Deb Roy, Dutta, & Devi, 2012). These findings argue the importance of focusing public health efforts on improving maternal health.

Factors that impact health status

Several previous studies highlight factors that may have a significant role in health outcomes of women measured using BMI as the outcome. There are few studies that

examine all of India, many observe specific regions. In Assam, India, family size, if greater than 5 individuals in a household, and low income were correlated with a lower BMI in pregnant women (Mahanta, Deb Roy, Dutta, & Devi, 2012). Parity (the number of children a woman has) also needs to be examined for its utility in measuring health outcomes in India as it is very common for elders or other family members to reside in the same household, therefore making family size a more accurate indicator of the woman's immediate family. In a Bangladeshi study, autonomy had an association with BMI; women who worked and were the head of the household had a higher BMI (Pryer JA, 2003).

The Dalit, also known as Untouchables, are regarded by Hindus in India as a hereditary classification, and they have been disadvantaged for several generations by experiencing stigma and discrimination (Waughray, 2010). Although the government constitutionally prohibits discrimination based on 'Untouchability', the group still appears to experience greater discrimination compared to those of a higher caste (Waughray, 2010). Overall, although Muslims in India have a similar SES to low-caste Hindus and no access to reserved places in higher education and the public sector, Muslims experience a lower child mortality rate compared to that of low-caste Hindus (Bhalotra, Valente, & van Soest, 2010). Individuals in Tribes have also faced discrimination similar to the Dalit (Waughray, 2010). There are no current studies on the health outcomes of individuals in Tribes living in urban areas including slum dwellings.

Data from the Indian National Family Health Survey have been published in various papers. As previously mentioned, analysis by Bharati et al. (2007) used the data set from 1998-1999. In their multiple linear regression they found that nutritional status had a strong correlation with the state that the women lived in. Their reported covariates were

age, education, caste, husband's education and standard of living index (Bharati et al., 2007). They did not look at slum dwelling as an important factor, though they did consider the difference between living in an urban or rural setting. These characteristics were assessed against Body Mass Index (BMI) that was recorded for the respondents.

These are some main factors that stood out in the literature; however, there are other studies that look at common sociodemographic factors such as age, state, religion and education among other factors. In the following project, the main sociodemographic factors are used in the regression as well as any other variables that were cited as a contributor to health status. BMI is used as a continuous outcome variable to assess health status, women with lower values are more likely to be underweight and at risk of maternal complications and micronutrient deficiencies, while increased values are associated with being overweight and more vulnerable to developing chronic diseases such as cardiovascular disease.

Methods

This research project consists of secondary data analysis in the form of a multiple linear regression. The primary aim of the project is to address the research question: *What are the factors associated with the health of Indian slum-dwelling women, in terms of body mass index?* The multiple linear regression analysis is presented in the embedded manuscript, which is formatted for submission to the *Global Journal of Health Sciences*. Ethics approval was granted by the Research Ethics Board at the University of Ottawa (see Appendix 1).

Data Source

Permission was obtained to use the Indian National Family Health Survey (a type of household health survey), which was conducted from 2005 to 2006 by the International Institute of Population Studies (IIPS) in Mumbai, India (see Appendix 3), the data set is commonly referred to as NFHS-3. The survey has been conducted twice prior, 1992-1993 and 1998-1999, the NFHS-3 is the most recent complete data available. The survey was conducted under the stewardship of the Ministry of Health and Family Welfare, Government of India and the nodal agency was the International Institute of Population Studies in Mumbai (International Institute for Population Sciences, 2009). There are three sets of completed interviews: household, men and women. The interviews consisted of questions that were created in consultation with various Ministries of the Government of India, international development agencies, non-governmental organizations and researchers in the field of health and social sciences (International Institute for Population Sciences, 2009). In addition to the interview, height and weight measurements were also recorded. The women's dataset was used for this study and contained responses from over 100 000

women, Appendix 4 provides supplementary information that was available with the interview responses and Appendix 6 provides further information on the sampling. The sampling design was created by the Central Statistical Agency, Government of India and was based on the number of ever-married women of reproductive age (International Institute for Population Sciences, 2009). The survey was conducted throughout India by 18 research organizations that were selected by the IIPS, and manuals as well as training programs were created to ensure uniform data collection at all sites (International Institute for Population Sciences, 2009). The interview contained several questions on living conditions, health and family planning. Some examples of questions that are referred to as variables in the SPSS file can be found in Appendix 5.

Multiple Linear Regression

The data were analysed using SPSS version 20. A multiple regression was conducted with BMI as the outcome variable. The inclusion criteria were slum dwelling women with a recorded BMI, who were not pregnant at the time of interview (as this can skew the BMI value). There were two slum dwelling variables in the data set, SHSLUMC and SHSLUMS. SHSLUMC referred to women who were classified as slum dwellers based on the 2001 census definition created by the Indian government. SHSLUMS represented slum classification that was determined by the research supervisor who conducted the interview, and it was determined using the 2001 census definition. The SHSLUMS variable was used in this regression because it appears to be a more current characterization since the research supervisor applied the definition to 2005-2006 conditions. This narrowed down the data set to 7952 women.

All of the variables in the data set were examined. Those that seemed to be relevant in influencing the health and environment of women were noted. Dr. Deonandan and I then went through the list of noted variables and decided which ones should be included in the regression. The variables initially underwent univariate analysis to determine skewness and normality. The outliers that were found were mainly due to coding issues that inputted large numbers such as '98' to represent an answer that deviated from the norm such as 'other' or "don't know". These values were changed to missing, where appropriate, to ensure the mean was not skewed inappropriately. Categorical variables were recoded into dichotomous dummy variables.

The regression was conducted, and the correlation coefficients between variables were analyzed for collinearity. A value greater than .300 was determined to be the threshold for collinearity, and one of the variables was removed from the regression to ensure that the goodness of fit of the final regression was not compromised.

. The adjusted p-values were assessed, with significance set as cases with $p \leq .05$. A sub-analysis of the Tribe variable was conducted, because it was on the threshold of significance ($p=.053$), in terms of a relationship with BMI, and since it represents a variable of special social policy interest. The sub-analysis included a t-test of BMI and the Tribe variable. Crosstabs were also conducted with the other significant variables in the regression: states, wealth indexes, diabetes, and whether the respondent does manual labour. Results of the crosstabs can be found in Table II.

Paper formatted for submission to Global Journal of Health Science

Title: "Factors Associated with Body Mass Index of Slum-Dwelling Indian Women: An Analysis of the 2005-6 National Family Health Survey"

Abstract

Background: Urbanization is increasing around the world, and in India this trend has translated into an increase in the size of slum dwellings. Slum environments may have a negative effect on human health, in particular women's health. The objective of the study is to determine factors associated with Indian women's health in slum environments.
Methods: The relationship between women's health, measured by BMI, and demographic, behavioural, and socioeconomic factors was statistically modelled. A multiple linear regression was performed, using data from the India National Family Health Survey.
Results: Increasing BMI is significantly and positively associated with: frequency of watching television, having diabetes, age, wealth index, and residency status in the areas of New Delhi, Andhra Pradesh or Tamil Nadu. **Conclusion:** While belonging to a Tribe was not associated with changes in BMI, unadjusted rates suggest that tribal status may be worthy of deeper investigation. Among slum dwellers, there is a double-burden of under-nutrition and over-nutrition. Therefore a diverse set of interventions will be required to improve the health outcomes of these women.

Keywords: Indian women, slum dwelling, women's health, Tribe in slums, BMI

Introduction

Globally, urbanization is on the rise. For India, this phenomenon has contributed to an increase in slum dwellers (Gupta & Mondal, 2014). The health of Indian women living in slum dwellings is relevant to two of the eight United Nations' Millennium Development Goals (MDGs): to improve maternal health and to eradicate extreme poverty and hunger. The Indian National Family Health Survey conducted from 2005-2006 (NFHS-3) represents a special opportunity to explore slum-dwelling women's health epidemiologically, given its care to classify respondents into slum dwelling and non-slum dwelling groups.

The way that slums were classified in the NFHS-3 was based on the 2001 census that determined slum dwellings in one of three ways: (i) based on the designations by the government established by any act including the Slum Act, (ii) governmental recognition of the slum regardless of any previous identification, or (iii) under the criterion of "a compact area of at least 300 population or about 60 to 70 households of poorly built congested tenements, in unhygienic environment usually with inadequate infrastructure and lacking in proper sanitary and drinking water facilities" (Swaminathan & Mukherji, 2012, p. 1330).

Defining health epidemiologically is innately problematic. But Body Mass Index (BMI) is a useful first step. Several studies have attempted to determine the factors that have the greatest impact on the nutritional status of women in South Asia, commonly measured via BMI. With a large population, BMI is both a non-invasive and time efficient measure (Barao & Forones, 2012).

Studies indicate that BMI has strong relationships with putatively deterministic variables. Pregnant women in Assam, India, were found to have a lower BMI if the household consisted of five or more individuals; low income also had the same impact on BMI (Mahanta, Deb Roy, Dutta, & Devi, 2012). According to the National Family Household Survey from 1998-1999 (NFHS-2), there was a correlation between state and BMI (S. Bharati, 2007). More developed states, such as Punjab, had higher rates of obesity, while less developed states, such as Bihar, had higher levels of chronic energy deficiency (S. Bharati, 2007). Another study used the NFHS-3 survey with BMI as an indicator of nutritional status; however, they modeled it to three nutritional statuses: under-nutrition, normal, and over-nutrition (Swaminathan & Mukherji, 2012). Based on these variables,

they found no association between census slum designation and nutritional status. However, slum dwellers were about 10% more likely to be underweight (Swaminathan & Mukherji, 2012).

Variables such as age, education level, occupation, and state are commonly used in many studies to model a multifactorial relationship between South Asian population health and demographic considerations. However, there remains a need to consider additional factors, especially with respect to a deeper consideration of the interrelationships between caste, social class, and the social determinants of health.

Caste classification is an important consideration in researching health outcomes among the impoverished in India. The Dalit, also known as Untouchables, are regarded by Hindus in India as a hereditary classification, and they have been disadvantaged for several generations by experiencing stigma and discrimination (Waughray, 2010). Individuals in Tribes have also faced discrimination similar to the Dalit (Waughray, 2010). Previous studies have not explored the impact of belonging to a Tribe or caste system, with regards to the impact belonging to a discriminated group has on the health outcomes of women in slums.

Low BMI in women of child-bearing age can negatively impact the health of the future generation. The Developmental Origins of Health and Disease (DOHaD) theory suggests that when individuals experience under-nutrition as a foetus or in the early stages of life, they have an increased risk of being susceptible to a non-communicable disease later in life, even if their situation improves (Wang, Chen, Shaikh, & Mathur, 2009). This is troubling as under-nutrition is already known to cause a myriad of health complications apart from this additional susceptibility to NCDs (Jorgenson, Rice, & Clark, 2012).

The overall health of adult women in South Asia is worthy of study beyond maternal and child health considerations. Sedentary lifestyles are common in urban centres, and unfortunately this trend does not exclude slum dwellers (Subbaraman, et al., 2012). The concept of the double-burden of malnutrition is becoming increasingly prominent in India. Whereas under-nutrition had been the main focus of interventions in slum dwellings in the past, a major global shift toward lifestyles conducive to obesity has caused over-nutrition to become an issue (Garg, Khan, Ansari, & Garg, 2010). This can be attributed to access to high calorie foods at relatively low prices. The impact of obesity is a challenge that is global in scope because it is now apparent in both developing and developed countries (Wang, Chen, Shaikh, & Mathur, 2009).

This study uses a multiple linear regression to determine which factors have the greatest association with slum-dwelling women's health status, assessed via BMI, with special attention paid to social class, as determined by caste or tribal status.

