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Micronutrient intake in Nepalese mothers and children

Study of the current stage and changes over time and determinants of vitamin A and iron intake in Nepalese mothers and their children from 2001 to 2011.

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HADKHALE KISHOR: MICRONUTRIENT INTAKE IN NEPALESE MOTHERS AND CHILDREN Study of the current stage and changes over time and determinants of vitamin A and iron intake in Nepalese mothers and their children from 2001 to 2011.
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ABSTRACT

Background: Malnutrition is a key contributor and serious public health problem in Nepal. Nutritional deficiency affects about 32 percentages of the population with approximate 26% of Nepalese consuming less than required daily intake of 2250 Kcal of energy. The national prevalence of stunting is 41% underweight and 29% and wasting 11% among children and under five years of age. Micronutrient intake particularly vitamin A and iron intake is low in both mothers and children. In recent years both supplementation and complementary feeding seem to have improved. Information on the trends in micronutrient intake and factors influencing intake will help to initiate appropriate public health interventions for improvement of the existing situation.

Aim of the study: The aim of this study was to investigate the current intake of micronutrient (Vitamin A and iron), changes over time and determinants among Nepalese mothers and children under five years of old.

Methods: The data for this study was drawn from the Nepal Demographic and Health Survey (NDHS) 2001 (N = 8,726), 2006 (N = 10,793) and 2011(N= 12,674), a nationally representative survey. The micronutrients accessed in the survey were vitamin A and iron

intake both as intake from food and supplements. Multilevel logistic regression was used to study the determinants of micronutrient intake.

Results: Vitamin A intake in mothers has increased from 21.1% in 2001 to 74.1% in 2006 and vitamin A supplement 2 months after delivery has increased from 11.3% in 2001 to 43.5% in 2011. Similarly iron tablet supplementation during pregnancy has increased from 57% in 2006 to 80% in 2011. Likewise vitamin A intake in children from food slightly increased from 52.5% in 2006 to 54.8%in 2011but iron intake from foods decreased from 42.1% in 2001 to 11.1% in 2011. Similarly Vitamin A supplementation has decreased from 82.5% in 2001 to 76.7% in 2011. Mothers' level of education, region of residence, current age of children, mothers' tobacco smoking status and mother's age at the time of pregnancy were the major socio demographic determinants of iron and vitamin A intake in mothers' and children under five years of age.

Conclusion: Mothers' vitamin A intake from food as well as supplementation of iron tablet during pregnancy and vitamin A intake after 2 months of delivery were increased between 2001 and 2011. However the current figure shows that vitamin A supplementation were still less than half of the mothers in 2011. Likewise vitamin A from food and supplement from capsule in children were increased during the same period. However, vitamin A intake from food was little more than half of the total children in 2011. Iron intake from food in children has decreased between 2001 and 2011, indicating the need of better planning, campaign, and more active distributional channels to increase intake of micronutrients among Nepalese children as well as in mothers.

Key words: Micronutrient malnutrition, Mother and children under five, Vitamin A, iron intake, Nepal.

LIST OF ABBREVIATIONS

ADB	Asian Development Bank
AUSAID	Australian Development Assistance agency
CDC	Center for disease control and prevention
CI	Confidence interval
EW	Elsewhere
FAO	Food and Agricultural Organizations
GDP	Gross domestic product
HDI	Human Development Index
IDD	Iodine Deficiency Disorder
MDG	Millennium Development Goal
MMR	Maternal Mortality ratio
NDHS	National Demographic Health Survey
NMSS	Nepal Micronutrient status survey
NSP	National Planning commission
NTAG	Nepal technical assistance group
OR	Odds Ratio
SLC	School leaving certificate
USAID	United States Agency for International Development
USD	United States Dollar
UNDP	United Nations Development Programme
UNICEF	United Nations children education fund
WHO	World Health Organization

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1. INTRODUCTION

Nutrition issues have remained a global concern for a long time in the past. It has been discussed for many decades and its importance is still very essential in the area of public health. High-income countries are mostly concerned with nutritional disorder such as obesity related nutrition diseases, diabetes etc. whereas low and middle-income countries are facing the double burden of the disease with both over and under nutrition (United Nations Millennium Development goal 1990 & WHO world health statistics, 2011). Under nutrition is also defined as malnutrition, which is a serious public health problem mostly in the developing countries affecting most of the south Asian and sub Saharan countries' (United Nations Millennium development report 2011). According to Cambridge online dictionary, Malnutrition is defined as "physical weakness and bad health caused by having too little food, or too little of the types of food necessary for good health" (Cambridge online dictionary & thesaurus 2013).

Malnutrition is devastating. It is affecting both developed and developing countries but mostly developing countries are in a severe condition (Food and Agricultural organization of the United Nations 2012). According to the World Health Organization, Malnutrition is estimated to contribute to more than one third of all child deaths, although it is rarely listed as the direct cause (WHO Nutrition 2013). According to the Food and Agricultural Organization (FAO) hunger statistics, 870 million people in the world have not enough food to eat. Although this number has fallen by 130 million since 1990 but the progress has been slowed after 2008. The same statistics shows that vast majority of hungry people live in developing countries (98 percent) and among them 15% of the population is undernourished. This has resulted to 2.6 million deaths of children under five each year, which is one third of the global total number of children (FAO 2012). From the Millennium development report, countries in Africa and Southeast Asia are most vulnerable to malnutrition. Very slow progress rate shows that most effort and commitments are required to achieve the aim by the set target of 2015 (MDG 2011).

Nepal is one of the South Asian countries where maternal and child nutrition status is poor. However, in the recent years some progress has been seen both in maternal and child health with decreased mortality (MDG 2011). United Nations has set the goal to reduce the maternal mortality ratio by three fourth and achieve universal access to reproductive health and reducing child mortality by two third in between the time period of 1990 and 2015(UN Millennium Development Goals 1990). With huge effort from the national and international governmental and non-governmental organizations, Nepal is on track of achieving goal. However, there are still more challenges to maintain and progress to reach the target within designated time frame (UN millennium development report 2011).

Nepal is among the poorest countries in the world with an annual per capita income of approximately US$1260 or less than US$4/day (UNDP 2012). Despite improvements in economic and social indicators over the past two decades, human development indicators remain low, with life expectancy at birth, adult literacy, and nutrition amongst the lowest category in the world (UNDP 2012). The Human Development Index (HDI) rank of Nepal in 2009 was 157 out of 186 countries indicating a low life expectancy at birth, low educational attainment, low nutritional intake and a low standard of living (UNDP 2012).

Food insecurity is a persistent challenge in Nepal. The country has been unable to produce sufficient amounts of food to meet the needs of the population since 2005 (The Food Security Atlas of Nepal 2010). Persisting poverty and faster growth in population than food production have exacerbated food insecurity. An estimated 31 to 32 percent of the population lives below the national poverty line (FAO 2003). Nutritional deficiencies affect 40 percent or more of the population and approximately 36 percent of Nepalese people were estimated to consume less than the minimum daily caloric intake of 2250 Kcal per day (FAO 2003). The number of hungry people rose from 3.5 million (19 percent of the population) to 5 million (23 percent of the population) between 1995 and 2002 (FAO 2003 & IFAD 2012). These figures combined with the latest high national prevalence of stunting (41percent), underweight (29 percent) and wasting (11percent) among preschool children under 5 years of age (Demographic and Health Survey Nepal

2011). The figures show the improving trends from the last decades but still the number in itself is very high as compared to other middle and high-income countries.

Malnutrition, one of the key contributors to mortality, is a serious public health problem throughout Nepal, and the situation is quite critical in the far-western region of the country. The most significant nutritional disorders in Nepal are protein-energy malnutrition, vitamin A deficiency, iodine deficiency disorders (IDD) and iron deficiency anemia (Nepal Micronutrient and Status Survey 2006). Poor nutritional status of children in rural areas is well correlated with the high infant mortality. The Nepal Micronutrient Status Survey revealed that more than one percent of all school-age children suffered from night blindness, a direct result of insufficient vitamin A intake, and the prevalence increased with age (NMSS 2006).

Likewise Iron deficiency is another serious concern in both children and mother on pregnancy and non-pregnancy period (WHO Nutrition 2013). National level program on Vitamin A and iron supplementation are ongoing each and every year to decrease the incidence and prevalence of micronutrient deficiency (Fiedler JL 2000). Therefore this study aims at investigating the intake of micronutrient (Iron and Vitamin A) among under five Nepalese children and mothers during a 10 years' time period (2001 to 2011) and their determinants. The overall objective of this study is to contribute to knowledge of the changes in intake of micronutrient in Nepalese children and mothers over time and to understand the population characteristics that determine the intake of micronutrient in Nepal. This endeavor can also help in tracking the MDG goal, to access the outcomes and drawbacks of the past interventions, future implications and the trend in maternal and child micronutrient intake. Due to its strong focus on factors and determinants on micronutrient intake in all local, regional and national level, it can also help shape and reform the national public health policy in the future.

2. LITERATURE REVIEW

For review of previous literature, highly sensitive search strategy was developed to locate potentially relevant studies. Literature search was undertaken PubMed and Medline databases using the keyword malnutrition, 'Vitamin A' and 'Iron' as a MESH heading. It was also searched in different combinations with words, micronutrient deficiency, Vitamin A and Xerophthalmia, iron deficiency with country specific as Nepal and some other south Asian and African countries. Vitamin A and iron were the main search heading in Medline Ovid–databases. The other databases were, pub med central, Rex, the Cochrane library, goggle scholar etc. Search was even expanded to UNDP, WHO & CDC databases. The searches covered the full range of publication years available in each database from 1990 to the year May 2013. During the search, articles were carefully selected, priority was given to those published from renowned publishing groups with high impact factor and lately published unless there were missing updates.

2.1. Inclusion Criteria

Inclusion criteria was developed and applied to each study. The first selection was to identify studies to populate the map. To be included, a study had to:

i. Focus on micronutrient intake as Vitamin A and Iron.
ii. Include the population group children under 5 years and their mothers.
iii. Intervention and non-intervention study design.
iv. Regardless of sex, race, ethnicity and geographical boundary.
v. Focus on Nepalese children and mothers.
vi. Regardless of associated confounder.

2.2. Exclusion criteria

The following exclusion criteria were applied to the abstracts identified in the literature search:

I. The study with no original data.
II. Studies did not address the micronutrient intake as Vitamin A and Iron.
III. Studies that were not conducted in humans.
IV. Articles published other than English and Nepali language.

2.3. Definition of key terms

Malnutrition: When a person is not getting enough food or right sort of food, it is called malnutrition. Disease is often a factor, either as a result or contributing cause. Even if people get enough to eat, they will become malnourished if the food they eat does not provide the proper amounts of micronutrients to meet daily nutritional requirements (World food programme 2013). According to the Center for Disease Control and prevention (CDC), deficiencies of Micronutrients such as iron, iodine, vitamin A, folate and zinc affect nearly one third of the world's population with devastating consequence (CDC 2013). In this research paper malnutrition mostly refers lack of proper nutrition, caused by not having enough to eat, not eating enough of the right things or being unable to use the food that one does it (Oxford online dictionary 2013).

