

**DIETARY DIVERSITY AND NUTRITIONAL STATUS OF
REPRODUCTIVE AGE (15-49 YEARS) FEMALES IN CHICHILA RURAL
MUNICIPAL, SANKHUWASABHA**

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**Dietary Diversity and Nutritional Status of Reproductive Age (15-49 years)
Females in Chichila Rural Municipal, Sankhuwasabha**

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Technology, Tribhuvan University, in partial fulfillment of the requirements for the degree of
B.Sc. in Nutrition and Dietetics*

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Approval Letter

This *dissertation* entitled *Dietary Diversity and Nutritional Status of Reproductive Age (15-49 years) Females in Chichila Rural Municipal, Sankhuwasabha* presented by **Manisha Niroula** has been accepted as the partial fulfillment of the requirement for the degree of **B.Sc in Nutrition and Dietetics**.

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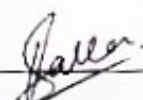
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(Manisha Niroula)

Abstract

The study aimed to assess the dietary diversity and nutrition status and associated factors among reproductive-age (15-49 years) females residing in Chichila Rural Municipal of Sankhuwasabha district. A cross-sectional descriptive study was done on 196 reproductive-aged females using a semi-structured questionnaire. Weight, height, waist circumference and hip circumference were measured to determine indicators related to nutritional status. The anthropometric measurements were then analyzed using WHO criteria. Microsoft excel and SPSS version 20 were used to analyze data. A Mann-Whitney U and Kruskal-Wallis tests were used to test the significant difference in dietary diversity, including a post-hoc analysis. Chi-square test was applied to analyze the factors associated with BMI, WC and WHR.

Significant difference in dietary diversity of females was found among address, skipping of meals, fuel source, having snacks and provision of water purification. The analysis of the survey revealed, that the percentage of females consuming pulses regularly were 10.2%, consuming green leafy vegetables were 35.7%, other vegetable consuming were 20.4%, dairy, fruit, meat and egg consuming were 13.3%, 5.6%, 1.5% and 0.5% respectively. Females who consumed tea/coffee, cold drinks and fast food regularly were 51.5%, 18.4% and 22.4% respectively. Out of total females, 9.2% were underweight, 34.2% were overweight/obese and remaining 56.6% were normal according to international BMI classification. Central obesity was present in 50.5% females and 59.7% had high waist-hip ratio. Nutrition awareness was the common factor affecting BMI, waist circumference as well as waist-hip ratio. Properly planned interventions from authorities would be vital in improving food consumption and nutritional status of the target population.

Table of contents

Approval Letter	iii
Acknowledgements	iv
Abstract	v
List of Tables.....	x
List of Figures	xi
List of Abbreviations.....	xii
1. Introduction	1-5
1.1 Background	1
1.2 Statement of problem	2
1.3 Objectives	3
1.3.1 General objectives	3
1.3.2 Specific objectives.....	3
1.4 Research question.....	4
1.5 Significance	4
1.6 Framework of study.....	5
1.7 Limitations.....	5
2. Literature Review	6-22
2.1 Female	6
2.2 Changes in reproductive age span of females	6
2.2.1 Puberty.....	6
2.2.2 Sexual Maturity	6
2.2.3 Menopauses	7
2.3 Nutrition and nutritional status.....	7
2.4 Nutrient requirement in reproductive age females	8
2.5 Malnutrition.....	9
2.6 Forms of malnutrition.....	9

2.7 Overview of female nutrition status in Nepal	9
2.8 Food Consumption	10
2.9 Changing food consumption pattern (Nutrition Transition).....	10
2.10 Dietary diversity	11
2.10.1 Dietary diversity score.....	12
2.11 Factor affecting nutrition status and food consumption in females	13
2.11.1 Education status.....	13
2.11.2 Marital Status	13
2.11.3 Household Economic Status.....	14
2.11.4 Age	14
2.11.5 Culture	15
2.11.6 Food security	15
2.11.7 Individual preferences	15
2.11.8 Price of food and marketing	16
2.11.9 Lifestyle.....	16
2.12 Assessment of nutrition status	16
2.13 Anthropometric assessment.....	17
2.14 Assessment of individual food consumption (Joshi, 2017; Lee and Nieman, 2012)	18
2.15 Physical activity	21
2.16 Indicator of nutrition status	21
3. Materials and Methods	23-31
3.1 Study Area.....	23
3.2 Study Population	23
3.3 Selection Criteria.....	23
3.3.1 Inclusion criteria.....	23
3.3.2 Exclusion criteria.....	23
3.4 Research Design	23
3.5 Sample Size	24

3.6 Sampling Technique.....	25
3.7 Research Instruments	26
3.8 Study Variables	26
3.8.1 Dependent Variables	26
3.8.2 Independent Variables.....	26
3.9 Pre-testing.....	27
3.10 Validity and Reliability	27
3.11 Data Collection Techniques	27
3.12 Data Management.....	30
3.13 Data Analysis	31
3.14 Ethical Considerations.....	31
4. Result and Discussion.....	32-52
4.1 Demographic and socio-economic characteristics	32
4.1.1 Age distribution.....	32
4.1.2 Ethnicity and religion distribution.....	32
4.1.3 Marital status and parity	33
4.1.4 Socio-economic factors	34
4.1.5 Behavioral factors.....	36
4.2 Eating behaviors	37
4.3 Health related factors.....	39
4.4 Dietary intake	40
4.4.1 Food consumption pattern	40
4.4.2 Dietary diversity score.....	41
4.4.3 Nutrient intake	43
4.5 Nutritional status of the study population	45
4.5.1 Nutritional status based on International BMI classification	45
4.5.2 Nutritional status based on Asian BMI classification	46
4.5.3 Nutrition status based on waist circumference.....	46

4.5.4 Nutritional status based on WHR	47
4.6 Factors associated with nutrition status.....	48
4.6.1 Factors associated with nutritional status based on BMI	48
4.6.2 Factors associated with nutritional status based on Waist Circumference.....	49
4.6.3 Factors associated with nutritional status based on WHR	50
5. Conclusions and Recommendations	53
5.1 Conclusions	53
5.2 Recommendations	53
6. SUMMARY.....	54
References	55-77
Appendix A Consent form.....	66
Appendix-B Survey questionnaire.....	67
Appendix-C Photo Gallery	75

List of Tables

Table No.	Title	Page no.
2.1	RDA for reproductive aged females	8
2.2	Interpretation of BMI	21
2.3	Cutoffs of waist circumference and WHR for South Asian women	22
3.1	Probability proportional sampling	25
4.1	Percentage distribution of age group of study population	32
4.2	Percentage distribution of religion and ethnicity of study population	33
4.3	Percentage distribution of marriage and parity of study population	34
4.4	Percentage distribution of socio-economic factors of study population	35
4.5	Percentage distribution of family type and family size	36
4.6	Percentage distribution of behavior factor of study population	37
4.7	Percentage distribution of eating behavior factor of study population	38
4.8	Distribution of study population who skipped meals	39
4.9	Distribution of health-related factor of study population	39
4.10	Food consumption and food frequency of study population	40
4.11	Distribution of DDS among reproductive age females	42
4.12	Factors with significantly differing median dietary diversity score	43
4.13	Mean nutrient intake of study population	44
4.14	Adequacy of nutrient intake of study population	44
4.15	Anthropometric status of women of reproductive age	45
4.16	Factor associated with nutritional status based on BMI	48
4.17	Factor associated with nutritional status based on waist circumference	50
4.18	Factor associated with nutritional status based on WHR	51