2. Methods

2.1 Data source

The responses from the Indian National Family Health Survey, which was conducted in 2005-2006, was used for this study (The DHS Program, 2014). The following is a brief description of the data set from the International Institute of Population Sciences website. "There were 18 research organizations involved in the collection of data from over 200,000 women aged 15-49.[…]The survey provides state and national information for India on fertility, infant and child mortality, the practice of family planning, maternal and child health, reproductive health, nutrition, anaemia, utilization and quality of health and family planning services." (International Institute for Population Sciences, 2009) The

number of participants included was based on the reported population of the state to ensure there was an appropriate distribution, increased detail on selection of participants can be found on the website (International Institute for Population Sciences, 2009).

2.2 Statistical methods

A multiple linear regression analysis was applied to these data, with a series of demographic and behaviour independent variables (see Table 1) modelled against the continuous dependent variable of BMI. For this study, only data from slum dwelling women was required.

In the data set, there are two slum variables, "SHSLUMC", reflecting slum designation according to the 2001 census, and "SHSLUMS", reflecting slum designation by the researcher that originally conducted the survey using the 2001 census criteria. In this study, the SHSLUMS variable is used because it represents a current characterization of slums from when the survey was conducted in 2005-2006. Individuals who were characterized as slum dwellers based on SHSLUMS variable were isolated for the regression.

Women who indicated they were currently pregnant were excluded since they provide a skewed relationship between demographic factors and BMI. Variables that had relevance in previous studies or were associated with the social determinants of health were noted for use in the regression.

A cursory sample size computation, with α set at 0.5 and desired power set at 0.80 determined that the data set represents sufficient power for the proposed analyses. The variables that were initially selected underwent univariate analysis using descriptive statistics that include mean values and frequency graphs. Putative continuous covariates

were first assessed for normality and skewness by both visual appraisal of their distributions, and by the identification of outliers based upon interquartile ranges. Categorical variables with more than two levels were recoded into dichotomous dummy variables or values were grouped to provide a dichotomous outcome for the variable. All variables were tested for independent associations with BMI, using t-tests for dichotomous and chi-square for continuous variables.

Once all variables were processed accordingly, and the assumptions for conducting a multiple linear regression were found to be met, collinearity between covariates was assessed by determining if any correlation coefficients between variables were above .300. If above .300, one of the variables was removed from the regression, to ensure that the goodness of fit was not compromised. This was particularly important because the wealth index, a variable hard coded into the dataset, is an imputed construct based on the assets and living conditions of the individual. From the supplementary information provided by the researcher, wealth index included information on household assets (such as furniture and vehicles) as well as access to water, sanitation and the type of materials used for their dwelling. Therefore, there is some overlap between the variables used to calculate the wealth index and the variables used in the regression. It was important to eliminate variables with high correlation to ensure the regression outcomes were relevant.

After correlated variables were removed, the final regression was computed with all statistical assumptions addressed, run in SPSS v20.

This study received ethical approval from the University of Ottawa Research Ethics Board, file number H02-13-14.

3. Results

Table 1 summarizes the descriptive statistics and indicates the variables included in the regression. The variables that showed significant association with BMI ($p \leq .05$) were: frequency of watching television, diabetes, not being in the richest wealth index, living in New Delhi, Andhra Pradesh or Tamil Nadu, and the current age of the respondent. The two variables that were approaching significance (i.e., p-value was barely over 0.05) were Tribe and whether the respondent does non-manual labour.

Table 1. Variables in multiple linear regression with BMI as the outcome variable

Variable	Type of Variable	Unadjusted p-value (obtained from t-test or Chi-square)	Adjusted p-value (obtained from multiple linear regression)	Standardized coefficients - Beta
Constant	n/a	n/a	0.77	n/a
Frequency of watching television	**Categorical**	**.000**	.000	**-.098**
Do you have diabetes	**Categorical**	**.000**	**.009**	**-.067**
Poorest wealth index	**Categorical**	**.002**	**.013**	**.080**
Poorer wealth index	**Categorical**	**.000**	**.000**	**.147**
Middle wealth index	**Categorical**	**.000**	**.000**	**.175**
Richer wealth index	**Categorical**	**.000**	**.000**	**.148**
Lives in Delhi	**Categorical**	**.199**	**.030**	**-.063**
Lives in Andhra Pradesh	**Categorical**	**.001**	**.004**	**-.091**
Lives in Tamil Nadu	**Categorical**	**.000**	**.000**	**-.166**
Current age of respondent	**Continuous**	**.000**	**.000**	**.242**
Source of drinking water	Categorical	.000	.117	-.048
Highest education level	Categorical	.037	.828	-.007
Toilet Facility	Categorical	.000	.141	-.045

Household has electricity	Categorical	.000	.570	.018
Household has radio	Categorical	.002	.717	.010
Household has refrigerator	Categorical	.000	.325	-.032
Household has bicycle	Categorical	.269	.319	-.027
Household has motorcycle/scooter	Categorical	.000	.664	.013
Religion	Categorical	.035	.157	.038
Smokes	Categorical	.284	.269	.029
Partner's education level	Categorical	.000	.791	.008
Respondent works at home or away	Categorical	.507	.188	-.036
Who decides how to spend money	Categorical	.793	.756	-.008
Drinks alcohol	Categorical	.223	.603	.014
Respondent does not work	Categorical	.000	.966	-.001
Respondent does non-manual labour	Categorical	.040	.060	-.054
Lives in Uttar Pradesh	Categorical	.630	.735	-.010
Lives in West Bengal	Categorical	.852	.097	-.052
Lives in Madhya Pradesh	Categorical	.000	.150	.039
Tribe	Categorical	.000	.053	.051
Not part of caste/tribe	Categorical	.657	.220	-.032
Don't know if part of caste or tribe	Categorical	.362	.998	.000
Number of household members	Continuous	.000	.180	-.039
Total children ever born	Continuous	.000	.369	-.033

Note. The unadjusted p-value and adjusted p-value in the regression as well as the coefficient estimates (beta) of variables used in the regression, with BMI as the outcome variable. Statistically significant variables in the regression are bolded.

Watching television everyday, having diabetes, living in Delhi, living in Andhra Pradesh, living in Tamil Nadu and increased age are all associated with an increased BMI.

The absolute increase in BMI diminishes as the wealth index increases from poorest to richer, indicating that not belonging to the richer wealth index has the smallest impact on BMI. In other words, there may be a gradient in the extent to which wealth is associated with BMI.

The overall equation was determined to be significant (F= 9.776, p≤.000). The regression model produced an R^2=.206.

The Tribe variable was not deemed to be significantly associated with changing BMI, but the p-value of that association was nonetheless quite low. As this is a variable of deep policy relevance, it was therefore useful to conduct an exploratory sub-analysis of tribal levels' unadjusted association with BMI.

Table 2 summarizes the finding that women belonging to a Tribe are associated with a lower BMI than women who do not belong to a Tribe (p≤.000). The mean BMI is lower when belonging to a Tribe, which indicates that they may have a lower nutritional status.

Table 2. Tribe sub-analysis

	Tribe	N	Mean
Body Mass	Yes	104	20.43
Index	No	7096	22.02

Note. For the t-test p≤.000

State, wealth index, diabetes and manual labour were explored via crosstabs in SPSS to determine the characteristic of individuals belonging to a Tribe. It was found that those belonging to a Tribe were more likely to dwell in Maharashtra or Andhra Pradesh, be in the poorest or poorer wealth index, and to perform manual labour, regardless of BMI. It

is likely that one of those factors contributed to the significance illustrated in the unadjusted sub-analysis.

The rise in obesity rates in India has also seen a subsequent increase in non-communicable diseases, including type 2 diabetes mellitus (Misra & Khurana, 2009). The aforementioned cultural bias towards South Asian obesity cut-off notwithstanding, the measurement of obesity has been internationally accepted as a BMI of 30 kg/m^2 or higher (WHO Expert Consultation, 2004). The strong correlation between obesity (measured via BMI) and diabetes in the examined sample may affect the correlation of BMI with the other variables. To explore this concept, the regression was run again without the diabetes variable included. There was no change in which variables were included in the model, thus the diabetes variable was included in the final regression and deemed not to be an effect modifier or confounding influence.

4. Discussion

The results from the regression indicate that the BMI of slum-dwelling women is most significantly and positively associated with the following factors: frequency of watching television, having diabetes, current age, higher wealth index and living in New Delhi, Andhra Pradesh or Tamil Nadu. Belonging to a Tribe, while not technically statistically significant in the adjusted model at the 0.05 significance level, was an interesting variable in that it showed significant unadjusted association with living in Maharashtra or Andhra Pradesh, doing manual labour, and being in the poorer or poorest wealth index.

The main limitation in the data set relates to issues created by coding. An example is the caste variable. The caste system is a religious classification system mostly among

Hindus (Waughray, 2010), but represented in some other religions, as well. It renders a social hierarchy among individuals, often dictating profession, diet, and living conditions. Currently, according to the Indian constitution, Scheduled Caste (Dalit) designation is reserved for Hindus, Sikhs and Buddhists (Waughray, 2010).However in the data set, of the 7952 women, 68.2% are Hindu, 0.1% are Sikh and 3.5% are Buddhist/Neo-Buddhist and 95.3% identified as belonging to a caste. It is unclear as to whether there are individuals of different religions who believe they are part of this hierarchy, or if the information was not communicated to them accurately. As with most secondary data analysis, there is no control over any coding errors that may have occurred during data collection.

Changing categorical variables into dichotomous variables required that the appropriate groups were created. For example, for the highest education variable, there were four categories: no education, primary, secondary, and higher. The variable was dichotomized into primary or lower vs secondary or higher, due to a need to cluster somewhat equal numbers of respondents in each new category. Similarly, for the variable indicating the respondent's occupation, re-coding was done into non-manual vs manual labour, which required a subjective appraisal on the part of the researchers. While done for defensible reasons, it is possible that these re-codings may have influenced the quality of the final model.

Furthermore, there is literature on unidentified slums that have similar, if not worse, conditions than identified slums (Subbaraman, et al., 2012). This regression focuses only on identified slum dwellings. Therefore, there may be individuals facing worse health outcomes in slum dwellings that lack formal recognition as a "slum", measured via a lower BMI, whose realities are not captured within these statistics. The variables affecting their

BMI would differ from the variables affecting the BMI of individuals living in officially recognized slums. It should therefore remain clear that these results reflect the experiences of formal, identified slum-dwellers only. It would be problematic to draw comparisons to non-slum dwellers, given that many of those may in fact experience similar slum-like conditions without the mantle of a formal slum designation.

Key Observations

One clear message arising from these data is that slum dwellers in India are not a homogenous population. Factors such as basic housing and sanitation contribute to the wealth index calculation and are important to examine in slum dwellers because a need for improvement is still prevalent. However, while slum dwellers have largely been characterized as profoundly impoverished, in these data it was revealed there are slum dwellers belonging to the middle and richer wealth indexes, indicating that certain slum dwellers experience significantly greater economic standing than others. This is a critical consideration in the development of interventions or for providing resources because slum dweller needs will vary; some segments of the population may already have significant assets available to them while many others require some form of financial assistance. It will be important for future research to analyze the economic characteristics of the slum population under study before an appropriate intervention is formulated.

The number of slum dwellers belonging to a Tribe was small (n=110), compared to the total number of individuals in the data set (n=7952). However, their membership in the poorer wealth indexes suggests that there may be other slum dwellers who identify as belonging to a Tribe but reside in unidentified slums.

Unidentified slums are known to have similar, if not worse, living conditions than identified slums; comparatively inferior conditions are related to the fact that unidentified

slums are not eligible for publicly funded amenities due to their lack of classification. This reality serves to keep slum dwellers from unidentified slums, including those who may belong to a Tribe, in a lower wealth index compared to slum dwellers from identified slums (Milbert, 2006).