Micronutrients: A chemical element or substance required in the trace amounts for the normal growth and development of living organisms. There are different micronutrients and macronutrients required in the body. Many different types of micronutrients are essential for the normal growth and development of the human body (CDC 2013) Despite that, this research is focused on lack of iron and Vitamin A in the Nepalese mothers and their children of from 0 to 5 years of age

Vitamin A: Vitamin A is found in foods such as butter, egg yolk, milk and fish oils or produced in the body from the carotene in fruits and green vegetables. It is important for normal growth, healthy skin, and the ability to see well especially at night (Cambridge online dictionary 2013). According to the world health organization, Vitamin A deficiency is the leading cause of preventable blindness in children and increases the risk of disease and death from severe infections. In pregnant women deficiency causes night blindness and may increase the risk of maternal mortality (WHO 2013).

Iron: It is one of the most important micronutrient that is present in the cells of the human body. It is one of the most common nutritional deficiencies. Iron carries oxygen to the tissues from the lungs and in the form of hemoglobin. There are about 4 to 5 billion people suffering from iron deficiency and an estimated 2 billion are anemic. Women and young children are most vulnerable. 50 percent of the pregnant women and 40-50 percent of the children under five of age in developing countries are iron deficient (WHO 2013).

Children and Mothers: In this paper, children refers to the children aged 0-59 months old preceding the month of interview and mothers refer to the mothers of those children who participated in the Demographic and Health Survey (NDHS 2011).

2.4. Background and relevance in context of Nepal: Prevalence, intervention and outcome.

Micronutrient malnutrition is a major public health problem throughout Nepal. Iron and Vitamin A deficiency are one of the major causes of anemia and night blindness in women during pregnancy and children at different age groups. One of the earlier study demonstrated that an average reduction of 50% in the iron prevalence and 70% in the prevalence of iron deficiency anemia with iron supplementation in the third trimester in Nepalese pregnant mothers (Christian et al 2003). This shows the prevalence of iron

deficiency and progress after intervention. According to Goerstein and his colleagues, Vitamin A intervention programmes were highly effective in reducing the incidence and prevalence of Vitamin A deficiency (Goerstein et al 2003). Data on dietary intake of Vitamin A indicated that there is severity of vitamin A problem in Nepal therefore continuation of Vitamin A capsule supplementation programme is a rational strategy and needs to be placed until alternative intervention approaches becomes adequate for the long term (Gorstein et al 2003).

In the article by Grubesic et al. 2003 Vitamin A is the severe public health problem in Nepal and supplementation of Vitamin A capsules was associated with better health outcomes regardless of age, sex or father's occupation (Grubesic et al 2003). According to the data from the demographic health survey of Nepal, Mothers' higher education, greater wealth index etc. shows significant result with positive health outcome. Similarly the surveys conducted in different districts of Nepal have shown the severity of Vitamin A situation and the effectiveness of intervention in the various districts. As Henning and his colleagues describes; Xerophthalmia was a critical problem in both mother and children. 1:14 per 1000 children are suffering from one or the other form of vitamin A deficiency and mostly night blindness (Hennig et al. 1991). The present situation is also very serious to look at with more than 4% vitamin A related deficiency such as Bitot's spots and night blindness in pregnant women and significant proportion in Children (UNICEF 2012).

Review of the literature showed that prevalence of Vitamin A and iron related disease are decreasing due to successful intervention programmes through national and international efforts. Due to the lack of this essential micronutrients, maternal and children under five-mortality rate was very high. It has been significantly improved in the past few years (Millennium development report 2013). Vitamin A was not a proximal determinant of death. Children die mainly because of infections such as diarrhea, measles, respiratory disease etc. It happens mostly in developing countries where the health system of the country is not fully able to tackle it as per the need. The severity of such diseases altered the child's immune to withstand the consequences. Such interventions were helping to

improve the immune system. It had reduced the number of infection related deaths. (Katz et al. 1995 and Lozoff et al. 2006)

An interesting association of prevalence of IDA and stunting was found in the research done in Nepal and Zanzibar among the children in 6-18 months of old. Result showed that both IDA and stunting were associated with differences in reported sleep characterized by shorter night sleep duration and higher frequency of night walking. It was concluded that stunting was also associated with shorter nap duration. This might eventually retard the immune system and makes the child weaker and susceptible to infection (Kordas et al. 2008). There were many other researches and interventions conducted to see the prevalence and effectiveness of intervention against iron and Vitamin A, which is one of the most chronically affected diseases. Iron intake was even more critical as compared to Vitamin A intake according to the most recent statistics (NDHS 2011 and UNICEF, Nepal 2009). Vitamin A deficiency was a problem at clinical as well as sub clinical levels especially in pregnant women in their third trimester. In developing countries like Nepal where vitamin A deficiency is widespread, the prevalence of Night blindness is very high (Radhika et al 2002). Vitamin A deficiency with serum retinol (less than 20 microgram per liter) appears vital problem during pregnancy. It is most common in country like Nepal in the community among low socioeconomic status that can result into spontaneous preterm delivery and moderate to severe maternal anemia (Radhika et al. 2002).

Search was even extended to see the overview of the similar developing countries. Firstly the countries were selected mainly from south Asia and sub Saharan Africa where the situation of malnutrition is comparable. Countries were also chosen where the situation of malnutrition is acute and chronic for e.g. in sub Saharan Africa. In some cases the situation was more severe than in Nepal. Ramakrishnan and his colleagues in their research article described that countries in the south East Asia and Africa are the most vulnerable in prevalence of micronutrient malnutrition in the global figure. Iron, vitamin A and iodine were most common whereas zinc, calcium, vitamin B was also very

common. Interventions for the prevention and control typically were focused on young children and their mothers. These groups of people were the most vulnerable (Ramakrishnan et al. 2002). The high prevalence of iron deficiency in the developing world has substantial health and economic costs. Although there were technical challenges to limit the iron fortification, few interventions on the controlled trial has shown that technical challenges is the effective method of controlling iron deficiency especially in the developing world. (Zimmerman et al. 2007) evidences also showed that universal iodine fortification has very significant positive outcome in many developing countries like Nepal (WHO 2012).

2.5. Micronutrient malnutrition in South Asia and Sub Saharan Africa

Literature review and database of different governmental and nongovernmental organization working in low and middle income countries mainly in the field of maternal & child nutrition showed that south Asian and sub Saharan African counties are the most vulnerable in terms of malnourished children and women. Report from the World Bank stated that south Asia has the largest number of malnourished children in the world by figure (World Bank 2013). Malnutrition rates in several south Asian countries were much higher than in those the countries in Africa. Under nutrition prevalence rates in India, Pakistan, Bangladesh and Afghanistan range between 38 to 51%. Likewise the prevalence rates in sub-Saharan Africa are 26%. From the economic perspectives, a country can lose up to 3% of GDP per year and individuals lose more than 10% of the lifetime earnings because of malnutrition (World Bank 2013).

Looking at the figures from Nepal, unlike the other south Asian counties such as India and Pakistan there is slight lower prevalence. However, the number in itself is very high in comparison. Trend showed the decreasing order from last 10 years but the rates were still high. Stunting being 41%, wasting 11% and underweight 29% which is more than 10% less as compared to the demographic survey of 2000 (NDHS 2011). In general

nutritional status of the children in Nepal has been improved over the last decade but the comparative proportion with other middle and high-income countries is very low. Mothers have also the similar situation where the progress rate is very low (NDHS 2011).

2.6. Determinants of Micronutrient intake in Nepal

Nepal is a Himalayan kingdom sandwiched between India and China. There is greater diversity in the social life, behavior of the people and cultural practices. These all affect the way of living of the people. There are cultural restrictions in food intake in certain religions and cultural practices hindering the required amount of calorie intake in Nepalese mothers and children (Joel Gittelsohn et al. 1997). It is practiced mostly in rural areas than in urban areas. In some cultures meat and especially chicken meat is strictly prohibition. Meat and egg consumption in general is not so common. Due to this reason children and childbearing mother lacked many micronutrients required for the normal healthy living. The latest national Demographic and Health Survey reports (NDHS 2011) showed that there are various socioeconomic determinants affecting adequate maternal and child nutrition. According to the survey report children age, place of residence, mothers' education, wealth index etc. plays a key role in micronutrient intake such as vitamin A and iron. Another study showed that the higher index of wealth and higher level of education is directly associated with good nutrition intake in children in early school age (Christain et al 2010). Similarly study conducted by Binkin and his colleagues showed that higher level of education and urban residence is associated with increased nutrition intake in children (Binkin et al 2009). Research conducted in Texas women college of nursing among Nepalese children aged 6-60 months of age presented that SLC and higher level of education, maternal age of pregnancy were the determinants of vitamin A intake from foods in the age group of children age in between 6-60 months of age. Similarly, the study by Gorstein among children living in low land Terai with lower educational level (below SLC) are more prone to the vitamin A intake (Gorstein J et al 2003). Likewise research conducted in implication of Vitamin A supplementation in children to see the implication of mortality and morbidity of children at the Harvard school of Public Health, Department of Nutrition and Epidemiology showed that both

mortality and morbidity due to vitamin A is high among the children living in low socio economic status and those living in high hill region.

In addition to that the proportion of women taking daily iron supplements differs substantially between urban and rural areas. Pregnant women in the Terai were more likely to take supplements daily than those in the Mountain region. However, it is correlated to age, level of education, wealth quintile etc. (Helen Keller International, Nepal 2010 & NDHS 2011)

Table 1: Summary of Literature review: Researches based on study setting and study outcome.

1	**Title**	**Author/s**	**Study setting**	**Study outcome**
2	The millennium development goal reports 2013.	United Nations, 2013	Global	Tracking the MDG indicators.
3	Coverage of vitamin A supplementation programme for child survival in Nepal; success and challenges.	Nguyen A.M. wt al, 2012	Nepal	National level vitamin A supplementation programme in Nepal is relatively high coverage of children aged 12-59 months old.
4	Under nutrition in Nepalese children: Biochemical and Hematological study.	NMC Department of Clinical physiology, 2012	Nepal	Parental education and poor SES direct relationship with vitamin A intake.
5	Preschool Iron- Folic acid and Zinc Supplementation in Children exposed to iron folic	Christian et al. 2011	Nepal	Upper wealth index and higher education highly associated with good

	acid In Utero confers in no added Cognitive benefit in early school age.			nutrition intake.
6	Determinants of anemia among young children in rural India.	Pasricha S.R. et al, 2010	India	Hemoglobin level was primarily associated with iron status in Indian toddlers. However maternal hemoglobin level, family wealth, food insecurity were also the important factors.
7	Tracking progress on maternal and child Nutrition.	UNICEF 2009	Nepal & EW	High SES, Education and Urban residence is positively associated with Nutrition diet in food. (Folic acid and Zinc)
8	Do improvements in Outreach, Clinical and family and community based services predict in child survival? Analysis of serial cross sectional national surveys.	Binkin et. al, 2009	Nepal & EW	High education and urban residence is significantly associated with Nutrition in children.
9	Micronutrient profile of children and women in rural Bangladesh. Study on available data on iron and vitamin A supplementation.	Rahman M. 2009	Bangladesh	Wealth index, mothers education, fathers occupation and various other demographic variables are associated with increased intake of Iron and Vitamin A.