List of Figures

Figure No.	Title	Page no.
1.1	Frame work of study	5
4.1	Percentage distribution of adequacy of dietary diversity in study population	41
4.2	Nutritional status based on International BMI	45
4.3	Nutritional status based on Asian BMI	46
4.4	Nutritional status based on waist circumference	47
4.5	Nutritional status based on waist hip ratio	47

List of Abbreviations

Abbreviation	Full form
AND	American nutrition and dietetics
BAPEN	British association for parenteral and enteral nutrition
BMI	Body mass index
CBS	Central bureau of statistics
CDC	Centers for disease control and prevention
DBM	Double burden of malnutrition
FFQ	Food frequency questionnaire
GON	Government of Nepal
HEPA	Health enhancing physical activity
IBM	International business machine
ICMR	Indian council of medical research
LMICs	Low-and middle-income countries
MoFAGA	Ministry of federal administration and general affairs
MoHP	Ministry of health and population
MUAC	Mid-upper arm circumference
NDHS	Nepal demographic and health survey
NFC	Nepal food corporation
PPS	Probability proportional sampling
RDA	Recommended daily allowance
SNNPR	Southern nations nationalities and people region
UNICEF	The United Nations International Children's Emergency
WHR	Waist hip ratio

Part I

Introduction

1.1 Background

The double burden of malnutrition (DBM), the simultaneous presence of under nutrition and overweight or obesity, disproportionately affects women of reproductive age and continues as a major public health problem worldwide (Jayalakshmi *et al.*, 2023). Reproductive age women group are particularly important as they are the host of continuing the DBM paradox during the life course by generating malnourished birth outcome (Modjadji and Madiba, 2019). In low- and middle-income countries (LMICs), particularly in Southern Asia, the DBM, is a significant health issue with the prevalence of underweight and overweight/obesity in women being 11.8% and 36.3% respectively. One third of world anemic population live here. Among LMICs, the highest increase in overweight was in Nepal (Ferdausi *et al.*, 2022).

Nepal is a developing country in South Asia with a growing population that has doubled from 15 million in 1981 to 29 million in 2021 (CBS, 2023). MoHP *et al.* (2017) found among women of reproductive age (15-49 years), 17% were underweight and approximately 22% were overweight or obese. While MoHP *et al.* (2022) states, 34% of women in Nepal being anemic. Socio-demographic factors, including age, educational status, marital status, religion, and employment status have been shown to influence the nutritional status of women of reproductive age in Nepal (Khanal, 2022). Healthy eating pattern promotes good nutritional status while poor dietary eating choices may cause malnutrition (Otuneye *et al.*, 2017).

Improper and inadequate dietary intake pattern have resulted in the deficiency of essential nutrients especially in women of reproductive age residing in Nepal which pose threat to their physical, mental and social wellbeing (Bhandari *et al.*, 2016). In the surrounding regions, Bangladesh was presented with 86% of calorie intakes accounted by starchy staples (nearly solely polished rice) suggesting that diets at this location would still be the most monotonous (Arimond *et al.*, 2011). In a study by Kapoor *et al.* (2023) among indigenous women of reproductive age in India, it was found that there was deficit in pulse consumption up to 84.3%, green leafy vegetables up to 96.6%, fruits up to 97.9% and milk and milk products up to 96.8%; all of which hints towards significant dietary and food consumption related issue in the region as well.

Several factors have been found to determine the dietary habits of the people. Cereal crop plays a major role in food and nutrition security in Nepal as Nepalese food habits are based on the cereal crops. The major staples of the Nepali population include rice and wheat in the Terai; maize and millets in the hills; and millet, maize, and barley in the mountains. Potatoes are also an important part of the diet in the mountains (Gairhe *et al.*, 2018). However, in recent years, more food has been imported from outside, resulting in changes in food habits of the people living in the remote hills and mountain districts. In addition, the Government of Nepal has been transporting rice and other food items to remote mountain districts since the establishment of Nepal Food Corporation (NFC) in 1974-5 leading to an increase in rice consumption in those districts (USAID, 2010).

The current literatures provide limited information regarding dietary diversity, food consumption and nutritional status in himalayan region of Nepal. Therefore, the objective of this study was, to assess the dietary and nutritional status of women of reproductive age and associated factors in Chichila, Nepal. In other words, the study intends to measure diversity in dietary behavior with regard to important and commonly consumed foods groups and assess nutritional status of women.

1.2 Statement of problem

Both under nutrition and over nutrition are major global public health challenges and concern that contribute to increased risk of morbidity and mortality (Popkin *et al.*, 2020). Approximately, 462 million adults are affected by underweight, while 1.9 billion adults are affected by overweight or obesity, worldwide (UNICEF *et al.*, 2021). In 2030, greater than 50% of women in 22 LMICs are projected to be overweight, with Nepal 64.5%, projected to have higher burden of overweight (Hasan *et al.*, 2022). Even though quite adequate government policies and guidelines have been prepared and some progress has been made over the years, it is still stalled and remains unsatisfactory in Nepal (Sunuwar *et al.*, 2020).

The pattern of malnutrition among children and women is changing from the previously observed under nutrition among women and children to under nutrition among children and overweight/obesity among women (WHO, 2017). Since 2000, women have had a higher prevalence of overweight and obesity than men worldwide. In adults, along with obesity, women are more likely than men to be overweight (39.2% and 38.5% respectively in 2016). An important global health problem, malnutrition, is most prevalent in young girls, women, and preschool children (Kiran *et al.*, 2022). Underweight is declining slightly to 9.7% of women but it is not

significant. The proportion of adolescent girls who are underweight has risen from 5.5% in 2000 to 5.7% in 2016 (GlobalNutritionReport, 2022).

Additionally, no regional block has been exempted from the rising prevalence of overweight/obesity rather it was thought as the result of the rate of dietary changes such as consumption of energy-dense foods (Christian and Dake, 2022). A shift away from traditional foods has resulted to a sweetening of the global diet (Ford *et al.*, 2017). Sugar-sweetened beverage were an important source of caloric intake in many parts of the developing world and liquid calories influence weight gain by contributing to excess caloric consumption because liquids were less satiating than solid foods (Mattes, 1996). A meta-analysis of sugar sweetened beverages and health outcomes commissioned by the WHO found a positive association between sugar sweetened beverages intake, total caloric intake, and body weight (Hirotsu *et al.*, 2015).

Despite the highest average calorie intake in mountainous region among all ecological region of Nepal, that had surpassed both hilly and terai region in the span of 25 years; the dietary diversity is among the lowest (P. Kumar *et al.*, 2016). This hints towards excessive carbohydrate consumption or penetration of processed foods. Females were the most obese of both gender in Nepal (Dhimal *et al.*, 2020; MoHP *et al.*, 2022). Only mere policy and strategy cannot yield foreseeable results (Devkota *et al.*, 2015). This shows the necessity of assessment of dietary diversity and nutritional status among females of mountainous region. Since, no study on dietary diversity and nutritional status of reproductive age females of Chichila Rural Municipal till date, this study was done to assess nutrition status and dietary diversity of female residing there.

1.3 Objectives

1.3.1 General objectives

To assess dietary diversity and nutritional status of reproductive age (15-49 years) females of Chichila Rural Municipal, Sankhuwasabha district and identify the associated factors of malnutrition.