While Tribe membership accounts for only a small fraction of the individuals in this data set (consisting of 'identified slums' only), Tribe populations may nonetheless constitute a largely socioeconomically disadvantaged group that requires intervention. The literature is lacking with respect to Tribe populations in urban centres, and more specifically in slums. This is a concept that is emerging in the research, particularly in light of evidence demonstrating the poverty experienced by individuals living in Tribes (Kasi, 2011).

The Caste variable was not statistically significant to this regression model, which is why it was not included in the regression. However, Tribe was approaching significance which emphasizes their importance with relation to BMI outcomes. Therefore, they are a sub-group that requires further analysis; this finding may be influenced by the fact that individuals belonging to a Tribe have similar disadvantages to low-caste Dalit, as discussed earlier.

It is important to note that all of the previous research that found a significant association between state or residence and health status mentioned the concept of the double burden of under-nutrition as well as over-nutrition in India. This phenomenon will undoubtedly create a significant health care burden for the country. Slum dwellings, which were historically associated with under-nutrition, are now experiencing growing rates of obesity due to increased urbanization and the lifestyle associated with it (Gaur, Keshri, &

Joe, 2013). Thus, slum dwellings, like Indian urban centres in general, are experiencing an emergence of this dual burden of over-nutrition and under-nutrition. Another study using NFHS-3 data examined various socioeconomic factors of slum-dwelling and non-slum dwelling women in the eight Indian megacities. The double burden was found to be prevalent in the megacities as evidenced by a large portion of both underweight and overweight women (Gaur, Keshri, & Joe, 2013). Interestingly, the researchers noted that a significant number of slum-dwelling women were found to be overweight in a similar fashion to non-slum dwelling women, whereby those in the higher wealth indexes were likely to be overweight, and those in the lower wealth indexes were likely to be underweight (Gaur, Keshri, & Joe, 2013). Although this study did not explore BMI cut-offs the factors associated with BMI may be relevant to future interventions targeting healthier BMI outcomes.

This regression did not find a significant association between education level and BMI outcomes. Unadjusted, education is associated with BMI (p=.037); however, adjusted (i.e., in the regression) association is not (p=.828). This suggests that other factors may have been mediating the relationship between education and BMI; it can be assumed that wealth index may have been one of the factors. Education has been associated with increased wealth due to the associated career opportunities and economic advancement. This leads us to believe that having assets and adequate housing (as measured by the wealth index) is more influential than educational status, recognizing, however, that sometimes the acquisition of those assets is due to having attained higher education and the economic improvement associated with this. Other studies note the significant association between education level and health outcomes, therefore it will be important to assess

whether this is a statistical anomaly or, if, in fact, assets and housing (measured via wealth index) are more important in determining health outcomes.

In conclusion, it will be important to conduct further research with Tribal populations that may be underserved. Furthermore, the role of education and over-nutrition need to be explored in slum dwellings with consideration for the heterogeneous nature of slums.

Works Cited

Barao, K., & Forones, N. M. (2012). BODY MASS INDEX:different nutritional status according to WHO,OPAS and Lipschitz classifications in gastrointestinal cancer patients. *Arquivos de Gastroenterologia*, 169-171.

Bhalotra, S., Valente, C., & van Soest, A. (2010). The puzzle of Muslim advantage in child survival in India. *Journal of Health Economics*, 191-204.

Bharati, S., Pal, M., Bhattacharya, B., & Bharati, P. (2007). Prevalence and Causes of Chronic Energy Deficiency and Obesity in Indian women. *Human Biology*, 395-412.

Brant, R. (2014). *Inference for Proportions: Comparing Two Independent Samples*. Retrieved from http://www.stat.ubc.ca/~rollin/stats/ssize/b2.html

Garg, C., Khan, S. A., Ansari, S. H., & Garg, M. (2010). Prevalence of obesity in Indian women. *Obesity Reviews*, 105-108.

Gaur, K., Keshri, K., & Joe, W. (2013). Does living in slums or non-slums influence women's nutritional status? Evidence from Indian mega-cities. *Social Science & Medicine*, 137-146.

Gupta, I., & Mondal, S. (2014). Urban health in India: who is responsible? *The International Journal Of Health Planning And Management*.oik

International Institute for Population. (2009). *NFHS-3*. Retrieved from National Family Health Survey, India: http://www.rchiips.org/NFHS/nfhs3.shtml

International Institute for Population Sciences. (2009). *Home*. Retrieved from National Family Health Survey, India: http://www.rchiips.org/NFHS/index.shtml

Jorgenson, A., Rice, J., & Clark, B. (2012). Assessing the Temporal and Regional Differences in the Relationships between Infant and Child Mortality and Urban Slum Prevalence in Less Developed Countries, 1990-2005. *Urban Studies*, 3495-3512.

Kasi, E. (2011). Poverty and development in a marginal community: case study of a settlement of the Sugali Tribe in Andhra Pradesh, India. *Journal of Asian and African studies*, 5-18.

Mahanta, L. B., Deb Roy, T., Dutta, R. G., & Devi, A. (2012). Nutritional Status and the Impact of Socioeconomic Factors on Pregnant Women in Kamrup District of Assam. *Ecology of Food and Nutrition*, 463-480.

Milbert, I. (2006). Slums, Slum Dwellers and Multilevel Governance. *The European Journal of Development Research*, 299-318.

Misra, A., & Khurana, L. (2009). The metabolic syndrome in South Asians: epidemiology, deteminants, and prevention. *Metabolic syndrome and related disorders*, 497-514.

Pryer JA, R. S. (2003). Factors Affecting Nutritional Status in Female. *Social Biology*, 259-269.

Subbaraman, R., O'Brien, J., Shitole, T., Shitole, S., Sawant, K., Bloom, D. E., & Patil-Deshmukh, A. (2012). Off the map: the health and social implications of being a non-notified slum in India. *Environment & Urbanization*, 643-663.

Swaminathan, H., & Mukherji, A. (2012). Slums and Malnourishment: Evidence From Women in India. *American Journal of Public Health*, 1329-1335.

The DHS Program. (2014). *New User Registration*. Retrieved from https://dhsprogram.com/data/new-user-registration.cfm

Wang, Y., Chen, H. J., Shaikh, S., & Mathur, P. (2009). Is obesity becoming a public health problem in India? Examine the shift from under- to overnutrition problems over time. *Obesity Reviews*, 456-474.

Waughray, A. (2010). Caste Discrimination and Minority Rights: The Case of India's Dalits. *International Journal on Minority and Group Rights*, 327-353.

WHO Expert Consultation. (2004). Appropriate body-mass index for Asian populations and its implications for policy and intervention strategies. *Lancet*, 157-163.

General Discussion

Additional Limitations

We are unclear on the nature of the interviews; whether leading questions were asked, how controlled the environments were and whether identities were confirmed.

There are several articles arguing against the relevance of BMI as a predictor of health; however, for a large sample size, it is the most efficient measure (Barao & Forones, 2012). There are also articles on the varied BMI cut-offs for South Asians and the observed risk at 22-25 kg/m^2 (WHO Expert Consultation, 2004). In this study, BMI cut-offs were not used since the rationale for defining such cut-offs was insubstantial. This may be a limitation by not indicating the variables associated with the specific health status of underweight or overweight. The regression, therefore, only helped to identify which factors played a significant role in altering the continuous BMI variable. There is statistically significant variance in BMI outcomes, however the clinical distinction may not be present.

Comparison to literature findings

Several studies were conducted using the NFHS data set to determine factors that had the most impact on the health of individuals. A study that analyzed women in the data set, without regard for slum status, found that age, place of residence, education, wealth index, religion, caste and occupation were strong determinants of women being either underweight or overweight (Sengupta & Syamala, 2012). Another study that looked at both males and females in India, using the NFHS-2 data set, found age, standard of living index, literacy composition, religion, household type, and region of residence to be important determinants of adult mortality (Saikia & Ram, 2010). An alternate study, analyzing women from the NFHS-2 data, found that the state that a woman resided in had a strong

impact on the nutritional status measures of being underweight or overweight (Ackerson, Kawachi, Barbeau, & Subramanian, 2008). Several studies indicate the association between nutritional status and place of residence; it is therefore surprising that a study analyzing only women from Andhra Pradesh, using NFHS-2 data set, found that socioeconomic status had a greater impact on BMI than did location of residence. This finding was similar to our regression, where wealth indexes, as related to socioeconomic status, were significant. Concordant with other studies (Saikia & Ram, 2010) (Sengupta & Syamala, 2012), in our sample, the state of residence and age of the respondent had a significant association with BMI (See Table 1).

Of the three states that were significant in this regression, Tamil Nadu is experiencing an increasing percentage of overweight women, while Delhi and Andhra Pradesh face the double health burden of an increasing percentage of both overweight and underweight women (Ackerson, Kawachi, Barbeau, & Subramanian, 2008). It is surprising that a more recent study indicated that Delhi would be facing the burden of obesity and that Tamil Nadu is soon to follow, with no mention of Andhra Pradesh (Sengupta & Syamala, 2012).

There was a 2.0% elevated mortality risk associated with increased BMI as of 2005; however, that number was predicted to rise to 30% in 2015 (WHO, 2005). A study analyzing determinants of adult mortality indicated that lifestyle factors, such as smoking and alcohol consumption, had the greatest impact (Saikia & Ram, 2010). However, with the women in this study, the majority did not smoke (94.2%) and did not consume alcohol (98.7%). The second most influential factors were socioeconomic and demographic factors, which are measured by wealth and educational status (Saikia & Ram, 2010). It is surprising

that educational status is relevant in their findings; in our regression, highest education level is not significant.

Policy Interventions

While the regression did not show education level to be significantly associated with BMI outcomes, there are numerous benefits to improving the education level of slum-dwelling women, including combating under-nutrition (Swaminathan & Mukherji, 2012). Previous research notes over-nutrition as an eventual consequence of improved education levels due to changes in lifestyle with economic improvement (Swaminathan & Mukherji, 2012); however, this remains a useful intervention nonetheless.

Targeting factors associated with increasing wealth index may also improve the health status of women. However, from these data, many slum-dwelling women already belong to the middle or richer wealth index (15.1% and 40.2% respectively). This may suggest that wealth-focused interventions may not benefit them as dramatically as might be assumed. However, it appears more plausible that a more functional definition of wealth may be in order for urban populations, perhaps one focused on access to critical amenities and services, rather than the current index, which is focused upon assets and possessions.

Although BMI and malnutrition are large areas of concern, it is also worth mentioning the prevalence of micronutrient deficiency (Boy, et al., 2009). This can lead to health concerns for women and, if they are pregnant, their children as well. The need for vitamin A and iodine supplementation in developing countries is well documented; the need is even more so in remote areas (Boy, et al., 2009). Iron and zinc are also important to improve health outcomes and to prevent future complications (Boy, et al., 2009). Anemia is a large health concern among women in India; it does not discriminate between class

boundaries, and is present in both well-nourished and under-nourished women (Bharati, Som, Chakrabarty, Bharati, & Pal, 2008). Similar to BMI, education and the standard of living index are the main variables that contribute to the severity of anemia (Bharati, Som, Chakrabarty, Bharati, & Pal, 2008). According to the supplementary information provided with the data set, the standard of living index is measured using variables associated with house, facilities in the house, and items in the household. Micronutrient deficiencies and their associated factors are important development targets for women of childbearing age (Menon, et al., 2011). Future research, using micronutrient status as a proxy for health outcomes, would be beneficial in determining the factors to target to improve this health outcome.