10	Vitamin A deficiency and clinical disease: An historical overview.	John Hopkins Bloomberg school of Public Health, 2008	Global	Vitamin A deficiency, xerophthalmia and impact of deficiency among poor of low and middle-income countries.
11	Controlling Iron deficiency anemia through the use of home fortified complementary food.	Zlotkin et al, 2007	South Asia	SES and Education are the highly associated with increase and decrease of prevalence of Iodine deficiency and disorders.
12	Iron supplementation of young children: Learning from evidence.	Colonel University, 2007	Global	Family income and parental education true association with Iron supplementation.
13	Critical review to prevent and control iron deficiency in children.	Eastern Virginia Medical school, 2007	Global	Accessibility and availability of iron containing foods differs from one geographical region to other.
14	Is there an association between the nutritional status of the mother and that of her 2 years to 5 years old child?	Faber M et al, 2005	South Africa	There seems no mother child association of serum retinol concentration. Children are more susceptible to vitamin A deficiency in adult because of childhood disease.
	Children aged 6 to 60 months in Nepal may require vitamin a	Grubesic et. al, 2004	Nepal	Regardless of Consumption of

14	supplement regardless of dietary intake from plant and animal food sources.			Vitamin A rich foods children who were regularly supplemented were protected against malnutrition, diarrhea related diseases rather than who were supplemented once or twice.
15	Children aged 6 – 60 months in Nepal May require a vitamin A supplement regardless of Dietary Intake from plant and animal food sources.	Texas women college of Nursing, 2004	Nepal	SLC and above education, maternal age of pregnancy and education positively associated with Vitamin a intake.
16	Effect of maternal micronutrient supplementation on fetal loss: A cluster randomized trial in Nepal	Christian et al ,2003	Nepal	Maternal micronutrient supplementation failed to reduce overall fetal loss or early infant mortality.
17	Supplementation and Micronutrients in addition to Iron and folic acid doesn't further improve the hematologic status of pregnant women in rural Nepal.	Christian et al, 2003	Nepal	The combination of folic acid, Iron and Zinc with multiple micronutrients provided no additional benefit in improving maternal hematologic status.
18	Current status of vitamin A deficiency and National vitamin A control programme in Nepal: Results of 1998 National	Gorstein J et. Al, 2003	Nepal	Children in low land and with low level of education (below SLC) are more prone to

	Micronutrient status survey.			vitamin A intake.
19	Micronutrient malnutrition, infection, and immunity: an overview.	Bhaskaram et al, 2002	Global	Micronutrient Nutrition and infectious disease interactions is complex. The consequences of such interactions are of immense clinical and public health relevance in developing countries.
20	Longitudinal study of diet and Iron deficiency anemia in infants during first two years of life.	Heath A.L., 2002	New Zealand	None of them have Iron deficiency anemia in 24 months however the rate of Iron deficiency anemia was lower than that of reported in earlier studies.
21	Control of Iron deficiency in developing countries.	Institute of Research and Development, France, 2002	Low income countries	Higher Parental education and effective social mobilization campaigns increases the intake of Iron containing Foods and supplementation.
22	Infectious Disease and malnutrition status in Nepal: an overview.	Shiva kumar Rai et. al, 2002	Nepal	High prevalence of malnutrition and disease are associated with SES, education of the parents & family and place of residence that determines accessibility.
	Experiences and challenges in	UNICEF	Developin	Food Supplementation

23	developing countries.	Beijing, 2002	g Countries.	and salt fortification are the important co variants of improvement in Micronutrient intake.
24	Vitamin A supplementation: Implication for Morbidity and Mortality In children.	Harvard school of public Health, Department of Nutrition and Epidemiology , 2000	Nepal & EW	Mortality and morbidity due to vitamin A is high between low SES and children living in High hill region.
25	Vitamin A deficiency in Bangladesh: A review and recommendations for improvement.	University of Dhaka, Institute of Nutrition and food science, 1999	Bangladesh	Mortality and morbidity due to vitamin A is high among low SES and children living in High hill region.
26	Nutrition education and mega dose vitamin A Supplementation in Nepal.	Kathmandu eye hospital, 1998	Nepal	Mortality and morbidity due to vitamin A is high among low SES and children living in High hill region.
27	Cultural factors, calorie intake and micronutrient intake sufficiency in rural Nepali households.	Gittelsohn J et al, 1997	Nepal	Staple foods mostly containing foods are fairly distributed to all the family members where as high proportion of micronutrient intake only among the valued members of the family.

28	Chronic low intake of vitamin A rich foods households in Xerophthalmic children: Case control study in Nepal.	Shankar AV et al. 1996	Nepal	Mortality and morbidity due to vitamin A is high among low SES and children living in High hill region.
29	Dietary Vitamin a Intake and the risk of mortality among children.	Fawzi et. al, 1994	Sudan	SES is the major factor of Micronutrient intake in the family.
30	Vitamin A deficiency and corneal ulceration in southeast Nepal: implications for preventing blindness in children.	Lahan eye Hospital, 1991	Nepal	Parents' level of education and their living in rural areas have direct association with intake of Vitamin A intake in foods.

2.7. Micronutrient intake and deficiency in mothers and children

Reports, surveys and data show that Nepal has been facing the problem of micronutrient deficiency from the long time in the history with the adverse health situation (UN MDG report 2013). As described earlier, there are various factors responsible for the cause. According to the demographic and health surveys report from 2001, 2006 & 2011 and United Nations millennium development report, in general nutritional status of children in Nepal has improved over the past 15 years reducing the percentage of underweight children and showing a downward trend in stunting and underweight over time. Percentage of wasting has also decreased as compared to 2006 report from 13% to 11% but looking from 2001, it was 11 % that shows no any change. The improvements have been seen but the figure in itself is very high. The cases of mother are also similar as reported in Nepal Demographic and Health Survey report. (NDHS 2001, 2006 & 2011)

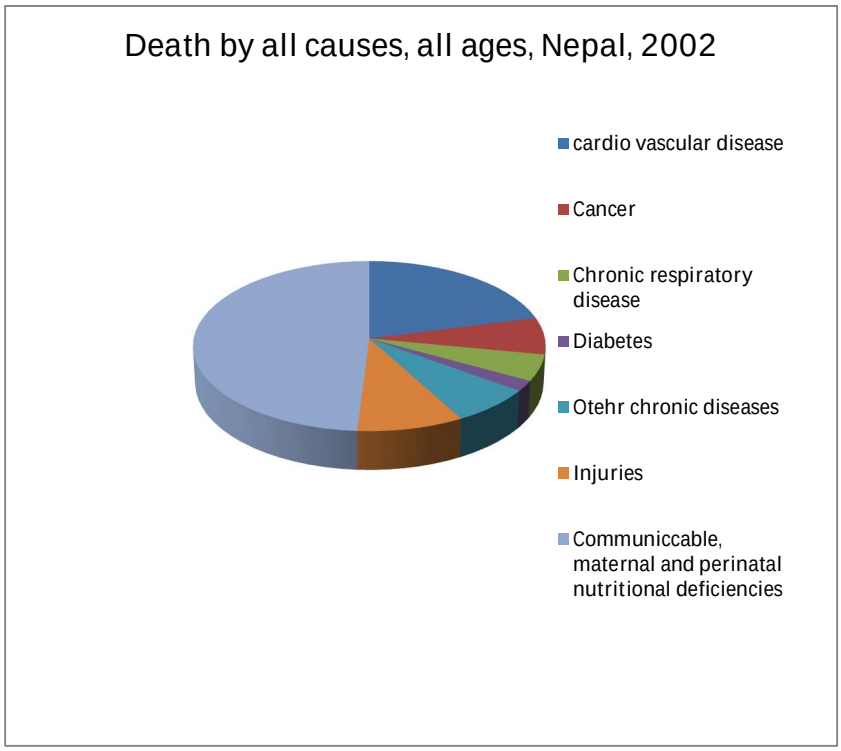


Fig. 1: Death by all cause, all ages, Nepal, 2002, Source: WHO 2013

Nutritional status of people of Nepal in general is poor and it is a public health problem all over the country. The prevalence of night blindness still remains as high as 4% (Gorstein et al 2003). Despite the overall progress in iron deficiency and worm infestation related diseases in general, the prevalence among children and pregnant still remains high. Present statistics shows about 41 % under 5 years children are suffering from stunting, 11% wasting, 29% underweight, 49 % protein energy malnutrition and 48 % anemia (WHO 2012 & NDHS 2011). Anemia trend has been reduced as compared to the last five years. It is mainly due to the advocacy, supplementation, deworming tablet and improvement of nutritional food habit. Distribution of Vitamin A capsule twice a year to the children of age group 6-59 months is still ongoing as a national level programmes through the ministry of health and population in Nepal. Similarly free

distribution of iron capsules to the pregnant women is still in progress to reduce the mortality of anemic mothers and children (WHO 2012).

2.8. Socio cultural and demographic variables of micronutrient intake

In light of above, there are various factors responsible for the micronutrient intake in both mothers and children. Nepal is a country of multilingual and culturally diverse in nature. Culture varies from region to region. Some cultures even restrict certain types of foods that are highly recommended for the children of growing ages and the pregnant mothers e.g. egg and meat (Joel Gittelsohn et al. 1997). The caste system is still prevailing in the country where so called high caste society people in the remote areas are prohibited of consuming and even touching those foods for e.g. eggs. These are so called upper class groups called Brahmins. Nepal's unique and diverse culture, demographic distribution, taboo and religious factors play great role in consumption of food. It affects the overall micronutrient intake for all types of people mostly affecting the vulnerable groups like pregnant mothers and children. Several socio economic and socio demographic variables have influenced the food eating behavior and ultimately the intake of micronutrient. Some of these variables are such as gender, family income, mothers' education, occupation etc. (WHO 2013, UNICEF 2012 & NDHS 2011). However in this research, these variables have been explored as a potential determinant of micronutrients among Nepalese children and mothers.

2.9. Nepal national policy and campaign on micronutrient intake among mothers and children

Maternal and child mortality in Nepal was very high during 1990's and before. (World Bank report 2012 & Nepal MDG progress report 2010). Due to series of successive intervention the rate has been sharply reduced in the past few years. There have been

national level campaigns and programs for the distribution of Vitamin A and Iron capsules. Statistics show that 35% of the women age in between 15-49 are anemic, 6% are moderately anemic and less than 0.3 % severely anemic (NDHS 2011). Due to High prevalence, supplementation of iron with folic acid tablets are provided for pregnant and breastfeeding women. Since pregnant women are more likely to be anemic than breastfeeding women, interventions are mostly targeted to the pregnant women (Helen Keller International Nepal 2004). Likewise there is one of the most successful campaigns of Vitamin A distributions in the history of the country. This programme contributed to save 9000 young lives and 2500 children becoming permanently blind in preschool children. It is considered as one of the highly successful programme. It was begun on 1993 in eight of 75 districts and nationwide coverage in 2003. It consists primarily of distributing high dose of Vitamin A capsules to all children from 6 to 60 months of age. The campaign is conducted twice a year through the existing network of female community health volunteers (FCHVs). The government of Nepal, UNICEF, USAID, AUSAID and Nepal technical assistance group supports the programme (NTAG) (AAMA & MTE report, Helen Keller International, Nepal 2012)

2.10. Nepal national health Policies and MDG Goal No. 4 and 5

United Nations has set the goal of reducing the child mortality by two third in MDG goal no. 4 and maternal mortality ratio (MMR) by three fourth in MDG goal no. 5 in the time period between 1990- 2015 (UN MDG 1990) According to world Health organization, UNICEF, UNFPA etc. on tracking the progress of Millennium development goals; Nepal is on track to achieve MDG 4 and 5. However there are significant inequalities in both health care utilization and maternal and newborn health outcomes. Poverty, gender disparity, malnutrition, limited access to health services especially for the poor and disadvantaged communities, still needs to be addressed (WHO 2012). Ministry of Health and population, Government of Nepal has set long term plan for safe motherhood and newborn health (2006-2017) and the national policy on skilled birth attendance. It has aimed to expand the birthing centers, comprehensive emergency obstetric care facilities

and increased access to free institutional deliveries (Ministry of Health and population, Nepal, National Health Planning commission 2005)

Nepal health sector programme 2010- 2015 emphasizes on strengthening and expanding equitable access and utilization of maternal and newborn health services with special focus on vulnerable population groups (Maureen Dari & UNFPA 2011). National Health planning commission has also emphasized poverty reduction and maternal and child health care on its five year plan with especial focus on and from 2002 (Nepal Planning commission 2012). National planning commission of Nepal has significantly put efforts on health and wellbeing of mothers and children through the reformed health policy. This includes private investment in health care, maternity and child ward in each and every hospitals, investment in safe delivery, training and workshops to the female community health workers, promotion of institutional delivery etc. in most recent three years plan and also in previous five year interim plan (Ministry of Health and population, Nepal, National Health Planning Commission 2005). The programme is based on bottom up approach that is from local to regional and national level. The local female community volunteers help in many health issues such as free distribution of capsules, institutional delivery and other simple and complex health issues mostly for the pregnant mothers and children. Due to this combined effort, MDG 4 and 5 in both maternal and child health are significantly improving with decreased mortality rate. It is likely to achieve the goal by the target within the time frame (Nepal Millennium Development goal progress report 2011)

3. AIM AND OBJECTIVES

Aim: To investigate the current stage and changes in intake of micronutrients between 2001 and 2011 among under five years Nepalese children and their mothers and to examine the determinants of intake.