1.3.2 Specific objectives

1. To collect information about dietary habits, dietary diversity and dietary intake of reproductive age female residing in Chichila.
2. To study nutritional status of the reproductive age females of Chichila Rural Municipal by anthropometric measures.

3. To identify the factors associated with malnutrition.

1.4 Research question

1. What type of dietary diversity exists in Chichila rural municipal that influence nutritional status of reproductive age females?
2. What are the factors significantly differing in dietary diversity?
3. What is the present nutritional status of reproductive age females residing in Chichila Rural Municipal, Sankhuwasabha district?
4. What are the different factors associated with nutritional status of reproductive age females?

1.5 Significance

1. Identify individual or group of people who are at risk of being malnourished and the one who need special care and attention.
2. Reflect degree of malnutrition, dietary belief, sanitary condition, socio economic variables and other conditions of reproductive age females to make people aware of real situation.
3. Provide baseline information to the governmental as well as to non-governmental organizations about the dietary beliefs and nutritional status of females of this area.
4. Encourage government and other stake holders for the development of plans and policies for conducting programs related to the nutrition.
5. Determine the issues concerning nutrition and dietary habits of this group people.

1.6 Framework of study

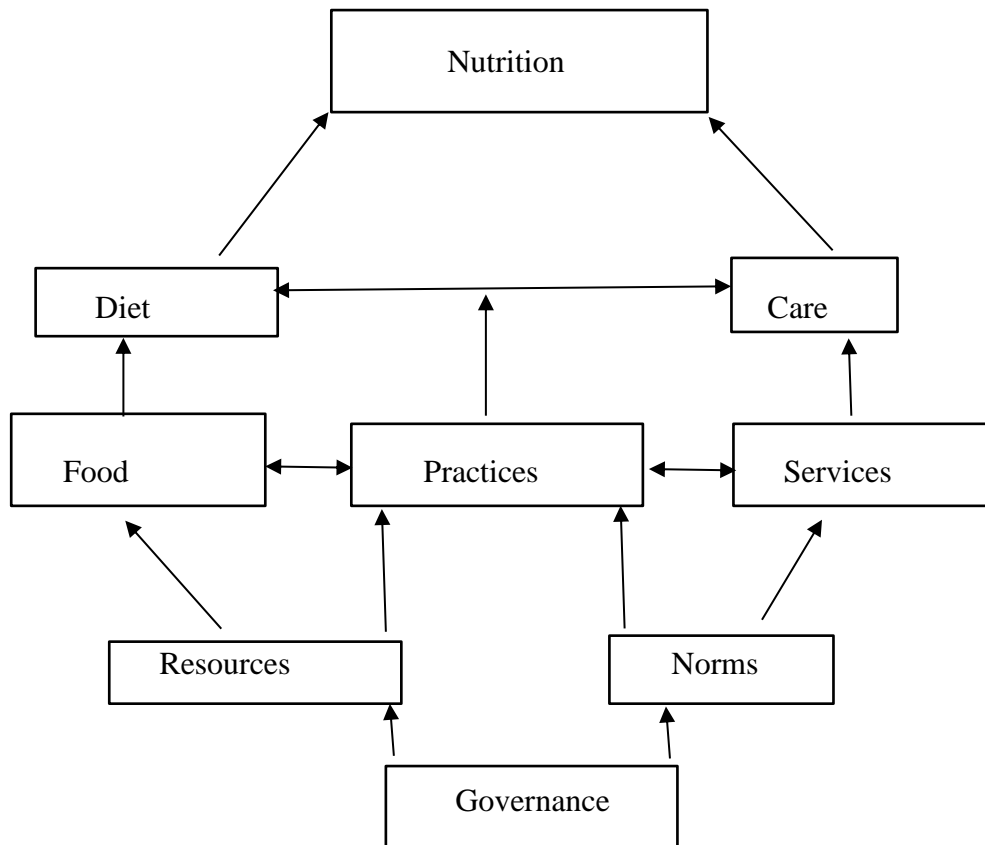


Fig:1.1 Conceptual framework on nutrition (UNICEF, 2020)

1.7 Limitations

1. Survey was a single-center experience that may not be representative of the entire Nepalese population so the results could not be extrapolated to other populations without additional research.

PART II

Literature Review

2.1 Female

According to biologist Haig (2004), female is the ‘sex’ category (biological and physiological characteristics) that define women. UN (2020), data shows female to be 49.6% of world population. Reproductive system of this sex is responsible for producing ova, maintaining fertilized eggs to mature fetuses and delivering. Menarche is the event signaling the onset of female reproductive cycle and menopause is permanent cessation of ovulation and menses (Norman, 2014). Menarche and menopause does not have a fixed designated age but comes with dramatic and life-changing transitions (Bjelland *et al.*, 2018). However, age 15-49 years in general is taken as the reproductive age span in females (Acharya *et al.*, 2017; Bhandari *et al.*, 2016; Ferdausi *et al.*, 2022).

2.2 Changes in reproductive age span of females

According to Norman (2014), reproductive age in females has three major phases:

1. Puberty
2. Sexual Maturity
3. Menopause

2.2.1 Puberty

Puberty is the process of physical maturation where an adolescent reaches sexual maturity and becomes capable of reproduction. On average, puberty typically begins between 8 and 13 in females (Breehl and Caban, 2023). The onset of puberty brings a number of changes, including the development of primary and secondary sex characteristics, growth spurts, an increase in body fat, and an increase in bone and muscle development. Puberty can also bring about emotional changes and stress to individuals as they come to terms with their changing bodies. All of these changes must be supported with adequate intake and healthy food choices as well as psychosocial and emotional support (Breehl and Caban, 2023; Cabbage and Tewari, 2020).

2.2.2 Sexual Maturity

The ability to reproduce is one of the hallmarks of sexual maturity. Sexually mature women who are not taking birth control pills have regular menstrual cycles that average 26–35 days in length

and that are (can be) occasionally interrupted by pregnancy and lactation. Menarche signals the beginning of the ability to reproduce although it is possible to become pregnant before the first menstrual period because ovulation can occur during this time. Menopause marks the end of the reproductive lifespan which lasts nearly 40 years from about 13 years (menarche) to 51 years (menopause) (Norman, 2014).

2.2.3 Menopauses

In the middle-aged years, women undergo a specific change that has a major effect on their health. They begin the process of menopause, typically in their late forties or early fifties. The ovaries slowly cease to produce estrogen and progesterone, which results in the end of menstruation (Cabbage and Tewari, 2020). Menopause is recognized when a woman has not had a menstrual period for 12 months (Norman, 2014). Symptoms of menopause that most women complain about are vasomotor changes (hot flashes), sleep disruption, mood changes, and urogenital problems. Hot flashes are experienced by about 75 % of menopausal women and typically last for about 3.8 years (Freedman, 2005). Long-term effects of decreased estrogen levels invites increased cardiovascular disease, osteoporosis, and decreased mental function are far more debilitating than the transitional changes that occur at menopause (Norman, 2014).

2.3 Nutrition and nutritional status

Nutrition is the branch of science that studies the process by which living organisms take in and use food for the maintenance of life, growth, reproduction, the functioning of organs and tissues, and the production of energy. Optimal nutrition is achieved through a balanced diet that provides all essential nutrients, while poor nutrition can result from inadequate or excessive nutrient intake or poor utilization (Webster-Gandy *et al.*, 2006).