Obesity rates continue to rise and are noted as a growing health concern due to the resulting NCDs that may develop (Maher, Ford, & Unwin, 2012). Immediate public health interventions are necessary to educate individuals on making healthy dietary choices, as well as to invest in community programs that increase physical activity. Such public health initiatives may be beneficial in effecting the desired BMI. Public health efforts to educate both underweight and overweight women on healthy food choices are necessary since resources on dietary recommendations are currently lacking (Swaminathan & Mukherji, 2012). Such education may be particularly effective with women who are in the middle or richer wealth indexes who can access higher quality nutrition. For those in lower wealth indexes, however, a dual approach of increasing nutritional awareness as well as improving access to higher quality nutrition, via food assistance programs, would be necessary. In addition, as with any educational intervention, the current education level of the population

would need to be taken into account. Educational programs would need to be appropriately geared to the various education levels present in this population.

One of the biggest health issues globally is the rise in non-communicable diseases. This is a discussion that all countries need to participate in because it is no longer mainly an issue in developed countries where there is a prevalence of sedentary lifestyles (Maher, Ford and Unwin, 2012). Of the worldwide NCD burden, low and middle-income countries have the burden of accounting for 80% of the deaths (Maher, Ford and Unwin 2012).This emphasizes the need for interventions; preventative measures may be too late because as the population ages, there is a higher chance for the development of a NCD (Krishnan, 2008). It is important to assess the full extent of the issue and strike a balance between using resources for NCD prevention, NCD intervention or infectious disease interventions; each slum dwelling will have different health care needs. Along with addressing the current prevalence of NCDs, it is also important to target the UN MDG of improving maternal health because there is literature on the maternal environment having a long-term impact on the child by influencing NCD prevalence in adulthood (Mi, et al., 2000). This indicates that the issue will span generations. Middle and high income urban residents in India need to shift their perceptions to understand that they are not immune to the same global health care burden that affects slum dwellers and urban populations worldwide.

The World Health Organization (WHO) defines health as “a state of complete physical, mental and social well-being” (World Health Organization, 1947, p. 2). From this definition, it is deduced that slum dwellers are in a state of ill-health (Sheuya, 2008). In situations wherein slum dwellers constitute a substantial proportion of the population, it is incumbent upon government to develop more effective policies for addressing this health

shortfall. Slum populations are at a disadvantage compared to the rest of the population, they do not have access to many of the services that are taken for granted by the middle and upper classes. These are basic human needs that should not create disadvantages for anyone as emphasized in the UN Millennium Development Goals. Many previous housing projects involved eradicating slums and building new housing. However, this housing is not affordable to slum dwellers and simply creates more housing for the middle class (Milbert, 2006). This does not eradicate slums; it means that slum dwellers have to find a new slum to overcrowd or look for any other vacant private land in order to re-establish themselves. There are stresses involved with constantly having to relocate, further accentuating the decreased quality of life.

Peri-urban dwellings or inhabiting public land should not be limiting factors in deciding policy-wise if individuals are slum dwellers. It is important to look at the overall circumstances of the slum dwellers. They choose to reside in certain areas because they do not know of any other vacant land that fits their needs. One of the characteristics of slums is that they are overcrowded so it is understandable that individuals would occupy any free land that they find. They should not be neglected because of this 'forced' decision. There needs to be a more conscious effort made to provide them with a more socially and personally accepted alternative as opposed to the threats they receive from law enforcement officers. Families should not have to live in constant fear of being evicted; it deteriorates their quality of life. Settlement on private land or in undesignated slums also means there are likely fewer services, such as access to clean water or sanitation practices (Milbert, 2006). This means more time and energy are spent ensuring that they have the resources to stay alive as well as ensuring they have somewhere safe to stay at the end of the day, which

leads to less time available for work, contributing to a lower overall income or fewer job opportunities. This further highlights the need for a more inclusive slum definition, and subsequent differentiation amongst the diverse needs of slum dwellers.

The increased access to affordable technology, such as mobile phones, has the potential to support better health outcomes at the individual level. It would be beneficial to incorporate technology into interventions, because it may be a more systematic and financially feasible method of gaining access to individuals. There are millions of apps available for smartphones; new ones are easily created to meet the specific needs of individuals. Apps are convenient and can even help generate interest from users (participants) because they are interactive.

The results of this research indicate that slums are heterogeneous, therefore a single definition likely will not encompass the whole slum dwelling population. There may need to be some sort of continuum created as suggested by Jankowska et al. (2011) to ensure that the definition can accommodate the diverse characteristics present in slum dwellings. A better system for defining slums and an in-depth needs assessment survey would increase dialogue between slum dwellers and government officials or non-governmental organizations. A current assessment will also ensure that resources are being used efficiently; there have been ongoing efforts to improve slum dwellings, therefore this may help to identify any infrastructure gaps that continue to exist.

Future Research

An important insight from previously mentioned studies is that education level of slum-dwelling women plays a very large role in improving health outcomes. Further research is indicated with respect to identifying efficient ways to address these education

needs in both girls and women. Higher education is associated with increased wealth and improved health outcomes, with the exception of over-nutrition. The focus on educating girls and young women will lead to a decreased health burden by improving their health outcomes as well as pregnancy outcomes. It is surprising that, in our regression, education, which was measured via highest education level, was not significantly associated with BMI. The insignificance of the association between education level and BMI may be a statistical anomaly; therefore, it will be important to conduct further studies on their specific association to determine if there is, in fact, a significant association.

Future studies should analyze the supplementary Caste and Tribe data set that provides the name of the Caste or Tribe that the individual identified as belonging to in the NFHS-3. There were discrepancies between currently employed Caste and Tribe definitions and the number of people who identified as belonging to a Caste or Tribe in our data set. Future in-depth analysis of Caste and Tribe data would clarify the classification of individuals belonging to a Caste or Tribe.

Future research should also analyze the health risk factors that specifically cause worse outcomes for individuals belonging to a Tribe in order to address their health needs. In Table 2, it appears that under-nutrition is the main concern for individuals belonging to a Tribe; it will be interesting to examine whether the mean BMI has increased since, similar to the urban trend. The impact that urban dwelling has on individuals belonging to a Tribe should also be explored. The traditional Tribal lifestyle is likely greatly altered by urban environments, and members' socioeconomic status would augment any negative health impacts.

Further research needs to be conducted to determine the characteristics of individuals living in unidentified slums. These individuals were not included in this regression; however, their living conditions may be similar or worse than those found in identified slums as noted earlier. Jankowska et al.(2011) made an important contribution to this issue by suggesting the creation of a continuum using the UN-Habitat definition and scoring areas based on the number of missing factors (Jankowska, Weeks, & Engstrom, 2011). This would eliminate the issue of providing resources for known slums only and treating all areas of poverty the same; resources would then be allocated more efficiently, and individuals demonstrating genuine need would have greater access to resources. Once the characteristics of unidentified slums are determined, a comparison should be conducted with our regression findings to determine if the same factors are altering BMI in other individuals living in poverty. Appropriate interventions can then be designed to address the specific needs of those residing in unidentified slums. This work could also inform future efforts of researchers and policy makers to expand the policy definition of slum/slum-dwelling to include all such areas that are in dire need of resources.

Ideally, research and interventions with respect to identified and unidentified Indian slums need to strategically and collaboratively move the country towards nation-wide eradication of poverty and poor health outcomes among slum dwellers. Gains that are achieved in individual regions or states towards better health outcomes in slums should inform a collective body of health promotion best practices specific to slums. Sharing of best practices among regions and states would facilitate further gains in other parts of the country. Additionally, there is a need for reassessment of current official slum definitions to put an end to the social 'invisibility' of unidentified slums in policies that are aimed at

improving slum resources. Of course, all of this is only possible with sufficient and sustained political will at all levels of government in India and a radical cultural shift in attitudes towards poor women and men and their right to a dignified existence for themselves and their families.

As related to the UN MDGs, this research as well as the current literature, outline the double burden of over- and under-nutrition in India. There is still a need to eradicate extreme poverty and hunger in some areas of India to effectively combat the issue of under-nutrition. However, in the identified slums, there were fewer people in the poorest wealth index (.8%), indicating that extreme poverty is not a large issue in identified slums as previously thought. Unidentified slums may have worse conditions, thus these need to be explored in order to provide necessary resources. In terms of improving maternal health, it is clear via the DOHaD theory that it is important that all women are well nourished during pregnancy to help ensure that offspring do not experience future health complications. The findings from this study can provide insight into the variables associated with BMI outcomes so appropriate interventions can be devised.

Conclusion

Slums will not disappear by administratively eradicating them; current trends indicate that there will be an increase in slum dwellers over time. Therefore, it is important to shift the mindset of ignoring slum dwellers on the basis that the majority do not have voting power (Milbert 2006) or that they are somehow less deserving than to the rest of the population. The improvement of slums will have a long-term impact on all urban dwellers, especially with regards to easing the burden on the health care system. The rise of non-communicable diseases highlights long-term illnesses that are now also affecting the very

large slum populations. Policy-makers and the population at large need to recognize that slum dwellers' issues now align with the global health issues that they themselves face as the middle and upper classes.

Poverty in India continues to be an issue that is highlighted to meet the MDG 1 target to eradicate extreme hunger and poverty. We must be on guard when describing poverty using slum dweller as a descriptor because this research indicates that they are not synonymous. In addition the nutritional status of women is most important to improving maternal health outcomes. The global increase in urbanization is creating a double burden for health interventions in India; the increasing obesity rates amongst women are as critical to address as the existing under-nutrition faced by this population. As a woman's wealth index increases so does her BMI, which means an increase in her chance of being overweight. Women in slum dwellings are not exempt from the lifestyle changes that are characteristic of urban dwellings, namely less physical activity and increased access to high calorie processed foods.

The heterogeneity of slums is additionally highlighted by the income gap within the slum-dwelling population; a significant proportion of slum-dwelling women surprisingly belong to the middle or higher wealth indexes. This heterogeneity of India's slum population requires a tailoring of solutions to the specific needs of a given slum dwelling. For instance, slum-dwelling women in the higher wealth indexes would benefit from obesity prevention programs, whereas those in the lower wealth indexes are likely to require resources to address knowledge and financial gaps with respect to accessing proper nutrition. Delhi, Andhra Pradesh, and Tamil Nadu are the states that demonstrate the

greatest need for interventions combatting obesity in women according to the regression outcomes.

With the global rise of urbanization, slum dwellings will undoubtedly continue to expand in number. Research and policy interventions need to include underserved, under-resourced groups, namely unidentified slums and Tribes. Regardless of wealth index or whether they reside in official or unofficial slums, all slum dwellers will benefit from nutritional food available at reasonable prices; this will directly influence BMI outcomes and may also improve micronutrient status. Slum dwellers make up a significant part of the urban population; therefore, their health needs, specifically maternal health, have to be addressed lest India faces a larger health care burden in the current and future generations.

Summary

This study aimed to explore the health experiences of slum dwelling on Indian women. The secondary data analysis provided insight into the lifestyle factors that had the greatest impact on the health status of women, measured via BMI. From these findings, it is evident that future interventions that are targeted at slum dwellers should first invest resources in researching the specific needs of the slum due to the heterogeneous nature of slums. One cannot simply describe slum-dwellers and their health needs with an easy, all-encompassing but convenient definition.

From a global health perspective, slum dwellings have become a critical concern due to rapid urbanization. Urbanization has led to an increase in urban poverty compared to rural poverty due to the large influx of migrants to urban centres (Chen & Ravallion, 2007). India has proposed to be slum-free by 2020, according to the National Urban Poverty Reduction Strategy created in 2009. However, while many slum dwellers have been evicted to rehabilitate land, few have received adequate housing (Arabindoo, 2011). Furthermore, there are a significant number of individuals living below the nationally appointed poverty line who are not slum dwellers (Arabindoo, 2011). Thus, poverty in India continues to be a large issue despite a national economic development boom due to private capital (Arabindoo, 2011). It is crucial that sufficient resources are allocated to improving the living conditions of slum dwellers, and, in turn, affords them the opportunity to contribute positively to the economy.