Objectives:

a) To describe the current micronutrient (vitamin A and iron) intake among Nepalese mothers and children under five years old.
b) To examine the changes between 2001 & 2011 in intake of vitamin A and Iron among Nepalese mothers and children under five years.
c) To access the socioeconomic and socio demographic determinants of vitamin A and iron intake among under five years Nepalese children and their mothers.

4. MATERIALS AND METHODS

4.1. Study area:

This study was carried out within the geographical boundary of Nepal. Nepal is a landlocked country sandwiched between two neighboring countries China in the north and India in the east, west and south. Total area of the country is 147,181 square kilometers. According to the population census of Nepal, it stands 26.6 million people (Central Bureau of statistics, 2011). Topographically Nepal is divided into three distinct ecological zones (Mountain, Hill and Terai or plain). Mountain region accounts for 35% of the total land area. It is situated in the highest region in altitude. Population distribution is least and food production is very low and only seasonal crops due to harsh terrain lands. Hill regions whereas is the most densely populated region with 42% of total land area. It includes nations most urbanized area e.g. Kathmandu, the capital city. Due to high density of people, transportation, communication and health facilities are developed than in Mountain region.

Likewise, Terai or the flat zones has gigantic plains. It only consists of 23% of the total land area. According to the bureau of statistics, 50% of the population resides in this region. Soil is very fertile and considered to be the food storage of the country. Due to plain landscape, transportation and communication facilities are more developed than the rest two. Climatic conditions too vary from mountainous region to the flat Terai region. Due to varying landscape, temperature in the Terai is comparatively higher than to the mountainous region. During summertime Terai region can go up to 44 degrees Celsius and 1degree Celsius in winter. Similarly the corresponding temperatures for hill and mountains are 43 and 29 degree Celsius respectively in summertime and -1 and even less than zero during the wintertime. (Central bureau of statistics 2006 & NDHS 2011)

Administratively Nepal is divided into 5 development regions, 14 zones and 75 districts. From the viewpoint of malnutrition, far western development region is most critical to this issue and central and eastern development region are comparatively better. Many rural areas of this region are most vulnerable to malnutrition in mothers and children. Under-five mortality rate among children is highest in these regions. According to 2011 census, there are 103 diverse ethnic/caste groups, with their own distinct language and culture. Major groups are Chettri, Brahmins, Magar, Tharu, Tamang, Newar and 92 different mother tongues. Statistics also shows that Majority of the Nepalese are Hindus, and rest are Buddhists, Muslims, Kirants etc (Central Bureau of Statistics 2003).

The gross domestic product was 4.6% in the fiscal year 2012 with slowdown of industries and lingering political uncertainties. Remittance is one of the main sources of Nepalese economy (Asian development bank 2013). The good sources of resources are hydropower and tourism. Due to non-commitment and unstable government, it has been exploiting. Insecure social security and unnecessary interference by the workers and trade unions are worsening the economic stability and secure foreign trade. Economic growth of the country is 3.4% due to slow growth in non-agricultural sector. Agriculture is the major occupation and nearly 56% of the households receive some sort of remittance. In the past few years, remittance has become one of the foremost sources of income in Nepal. (NDHS 2011)

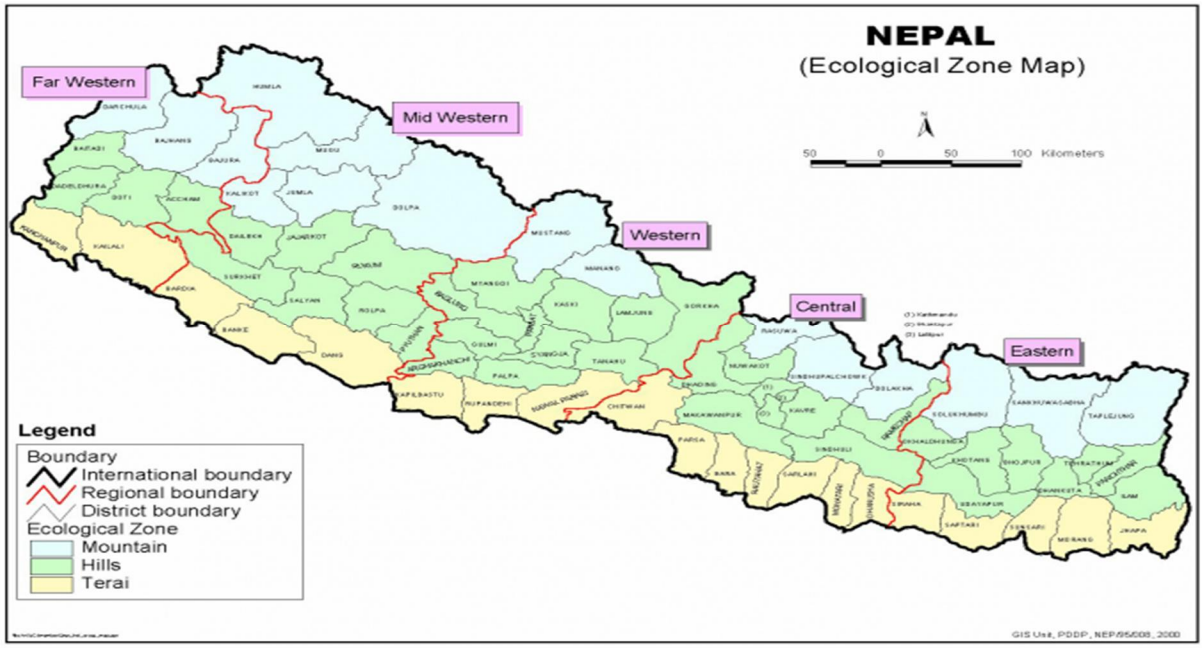


Fig. 2: Political map of Nepal

Source: Downloaded from reliefweb.int/map/Nepal/Nepal-ecological-zone-map 2000

4.2. Data source

The present data is based on Nepalese Demographic and Health Surveys carried out in 2001, 2006 and 2011. Demographic and Health Surveys are nationally- representative household surveys that provide data for a wide range of monitoring and impact evaluation indicators in the areas of population, health and Nutrition. These surveys are similar to the surveys conducted in other developing countries therefore it is affordable to national and international comparisons. All the surveys conducted in every five years, which are the part of worldwide DHS programme, are comparable from the earlier DHS surveys in Nepal.

For the sampling methods, Nepal was divided into three horizontal ecological zones, namely Mountain, Hill and Terai and vertically into five development regions. The cross section of these ecological zones and development regions makes a total of 15 eco-development regions. However, due to population size in mountain region, far western,

mid-western and western combined into one domain making a total of 13 domains. An enumeration area is defined as ward in rural area where as sub ward in urban area. These domains were stratified using urban and rural areas. All the three surveys used the same urban- rural stratification creating 25 sampling strata. However there are no urban areas in far western, mid-western and western development regions. Samples were selected independently in each stratum in two-stage selection. In the first case, enumeration area was selected using probability-proportional-to-size strategy and in each domain resulting 95 urban and 194 rural enumeration areas. The second phase consisting 35 households in each urban enumeration area and 40 households in each rural household due to non-proportional allocation of samples to different domains. Two-stage stratified cluster sample was calculated based on sampling properties for each sampling stage. Ethical clearance for the survey was received from Nepal Health Research Council. Informed verbal consent was obtained from all the interviewees prior to the interview (NDHS 2011 & Nepal Health Research Council).

4.3. Study population

The total number of participants was different in each of the surveys: in 2011 sample size was 10,826 households. This includes both men and women from 15 -49 years of age. The total number of women participants was 12,674 and sample size of men was 4121. Likewise in 2006 total households were 8707 that includes both men and women from age 15 – 49 years and men 15 -59 years. Sample size of female was 10793 and male 4397.Similarly respondents for 2001 was 8602 households where the total of 8726 female participants with age in between 15 to 49 years and 2261 male participants of age in between 15 to 59 years of age. Similarly mothers were interviewed about their children nutritional status and food-eating behavior. In 2001 there were 8726 children, in 2006 there were 10,793 children and in 2011 total of 12,674 children under 5 years of old whose mother answered about their children's food eating and nutritional status. In this study children were the last child of the women aged 5 years of old or younger.

Response rates of the survey are very high with 99% in 2011. Among the selected eligible male response rate was 95% and the female was 98%. Likewise in 2006 the household response rate was nearly 100% and individual response rate of eligible male and female was 98% and 96% respectively. In 2001, figures are similar to that of 2006.

Three types of questionnaires were administered in all health surveys: The household questionnaire, women´s questionnaire and men´s questionnaire. These questionnaires were adapted from the standard DHS6 core questionnaire, which is standard questionnaire used in all measure DHS surveys. It includes major basic demographic and health topics however it has also been modified according the need for special information on the topics that are not covered by the core questionnaires to reflect the population and health issues relevant to Nepal. The present study is primarily focused on women´s questionnaire and some background information from the household questionnaire. These data elaborates primarily in relation to maternal &child health and feeding practices. All the questionnaires were finalized after pretesting.

4.4. Description of study variables

In this thesis the outcome variables of the study includes vitamin A intake and iron from food as well as supplement for both mothers and children under 5 years of age. Similarly for children it includes Vitamin A intake from Food, vitamin A capsule supplementation, Iron intake from food and iron as a supplement for children. Likewise for mothers' vitamin A intake from food, vitamins A after 2 months of delivery, iron from food intake and iron tablet supplement during pregnancy were included.

The DHS questionnaires used to measure the outcome of the variable were the following.

a) Did (NAME) receive a vitamin A capsule during the event in Kartik/ Baishak?
b) In the last seven days, was (NAME) given VITA MISHRAN or iron syrup like (this / any of these?)

c) Did (NAME) eat/ drink the following had yesterday or at night?