Nutritional status is the condition of the body as it relates to consumption and utilization of food. The nutritional status of a person may be either good or poor (Joshi, 2017). Under nutrition and obesity are quite common in the same community, household, or even individual. Many families cannot afford or obtain enough nutritious foods while unhealthy foods are cheaper and more readily available, resulting in a rapid increase in the number of overweight and obese children and adults in both poor and rich countries (WHO, 2020b).

2.4 Nutrient requirement in reproductive age females

Nutrient required by females of reproductive age (15-49 years) is not same for all, it differs according to age, physical activity and bodily condition (pregnancy, lactation or disease) (ICMR, 2020). RDA of female given by ICMR (2020), that co-insides with the age-span of reproductive aged females is shown in the table 2.1.

Table 2.1:Recommended Daily Allowance (RDA) for females of reproductive age (ICMR, 2020).

Age/ Physical Activity	Adolescent		Women		
	13-15 years	16-18 years	Sedentary	Moderate	Heavy
Nutrients					
Protein (g/kg)	0.87	0.83	0.83	0.83	0.83
Dietary Fibre (g/day)	36	38	25	30	40
Calcium (mg/day)	1000	1050	1000	1000	1000
Magnesium (mg/day)	340	380	370	370	370
Iron (mg/day)	30	32	29	29	29
Iodine (mcg/day)	140	140	140	140	140
Thiamine (g/day)	1.6	1.7	1.4	1.7	2.2
Riboflavin (mg/day)	2.2	2.3	1.9	2.4	3.1
Niacin (mg/day)	16	17	11	14	18
Vitamin B6 (mg/day)	2.2	2.3	1.9	1.9	2.4
Folate (mcg/day)	245	270	220	220	220
Vitamin B12 (mcg/day)	2.2	2.2	2.2	2.2	2.2
Vitamin C (mg/day)	65	70	65	65	65
Vitamin A (mcg/day)	890	860	840	840	840
Vitamin D (IU/day)	600	600	600	600	600

2.5 Malnutrition

Malnutrition is defined as deficiencies, excesses or imbalances in a person's intake of energy and/or nutrients. Malnutrition affects people in everywhere. (WHO, 2020b). Malnutrition occurs when the body experiences physical effects from insufficient dietary intake, and under nutrition specifically refers to low food intake (Webster-Gandy *et al.*, 2006). Young children and women particularly who are pregnant or breastfeeding are most vulnerable to malnutrition. Their bodies have a greater need for nutrients, such as vitamins and minerals, and are more susceptible to the harmful consequences of deficiencies (WHO, 2020c). For instance, S. Kumar *et al.* (2022) states Iron deficiency anemia (IDA) has reached epidemic proportions in developing countries and has become a major global public health problem, affecting mainly 0–5 years old children and young women of childbearing age, especially during pregnancy. Causes of malnutrition are often complex and multifactorial, and can include acute illness or injury, chronic disease, and a variety of socioeconomic factors (Doley and Marian, 2023).

2.6 Forms of malnutrition

- a. Under nutrition: It is the pathological condition brought on by eating insufficient amounts of food for an extended period of time. (Joshi, 2017).
- b. Over nutrition: It is the pathological condition caused by an higher intake of essential nutrients, particularly excessive calorie intake present topic of concern (Joshi, 2017).
- c. Specific deficiency: It is the pathological state resulting from a relative or absolute lack of an individual nutrient for instance iron deficiency anemia is a very common deficiency disease in women and young girls. Menstrual losses and increased needs in pregnancy are some of the causes of anemia (Joshi, 2017).

2.7 Overview of female nutrition status in Nepal

In Nepal, overall, 11% of women are shorter than 145 cm. 17% women are thin, 11% are mildly thin and 6% are moderately and severely thin. Further, 22% are overweight or obese, with 17% being overweight and 5% obese. Younger women are more likely to be thin with the data of 30% of women aged 15-19 thin compared with 13% of women aged 40-49. Consumption of food from 5 or more food groups among women is higher in urban (55%) than in rural (44%) areas (MoHP *et al.*, 2017). Dhimal *et al.* (2020) in the survey for analyzing non-communicable disease risk factors in Nepal found out the prevalence of higher waist circumference and waist hip ratio in Nepalese females to be 19.5% and 70.2% respectively. Obesity in females is a growing problem

not only in Nepal but around the globe, a study by IIPS and ICF (2021) in India, found 57% of females had higher WHR also in Malaysia more than half of the females were under the risk WHR categorization (Ahmad *et al.*, 2016).

Anemia, a condition in which hemoglobin concentration and/or red blood cell numbers are lower than normal and insufficient to meet an individual's physiological needs affects roughly one-third of the world's population (Chaparro and Suchdev, 2019). It can lead to increased maternal mortality, poor birth outcomes, decreased work productivity and impaired cognitive and behavioral development and is a major concern among pregnant women (Haider *et al.*, 2013). MoHP *et al.* (2022) states, 34% of women are anemic, including 18% mildly anemic, 15% moderately anemic and 1% severely anemic.

Folic acids help to prevent neural tube defects (CDC, 2022). 90% of non-pregnant women had RBC folate insufficiency for preventing neural tube defects (defects of brain and spinal cord). This rate was 87% in the Eastern region with 87% in Hilly area. Overall, 24% of non-pregnant women of age 15-49 years had zinc deficiency and prevalence of zinc deficiency ranged from 20 percent in the western region, 28 percent in eastern region to 32 percent in the Far-western region (MoHP *et al.*, 2016).

2.8 Food Consumption

Food is not just something to eat but an integral part of the culture of a community, region, or nation. It is a relative concept. A thing that is considered edible in one culture might be discarded in another. Societal influence and individual preference make food habit. Food habit together with availability and affordability influences what an individual consumes (Hartog *et al.*, 2006).

Nation wise data on food consumption of Nepal is scarce, a decade ago, in 2011, per capita consumption of cereal, pulse, milk, oil, vegetables, fruits, meat/fish/egg and sugar in Nepal was 163.4 kgs, 11.1 kgs, 39.8 kgs, 7.4 kgs, 54.5 kgs, 14.5 kgs, 9.8 kgs and 4.59 kgs respectively while consumption of fruit in 96.3% of women and 97% men were inadequate (P. Kumar *et al.*, 2016).

2.9 Changing food consumption pattern (Nutrition Transition)

The Nepalese diet is shifting away from agricultural staples and toward modern processed foods that contain more total energy, total fat, and sugar. Overweight/obesity and diet-related noncommunicable diseases are becoming more common. Nepal's economic structure has also shifted away from agricultural food supply systems toward modern processing-based food supply

systems. Income and urbanization are driving these dietary changes in Nepal (Y. Subedi *et al.*, 2017)

The nutrition transition refers to the shift from traditional diets composed of whole foods, such as pulses and whole grains, and that are low in animal-source foods, salt, and refined oils, sugars, and flours, to an energy-dense and nutrient-poor diet composed of refined carbohydrates, high fat intake, and processed foods. A positive effect of the nutrition transition includes improved dietary diversity through greater inclusion of fruits and vegetables, eggs, cheese, milk, meat, and fish in some settings; however, processed foods are often included along with the new fresh, whole foods and are typically energy dense, nutrient poor, and low in fiber (Batal *et al.*, 2023).