India has the world's second largest urban population (Subbaraman, et al., 2012), yet the official classification of slum dwellings is far from adequate, as seen through the various slum definitions. There are several compelling reasons for characterizing slums

more effectively. The current process of slum identification is highly problematic due to the various definitions in use. Resource allocation is determined via official slum status, thereby depriving unidentified slums of much-needed resources. Confounding factors make each slum unique, which overly narrow definitions may fail to acknowledge. Additionally, a shift in focus from infectious to non-infectious diseases within slum populations is necessary in order to promote optimal health outcomes.

In addition, specific subgroups may require more attention, specifically Scheduled Tribes (tribes identified in the Constitution) and residents of so-called unidentified or informal slums. Scheduled Tribes residing in urban slum dwellings constitute a relatively new phenomenon, and, therefore, they may be more sensitive to changes in BMI, which can be used as a proxy of health status. This is of particular concern due to the global obesity epidemic and our findings that may imply that urban Tribe dwellers may be more susceptible to large increases in BMI.

Globally, non-communicable diseases are becoming the major health concern, for which there is clearly no simple fix. Interventions will be relevant for both slum and non-slum dwellers, and it is important that researchers understand that slum-dwellers are also at increased risk and can benefit from similar interventions.

It is also important to engage slum-dwellers during the process of devising interventions. This will provide two significant advantages. Firstly, it will provide a deeper understanding of the needs of the slum. Secondly, it will enhance the degree to which interventions are utilised by slum dwellers as interventions show greater success where those targeted have had the opportunity to meaningfully participate in the process of devising solutions that affect them.

Obesity will continue to be a prominent issue, especially with the proposed lower obesity cut-off for South Asians due to increased body fat (WHO Expert Consultation, 2004). There is also the occupational health risk created from increased greenhouse gases in urban centres (Sahay & Ghosh, 2013). Urban living provides easier access to amenities for those with wealth; however, there is a clear exposure to health risks for all urban dwellers regardless of income level.

Executive Summary

- There is a need for a better slum definition because there are various competing definitions in use
- There may be a significant number of individuals living in slum conditions that are not officially recognized by the government as true slums
- Slums are heterogeneous. Previously thought to be in complete poverty, there are many individuals in identified slums classified as belonging to the middle wealth index or higher
- The dual burden of under-nutrition and over-nutrition in slums, similar to that experience in developed countries is observed in slums, presenting challenge to future simplistic, monolithic or undifferentiated health interventions
- Tribal populations in slums may have health experiences distinct from non-tribal peoples. Further research into the needs of this sub-group is needed.

Tables

Table I. Proposed variables for regression

Variable	Description
V012	Current age
V024	State
V025	Type of place of residence
V026	De facto place of residence
V101	State
V102	Type of residence
V106	Highest education level
V113	Source of drinking water
V115	Time to get to water source (min)
V116	Type of toilet facility
V119	Household has electricity
V120	Household has radio
V121	Household has television
V122	Household has refrigerator
V123	Household has bicycle
V124	Household has motorcycle/scooter
V125	Household has car
V130	Religion
V136	Number of household members
V150	Relationship to household head
V155	Literacy
V157	Frequency of reading newspaper
V158	Frequency of listening to radio
V159	Frequency of watching TV
V190	Wealth index
V201	Total children ever born
V208	Birth in last 5 years
V212	Age of respondent at 1st birth
V463	Smoking
H1$1-6	Has health card
V501	Current marital status by individual
V605	Desire for more children
V614	Ideal number of children
V621	Husband's desire for children
V632	Decision maker for using contraceptive
V634	Husband knows that respondent is using contraceptive
V701	Partner's education level
V717	Respondent's occupation
V721	Work's at home or away
V739	Who decides how to spend money
V743a	Final say on own health care
S44	Household head's religion
S45	Caste/Tribe of household head
S117	Caste or Tribe
S301	Marital status
S569	Drinks alcohol
S570	Frequency of consumption of alcohol
S575	Have diabetes
S824A	Allowed to go to health facility

Table II. Initial variables chosen for regression, including alterations made and reason for inclusion

Variable	Statistics conducted for slum dwelling women	Range	Comments	New Variable (N=no new variable)	Why the variable was chosen/citation of use
V012-Current Age	Spearman correlation	15-49	Frequency decreases with time	N	(Bharati, Som, Chakrabarty, Bharati, & Pal, 2008)
V024-State	Anova	Delhi, Uttar Pradesh, West Bengal, Madhya Pradesh, Maharashtra, Andhra Pradesh, Tamil Nadu (only 7 states in slum-only data)	Highest frequency from Uttar Pradesh [UP] (1000's more than rest)	N	(Bharati, Pal, Bhattacharya, & Bharati, 2007)
V025-Type of place of residence	All urban	urban/rural (only urban in slum-only data)	Split pretty evenly (about 55000 vs 65000)	N	(Ompad, Galea, Caiaffa, & Vlahov, 2007)
V026-De facto place of residence	All capital, large city	Capital- large city, Small city, Town, Countryside (only capital-largest city in slum-only data)	Large frequency from countryside	N	(Ompad, Galea, Caiaffa, & Vlahov, 2007)
V106-Highest Education level	Anova	No education, Primary, Secondary, Higher, missing (9) * from NFHS3SUP document: Primary = 1 to 5 years of education Secondary = 6 to 12 years of education Higher = more than 12 years of education	Large frequency of secondary followed by no education	O106 0=Primary or less 1= Secondary or higher Missing = system missing	(Ompad, Galea, Caiaffa, & Vlahov, 2007)
V113-	t-test	Piped water, piped	Largest	SODW	(Dharmalinga

Source of drinking water		into dwelling, piped to yard/plot, public tap/standpipe, Tube well water, Tube well or borehole, dug well (open/unprotected), protected well, unprotected well, surface water, protected spring, unprotected spring, river/lake/dam/pond/stream/canal/irrigation channel, rainwater, tanker truck, cart with small tank, bottled water, other , not de jure resident	frequency is Tube well or borehole, then piped water	1= piped to premise 2= not on premise 1= Piped water, piped into dwelling, piped to yard/plot 2= everything else	m, Navaneetham, & Krishnakumar, 2010)
V115-time to get to water source (min)	Spearman correlation	1-360 min + on premise, not de jure resident, don't know, missing (999)	Largest frequency on premise or else less than 30 minutes	N115 not de jure resident, don't know, missing = sys missing On premise 996=1 min All else the same	Relates to source of drinking water but expands on accessibility.
V116-type of toilet facility	Anova	Flush to piped sewer system, Flush to septic tank, Flush to pit latrine, Flush to somewhere else, Flush-don't know where, Ventilated Improved Pit latrine (VIP), Pit latrine with slab, Pit latrine without slab/open pit, No facility/bush/field, Composting toilet, Dry toilet, other,	Largest frequency of no facility or flushes to septic tank	O116 0=no toilet facility 1=toilet facility 0= No facility/bush/field, Composting toilet, Dry toilet, Not de jure resident 1= Flush to piped sewer system, Flush	(Ackerson, Kawachi, Barbeau, & Subramanian, 2008)

		Not de jure resident		to septic tank, Flush to pit latrine, Flush to somewhere else, Flush-don't know where, Ventilated Improved Pit latrine (VIP), Pit latrine with slab, Pit latrine without slab/open pit, other	
V119-Household has: electricity	t-test	No, Yes, Not a de jure resident, missing(9)	Most people yes	N119 1=Yes 2=No Not a de jure resident, missing =system missing	(Ackerson, Kawachi, Barbeau, & Subramanian, 2008)
V120-Household has: radio	t-test	No, Yes, Not a de jure resident, missing(9)	Most people NO	N120 1=Yes 2=No Not a de jure resident, missing =system missing	(Ackerson, Kawachi, Barbeau, & Subramanian, 2008)
V121-Household has: television	t-test	No, Yes, Not a de jure resident	Somewhat split but more yes	N121 1=Yes 2=No Not a de jure resident, missing =system missing	(Ackerson, Kawachi, Barbeau, & Subramanian, 2008)
V122-Household has: refrigerator	t-test	No, Yes, Not a de jure resident, missing(9)	Most people No	N122 1=Yes 2=No Not a de jure resident, missing =system missing	(Ackerson, Kawachi, Barbeau, & Subramanian, 2008)
V123-	t-test	No, Yes, Not a de	Split evenly	N123	(Ackerson,

Household has: bicycle		jure resident, missing(9)	between yes and no	1=Yes 2=No Not a de jure resident, missing =system missing	Kawachi, Barbeau, & Subramanian, 2008)
V124-Household has: motorcycle/scooter	t-test	No, Yes, Not a de jure resident, missing(9)	Most people NO	N124 1=Yes 2=No Not a de jure resident, missing=system missing	(Ackerson, Kawachi, Barbeau, & Subramanian, 2008)
V125-Household has: car	t-test	No, Yes, Not a de jure resident, missing(9)	A lot more NO	N125 1=Yes 2=No Not a de jure resident, missing =system missing	(Ackerson, Kawachi, Barbeau, & Subramanian, 2008)
V130-Religion	Anova	Hindu, Muslim, Christian, Sikh Buddhist/Neo-Buddhist, Jain, Jewish, Parsi/Zoroastrian, No religion, Donyi polo, other, missing(99)	Mainly Hindu	O130 1=Hindu 2=other Missing =system missing	OMPAD article
V136-number of household members	Spearman correlation	1-35	Trend is 3-8 members, very few people have more than 15 members	N	(Menon, et al., 2011)
V155-Literacy	t-test	Cannot read at all, Able to read only parts of sentence, Able to read whole sentence, No card with required language, Blind/visually impaired, missing(9)	Mainly can either read whole sentence or can't read at all	N155 1= Able to read some 2= Cannot read 1= Able to read only parts of sentence, Able to read whole sentence	(Ompad, Galea, Caiaffa, & Vlahov, 2007)

				2= Cannot read at all No card with required language, Blind/visually impaired, missing(9) = system missing	
V157-frequency of reading newspaper or magazine	anova	Not at all, Less than once a week, At least once a week, Almost every day, missing(9)	Mainly not at all, other 3 options evenly split	O157 0= Not at all 1=Reads any amount 0=not at all 1= Less than once a week, At least once a week, Almost every day Missing =system missing	(Griffiths & Bentley, 2001)
V158-frequency of listening to radio	anova	Not at all, Less than once a week, At least once a week, Almost every day, missing(9)	Mainly not at all, other 3 options split	O158 0=Not at all 1=Listens to any amount 0=not at all 1= Less than once a week, At least once a week, Almost every day Missing =system missing	(Griffiths & Bentley, 2001)
V159-frequency of watching TV	anova	Not at all, Less than once a week, At least once a week, Almost every day, missing(9)	Mainly almost every day	*t-test of O159 and A159, A159 chosen because better	(Griffiths & Bentley, 2001)

				distribution 0159 0=not at all 1=watches any amount A159 0= less than every day 1=almost every day 0 = Not at all, Less than once a week, At least once a week 1= Almost every day Missing =system missing	
V190-Wealth index	anova	Poorest, Poorer, Middle, Richer, Richest	Evenly increases from poorest to richest with most people in the richest category	N	(Ompad, Galea, Caiaffa, & Vlahov, 2007)
V201-Total children ever born	Spearman correlation	0-16	Mainly 0 or less than 6	N	(Ackerson, Kawachi, Barbeau, & Subramanian, 2008)
V208-birth in last five years	Spearman correlation	0-5	Mainly no births	N	(Ackerson, Kawachi, Barbeau, & Subramanian, 2008)
V212-Age of respondent at 1st birth	Spearman correlation	7-45	Highest frequency at 19, but curve from 14-26	N	(Ackerson, Kawachi, Barbeau, & Subramanian, 2008)
V463Z-Smokes nothing	t-test	No, Yes-smokes nothing, missing(9)		N463-Smokes 1=Yes 2=No Missing	(Ackerson, Kawachi, Barbeau, & Subramanian, 2008)