Plain water, juice or juice drink, Milk and how many times/ types, liquids, yogurts, any fortified baby food, grain foods, vitamin A foods, dark green leafy vegetables, ripen fruits, fruits and vegetables, liver, kidney, any meat of lamb, pork, buff, goat, duck etc. fresh or dried fish, selfish, foods from beans, peas, lentils, nuts, cheese, milk, solid, semi-solid or soft foods e.g. Jaulo, lito, sarbottam pitho etc.

Likewise in this study, the demographic variables studies include the following.

- Age of mother and children
- Marital status
- Place of residence
- Ecological zone
- Development region
- Mother's education
- Wealth index
- Duration of breastfeeding
- Smoking status of mother

Demographic variables were recoded and then categorized according to the required method to facilitate the analytical process. Religion was categorized into two: Hindu and others. Mother's highest level of education was divided into four categories. No education, primary level, secondary level and higher education. Wealth index was categorized into poorest, poorer, middle, richer and richest. Place of residence as urban rural. Current age of child is categorized into 2 different categories: 0-1 month and 2 – 33 months likewise age of mother was divided into seven different categories. 15-19 years and 20 – 24 years, 25-29 years, 30- 34 years, 35- 39 years, 40-44 years, and 45- 49 years. The variables such as child given meat, child given vitamin A containing foods, child given vitamin A capsule, iron from supplement for child, mothers smoking status, marital

status of mother, mother given iron folic tablets during pregnancy, mother's breastfeeding status, mother given Vitamin A tablets in the first 2 months of delivery were all categorized into 'yes' and 'no' category. Similarly the following outcome variables were derived to measure the intake of vitamin A and Iron intake in Nepalese mothers their children under the age group of 5 years.

To measure the iron and vitamin A intake in mothers and children under five years old following outcome variables were considered.

For children	**For Mothers**
a) Vitamin A intake from Food,	a) Vitamin A intake from food
b) Vitamin A capsule,	b) Vitamin A after 2 months of delivery
c) Iron from Food (meat)&	c) Iron from food (meat)
d) Iron from supplement	d) Iron tablet during pregnancy

Vitamin A from foods was defined as consumption of meat (and organ meat), fish poultry, eggs, pumpkin, red or yellow yams or squash, carrots, red sweet potatoes, dark green leafy vegetables, mangoes, papayas and other locally grown fruits and vegetables that are rich of vitamin A. Iron intake from food was defined as meat consumption. Iron intake from supplements was defined as the intake of folic acid tablet by the mother Similarly variables such as religion, place of residence, and smoking status of mother, wealth index etc. to access the socioeconomic and socio demographic determinants of the mothers along with the predictors with change in micronutrient intake. Supplementation is considered as the additional intake. For the children vitamin A capsule was used for vitamin A supplement and intake of folic acid tablets as iron supplement to mothers.

Table 2: Operational definition of variables and their coding

Variables	**Description**	**Coding**
Region	Total regions of Nepal as described in domain	1 = Eastern, 2 = Central, 3 = western, 4 = Mid-western, 5 = far western.
Religion	Religion of the respondents. Other refers Buddhists, Christian, Muslims, Kirants etc.	0 = others, 1 = Hindu
Mother's highest level of education.	Mothers education level at the time of Interview.	0 = No education, 1 = Primary education, 2 = Secondary education, 3 = Higher.
Wealth Index	Households commulative income.	1= Poor, 2 = Poorer, 3 = Middle, 4 = Richer, 5 = Richest.
Place of residence.	Residents at the time of interview.	1 = Rural, 2 = Urban
Current age of child.	Respondents age of children.	1 = 0-1 month, 2 = 2- 33 months.
Tobacco smoking.	Smoking any form of tobacco.	0 = no, 1 = yes
Children ever breastefeed.	Children if breastfeed	0 = no, 1 = yes
Current age of mother.	Respondents age at the time of interview	1 = 15- 19 years, 2 = 20- 24 years, 3 = 25- 29 years, 4 = 30- 34 years, 5 = 35- 39 years, 6 = 40- 44 years, 7 = 45- 49 years

Children vitamin A intake from food.	Vitamin A intake mainly from green leafy vegetables, yellow fruits, fish, poultry eggs, pumpkin, red or yellow yams or squash etc.	0 = no, 1 = yes
Children iron intake from food.	Meat intake from poultry, goat, pork, buffalo etc.	0 = no, 1 = yes
Vitamin A capsule for children.	Supplement tablets distributed freely and also during national vitamin A programme twice a year.	0 = no, 1 = yes
Mothers' vitamin A from food.	Vitamin A intake mainly from green leafy vegetables, yellow fruits, fish, poultry eggs, pumpkin, red or yellow yams or squash etc.	0 = no, 1 = yes
Iron Intake from food for mothers	Meat intake from poultry, goat, pork, buffalo etc.	0 = no, 1 = yes
Vitamin A after 2 months of delivery.	Mother's vitamin A intake after 2 months of delivery given as a postpartum supplement.	0 = no, 1 = yes
Iron tablet during pregnancy.	Iron tablet distributed freely to the pregnant mothers as a supplement.	0 = no, 1 = yes

4.5. Data analysis

Analysis was done to look at the current micronutrient status of mother and children. The cross tabulation with socio demographic variables were done to look at the micronutrient intake in mothers and their children, changes over time and determinants. The socioeconomic and socio demographic variables responsible for the intake of iron and vitamin A intake in mothers and children under the age of 5 years were also observed. Cross tabulation with odds ratio (OR) and P- values demonstrated the frequency, significance and association of the socio economic and socio demographic variables in different survey years. In the second phase the socioeconomic and socio demographic variables in association with the outcome variables of iron and vitamin A intake were merged as add cases in the statistical software.

Simple frequencies and Pearson's chi square test were used for descriptive analysis. To examine the relation of the demographic characteristics to the intake of vitamin A and iron, multilevel logistic regression was used due to clustered nature of the data. The individual level was used as level 1and the sampling cluster was used as level 2. In the multilevel model, the survey data for the three years were pooled together. Two multilevel logistic regression models were fitted for each outcome: the first model was bivariate model in which each demographic was studied in relation to each outcome. In the second model, the demographic variables that achieved as p- value of ≤ 0.25 in the first model were simultaneously adjusted in relation to each outcome. Both in the unadjusted and adjusted model year of survey were included as covariate. Odds ratio and their corresponding 95% confidence interval are reported for multilevel logistic regression results. Statistical significance was set at $p \leq 0.05$. SPSS version 17 was primarily used for descriptive analysis while the adds-on programme GLLAMM in STATA 11was used for multilevel modeling.

5. RESULTS

Table 3 shows the characteristics of the study population by year. According to the result, association of the socio demographic variables with covariate years is highly associated with most demographic variables ($p < 0.001$). The following socio economic and socio demographic variables such as region, religion, mother's highest level of education, wealth index, place of residence, current age of children, mother's tobacco smoking status and mothers' current age were highly significant ($p < 0.001$) whereas 'children ever breastfeed' was statistically insignificant ($p = 0.482$) in all 2001, 2006 and 2011 survey years. No information available for the association with quintile of wealth index in the year 2001 and marital status of the mother in 2001and 2011 survey years.

The following table also explains that there are significant changes in the period of 10 years (2001- 2011). Many socio demographic and socioeconomic changes were taken place during the time frame. Central development region was the densely populated region whereas far western development region was least populated. Looking at the change in the time frame of 10 years, central and western development regions are the two having highest number of population and total numbers of inhabitants were significantly increased from 2001 to 2011. Between the two, central development region was the highest in terms of population as well as the in total number of population difference in last 10 years of time. Similarly educated mothers were also increased during this time frame with significant decrease in total number of uneducated mothers. Mothers with secondary and higher level of education were significantly increased as compared to the mothers having primary level of education. Likewise, more than double increased the mothers living in urban areas and decreased by one eighth in rural mothers. It is statistically significant. Smoking status of mother was also very interesting to look at. Smoking mothers were decreased by almost half from 2001to 2011 and non-smoking mothers were also significantly increased by almost one fifth in time period of 10 years. It was also high statistical significance.

Table 3: Characteristics of the study population by year of survey

Determinants	**2001 (N= 8726)**	**2006 (N= 10,793)**	**2011 (N= 12,674)**	**Total**
Region				
Eastern	2068 (23.7%)	2529 (23.4%)	2033 (16.0%)	**6630(20.6%)**
Central	2392 (27.4%)	2739 (25.4%)	4974 (39.2%)	**10105(31.4%)**
Western	1556 (17.8%)	2105 (19.5%)	1315 (23.2%)	**4976 (20.2%)**
Mid western	1142 (13.1%)	1691 (15.7%)	663 (11.7%)	**3496 (14.5%)**
Far western	1568 (18%)	1729 (16.0%)	555 (9.8%)	**3852 (11.3%)**
Religion				
Others	1241 (27.4%)	1444(31.3%)	1845 (14.6%)	**4530 (14.1%)**
Hindu	7485 (85.8%)	9348 (86.6%)	10829(85.4%)	**27662(85.9%)**
Highest level of Education	6269 (71.8%)	5677 (52.6%)	4877(38.5%)	**16823(52.3%)**
No Education	1724(14.6%)	1908 (17.7%)	2149(17.0%)	**5331(16.6%)**
Primary	1071(12.3%)	2727 (25.3%)	4584(36.2%)	**8382 (26.0%)**
Secondary	112(1.3%)	481 (4.5%)	1064(8.4%)	**1657 (5.1%)**
Higher				
[1]**Wealth Index**				
Poorest		2207(20.4%)	2446(19.3%)	**4653 (19.8%)**
Poorer		2005(18.6%)	2296(18.1%)	**4301 (18.3%)**
Middle		1974(18.3%)	2336(18.4%)	**4310 (18.4%)**
Richer		2267(21.0%)	2516(19.9%)	**4783 (20.4%)**
Richest		2340(21.7%)	3080(24.3%)	**5420 (23.1%)**
Place of residence	1154 (13.2%)	2949 (27.3%)	3701 (29.2%)	**7804 (24.2%)**
Urban	7572 (86.8%)	7844 (72.7%)	8973 (70.8%)	**24389(75.8%)**
Rural				

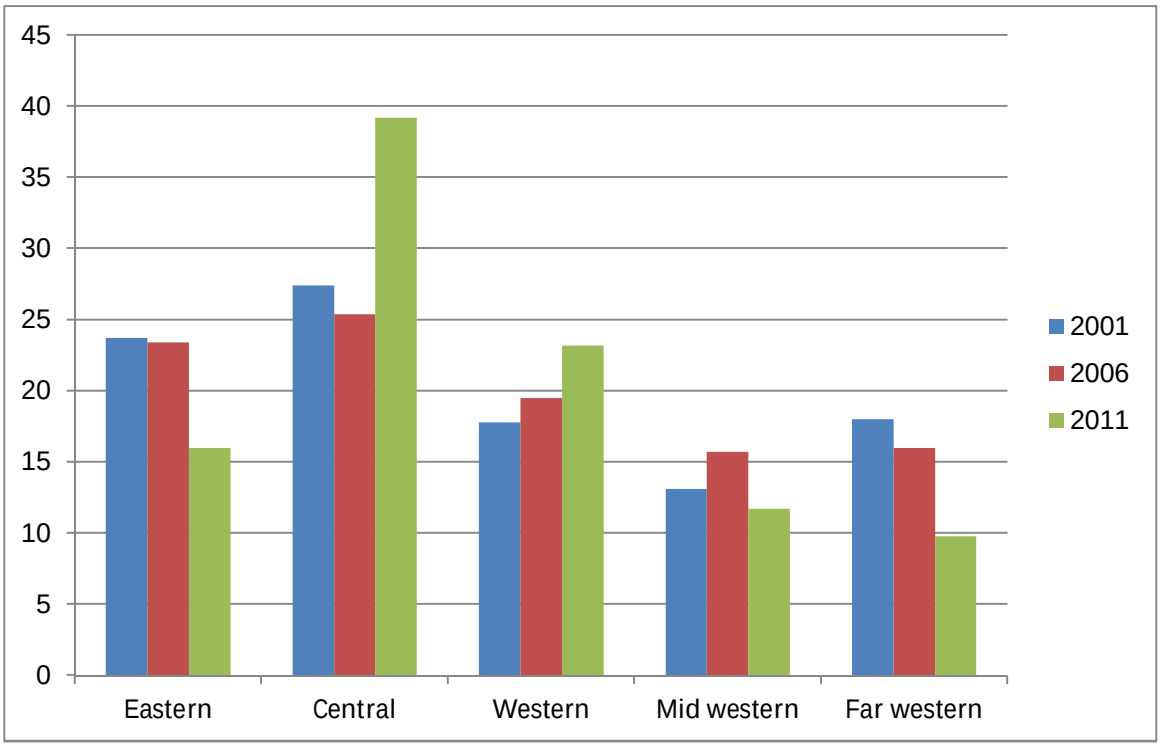
[1] Wealth Index was not measured in 2001.