According to WHO (2020a), for a diet to be healthy less than 10% energy derived should be from free sugar, fat intake should not be more than 30% of total calories and a person should eat good amount of fruits and vegetables each day i.e. around 400 grams. According to P. Kumar *et al.* (2016), per capita cereal consumption of Nepalese was in decreasing (177.1 kg to 163.4 kg) trend from 1995-2011, while sugar (3.09kg to 4.59 kg) and beverage consumption (16.7% to 21.9% of total food expenditure) seemed to be increasing. Shrestha *et al.* (2016), in their study among Nepalese adults found out that the refined grains-meat-alcohol pattern was significantly associated with high BMI among females and Yu *et al.* (2022) found high sugar intake to be significantly associated in children and adolescents whereas, beverage consumption is associated with obesity (Bosire, 2020) while inadequate protein consumption is positively associated with occurrence of obesity (Santesso *et al.*, 2012).

2.10 Dietary diversity

Dietary diversity has long been recognized as a key element of high-quality diets, based on the principle that no single food can provide the right amount of nutrients necessary to maintain optimal health. This theory has been historically documented on many occasions, such as the high prevalence of beriberi, as well as night blindness and scurvy, among the Imperial Japanese Army during the first half of the 20th century, due to rice-based rations that included little or no other foods (Hawk, 2006). As a result, many dietary diversity measure have been developed and used in the literature, either as proxies of nutritional adequacy of the diet or as recommendations to maintain optimal health (Ruel, 2003). One of which is measure given by Kennedy *et al.* (2010) for the measurement of dietary diversity score (DDS) of household and individual, where DDS for women is optimized taking into consideration importance of Iron and Vitamin-A required.

In the study by MoHP *et al.* (2016), the minimum dietary diversity for children 6-9 years, adolescents and adults were defined as consuming at least five out of ten defined food groups. Forty-two percent among children aged 6-9 years, 48 percent among adolescent boys, 43 percent among adolescent girls and 49 percent among women 15-49 years had achieved the minimum dietary diversity, which is consumption of less than 5 food groups, the day prior to the survey whereas, the minimum dietary diversity among all the target groups were lower in rural area than urban area.

2.10.1 Dietary diversity score

Dietary diversity can be assessed either in household level or individual level. The household dietary diversity score (HDDS) is meant to reflect, the economic ability of a household to access a variety of foods, studies have shown that an increase in dietary diversity is associated with socio-economic status and household food security (Hatloy *et al.*, 2000). Individual dietary diversity scores (IDDS) aim to reflect nutrient adequacy. Women dietary diversity score is designed to assess dietary diversity of reproductive age females Studies in different age groups have shown that an increase in individual dietary diversity score is related to increased nutrient adequacy of the diet. Dietary diversity scores have been validated for several age/sex groups as proxy measures for macro and/ or micronutrient adequacy of the diet. Scores have been positively correlated with adequate micronutrient density of complementary foods for infants and young children (FANTA, 2006).

According to Kennedy *et al.* (2010) food groups for assessment of Women dietary diversity score are:

1. Starchy staples
2. Dark green leafy vegetables
3. Other vitamin A rich fruits and vegetables [ripe mango, cantaloupe, apricot (fresh or dried), ripe papaya, dried peach, and 100% fruit juice made from these + other locally available vitamin A rich fruits and pumpkin, carrot, squash, or sweet potato that are orange inside + other locally available vitamin A rich vegetables (e.g. red sweet pepper)]
4. Other fruits and vegetables [other fruits, including wild fruits and 100% fruit juice made from these and other vegetables (e.g. tomato, onion, eggplant) + other locally available vegetables]
5. Organ meat (liver, kidney, heart or other organ meats or blood-based foods)
6. Meat and fish
7. Eggs

8. Legumes, nuts and seeds
9. Milk and milk products

The women are asked to recall all the food items and drinks they had consumed the previous day from the time they woke up until they went to bed. A point is awarded to each food group if consumed, over a reference period of time and sum of them is the dietary diversity score of that individual.

2.11 Factor affecting nutrition status and food consumption in females

2.11.1 Education status

Education serves as the most important resources that enable women to develop more awareness than those who had no education of how to utilize available resources for the improvement of their own nutritional status and that of their families, how to make independent decisions, how to be accepted by other household members, and how to have greater access to household resources that are important to improve their nutritional status (Mihretie, 2018). Significant association between nutrition status and education was found by Acharya *et al.* (2017) among rural females of reproductive age in Nepal. A comparative study on maternal malnutrition in ten sub-Saharan African countries and a study in the Southern Nations, Nationalities and Peoples Region (SNNPR) of Ethiopia showed that the higher the level of education the lower the percentage of undernourished women (Samson and Lakech, 2000; Teller and Yimar, 2000). Not just own nutrition status, but promoting female education can lead to beneficial long run gains in multiple dimensions as because the children of women who are educated are less likely to be underweight or stunted than uneducated women by interfering intergenerational cycle (Musaddiq and Said, 2023). The study in the Bolivia have shown a decreased incidence of malnutrition among young children with an increase in the level of mothers' education (Frost *et al.*, 2005). Data of CBS (2021c) shows, literacy rate of females in Chichila rural municipal to be 91.5%.

2.11.2 Marital Status

Several research point that more married women are obese with high abdominal obesity in comparison to unmarried women especially married women at later stages of their reproductive ages are observed to be obese (Lipowicz *et al.*, 2002). Farpour-Lambert *et al.* (2018), points out this may be due to the excessive gestational weight gain (GWG) and post-partum weight retention (PPWR) and being less conscious to their figures. Same findings were made by survey conducted by Verma *et al.* (2021) in Indian females, similar conclusion was drawn by Acharya *et al.* (2017) among reproductive aged females of rural Nepal. Gupta *et al.* (2022) found latter age group, and

being ever married were associated with higher prevalence abdominal obesity. Obesity of females increases with increase in parity and higher at late menopausal age (Amiri *et al.*, 2023). In a study conducted in Dharan, Nepal, similar conclusion was made by Bhattarai *et al.* (2018) regarding association of parity with WHR, another study in Bharatpur, Nepal by S. Subedi *et al.* (2020) revalidated this findings.

2.11.3 Household Economic Status

Household economic status is an indicator of access to adequate food supplies, use of health services, availability of improved water sources, and sanitation facilities that are prime determinants of child and maternal nutritional status (UNICEF, 1990). One study showed that the low wage, early marriage, poor dietary intake, high rate of communicable diseases and poor nutritional status were very likely related to each other, and one leads to another and accordingly, the vicious cycle goes on (Hossain *et al.*, 2017). According to Verma *et al.* (2021), in India richest wealth quintile had higher BMI of female of reproductive age. In Nepal, the women from low economic status households were affected consistently by malnutrition (MoHP *et al.*, 2017). There was significant association between income and nutrition status of rural females of reproductive age of Nepal (Acharya *et al.*, 2017). Economically weak, *dalits* and disadvantaged *janajatis* were significantly malnourished in Nepal (Bhandari *et al.*, 2016). And Chichila rural municipality is a prominent place of residence of disadvantaged *janajatis* (CBS, 2021a) and religious minorities of Nepal (CBS, 2021b).

2.11.4 Age

Age also plays an important role in consumption in the sense that, as people grow older; they tend to make choices based on health, weight watching (dieting), etc. Irregular eating habits and meal skipping is more common among adolescents (Tóth *et al.*, 2023). Pagliarini *et al.* (2005) conducted a study focusing on children of different age groups in Italy and concluded that the preference for most dishes among younger children (7 years old) differed from those of the older ones (10 years old) interpreting as children become increasingly aware of their preferences and become more critical in their choices with the increasing age.