				=system missing	
V501-current marital status by individual	anova	Never married [includes: married gauna not performed], Married, Living together, Widowed, Divorced, Not living together	Generally never married, or second frequent is never married	O501 0= no partner 1=partner 0= never married, widowed, divorced, not living together 1= married, living together	(Ackerson, Kawachi, Barbeau, & Subramanian, 2008)
V701-partner's education level	Anova	No education, Primary, Secondary, Higher, Don't know, missing (9)	Mainly secondary (split between other 3 (not don't know or missing)) [Don't know why there are two 'missing' variables (9+system), [maybe one is recorded as 9 when info is unavailable and the other the program knows there is no input]	N701 0= No education 1=Primary 2=Secondary 3=Higher Missing =system missing	(Griffiths & Bentley, 2001)
V717-respondents occupation	Anova	Not working, Professional/technical/managerial, Clerical, Sales, Agricultural, Services, Skilled and unskilled manual, Don't know, missing(99)	Mainly not working, then agricultural or manual	O717 0= not working 1= non-manual work 2= manual labor 0=not working 1=Professional/technical/managerial, Clerical, Sales 2= Agricultural-self employed,	(Ompad, Galea, Caiaffa, & Vlahov, 2007)

				Agricultural, Household and domestic, Services, Skilled and unskilled manual, [for NFHS-3 skilled and unskilled manual combined] Unskilled Missing =system missing	
V721-works at home or away	t-test	At home, Away, missing(9)	Mainly away	N721 1= At home 2= Away Missing =system missing	(Ompad, Galea, Caiaffa, & Vlahov, 2007)
V739-who decides how to spend money	anova	Respondent alone, Respondent and husband/partner, Respondent and other person, Husband/partner alone, Someone else, missing(9)	Mainly respondent and husband, second frequency is just respondent (surprising not mainly men)	O739 1=Respondent alone 2= Someone else 1= Respondent alone 2=Respondent and husband/partner, Respondent and other person, Husband/partner alone, Someone else Missing =system missing	(Pryer JA, 2003)
S117-Caste or tribe	anova	Caste, Tribe, No caste/tribe, Don't know, missing(9)	Mainly caste	N	(Ompad, Galea, Caiaffa, & Vlahov,

		* the name of the caste or tribe is in another file*READ NFHS3SUP			2007)
S569-Drinks alcohol	t-test	No, Yes, Missing(9)	Most respondents said No	N569 1=Yes 2=No Missing =system missing	(Ackerson, Kawachi, Barbeau, & Subramanian, 2008)
S575A-Do you have: diabetes	t-test	No, Yes, Don't know-8, Missing(9)	Most respondents said No	S575 1=Yes 2=No Don't know , missing = system missing	(Gaur, Keshri, & Joe, 2013)
V445-Body Mass Index	Spearman correlation	12.04-59.81+flagged(9998) and missing(9999)	Generally people are falling between 15 &24, so underweight or lower end of the normal range	BMI 9998& 9999= sys missing Divided all values by 100 to get the correct decimal place for BMI For the variable, changed decimal value from 2 to 0, therefore no decimals. Rounded in spss.	Outcome variable, proxy of health status

Table III. Correlation coefficients >.100 of initial variables chosen for regression

Variable	Variable	Value
Household has bicycle	Wealth index	.113
Household has radio	Wealth index	.180
Respondent works at home or away	Wealth index	.134
Partner's education level	Wealth index	.106
Source of Drinking water	Wealth index	.273
Household has motorcycle/scooter	Wealth index	.186
toilet facility	Wealth index	-.302
Household has electricity	Wealth index	.327
Household has refrigerator	Wealth index	.251
Household has television	Wealth index	.224
Current Age	Who decides how to spend money	.102
Frequency of watching TV	State	-.111
Respondent works at home or away	State	-.111
Toilet facility	State	-.181
Household has refrigerator	State	-.209
Total children ever born	State	.175
Respondent works away or at home	Religion	.192
Total children ever born	Religion	-.135
Household has bicycle	Source of drinking water	.104
Household has bicycle	household has motorcycle/scooter	-.120
Number of household members	Current Age	.164
Age of respondent at first birth	Current Age	-.438
Births in last five years	Current Age	.587
Total children ever born	Current Age	-.529
Household has television	number of household members	.126
Total children ever born	number of household members	-.365
Respondent works away or at home	Respondents occupation	.150
Highest education	Respondents occupation	.126
Birth in last five years	Age of respondent at first	-.354

	birth	
Total children ever born	Age of respondent at first birth	.385
Frequency of reading newspaper or magazine	Age of respondent at first birth	-.104
Household has television	Frequency of watching television	.385
Frequency of reading newspaper or magazine	Frequency of watching television	-.125
Literacy	Partner's education level	.101
Highest education level	Partner's education level	-.101
Household has refrigerator	Household has motorcycle/scooter	-.155
Total children ever born	Toilet facility	.141
Household has television	Household has electricity	-.109
Total children ever born	Literacy	-.108
Frequency of reading newspaper/magazine	Literacy	.438
Highest education level	Literacy	.416
Births in last five years	Total children ever born	-.219
Frequency of reading newspaper/magazine	Highest education level	-.250

Table IV. Crosstab of states, wealth indexes, diabetes and does manual labour against BMI for the Tribe variable.

			Lives in Tamil Nadu		Total
			Yes	No	
Tribe	Yes	Count	5	105	110
		% within Tribe	4.5%	95.5%	100.0%
	No	Count	1042	6800	7842
		% within Tribe	13.3%	86.7%	100.0%
Total		Count	1047	6905	7952
		% within Tribe	13.2%	86.8%	100.0%

			Lives in Maharashtra		Total
			Yes	No	
Tribe	Yes	Count	65	45	110
		% within Tribe	59.1%	40.9%	100.0%
	No	Count	2292	5550	7842
		% within Tribe	29.2%	70.8%	100.0%
Total		Count	2357	5595	7952
		% within Tribe	29.6%	70.4%	100.0%

			Lives in Madhya Pradesh		Total
			Yes	No	
Tribe	Yes	Count	3	107	110
		% within Tribe	2.7%	97.3%	100.0%
	No	Count	160	7682	7842
		% within Tribe	2.0%	98.0%	100.0%
Total		Count	163	7789	7952
		% within Tribe	2.0%	98.0%	100.0%

			Lives in Andhra Pradesh		Total
			Yes	No	
Tribe	Yes	Count	36	74	110
		% within Tribe	32.7%	67.3%	100.0%
	No	Count	1311	6531	7842

		% within Tribe	16.7%	83.3%	100.0%
Total		Count	1347	6605	7952
		% within Tribe	16.9%	83.1%	100.0%

			Lives in West Bengal		Total
			Yes	No	
Tribe	Yes	Count	0	110	110
		% within Tribe	0.0%	100.0%	100.0%
	No	Count	1106	6736	7842
		% within Tribe	14.1%	85.9%	100.0%
Total		Count	1106	6846	7952
		% within Tribe	13.9%	86.1%	100.0%

			Lives in Uttar Pradesh		Total
			Yes	No	
Tribe	Yes	Count	0	110	110
		% within Tribe	0.0%	100.0%	100.0%
	No	Count	878	6964	7842
		% within Tribe	11.2%	88.8%	100.0%
Total		Count	878	7074	7952
		% within Tribe	11.0%	89.0%	100.0%

			Lives in Delhi		Total
			Yes	No	
Tribe	Yes	Count	1	109	110
		% within Tribe	0.9%	99.1%	100.0%
	No	Count	1053	6789	7842
		% within Tribe	13.4%	86.6%	100.0%
Total		Count	1054	6898	7952
		% within Tribe	13.3%	86.7%	100.0%

			Richest Wealth Index		Total
			Yes	No	
Tribe	Yes	Count	15	95	110
		% within Tribe	13.6%	86.4%	100.0%
	No	Count	3189	4653	7842

		% within Tribe	40.7%	59.3%	100.0%
Total		Count	3204	4748	7952
		% within Tribe	40.3%	59.7%	100.0%

			Richer Wealth Index		Total
			Yes	No	
Tribe	Yes	Count	53	57	110
		% within Tribe	48.2%	51.8%	100.0%
	No	Count	3145	4697	7842
		% within Tribe	40.1%	59.9%	100.0%
Total		Count	3198	4754	7952
		% within Tribe	40.2%	59.8%	100.0%

			Middle Wealth Index		Total
			Yes	No	
Tribe	Yes	Count	23	87	110
		% within Tribe	20.9%	79.1%	100.0%
	No	Count	1177	6665	7842
		% within Tribe	15.0%	85.0%	100.0%
Total		Count	1200	6752	7952
		% within Tribe	15.1%	84.9%	100.0%

			Poorer Wealth Index		Total
			Yes	No	
Tribe	Yes	Count	13	97	110
		% within Tribe	11.8%	88.2%	100.0%
	No	Count	274	7568	7842
		% within Tribe	3.5%	96.5%	100.0%
Total		Count	287	7665	7952
		% within Tribe	3.6%	96.4%	100.0%

			Poorest Wealth Index		Total
			Yes	No	
Tribe	Yes	Count	6	104	110
		% within Tribe	5.5%	94.5%	100.0%
	No	Count	57	7785	7842

	% within Tribe	0.7%	99.3%	100.0%
Total	Count	63	7889	7952
	% within Tribe	0.8%	99.2%	100.0%

			Do you have: diabetes		Total
			Yes	No	
Tribe	Yes	Count	2	108	110
		% within Tribe	1.8%	98.2%	100.0%
	No	Count	140	7652	7792
		% within Tribe	1.8%	98.2%	100.0%
Total		Count	142	7760	7902
		% within Tribe	1.8%	98.2%	100.0%

			Respondent does manual labour		Total
			Yes	No	
Tribe	Yes	Count	56	54	110
		% within Tribe	50.9%	49.1%	100.0%
	No	Count	1933	5905	7838
		% within Tribe	24.7%	75.3%	100.0%
Total		Count	1989	5959	7948
		% within Tribe	25.0%	75.0%	100.0%

Table V. Descriptive statistics of variables included in final regression

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	16.133	9.126		1.768	.077
	Source of drinking water	-.428	.273	-.048	-1.568	.117
	Highest Education Level	-.063	.289	-.007	-.218	.828
	Toilet Facility	-.672	.456	-.045	-1.475	.141
	Household has electricity	.299	.526	.018	.568	.570
	Household has radio	.088	.243	.010	.362	.717
	Household has refrigerator	-.358	.363	-.032	-.984	.325
	Household has bicycle	-.243	.243	-.027	-.998	.319
	Household has motorcycle/scooter	.161	.371	.013	.435	.664
	Religion	.408	.288	.038	1.415	.157
	Frequency of watching television	-.903	.257	-.098	-3.519	.000
	Smokes	.391	.354	.029	1.106	.269
	Partner's Education Level	.069	.259	.008	.266	.791
	Respondent works at home or away	-.347	.263	-.036	-1.318	.188
	Who decides how to spend money	-.071	.230	-.008	-.311	.756
	Drinks alcohol	.406	.781	.014	.520	.603
	Do you have: diabetes	-2.204	.837	-.067	-2.633	.009
	Respondent does not work	-.124	2.869	-.001	-.043	.966
	Respondent does non-manual labour	-.595	.316	-.054	-1.881	.060
	Poorest Wealth Index	2.971	1.195	.080	2.486	.013
	Poorer Wealth Index	2.686	.696	.147	3.857	.000
	Middle Wealth Index	1.846	.475	.175	3.883	.000
	Richer Wealth Index	1.311	.375	.148	3.492	.000
	Lives in Delhi	-.960	.441	-.063	-2.177	.030
	Lives in Uttar Pradesh	-.150	.444	-.010	-.338	.735
	Lives in West Bengal	-.688	.413	-.052	-1.663	.097

	Lives in Madhya Pradesh	.870	.604	.039	1.441	.150
	Lives in Andhra Pradesh	-1.142	.391	-.091	-2.922	.004
	Lives in Tamil Nadu	-1.884	.364	-.166	-5.172	.000
	Tribe	1.372	.710	.051	1.933	.053
	Not part of caste/tribe	-1.470	1.198	-.032	-1.227	.220
	Don't know if part of caste or tribe	.003	1.129	.000	.003	.998
	Current age – respondent	.146	.019	.242	7.720	.000
	Number of household members (listed)	-.080	.060	-.039	-1.342	.180
	Total children ever born	-.081	.091	-.033	-.898	.369

a. Dependent Variable: Body Mass Index

Works Cited

Ackerson, L. K., Kawachi, I., Barbeau, E. M., & Subramanian, S. V. (2008). Geography of underweight and overweight among women in India:A multilevel analysis of 3204 neighborhoods in 26 states. *Economics and Human Biology*, 264-280.