Current age of children *0 –1 month* *2 – 33 months*	2510 (34.2%) 4824 (65.8%)	2018 (31.3%) 5429 (72.9%)	1918 (22.5%) 6601 (77.5%)	**6646 (27.7%)** **16854(72.3%)**
Tobacco Smoking *No* *Yes*	6196 (71.0%) 2530 (29.0%)	8639 (80%) 2154 (20%)	10886(85.9%) 1788 (14.1%)	**25721(79.9%)** **6472 (20.1%)**
Children ever breastfeed *No* *Yes*	[2]	40 (1.3%) 3150 (98.7%)	59 (1.4%) 4020 (98.6%)	**99 (1.4%)** **7170 (98.6%)**
[3] **Current marital status** *Not married* *Married at least once*		8244 (95.4%) 396(4.6%)		**8224 (95.4%)** **396 (4.6%)**
Current age of Mother *15- 19 years* *20- 24 years* *25- 29 years* *30- 34 years* *35- 39 years* *40- 44 years* *45- 49 years*	916 (10.5%) 1651 (18.9%) 1646 (18.9%) 1458 (16.7%) 1184 (13.6%) 1021 (11.7%) 850 (9.7%)	2437 (22.6%) 2042 (18.9%) 1770 (16.4%) 1331 (12.3%) 1249 (11.6%) 1097 (10.2%) 867 (8.0%)	2790 (22%) 2281 (18%) 2129 (16.8%) 1697 (13.4%) 1561 (12.3%) 1266 (10.0%) 950 (7.5%)	**6143 (19.1%)** **5974 (18.6%)** **5545 (17.2%)** **4486 (13.9%)** **3994 (12.4%)** **3384 (10.5%)** **2667 (8.3%)**

[2] Data not available

[3]Data not available for 2001 and 2011

Fig. 3: Total number population in five development regions of Nepal from 2001 to 2011 (P <0.001)



Micronutrient intake among Nepalese mothers and children from 2001 to 2011

Table 4 shows the current status and changes over time period of micronutrient intake in mothers and children. There are missing information of some of the demographic variables in various survey years. For e.g. Mothers vitamin A intake from food as well as iron intake from food was not available in 2011 but information was also not available for mothers' iron intake also in 2001. Similarly information was also not available for mothers' iron tablet supplementation during pregnancy in 2001. In case of children, information was missing on iron tablet supplementation in both two consecutive survey years 2001 and 2006. Likewise information on mothers' vitamin A from food was available only for two survey years 2001 and 2006 and iron tablet supplementation

during pregnancy for the survey years 2006 and 2011. All the variables were highly significant at statistical significance of $p \leq 0.05$.

Results show that mothers' vitamin A intake from food was significantly increased by four times in 2006 as compared to 2001 and the supplementation of vitamin A after two months of delivery was increased by more than 3 times in 2011 as compared to 2001. Similarly iron tablet supplementation for was also increased significantly in the year 2011. Overall significant positive improvement was seen in mothers' vitamin A intake form food as well as vitamin A and iron supplementation. Likewise children vitamin A intake from food was decreased by almost half and iron intake from food was significantly reduced by almost 4 times from 2001 to 2011. Vitamin A supplementation was also significantly decreased from 2001 to 2011 however the rate of decrement is comparatively slower than the other two outcome variables. Overall significant decrease in intake of both iron and vitamin A was seen from 2001 to 2011.

[4]**Table 4:** Intake of vitamin A and iron among Nepalese children and mothers (2001-2011)

	Mothers			
	(N= 8,726)	**(N=10,793)**	**(N= 12,674)**	**p-value**
Vitamin A from foods	1841(21.1%)	2158(74.1%)	NA	<0.001
Iron from foods (meat)	NA	559(19.2%)	NA	<0.001
Iron tab during pregnancy (Supplement)	NA	2385(57.0%)	3261(80.0%)	<0.001
Vitamin A supplement 2 months after delivery (Supplement)	533(11.3%)	1151(27.6%)	1767(43.5%)	<0.001

[4]Data source: NDHS 2001, 2006 & 2011

[5]Children				
Factors	**2001 (N= 5592)**	**2006 (N= 7448)**	**2011 (N= 8519)**	**[6]p- value**
Vitamin A from foods	1868(100%)	1527(52.5%)	1050(54.8%)	<0.001
Iron from food (meat)	507(42.1%)	369(12.7%)	213(11.1%)	<0.001
Vitamin A supplement (Capsule)	3396(82.5%)	3075(83.0%)	3026(76.7%)	<0.001
Iron supplement	NA	NA	88(2.2%)	<0.001

Socio demographic determinants of Vitamin A and Iron intake

The following table shows the result of unadjusted and adjusted variables with outcome variables and other socio economic and socio demographic variables. The outcome variables were statistically computed to calculate p-value, Odds ratio and confidence interval for both children and mothers. However due to lack of data, iron supplementation of children (2001 & 2006) and mothers iron intake from food (2001 & 2011) were not computed.

Table 5 shows the unadjusted and adjusted relationship between maternal and child demographic characteristics and consumption of foods rich in vitamin A. The question on consumption of foods rich in vitamin A was asked only in the 2006 and 2011 surveys but not in 2001. After simultaneous adjustment for the variables that achieved p-value of <=0.25 in the unadjusted, the results showed that the consumption of foods rich in vitamin A increased in 2011 than in 2006. Compared to the Eastern region, consumption

[5] Total no. of children under five (youngest one in the family under 5 years old)

[6]It shows the significant change in intake of vitamin A and iron throughout the study period (2001-2011).

of foods rich in vitamin A was lower in the Western and Far Western regions, but not in other regions. Compared to no education, children of mothers who had secondary education were more likely to consume foods rich in vitamin A. Likewise, maternal smoking and increasing maternal age increased the likelihood of consumption of foods rich in vitamin A. Older infants were more likely to consumed foods rich in vitamin A. religion, wealth index, place of residence (urban or rural), and breastfeeding status of the child did not statistically significantly influence consumption of foods rich in vitamin A

Table 5: Determinants of consumption of foods rich in Vitamin A among Nepalese children in 2006 and 2011.

Determinants	**Unadjusted**	**Adjusted**
Year	**p= 0.079**	**p<0.001**
2006	1	
2011	1.11(0.98-1.26)	1.70(1.44-2.01)
Region	**p<0.001**	**p =0.0012**
Eastern	1	1
Central	0.88(0.73-1.07)	0.94(0.77-1.16)
Western	0.58(0.47-0.71)	0.72(0.58-0.89)
Mid western	1.17(0.90-1.52)	1.10(0.83-1.47)
Far Western	0.98 (0.76-1.27)	0.73(0.55-0-96)
Religion	**p= 0.347**	
Others	1	
Hindu	0.92(0.77-1.09)	
Mother's highest level of education	**p= 0.014**	**p=0.005**
No education	1	1
Primary	0.76(0.65-0.88)	1.05(0.88-1.25)
Secondary	0.83(0.72-0.95)	1.37(1.14-1.64)
Higher	0.88(0.66-1.17)	1.36(0.97-1.91)
Wealthindex	**p = 0.0002**	**p =0.056**
Poor	1	1
Poorer	1.07(0.89-1.28)	1.10(0.91-1.33)
Middle	1.12(0.92-1.35)	1.12(0.91-1.38)
Richer	1.04(0.85-1.26)	1.01(0.81-1.27)
Richest	1.59(1.29-1.97)	1.42(1.08-1.88)

Place of residence	**p = 0.008**	**p = 0.583**
Urban	1	1
Rural	1.23(1.05-1.45)	0.94(0.78-1.14)
Current age of child	**p <0.001**	**p 0.001**
0-1 month	1	1
2-33 months	3.73(3.20-4.35)	3.50(2.88-4.25)
Tobacco smoking	**p <0.001**	**p =0.031**
No	1	1
Yes	1.46(1.26-1.70)	1.23(1.01-1.48)
Children ever breastfeed	**p = 0.205**	**p =0.500**
No	1	1
Yes	0.51(0.18-1.43)	1.57(0.42-5.87)
Current age of mothers	**p <0.001**	**p =0.008**
15-19yrs	1	1
20-24yrs	1.49(1.25-1.79)	1.39(1.13-1.72)
25-29yrs	1.72(1.42-2.07)	1.42(1.13-1.77)
30-34yrs	2.07(1.66-2.58)	1.50(1.15-1.95)
35-39yrs	1.98 (1.53-2.57)	1.59(1.16-2.19)
40-44yrs	2.28(1.52-3.42)	1.49(0.91-2.43)
45-49yrs	7.28(2.79-18.96)	4.05(1.42-11.55)

Table 6 shows the results of the determinants of consumption of foods rich in iron. Unfortunately, only the consumption of meat (and not other foods) was used to estimate the consumption of foods rich in iron, therefore, this could lead to underestimate the actual situation in the country as people may receive iron from other food sources than meat. The simultaneous adjustment for the variables that achieved p value of <= 0.25 in the unadjusted, The results showed that in comparison to 2001, intake of iron from food decreased significantly in 2006 and 2011. As compared to the eastern region, consumption of iron in food or that is to say the consumption of meat was lower in western and far western region however not that much in rest of the regions. Compared to no education, mothers who had primary level of education were more likely to consume iron-containing foods. There is not much statistical difference in between mothers with secondary and higher level of education. Likewise older infant were more likely to consume iron-containing foods. Increasing maternal age was more likelihood of increased consumption of iron containing foods however there is not much statistical difference in between the mothers of age group in between 35- 39 years and 40-44 years. Religion, wealth index, place of residence (Urban or rural), mothers' tobacco smoking and breastfeeding status of child did not statistically influence consumption of iron intake in food.

Table 6: Determinants of intake of vitamin A supplement (i.e. in the form of capsules) among Nepalese children in 2001, 2006 and 2011.