In Nepal, women are more likely to be thin at age 15-19 (37%) (MoHP *et al.*, 2017). Women's age and parity are important factors which affect maternal depletion (Taddese *et al.*, 1998). Researches by Faridah *et al.* (2015) and Adegoke *et al.* (2022) in South Asia and Africa respectively showed waist circumference in reproductive aged female increased with age.

2.11.5 Culture

Most people associate food with cultural rather than nutritional reasons. One of the most important things to remember about the cultural factors involved in food habits is that there are many food combinations that will produce the same nutritional results. Food habits are among the oldest and most deeply ingrained aspects of many cultures and, as a result, cannot be easily changed or, if forced, can result in a series of unexpected and unwelcome reactions. Certain foods are highly valued; others are reserved for special holidays or religious feasts; and yet others are a social status symbol. Food is classified culturally as 'inedible,' 'edible by animals,' and 'edible by human beings but not by one's own kind of human being' (Nizel, 1996). According to Hartog *et al.* (2006), food has prominent social roles, offered to express joy, sorrow, belongingness, love etc this inturn has a role to play in nutrition status of the members of society.

2.11.6 Food security

Food insecurity appears to have a negative impact on various aspects of health and wellbeing, food insecure individuals were more likely to be obese, gain weight as they had a significantly lower intake of fruits and vegetables (Zein *et al.*, 2020). About three-fifth (59%) of households in Nepal did not experience any food insecurity conditions and rarely worried about such conditions; about 6 out of 10 households were food secure and 16 percent were mildly insecure. A quarter combined was either moderately insecure (eighteen percent) or severely insecure (seven percent); all forms of food insecurity were higher in Mountains and in rural areas. 5% people had severe food insecurity and 16% and 17% people had moderate and mild food insecurity respectively, 61% people were food secure in hilly region (MoHP *et al.*, 2017). According to Vieytes *et al.* (2022), the intake of added sugars is consistent with reports stressing the pervasiveness of sugar-sweetened beverages and added sugar consumption in food insecure populations and similarly, to food insecurity, food insufficiency has been associated with poor health, chronic disease, poor functional health, altered nutrition-related laboratory values and decreased intake of healthful food groups.

2.11.7 Individual preferences

According to Hartog *et al.* (2006) humans are faced with several food choices each day and make decisions on what food to eat based on several criteria. Some people like certain food item while others don't like the same. Some people like a variety of foods while others might be picky eaters. Tuorila (2007) writing about food acceptance and consumption states, humans already know that there are some biological differences in how we perceive the basic tastes and that what foods we end up liking is to some degree caused by learning experiences we start forming already as infants

and continue to form throughout our lives. We all have different learning experiences with food, and this causes different food preferences.

2.11.8 Price of food and marketing

Food prices are a primary determinant of consumption patterns, and high food prices may have important negative effects on nutritional status and health, especially among poor people (Davis, 2000). As purchasing power declines, so does dietary quality and total energy intake, endangering child growth and cognitive development, increasing the risk of micronutrient deficiencies for all family members, and increasing the risk of infant and maternal mortality. Food allocation practices within households that reduce these effects for men and/or children almost always come at the expense of women. Other coping mechanisms at the household level include decreased use of health care services, decreased school enrollment, and increased labor-force participation by both women and children. Women, the rural poor, and the urban poor are among those who are most vulnerable to malnutrition at all times, and they are especially vulnerable during and after food price increases (Meerman and Aphane, 2012).

2.11.9 Lifestyle

Lifestyles are group-specific expressions of how people live and interpret their lives in social contexts. Social structure is linked to attitudes and behavior through lifestyles. The lifestyle perspective (derived primarily from market research and sociology) reveals societies socio-cultural diversity. There may be an "Indian Way of Life," similar to the "American Way of Life," but even within the United States, the market research institute Claritas Corp has identified about 60 different lifestyle groups (Madhvapaty and Dasgupta, 2015). According to Goindi *et al.* (2020), the emergence of ready to eat food in the global industry and now change in lifestyle and consumption behaviour, has brought out shift in consumption pattern in India which is true for Nepal as well.

2.12 Assessment of nutrition status

Nutrition assessment is a “systematic method for obtaining, verifying, and interpreting data needed to identify nutrition-related problems, their causes, and significance” (Raymond and Morrow, 2021). Nutrition assessment may be followed by nutritional diagnosis, intervention and monitoring and evaluation of the nutritional status (AND, 2022).

The assessment of nutritional status can be done using following information (BAPEN, 2022):

Anthropometry: Anthropometry allows for a measurement of the different component parts of the human body. A single measure will not provide a comprehensive overview of the patients' condition and so a number of measurements are required to form a more reasoned assessment. Measures like BMI, WC, WHR, skin-fold thickness, etc. can be incorporated.

Biochemical: The blood tests conducted within a nutrition assessment are interpreted in conjunction with a clinical examination; previous medical history; and current medications. This in turn is interpreted to make a nutritional diagnosis. For example, low hemoglobin levels can indicate anemia.

Clinical: A person's disease state may increase the risk of malnutrition due to increased energy requirements; reduced energy intake; or increased nutritional losses. Inversely, malnutrition may also show signs and symptoms in the body which might be assessed using clinical examinations. For example, low iron levels may lead to koilonychia.

Dietary: An estimation of the total daily calorie intake, as well as overall quality of diet should be assessed. Asking the person (or their family/career if patient unable) about their daily dietary intake will help understand patterns of eating, portion sizes, cooking methods and types of food and drink taken. Some methods that can be incorporated for dietary assessment are 24-hour dietary recall, food frequency questionnaire, weighed food records etc.

Environment: It involves assessment of social and physical environment. Social environment involves characteristics like ability to shop, cook, assistance with eating and drinking, mobility, budget restraints, limited storage facilities, meal timings, family support. And physical environment involves appetite, dentures, dexterity, use of cutlery, sight, taste changes, nausea, vomiting, heart burn, bloating, early satiety, diarrhea, constipation, pain, breathing difficulties, dysphagia (swallowing problems), food intolerances, special diets, diminished thirst, taste preferences.

2.13 Anthropometric assessment

Height

Height or stature of a subject can be measured in several ways. One of the simple ways is to fasten a measuring stick or non-stretchable tape measure to a flat, vertical surface for example a wall and use a right-angle headboard for reading the measurement. It might be inconvenient to find flat vertical surface in every place in field surveys so the stadiometer can be brought into use. Harpenden stadiometer or similar commercially available stadiometer can be used for this

purpose. Necessary considerations should be made to take the readings properly to the nearest 0.1 cm (CDC, 2023; Lee and Nieman, 2012; NHS, 2013).

Weight

One of the most important measurements in nutritional assessment is body weight which is an important measure in predicting caloric expenditure and assessing body composition (Lee and Nieman, 2012). Properly calibrated scales should be used for weighing. Scales should be placed on flat surface. Subject must be asked to stand on the scale after removing heavy wearing. Two readings can be made for accuracy and readings should be recorded to nearest 0.1 kg (NHS, 2013).