Alves, J. G., Gale, C. R., Mutrie, N., Correia, J. B., & Batty, G. D. (2009). A 6-Month Exercise Intervention Among Inactive and Overweight Favela -Residing Women in Brazil :The Caranguejo Exercise Trial. *American Journal of Public Health*, 76–80.

Ansari, W. E. (2005). Collaborative research partnerships with disadvantaged communities: challenges and potential solutions. *Journal of the Royal Institute of Public Health.*, 758-770.

Arabindoo, P. (2011). Rhetoric of the 'slum' Rethinking urban poverty. *City*, 636-646.

Barao, K., & Forones, N. M. (2012). BODY MASS INDEX:different nutritional status according to WHO,OPAS and Lipschitz classifications in gastrointestinal cancer patients. *Arquivos de Gastroenterologia*, 169-171.

Bhagat, R. B. (2012). A Turnaround in India's Urbanization. *Asia-Pacific Population Journal*, 23-29.

Bhalotra, S., Valente, C., & van Soest, A. (2010). The puzzle of Muslim advantage in child survival in India. *Journal of Health Economics*, 191-204.

Bharati, P., Som, S., Chakrabarty, S., Bharati, S., & Pal, M. (2008). Prevalence of anemia and its determinants among nonpregnant and pregnant women in India. *Asia-Pacific Journal of Public Health*, 347-359.

Bharati, S., Pal, M., Bhattacharya, B., & Bharati, P. (2007). Prevalence and Causes of Chronic Energy Deficiency and Obesity in Indian women. *Human Biology*, 395-412.

Boy, E., Mannar, V., Pandav, C., de Benoist, B., Viteri, F., Fontaine, O., & Hotz, C. (2009). Achievements, challenges, and promising new approaches in vitamin and mineral deficiency control. *Nutrition Reviews*, S24-S30.

Brant, R. (2014). *Inference for Proportions: Comparing Two Independent Samples*. Retrieved from http://www.stat.ubc.ca/~rollin/stats/ssize/b2.html

Braun, V., & Clarke, V. (2006). Using thematic analysis in psychology. *Qualitative Research in Psychology*, 77-101.

Butala, N. M., VanRooyen, M. J., & Patel, R. B. (2010). Improved health outcomes in urban slums through infrastructure upgrading. *Social Science & Medicine*, 935-940.

Chen, S., & Ravallion, M. (2007). Absolute poverty measures for the developing world, 1981-2004. *Proceedings of the National Academy of Sciences of the United States of America*, 16757-16762.

Dharmalingam, A., Navaneetham, K., & Krishnakumar, C. S. (2010). Nutritional Status of Mothers and Low Birth Weight in India. *Maternal and Child Health Journal*, 290-298.

Garg, C., Khan, S. A., Ansari, S. H., & Garg, M. (2010). Prevalence of obesity in Indian women. *Obesity Reviews*, 105-108.

Gaur, K., Keshri, K., & Joe, W. (2013). Does living in slums or non-slums influence women's nutritional status? Evidence from Indian mega-cities. *Social Science & Medicine*, 137-146.

Griffiths, P. L., & Bentley, M. E. (2001). The Nutrition Transition Is Underway in India. *The Journal of Nutrition*, 2692–2700.

Gupta, I., & Mondal, S. (2014). Urban health in India: who is responsible? *THE INTERNATIONAL JOURNAL OF HEALTH PLANNING AND MANAGEMENT*.

Hamelin, A.-M., Mercier, C., & Bedard, A. (2010). Discrepancies in households and other stakeholders viewpoints on the food security experience: a gap to address. *Health Education Research*, 401-412.

Harpham, T. (2009). Urban health in developing countries: What do we know and where do we go? *Health & Place*, 107-116.

International Institute for Population Sciences. (2009). *NFHS-3*. Retrieved from National Family Health Survey, India: http://www.rchiips.org/NFHS/nfhs3.shtml

Jankowska, M. M., Weeks, J. R., & Engstrom, R. (2011). Do the most vulnerable people live in the worst slums? A spatial analysis of Accra, Ghana. *Annals of GIS*, 221-235.

Jorgenson, A., Rice, J., & Clark, B. (2012). Assessing the Temporal and Regional Differences in the Relationships between Infant and Child Mortality and Urban Slum Prevalence in Less Developed Countries, 1990-2005. *Urban Studies*, 3495-3512.

Kasi, E. (2011). Poverty and development in a marginal community: case study of a settlement of the Sugali Tribe in Andhra Pradesh, India. *Journal of Asian and African studies*, 5-18.

Khan, M. H. (2012). Urban health in megacities of developing countries. *Public Health Forum*, 29.e1-29.e3.

Krishnan, K. Y. (2008). Changing patterns of diet, physical activity andobesity among urban, rural and slum populations in north India. *Obesity Reviews*, 400-408.

Mahanta, L. B., Deb Roy, T., Dutta, R. G., & Devi, A. (2012). Nutritional Status and the Impact of Socioeconomic Factors on Pregnant Women in Kamrup District of Assam. *Ecology of Food and Nutrition*, 463-480.

Maher, D., Ford, N., & Unwin, N. (2012). Priorities for developing countries in the global response to non-communicable diseases. *Globalization and Health*, 14-21.

Matous, P., & Ozawa, K. (2010). Measuring Social Capital in a Philippine Slum. *Field Methods*, 133-153.

Menon, K. C., Skeaff, S. A., Thomson, C. D., Gray, A. R., Ferguson, E. L., Zodpey, S., . . . Pandav, C. S. (2011). Concurrent micronutrient deficiencies are prevalent in nonpregnant rural and tribal women from central India. *Nutrition*, 496-502.

Mi, J., Law, C., Zhang, K., Osmond, C., Stein, C., & Barker, D. (2000). Effects of infant birthweight and maternal body mass index in pregnancy on components of the insulin resistance syndrome in China. *Annals of Internal Medicine*, 253-260.

Milbert, I. (2006). Slums, Slum Dwellers and Multilevel Governance. *The European Journal of Development Research*, 299-318.

Misra, A., & Khurana, L. (2009). The metabolic syndrome in South Asians: epidemiology, deteminants, and prevention. *Metabolic syndrome and related disorders*, 497-514.

Mystakidou, K., Panagiotou, I., Katsaragakis, S., Tsilika, E., & Parpa, E. (2009). Ethical and practical challenges in implementing informed consent in HIV/AIDS clinical trials in developing or resource-limited countries. *Journal of Social Aspects of HIV/AIDS*, 46-57.

Nakibinge, S., Maher, D., Katende, J., Kamali, A., Grosskurth, H., & Seeley, J. (2009). Community engagement in health research: two decades of experience from a research project on HIV in rural Uganda. *Tropical Medicine and International Health*, 190-195.

Nandi, S., & Gamkhar, S. (2013). Urban challenges in India: A review of recent policy measures. *Habitat International*, 55-61.

Ompad, D. C., Galea, S., Caiaffa, W. T., & Vlahov, D. (2007). Social Determinants of the Health of Urban Populations: Methodologic Considerations. *Journal of Urban Health*, i42-i53.

Pryer JA, R. S. (2003). Factors Affecting Nutritional Status in Female. *Social Biology*, 259-269.

Ranson, M. K., Sinha, T., Morris, S. S., & Mills, A. J. (2006). CRTs – Cluster Randomized Trials or "Courting Real Troubles": Challenges of Running a CRT in Rural Gujarat, India. *Canadian Journal of Public Health*, 72-75.

Sahay, S., & Ghosh, C. (2013). Monitoring variation in greenhouse gases concentration in Urban Environment of Delhi. *Environmental Monitoring and Assessment*, 123-142.

Saikia, N., & Ram, F. (2010). Determinants of adult mortality in India. *Asian Population Studies*, 153-171.

Sclar, E. D., Garau, P., & Carolini, G. (2005). The 21st century health challenge of slums and cities. *The Lancet*, 901–03.

Sengupta, A., & Syamala, T. (2012). The Changing Face of Malnutrition in India. *Journal of Health Management*, 451-465.

Sheuya, S. A. (2008). Improving the Health and Lives of People Living in Slums. *Annals of the New York Academy of Sciences*, 298-306.

Subbaraman, R., O'Brien, J., Shitole, T., Shitole, S., Sawant, K., Bloom, D. E., & Patil-Deshmukh, A. (2012). Off the map: the health and social implications of being a non-notified slum in India. *Environment & Urbanization*, 643-663.

Swaminathan, H., & Mukherji, A. (2012). Slums and Malnourishment: Evidence From Women in India. *American Journal of Public Health*, 1329-1335.

Swaminathan, H., & Mukherji, A. (2012). Slums and Malnourishment: Evidence From Women in India. *American Journal of Public Health*, 1329–1335.

The DHS Program. (2014). *New User Registration*. Retrieved from https://dhsprogram.com/data/new-user-registration.cfm

UN-Habitat. (2006). *The State of the World's Cities Report 2006/7.* London: Earthscan.

Vora, K. S., Mavalankar, D. V., Ramani, K. V., Upadhyaya, M., Iyengar, S., Iyengar, S., . . . Iyengar, K. (2009). Maternal Health Situation in India: A Case Study . *Journal of Health, Population and Nutrition*, 184-201.

Wang, Y., Chen, H. J., Shaikh, S., & Mathur, P. (2009). Is obesity becoming a public health problem in India? Examine the shift from under- to overnutrition problems over time. *Obesity Reviews*, 456-474.

Waughray, A. (2010). Caste Discrimination and Minority Rights: The Case of India's Dalits. *International Journal on Minority and Group Rights*, 327-353.

WHO Expert Consultation. (2004). Appropriate body-mass index for Asian populations and its implications for policy and intervention strategies. *Lancet*, 157-163.

World Health Organization. (1947). *The Constitution of the World Health Organization.* World Health Organization.

World Health Organization. (2000). *Obesity: Preventing and Managing the Global Epidemic.* World Health Organization.