Iron from Food	**Unadjusted**	**Adjusted**
Year	**p <0.001**	**p <0.001**
2001	1	1
2006	0.19(0.16-0.23)	0.19(0.16-023)
2011	0.16(0.13-0.20)	0.18(0.14-0.22)

Region	**p = 0.0003**	**p = 0.061**
Eastern	1	1
Central	0.70(0.55-0.90)	0.91(0.71-1.16)
Western	0.58(0.44-0.75)	0.82(0.63-1.07)
Mid western	0.98(0.70-1.38)	0.87(0.62-1.22)
Western	0.66(0.46-0.95)	0.59(0.42-0-84)
Religion	**p = 0.002**	**p =0.012**
Others	1	1
Hindu	0.72(0.59-0.88)	0.76(0.62-0.94)
Mother's highest level of education	**p = 0.061**	**p = 0.001**
No education	1	1
Primary	1.10(0.91-1.32)	1.39(1.14-1.69)
Secondary	0.93(0.78-1.12)	1.38(1.13-1.68)
Higher	0.64(0.43-0.95)	1.12(0.74-1.70)
Place of residence	**p = 0.559**	
Urban	1	
Rural	1.06(0.86-1.30)	
Current age of child	**p <0.001**	**p <0.001**
0-1 month	1	1
2-33 months	2.05(1.76-2.39)	1.56(1.32-1.86)
Tobacco smoking	**p = 0.006**	**p = 0.252**
No	1	1
Yes	1.28(1.07-1.54)	1.12(0.92-1.36)

Children ever breastfeed	**p =0.528**	
No	1	
Yes	0.65(0.17-2.42)	
Current age of mothers	**p = 0.756**	
15-19yrs	1	
20-24yrs	1.13(0.89-1.44)	
25-29yrs	1.07(0.83-1.38)	
30-34yrs	1.18(0.89-1.57)	
35-39yrs	1.11(0.79-1.56)	
40-44yrs	0.94(0.56-1.57)	
45-49yrs	1.69(0.76-3.76)	

Determinants of vitamin A supplements from capsule in Nepalese children

Table 7 describes the unadjusted and adjusted relationship between children vitamin A supplement. Supplement to children are measured from the intake of capsule distributed freely to the children under the age of five. After simultaneous adjustment of the variables that achieved the p value of < = 0.25 in the unadjusted, the result showed that the consumption of vitamin A capsule was decreased from 2001 to 2011. Likewise children in the western development region and central development regions consumed comparatively lower intake of vitamin A capsule however comparatively higher in mid-western development region. Mothers who had primary level of education was more likely to supplement their children with vitamin A capsule as compared to no education however there is not that high statistical difference in between secondary and higher level of education. Interestingly older infants were 12 times more likely to supplement vitamin A capsule as compared to younger adults. Similarly increased maternal age was more

likelihood of increased supplement capsule to their children, as compared to younger mothers however there is no statistical difference between the mothers' age in between the age groups of 35-39 years and 40-44years. Religion, wealth index, place of residence, mothers smoking status, breastfeeding status of the child did not statistically influence the supplementation of vitamin A capsules in children.

Table 7: Determinants of vitamin A capsule supplementation among Nepalese children in 2001, 2006 and 2011.

Child/ Vitamin A supplements from capsule	**Unadjusted**	**Adjusted**
Year	**p <0.001**	**p <0.001**
2001	1	1
2006	1.02(0.91-1.16)	0.89(0.78-1.02)
2011	0.68(0.60-0.76)	0.62(0.54-0.72)
Region	**p <0.001**	**p <0.001**
Eastern	1	**1**
Central	0.80(0.68-0.93)	0.78(0.66-0-92)
Western	0.73(0.62-0.86)	0.73(0.61-0.87)
Mid western	1.48(1.17-1.86)	1.35(1.05-1.72)
Western	0.98(0.80-1.21)	0.91(0.73-1.14)
Religion	**p = 0.205**	**p = 0.510**
Others	1	1
Hindu	1.09(0.95-1.25)	1.05(0.90-1.22)

Mother's highest level of Education	**p = 0.003**	**p = 0.049**
No education	1	1
Primary	0.92(0.81-1.05)	1.14(0.99-1.33)
Secondary	0.85(0.75-0.96)	1.20(1.04-1.39)
Higher	0.68(0.53-0.86)	1.00(0.77-1.32)
Place of residence	**p = 0.281**	
Urban	1	
Rural	1.07(0.94-1.22)	
Current age of child	**p <0.001**	**p =<0.001**
0-1month	1	1
2-33 months	13.19(11.43-15.22)	12.77(11.03-14.09)
Tobacco smoking	**p <0.001**	**p =0.834**
No	1	1
Yes	1.31(1.16-1.49)	1.01(0.87-1.17)
Current age of mothers	**p <0.001**	**p <0.001**
15-19yrs	1	1
20-24yrs	1.71(1.44-2.02)	1.26(1.05-1.51)
25-29yrs	2.53(2.13-3.01)	1.46(1.21-1.76)
30-34yrs	2.90(2.39-3.52)	1.43(1.15-1.77)
35-39yrs	4.02(3.16-5.10)	1.90(1.46-2.49)
40-44yrs	5.32(3.77-7.50)	1.90(1.30-2.78)
45-49yrs	7.34(3.89-13.85)	2.18(1.09-4.35)

Table 8 shows the unadjusted and adjusted relationship between maternal and child demographic characteristics and consumption of foods rich in vitamin A. The question on consumption of foods rich n vitamin A to the mothers was asked only in 2001 and 2006 surveys but not in 2011. It was simultaneously adjusted with the variables that achieved p value of < = 0.25 in the unadjusted. The result on adjustment showed that the consumption of vitamin A foods was likely to increase by 5 times in 2006 as compared to 2001. Children in western and far western development regions are more likely to consume vitamin A rich foods as compared to the mothers in other regions however mothers in mid-western region are likely to consume more than the eastern development region. As compared to mothers with no education, mothers with higher education are more likely to consume vitamin A rich foods. Likewise mothers with younger infants are likely to consume twice as much as the mother with older infants. Similarly older age groups of mothers are more likely to consume vitamin A rich foods as compared to the younger groups. Religion, wealth index place of residence (urban or rural), smoking status of mother, breastfeeding mother did not statistically significantly influence the consumption of vitamin A rich foods.

Table 8: Determinants of consumption of food rich in vitamin A among Nepalese mother in 2001 and 2006

	Unadjusted	**Adjusted**
Year	**p <0.001**	**p =<0.001**
2001	1	1
2006	11.63(10.47-12.91)	5.75(5.13-6.43)
Region	**p = 0.030**	**p =0.0004**
Eastern	1	**1**
Central	0.88(0.72-1.07)	0.81(0.67-0.99)
Western	0.84(0.67-1.05)	0.65(0.52-0.82)

Mid western	1.19(0.94-1.52)	0.77(0.61-0.97)
Western	0.85(0.67-1.07)	0.64(0.50-0-80)
Religion	**p = 0.351**	
Others	1	
Hindu (1)	0.93(0.82-1.07)	
Mother's highest level of education	**p <0.001**	**p = 0.0009**
No education	1	1
Primary	1.61(1.43-1.80)	1.12(0.98-1.29)
Secondary	2.15(1.91-2.43)	1.18(1.01-1.37)
Higher	3.70(2.74-4.99)	2.04(1.38-3.00)
Place of residence	**p <0.001**	**p = 0.461**
Urban	1	1
Rural	0.42(0.35-0.51)	0.93(0.78-1.11)
Current age of child	**p <0.001**	**p <0.001**
0-1 month	1	1
2-33 months	0.21(0.20-0.24)	0.46(0.41-0.51)
Tobacco Smoking	**p <0.001**	**p = 0.011**
No	1	1
Yes	0.61(0.55-0.67)	1.17(1.03-1.32)
Children ever breastfeed	**p = 0.592**	
No	1	
Yes	1.42(0.38-5.21)	

Current age of mothers	**p <0.001**	**p <0.001**
15-20yrs	1	1
20-24yrs	2.32(2.00-2.68)	1.06(0.87-1.30)
25-29yrs	1.87(1.61-2.18)	0.94(0.76-1.15)
30-34yrs	1.01(0.85-1.18)	0.65(0.52-0.81)
35-39yrs	0.58(0.48-0.69)	0.40(0.32-0-52)
40-44yrs	0.23(0.18-0.30)	0.21(0.16-0.29)
45-49yrs	0.09(0.064-0.13)	0.10(0.69-0.15)

The following table 9 shows the unadjusted and adjusted relationship between the maternal and child demographic characteristics and Iron tablet supplementation during pregnancy. The question on supplementation of iron tablet during pregnancy was asked in 2006 and 2011 survey but not in 2001 survey. The outcome variable was simultaneously adjusted for the variable that achieved the p value <= 0.25 in the unadjusted. The result on adjustment shows that the iron tablet supplementation was significantly increased in 2011 as compared to 2006. Likewise mothers in far western and mid-western development regions are the ones who were supplemented the least as compared to the eastern development region but not in all other regions. Mothers with higher level of education were supplemented most as compared to mothers with no education. Mothers belonging to richest group in the wealth index factor were likely to supplement more as compared to the mother in poor index factor. Likewise, younger age groups of mothers are more likely to supplement with iron tablet as compared to older age groups. Religion, place of residence, smoking status of mother and breastfeeding status did not significantly influence the iron tablet supplementation in mothers'.

Table 9: Determinants of intake of iron supplement (in terms of tablet) during pregnancy among Nepalese children in 2001, 2006 and 2011

Determinants	**Unadjusted**	**Adjusted**
Year	**p <0.001**	**p <0.001**
2006	1	1
2011	3.86(3.42- 4.34)	**3.13(2.67-3.67)**
Region	**p <0.001**	**p =0.0001**
Eastern	1	1
Central	1.77(1.44-2.17)	1.14(0.92-1.41)
Western	1.82(1.45-2.28)	0.83(0.66-1.06)
Mid western	0.35(0.26-0.46)	0.65(0.48-0.88)
Western	0.28(0.21-0.38)	0.70(0.51-0.97)
Religion	**p = 0.003**	**p = 0.013**
Others	1	1
Hindu	1.27(1.08-1.50)	1.25(1.04-1.50)
Mother's highest level of education	**p <0.001**	**p <0.001**
No education	1	1
Primary	2.40(2.08-2.77)	1.55(1.32-1.82)
Secondary	6.35(5.39-7.47)	2.89(2.39-3.50)
Higher	14.94(21.99-91.85)	14.85(7.12-30.98)
Wealth index	**p <0.001**	**p <0.001**
Poor	1	1
Poorer	1.73(1.49-2.02)	1.59(1.34-1.89)
Middle	2.77(2.34-3.28)	2.18(1.80-2.64)

Richer	3.93(3.27-4.73)	2.67(2.15-3.31)
Richest	7.23(5.80-9.01)	3.23(2.45-4.27)
Place of residence	**p <0.001**	**p = 0.895**
Urban	1	1
Rural	0.56(0.47-0.66)	0.98(0.81-1.20)
Child current age	**p <0.001**	**p <0.001**
0-1 month	1	1
2-33 months	0.53(0.48-0.59)	0.56(0.49-0.63)
Tobacco smoking	**p <0.001**	**p <0.001**
No	1	1
Yes	0.27(0.24-0.31)	0.56(0.48-0.66)
Children ever breastfeed	**p = 0.425**	
No	1	
Yes	1.20(0.75-1.93)	
Current age of mothers	**p < 0.001**	**p <0.001**
15-19yrs	1	1
20-24yrs	0.78(0.62-0.98)	0.94(0.73-1.21)
25-29yrs	0.65(0.52-0.82)	0.90(0.69-1.16)
30-34yrs	0.42(0.33-0-53)	0.69(0.53-0.91)
35-39yrs	0.28(0.21-0-36)	0.67(0.49-0.91)
40-44yrs	0.14(0.10-0.20)	0.38(0.26-0.55)
45-49yrs	0.86(0.05-0.14)	0.28(0.15-0.50)

Table 10 shows the unadjusted and adjusted between maternal and child demographic characteristics and consumption of food rich in vitamin A. After simultaneous adjustment of the variables that achieved the p value of <= 0.25 in the unadjusted, the result showed that the mothers receiving vitamin A dose after first 2 months of delivery was significantly increased in the preceding survey years i.e. from 2001 to 2011. Likewise, western and far western women's are less likely to get the vitamin A dose as compared to eastern development region. As compared to no educated mothers; mothers with higher level of education are more likely to get the dose after 2 months of delivery. Similarly mothers having younger child are more likelihood of getting vitamin A dose as compared to the mothers with older children. Younger mothers are also more likely to get vitamin A dose as compared to older mothers. Religion, Wealth index, place of residence, tobacco smoking and mothers' breastfeeding status did not statistically significantly influence supplementation of vitamin A dose after first 2 months of delivery.