2.14 Assessment of individual food consumption (Joshi, 2017; Lee and Nieman, 2012)

24-hour dietary recall

The traditional dietary recall method is a commonly used approach to collect information about what people eat and drink. It involves a trained interviewer asking a respondent to recall all the food and drink consumed during a specific time period, which is typically the previous 24 hours, but may also be the past 48 hours, the past 7 days, or even the preceding month in some rare instances. The interviewer then records this information for later coding and analysis. During coding, a number is assigned to each kind of food, allowing it to be identified easily for computer analysis.

The 24-hour recall method has several advantages. It is relatively quick and easy to administer, typically taking 20 minutes or less, and it can provide detailed information on specific foods, particularly if brand names can be recalled. It is also relatively inexpensive, making it a cost-effective method for collecting dietary data. Furthermore, it requires only short-term memory, which is generally well tolerated by most people. Another advantage of the 24-hour recall method is that it is well accepted by respondents because they are not required to keep records or complete lengthy questionnaires. This means that their expenditure of time and effort is relatively low, making it more likely that they will participate in the study. It also means that probability sampling within populations and individuals is possible.

However, the 24-hour recall method also has several limitations. For instance, respondents may withhold or alter information about what they ate due to poor memory or embarrassment, or to please or impress the interviewer and researchers. They may also underreport binge eating, consumption of alcoholic beverages, and consumption of foods perceived as unhealthful. Conversely, respondents may overreport consumption of name-brand foods, expensive cuts of

meat, and foods considered healthful. Additionally, some foods may be eaten but not reported, while other foods may not be eaten but still be reported, leading to missing or phantom foods. Therefore, researchers must be aware of these limitations when interpreting the data.

Food frequency questionnaire

Food frequency questionnaires (FFQs) assess nutrient intake by determining how often a person consumes a limited number of foods that are major sources of nutrients. The questionnaires consist of a list of approximately 150 or fewer individual foods or food groups. Respondents indicate how often they usually consume the foods. Some FFQs do not give a choice of portion size and instead use “standard” portion sizes drawn from large-population data. The simple, or non-quantitative, FFQs format asks how often a person eats a particular food or food group. The semi-quantitative FFQs gives respondents an idea of portion size. In addition to frequency of consumption, the quantitative FFQs asks the respondent to describe the size of their usual serving relative to a standard serving. FFQs are relatively quick to administer and can be self-administered, machine read, or administered online. However, data quality may be better when administered by a trained interviewer. FFQs have limitations, such as a limited food list, lack of comprehensiveness, tediousness of longer questionnaires, and reliance on respondents' ability to describe their diet. Grouping foods under broad categories precludes collecting information about specific food items. Portion sizes must be typical of what is usually eaten, and their usefulness is questioned by research suggesting they may not be meaningful to some respondents. Frequency is a more important determinant of nutrient intake than portion size. According to Tokudome *et al.* (2001), dietary practices of the respondents can be assessed using the food frequency questionnaire. The consumption of food can be considered “regular” if ingested at least once a day or 4-5 times in a week, “frequent” when ingested 2-3 times a week and “rare” if ingested once a week or less.

Food diary

In this method, the respondent records, at the time of consumption, the identity and amounts of all foods and beverages consumed for a period of time, usually ranging from 1 to 7 days. Food and beverage consumption can be quantified by estimating portion sizes, using household measures, or weighing the food or beverage on scales. In many instances, household measures such as cups, tablespoons, and teaspoons or measurements made with a ruler are used to quantify portion size. Certain items, such as eggs, apples, or cans of soft drinks, may be thought of as units and simply counted. This method is sometimes referred to as the estimated food record because portion sizes

are estimated (that is, in terms of coffee cups, dippers, bowls, glasses, and so on), or household measures are used. When food is weighed, the record may be referred to as a weighed food record.

Diet history

The diet history approach is a method for assessing an individual's usual dietary intake over an extended period of time, such as the past month or year. This approach was developed by B.S. Burke during the 1940s and involves a trained nutritionist conducting an interview with the respondent. The interview includes questions about various aspects of the respondent's life that may be helpful in obtaining further information, such as eating habits, supplements, smoking, and exercise. Following this, a 24-hour recall is conducted to inquire about the respondent's usual pattern of eating during and between meals. The respondent provides information about types of food eaten, serving sizes, frequency and timing, and significant seasonal variations. The strengths of the diet history approach include the ability to assess usual nutrient intake, including seasonal changes, and obtain data on all nutrients. This method is one of the preferred ways of estimating usual nutrient intake. However, the approach requires a significant amount of time (1-2 hours), highly trained interviewers, and is costly in terms of coding. Additionally, nutrient intake tends to be overestimated, and the method relies on a cooperative respondent with the ability to recall their usual diet. Despite its limitations, the diet history approach is suitable for research purposes where a list of items that are typical of an individual's diet is required.

Duplicate food collection

When performing duplicate food collections, participants place in collection containers identical portions of all foods and beverages consumed during a specified period. This then is chemically analyzed at a laboratory for nutrient content. To prevent bacterial decomposition of the duplicate samples, they should be kept refrigerated and delivered to the laboratory daily. This method has the strength of potentially providing a more accurate determination of actual nutrient intake, compared with calculations based on food composition data. Values in composition tables may not be representative of nutrient levels in the particular foods that respondents consume because of seasonal or regional differences, agricultural practices, and losses during marketing and preparation. A participant may have eaten a food that was introduced recently into the marketplace that is not listed in a food composition table or database. Among the method's limitations are the necessity of preparing the additional amount of food to be collected and the work involved in measuring or weighing exactly duplicate portions of food and beverage.

2.15 Physical activity

Physical activity is any bodily movement produced by skeletal muscles that requires energy expenditure. Here, physical activity refers to all movement including during leisure time, for transport to get to and from places, or as part of a person's work. Both moderate- and vigorous-intensity physical activity improve health (WHO, 2022b).

All adults should engage in regular physical activity that includes at least 150–300 minutes of moderate-intensity aerobic physical activity, at least 75–150 minutes of vigorous-intensity aerobic physical activity, or an equivalent combination of both throughout the week, as well as muscle-strengthening activities at moderate or greater intensity that involve all major muscle groups twice a week or more (WHO, 2020d).

Physical activity may be measured with the help of self-reported questionnaire (example: IPAQ), self-report activity logs, direct observation, device accelerometer etc. (Louisa *et al.*, 2014). The International Physical Activity Questionnaires (IPAQ) comprises a set of 4 questionnaires. Long and short versions for use by either telephone or self-administered methods are available. The purpose of the questionnaires is to provide common instruments that can be used to obtain internationally comparable data on health-related physical activity (IPAQ, 2002). IPAQ (short) collects data on type, frequency, duration and intensity of physical activity and categorizes total physical activity performed across the week as inactive, minimally active and HEPA active according to total accumulated MET-minutes (IPAQ, 2004). A MET is defined as the resting metabolic rate, that is, the amount of oxygen consumed at rest, sitting quietly in a chair, approximately 3.5 ml O₂/kg/min. As such, work at 2 METS requires twice the resting metabolism or 7.0 ml O₂/kg/min and three METS requires three times the resting metabolism and so on (Jetté *et al.*, 1990).

2.16 Indicator of nutrition status

BMI

Body mass index (BMI) is a person's weight in kilograms divided by the square of height in meters. It is an inexpensive and easy screening method for weight category-underweight, healthy weight, overweight, and obesity which does not measure body fat directly, but is moderately correlated with more direct measures of body fat. Furthermore, BMI appears to be as strongly correlated with various metabolic and disease outcome as are these more direct measures of body fatness (CDC, 2023; WHO, 2022a). Table 2.1 shows the interpretation of BMI.