Appendices

Appendix 1 – Research Ethics Board approval of Secondary data analysis

File Number: H02-13-14 **Date (mm/dd/yyyy):** 08/14/2013

Université d'Ottawa University of Ottawa
Service de subventions de recherche et déontologie Research Grants and Ethics Services

Ethics Approval Notice

Health Sciences and Science REB

Principal Investigator / Supervisor / Co-investigator(s) / Student(s)

First Name	Last Name	Affiliation	Role
Raywat	Deonandan	Health Sciences / Others	Supervisor
Maya	Patel	Health Sciences / Others	Student Researcher

File Number: H02-13-14

Type of Project: Master's Thesis

Title: Exploring the Definitions and Impacts of Slum Dwelling for Indian Women

Approval Date (mm/dd/yyyy)	Expiry Date (mm/dd/yyyy)	Approval Type
08/14/2013	08/13/2014	Ia

(Ia: Approval, Ib: Approval for initial stage only)

Special Conditions / Comments:
N/A

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File Number: H02-13-14 **Date (mm/dd/yyyy):** 08/14/2013

Université d'Ottawa University of Ottawa
Service de subventions de recherche et déontologie Research Grants and Ethics Services

This is to confirm that the University of Ottawa Research Ethics Board identified above, which operates in accordance with the Tri-Council Policy Statement and other applicable laws and regulations in Ontario, has examined and approved the application for ethical approval for the above named research project as of the Ethics Approval Date indicated for the period above and subject to the conditions listed the section above entitled "Special Conditions / Comments".

During the course of the study the protocol may not be modified without prior written approval from the REB except when necessary to remove subjects from immediate endangerment or when the modification(s) pertain to only administrative or logistical components of the study (e.g. change of telephone number). Investigators must also promptly alert the REB of any changes which increase the risk to participant(s), any changes which considerably affect the conduct of the project, all unanticipated and harmful events that occur, and new information that may negatively affect the conduct of the project and safety of the participant(s). Modifications to the project, information/consent documentation, and/or recruitment documentation, should be submitted to this office for approval using the "Modification to research project" form available at: http://www.research.uottawa.ca/ethics/forms.html.

Please submit an annual status report to the Protocol Officer four weeks before the above-referenced expiry date to either close the file or request a renewal of ethics approval. This document can be found at: http://www.research.uottawa.ca/ethics/forms.html.

If you have any questions, please do not hesitate to contact the Ethics Office at extension 5387 or by e-mail at: ethics@uOttawa.ca.

Signature:

Germain Zongo
Protocol Officer for Ethics in Research
For Daniel Lagarec, Chair of the Sciences and Health Sciences REB

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Appendix 2 - Permission to use Indian Nationwide Household Survey data set

Dec 10, 2012

You have been authorized to download data from the Demographic and Health surveys (DHS) on-line archive. This authorization is for unrestricted countries requested on your application.

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.

The data sets must not be passed on to other researchers without the written consent of DHS. Users are requested to submit a copy of any reports/publications resulting from using the DHS data files. These reports should be sent to the attention of the DHS Data Archive: archive@measuredhs.com.

It is essential that you consult the questionnaire for a country, when using the data files. Questionnaires are in the appendices of each survey's final report: http://measuredhs.com/publications/publications-by-type.cfm.

We also recommend that you make use of the Data Tools and Manuals: http://www.measuredhs.com/accesssurveys/technical_assistance.cfm.

DHS statistics can also be obtained using the STATcompiler tool: http://www.statcompiler.com. This tool allows users to select countries and indicators to create customized tables. It accesses nearly all of the indicators that are published in the final reports. Authorization is not needed to use the STATcompiler.

If you have any questions or need assistance, please send an email to: archive@measuredhs.com.

MEASURE DHS Data Archive
ICF International
11785 Beltsville Drive
Calverton, MD 20705

Appendix 3 – Calculation of the Wealth Index from supplementary survey information sheet

2.1 The Wealth Index: HV270, V190, MV190

The Wealth Index was constructed from household-level data, using Principle Components Analysis (PCA). The input information for this analysis came from household ownership of items ranging from furniture and vehicles; to dwelling characteristics such as water source, sanitation facilities, and the home's construction materials; and to whether a household member had a bank or post office account. The following gives a complete list of the items used to create the Wealth Index (with the original household questionnaire numbers cited):

Drinking Water Source (HV201)
Non-Drinking Water Source (HV202)
Toilet Facility (HV205)
Household Electrification (HV206)
Household Possessions (HV207-HV212, HV221, HV243A-C, SH47B-W)
Type of Cooking Fuel (HV226)
Main Floor Material (HV213)
Main Roof Material (HV215)
Main Wall Material (HV214)
Type of Windows (SH56A-D)
Number of de jure members per sleeping room (HV012/HV216)
House Ownership (SH58)
Household member having a bank or post office account (HV247)
Domestic Servant in Household (HV101 = 17)
Ownership of Agricultural Land (V740 = 0 or 1, or MV740 = 0 or 1)

Notes: For categorical items (e.g., water source, materials) missing values were not reassigned, i.e., they were left "missing." Whereas for dichotomous variables (e.g., electricity, possessions) missing values were assigned to the category "No/does not have".

Each asset was assigned a weight (factor score) generated through PCA, and the resulting asset scores were standardized in relation to a standard normal distribution with a mean of zero and a standard deviation of one. The sum of the scores of the assets possessed by each household resulted in that household's wealth index factor or score.

The sample was then divided into *population* quintiles, with each quintile given a rank from one (poorest) to five (wealthiest). These quintiles are based on the distribution of the *de jure* household population, rather than on the distribution of households, as it is thought that most analyses are concerned with poor people rather than poor households.

The cut-off points at which the quintiles were formed were calculated by obtaining a weighted frequency distribution of households, the weight being the product of the number of de jure members in the household and the sampling weight of the household (HV012 * (HV005 / 1,000,000)). Thus, the distribution represents the national household population, where each member is given the wealth index score of his or her household.

For more a more lengthy discussion of the wealth index, why it's of interest, and how it is calculated, see the *DHS Comparative Reports #6, The DHS Wealth Index*, which is available for download from the Measure DHS website (www.measureDHS.com).

Appendix 4 – India NFHS-3 DHS Documentation

Applicable to Dataset Version 52 (first re-issue)

India NFHS-3 (MEASURE DHS) Version 2 Doc 01
IA5

Name of Survey	National Family Health Survey 3 (NFHS-3)
Executing Agency	International Institute for Population Studies (IIPS) Mumbai, India
Dates of Fieldwork	Phase 1: December 2005 - April 2006 Phase 2: April 2006 – August 2006
Universe	Women 15-49, men 15-54
Coverage	National and State
Size	109,041 households with completed interviews (116,652 sampled) 124,385 women with completed interviews (131,596 sampled) 74,369 men with completed interviews (85,373 sampled)
Weights	Weighted by State and urban/rural, and within major cities by slum/non-slum (see: "**NFHS3 Supplemental Documentation [V52]**" for an expanded discussion)
Contents	DHS Model 5
Languages	Hindi, English
Anthropometry	Yes: women, men, and children 0-5
Domestic Violence	Yes
HIV testing	Yes: eligible women and men in selected households (~50% of entire sample))
Calendar	Yes: 1) Births, pregnancies & contraception 2) Reason for contraception discontinuation 3) Marriage & unions 6) Ultrasound conducted during pregnancy columns 4,5,7,8 and 9 unused

Appendix 5 – Example of Variables in dataset

S025	City\Town\Countryside
SPHASE	Survey fieldwork phase
SCITY	Selected cities
SDV	Women selected for HH relations section [ie domestic violence]
SANGAYN	Household in PSU covered by Angawadi/ICDS centre
SANGAYR	If PSU covered, year Angawadi/ICDS centre began operation
SSLUMC	Slum designation by census (used in survey sample)
SSLUMS	Slum designation by supervisor (observed during fieldwork)
D005S	State domestic violence weight (6 decimals)
S30	Any usual resident of the household suffers from TB
S31A	Respondent suffers from TB
S31B	Has received medical treatment for TB
S42	Where do HH members go for treatment when sick
S43A	Reason HH members don't use govt facility: no nearby facility
S43B	Reason HH members don't use govt facility: facility timing not convenient
S43C	Reason HH members don't use govt facility: health personnel often absent
S43D	Reason HH members don't use govt facility: waiting time too long
S43E	Reason HH members don't use govt facility: poor quality care
S43X	Reason HH members don't use govt facility: other
S44	Household head's religion
S45	Caste or tribe of household head
S46	Type of caste or tribe of the household head
S47B	Household has mattress
S47C	Household has pressure cooker
S47D	Household has chair
S47E	Household has cot/bed
S47F	Household has table
S47G	Household has electric fan
S47I	Household has B&W television
S47J	Household has colour television
S47K	Household has sewing machine
S47N	Household has computer
S47U	Household has water pump
S47V	Household has thresher
S47W	Household has tractor
S49	Food cooked on stove, chullah, open fire
S50	Cooking done under a chimney
S56A	House has any windows
S56B	House has windows with glass
S56C	House has windows with screens
S56D	House has windows with curtains or shutters
S58	Household owns this or any other house

Appendix 6 - Supplementary information on survey sampling

Note: The following is copied from (International Institute for Population Sciences, 2009)

Sample size

Since most of the key indicators to be estimated from NFHS-3 refer to ever-married women in the reproductive ages of 15-49, the target sample size for NFHS-3 in each state is estimated in terms of thenumber of ever-married women in the reproductive ages to be interviewed.

In NFHS-3, the initial target sample size was 4,000 completed interviews with ever-married women in states with a 2001 population of more than 30 million, 3,000 completed interviews with ever-married women in states with a 2001 population between 5 and 30 million, and 1,500 completed interviews with ever-married women in states with a population of less than 5 million. In addition, because of the sample-size adjustments required to meet the need for HIV prevalence estimates for the high HIV prevalence states and for slum and non-slum estimates in selected cities, the sample size in some states was higher than that fixed by the above criteria.

The sample size of HIV tests is estimated on the basis of the assumed HIV prevalence rate, the design effect of the sample, and the acceptable level of precision. With an assumed level of HIV prevalence of 1.25% and 15% relative standard error, the estimated sample size is 6400 tests each for men and women in high HIV prevalence states. At the national level, the assumed level of HIV prevalence of less than one percent (or 0.92%) and less than 5% standard error gave an estimate of 125,000 HIV tests needed at the national level.

All ever-married and never-married women age 15-49 and all men age 15-54 in all of the sample households in Uttar Pradesh and the six high HIV prevalence states were interviewed and blood was collected for HIV testing in all of those states except Nagaland. In the remaining 22 states, all ever-married and never-married women age 15-49, but all men age 15-54 from only a subsample of sampled households, were interviewed. The HIV tests were carried out only in a subsample of households in which men were interviewed.

Sample Design

The urban and rural samples within each state were drawn separately and, to the extent possible, the sample within each state was allocated proportionally to the size of the state's urban and rural populations. A uniform sample design was adopted in all the states. In each state, the rural sample was selected in two stages: the selection of Primary Sampling Units (PSUs), which are villages, with probability proportional to population size (PPS) at the first stage, followed by the random selection of households within each PSU in the second stage. In urban areas, a three-stage procedure was followed. In the first stage, wards were selected with PPS sampling. In the next stage, one census enumeration block (CEB) was randomly selected from each sample ward. In the final stage, households were randomly selected within each sample CEB.

Sample Selection

In rural areas, the 2001 Census list of villages served as the sampling frame. The list was stratified by a number of variables. The first level of stratification was geographic, with districts being subdivided into contiguous regions. Within each of these regions, villages were further stratified using selected variables from the following list: village size, percentage of males working in the nonagricultural sector, percentage of the population belonging to scheduled castes or scheduled tribes, and female literacy. In addition to these variables, HIV prevalence status, i.e. "High", "Medium" and "Low" as estimated for all the districts in high HIV prevalence states, was used for stratification in high HIV prevalence states. Female literacy was used for implicit stratification (i.e., the villages were ordered prior to selection according to the proportion of females who were literate) in most states although it may be an explicit stratification variable in a few states.

Mapping and Listing Operation

In every state, a mapping and household listing operation was carried out in each sample area. The listing provided the necessary frame for selecting households at the second stage. The household listing operation involved preparing up-to-date notional and layout sketch maps of each selected PSU, assigning numbers to structures, recording addresses of these structures, identifying residential structures, and listing the names of heads of all the households in residential structures in the selected PSUs.