Table 10: Determinants of receipt of vitamin A dose after first 2 months of delivery among Nepalese children in 2001, 2006, 2011

	Unadjusted	**Adjusted**
Year	**p <0.001**	**p <0.001**
2001	1	1
2006	3.26(2.89-3.68)	3.01(2.65-3.42)
2011	7.36(6.50-8.35)	5.79(4.99-6.71)
Region	**p <0.001**	**p <0.001**
Eastern	1	1
Central	1.62(1.35-1.94)	0.93(0.78-1.11)
Western	1.36(1.13-1.64)	0.67(0.55-0.80)

Mid western	0.33(0.25-0.44)	0.57(0.43-0.74)
Western	0.39(0.30-0.50)	0.92(0.72-1.18)
Religion	**p <0.001**	**p = 0.002**
Others	1	1
Hindu	1.36(1.19-1.57)	1.26(1.08-1.46)
Highest level of Education	**p <0.001**	**p <0.001**
No education	1	1
Primary	2.01(1.79-2.27)	1.51(1.33-1.72)
Secondary	4.25(3.80-4.74)	2.67(2.36-3.03)
Higher	6.36(5.13-7.88)	3.73(2.68-4.25)
Place of residence	**p <0.001**	**p = 0.804**
Urban	1	1
Rural	0.56(0.50-0.64)	0.98(0.85-1.12)
Current age of child	**p <0.001**	**p <0.001**
0-1 month	1	1
2-33 months	0.78(0.71- 0.85)	0.77(0.70-0.85)
Tobacco smoking	**p <0.001**	**p <0.001**
No	1	1
Yes	0.37(0.32-0.42)	0.63(0.54-0.72)
Current age of mothers	**p <0.001**	**p = 0.0007**
15-19yrs	1	1
20-24yrs	1.15(0.98-1.35)	1.25(1.04-1.50)

25-29yrs	0.98(0.83-1.16)	1.20(0.99-1.44)
30-34yrs	0.66(0.55-0.79)	0.98(0.80-1.21)
35-39yrs	0.57(0.46-0.71)	1.07(0.84-1.37)
40-44yrs	0.38(0.28-0.51)	0.81(0.58-1.13)
45-49yrs	0.27(0.15-0.46)	0.71(0.40-1.27)

6. DISCUSSION

6.1 Description of the main findings of the study and the objectives

The objectives of the study were to describe the current status of vitamin A and iron intake, changes over time and determinants among Nepalese mothers and children under five years of old from 2001 to 2011. The study was restricted to iron and vitamin A intake and data was extracted from Nepal demographic and Health Survey 2001, 2006 and 2011. Looking at the current micro nutrition intake of mothers, there is no information available on vitamin A intake and iron intake from foods in the year 2011. Likewise findings shows that four out of five mothers had taken iron tablet supplement during pregnancy and about two fifth of the mothers have had vitamin A supplementation after 2 months of delivery. Similarly in case of children, little more than half of the children had vitamin A rich foods and very few children; one out of ten had foods rich in iron intake. It is mostly meat or organ meat. Likewise three out of four children had vitamin A supplement in the form of capsule, which is significantly higher as compared to other variables. All the outcome variables were statistically significant at significance level of 95% confidence interval.

In the past ten years (2001- 2011), mothers' iron supplementation in the form of tablet was increased by four times and vitamin A supplementation after 2 months of delivery had increased by almost three fourth in this time frame. Likewise food rich in vitamin A intake was increased by almost four times however there is no information available for iron tablet supplementation during pregnancy in 2001 and vitamin A intake from food in 2011. Similarly children vitamin A intake from foods was reduced by almost half and iron intake from food was decreased by four times in this time period. Likewise children vitamin A supplementation in the form of capsule was also significantly decreased in the time period of 10 years. The socio demographic determinants of vitamin A and iron

intake in mothers and children under 5 years of age were mainly region of residence, mothers level or education, current age of children (age at the time of survey), mothers' tobacco smoking status and the age of mother at the time of pregnancy.

6.2 Strength and limitations

The research was primarily focused to find out the vitamin A and iron intake of mothers and children under five years of age. As it is totally based on the Demographic Health Survey data from 2001, 2006 and 2011, a national representative sample, one of the strengths of this study is that the results can be generalized to Nepalese general population. Questionnaire in the survey is very specific, approved and derived from standard core questionnaires to reflect the true issues on population and health issues. It was also pretested, translated into many different local languages to ensure the accuracy from the respondents. Response rate of all the three surveys are more than 95%, which is extremely good in the research community (NDHS 2011). With regards to the internal validity of the research, pretesting was done to measure the quality of questionnaire. The research committee, including research scientists, medical doctor, sociologists, etc., reviewed the questionnaire before survey implementation (Nepal DHS 2011). Thus, it is also comparable to the reference standard to measure the external validity of the research and has also been taken as the reference data in national health policy making. It has also been used my many national and international organizations for the interventions and to measure the national health outcome. The research in itself is new to look at the socio cultural and socio demographic variables comparing from three demographic surveys. Since previous studies assessing the trends and factors influencing the intake of micronutrients in the Nepalese population is lacking, the current study opens the opportunity for further exploration of this topic. In doing so, appropriate interventions and programmes would be effectively set up to promote better intake of micronutrients (Vitamin A and iron) in the country, particularly among mothers and children.

This study has some limitations as well. The data collection in the survey is cross sectional that cannot measure the casual relationship between the exposure and the

outcome variables studied. Similarly there can be greater possibility of recall bias as the data collection was retrospective and questionnaire formed is structured, because mothers who were interviewed might have failed to report properly the amount and types of foods consumed by them and their children. Furthermore, data were collected for the children only between the ages of 0-33 months despite the fact that it is for the children age in between 0-59 months. While intake of vitamin A from foods was derived from several foods rich in vitamin A, the intake of iron from foods was defined only from the consumption of meat or organ meat. This might have underestimated the intake of iron from foods rich in iron as those who do not consume meat but derive iron from other foods would have uncounted among those who consumed iron rich foods. Another limitation of the study is that the assessment of micronutrients and the determinants factors were not collected in all the three surveys for all the variables, hence it was impossible to study such variables across the three-survey period.

6.3 Comparison of findings with other studies

Maternal and child micronutrient intake is a serious global concern especially in the low income and middle-income countries (World Bank 2013). Studies show that Nepal is one among others where maternal and child micro nutrition intake is lower than the daily-required intake as set in WHO nutrition recommendation (WHO Nutrition 2013, FAO 2003). Researchers are very essential in this field. However, it is very limited. This field of research being new in itself to examine the socio-demographic determinants of iron and vitamin A intake, there are not many studies for comparison. According to Adhikari K. and his colleagues, as there are limited reviews in the iron deficiency situation, it requires lot of attention. In spite of the fact that there are lot many interventions going on through different national and international governmental and non-governmental organizations, mostly for young children (6-23 months) and the pregnant women; these groups are the victims and vulnerable due to their high iron requirements and lower intake of dietary iron vitamin A deficiency, hookworm infection, malaria etc. Despite this the trend has been decreasing in last 15 years (Adhikari et al 2012). Vitamin A deficiency is a root problem of malnutrition that will take many years to solve. However, in the

recent years it has been successful in combating vitamin A deficiency that they are now helping to address deworming, treat pneumonia. The distribution iron supplements to pregnant women was achieved a great success by the help of Female Community Health Volunteers in the in the particular area (Gottlieb 2012). Vitamin A programme has been effective with national overall coverage of average 87.5%. The socio demographic determinants of vitamin A intake are mainly mothers with no education, ecological and developmental regions, mothers' living in rural areas etc. (Thapa 2009)

According to FAO global hunger statistics, micro nutrition intake in both mothers and children under five are improving in recent years with significant improvement in maternal micro nutrition intake. Similarly UNICEF reports that under five mortality rates and micronutrient intake has significantly increased from 2007- 2011. United Nations Millennium Development report shows that maternal and child mortality has decreased significantly in the recent years showing significant positive outcome of the goal. It shows that goal no. 3 & 4 are on track to achieve the goal if progress is maintained. Likewise, World Bank reports that maternal mortality rate has declined significantly in the last few years. Infant mortality rates dropped from 79 in 1996 to 39 in 2010. Full immunization coverage increased from 43% in 1996 to 87% in 2011. Nepal earned MDG millennium award in 2010 for significant decrease in maternal mortality rate. World Bank reports that Nepal has achieved high rates of vitamin A supplementation of 6-59 months of age where children receive the two doses of vitamin A approximately 6 months apart. (World Bank, Nepal 2013). This all figures shows that maternal and child nutritional status has improved however according to this research finding intake of both vitamin A and iron from food has decreased in children particularly through iron intake in food in the past 10 years. Supplementation of vitamin A and iron has improved in the recent years resulting to significant decrease in maternal and child mortality rate.

7. CONCLUSIONS AND RECOMMENDATIONS

The study shows that there is significant increase in micronutrient intake mostly on iron tablet supplementation in mothers during pregnancy and vitamin A supplementation in children under five. However there is a significant decrease in intake of vitamin A and iron from food in children. It requires much more attention in case of iron intake from food both in children and also to the mothers.

Likewise, vitamin A supplementation in case of mothers is not satisfactory. However it is comparatively better, whereas intake from food is required to be taken care of during the intervention and policymaking. Despite that mothers' supplementation from both iron and vitamin A is also satisfactory that has significantly increased from 2001 to 2011. However national and local level programmes, interventions should frequently be carried out to maintain the sustainability. Region of residence (Five developmental regions) Mothers' education level, mothers' age at pregnancy, etc. are some of the most important socio demographic variables that have significant impact on maternal and children micronutrient intake. Interventions should be focused on literacy programmes, awareness campaign etc. Far western development region is most affected where interventions are mostly required. These programmes should be mother and children centered taking in consideration the other socio economic and demographic variables so that it can have significant positive impact. Future programmes are suggested to focus on these socio demographic determinants to reach the target group. It can make the project more successful with significant outcome. Sustainable programmes are required in the future to maintain the progress in the long run.

Furthermore Nepal national policy addressing the food and Nutrition security are weak and may not address properly the current issues on micronutrients intake. It might require reformation in policy focusing on these issues. Policy should also emphasize and address

the western development regions with especial focus on far western development regions of the country that is mostly affected. Future researches in these areas are highly recommended.

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