Table 2.2: Interpretation of BMI.

Interpretation	Asian BMI Range	International BMI Range
Underweight	<18.5	<18.5
Normal	18.5-22.9	18.5 – 24.9
Overweight	≥ 23.0 – 24.9	≥ 25.0 – 29.9
Obesity	≥ 25.0	≥ 30.0

Source: (WHO, 2000)

Waist and Hip Circumference and Waist-Hip ratio

Measurement of waist and hip circumference is another way of assessing fat deposits to identify the potential risks (CDC, 2023). Waist circumference should be measured at the midpoint between the lower margin of the least palpable rib and the top of the iliac crest, using a stretch-resistant tape that provides a constant 100 g tension. Hip circumference should be measured around the widest portion of the buttocks, with the tape parallel to the floor. For both measurements, the subject should stand with feet close together, arms at the side and body weight evenly distributed, and should wear little clothing. The subject should be relaxed, and the measurements should be taken at the end of a normal expiration. Each measurement should be repeated twice; if the measurements are within 1 cm of one another, the average should be calculated. If the difference between the two measurements exceeds 1 cm, the two measurements should be repeated. (WHO, 2008).

Table 2.3: Cut-offs of Waist circumference and Waist-hip ratio for South Asian women

Indicator	Cut-off points	Risk of metabolic complications
Waist circumference	>80 cm	Increased
Waist circumference	>88 cm	Substantially increased
Waist–hip ratio	≥0.85	Substantially increased

Source: (WHO, 2008)

Part III

Materials and Methods

3.1 Study Area

The study was conducted at Chichila rural municipality of Sankhuwasabha district, Koshi, Nepal. It is 702 m to 2298 m scattered around in elevation. It has an area of 88.63 square kilometers and consists of 5 wards (GON, 2022). The map of the study area is given in Appendix. According to 2011 census conducted by the Central Bureau of Statistics, it had total population of 7065 of which 3410 were male and 3655 were females (CBS, 2011).

3.2 Study Population

The population under study was reproductive age females (15-49 years) of Chichila rural municipality, Sankhuwasabha.

3.3 Selection Criteria

3.3.1 Inclusion criteria

1. Must be women belonging to the age 15 to 49 years.
2. Female, whose permanent residence is Chichila.

3.3.2 Exclusion criteria

1. Pregnant and lactating female.
2. Females, who were ill or not interested.

3.4 Research Design

A community based cross sectional survey was conducted among 15-49 years females from Chichila rural municipality in Sankhuwasabha to assess the dietary intake and nutritional status. The field work consisted of survey with the help of semi structured questionnaire followed by measurements of anthropometric variables.

3.5 Sample Size

The sample size was determined by using single proportional formula assuming rate of prevalence of malnutrition to be 50% and margin of error 7%. Confidence interval was taken 95% with the non-response rate 10%.

Mathematically,

For infinite population

$$n_0 = z^2 pq / d^2$$

Here,

n_0 = sample size for infinite population

Z = critical value at the given level of confidence (standard value of 1.96)

P = estimated prevalence of malnutrition

$$q = 1 - P$$

d = margin of error

So,

$$n_0 = z^2 pq / d^2$$

$$n_0 = 1.96^2 \times 0.5 \times 0.5 / (0.07)^2$$

$$n_0 = 196$$

As per the data, total number of females residing in Chichila was 1929 (CBS, 2011). So, N=1929

For finite population we have,

$$n = n_0 / [1 + (n_0 - 1) / N]$$

Here,

n = sample size for finite population

n_0 = sample size for infinite population

N = total number of finite populations

So, new sample size can be obtained as:

$$n = n_0 / [1 + (n_0 - 1) / N]$$

$$n = 196 / [1 + (196 - 1) / 1929]$$

$$n = 178.18$$

With addition of non-response rate of 10%, sample size becomes,

$$178.18 + 17.82 = 196$$

3.6 Sampling Technique

Cross-sectional descriptive study was conducted in Chichila rural municipal. All five wards were selected. Probability proportional to size (PPS) method was used for sampling and population of each ward was taken as per (CBS, 2011). Units of sample were selected proportionally from each ward as shown in Table 3.1. Each household of the ward was assigned with a number. And, household was chosen without replacement using computer generated random number to meet the sample size calculated proportionately. Only one female from each household were chosen for study.

Table 3.1: Probability proportional sampling

Ward number	Total female population	Sample size
Chichila 1	345	35
Chichila 2	447	45
Chichila 3	309	32
Chichila 4	394	40
Chichila 5	434	44
Total	1929	196

3.7 Research Instruments

Instruments used for the research work were:

1. Digital Weighing Machine: A digital weighing (microlife WS50), measuring up to 180 kg with the least count of 0.1 kg, to assess the weight of participants.
2. Stadiometer: A well calibrated stadiometer, measuring up to 200 cm with the least count of 0.1 cm, to assess the height of participants.
3. Measuring tape: A stretch-resistant tape was used to measure waist and hip circumference of sample with the least count of 0.01 m.
4. Questionnaire: A well designed and pretested set of questionnaires to collect information on demographic variables, socioeconomic condition, dietary practices and related habits, and environmental conditions of the target population.
5. Cups and spoons: Standardized cups and spoons for dietary recall.

3.8 Study Variables

3.8.1 Dependent Variables

The dependent variables under study were:

1. Body Mass Index: BMI of less than 18.5 kg/m² was classified underweight, 18.5 to 24.9 kg/m² was classified as normal, equal to and greater than 25.0 kg/m² was classified as overweight/obese; based on WHO standards of classification (WHO, 2016).
2. Waist Circumference: Waist circumference above 80 cm was identified as being abdominally obese (WHO, 2008).
3. Waist Hip Ratio: Waist to hip ratio equal to and greater than 0.85 was considered as abdominally obese (WHO, 2012).
4. Dietary Diversity Score: DDS of females was calculated based on Kennedy *et al.* (2010) guidelines. The DDS score of ≥ 5 was considered adequate (MoHP *et al.*, 2017).

3.8.2 Independent Variables

Independent variables included in this study were as follows:

1. Socioeconomic and demographic variables: Age, ethnicity, religion, marital status, income, parity, occupation, monthly income, education level, family size, family type.
2. Behavioral factors: Sleep, exercise, adequacy of physical activity and intensity of physical activity.

3. Eating behavior: Vegetarian/Non-vegetarian, have snacks, source of food production, smoking, alcohol intake, fasting, number of meals, eat together with family, skips meal
4. Health related factors: Menstrual disorder, contraceptive use
5. Dietary intake: Food frequency, food habit related variables (skipping of meal, fast food consumption etc.), adequacy of nutrient intake.

3.9 Pre-testing

Pre-testing of questionnaire and anthropometric tools was performed in few women of reproductive age of Chichila rural municipality. It was conducted in order to maintain accuracy and clarity of questionnaire, to check the consistency in interpretation of questions by respondents and to identify ambiguous items. As a result, no modification was made in questionnaire only the techniques of asking and probing females were learnt from pretest.

3.10 Validity and Reliability

To ascertain the degree to which the data collection instruments measure what they purposed to measure, the instruments were validated. Validity of weighing balance was ascertained by comparing the data provided by our weighing balance with standard weights. Instrument was set at 0 reading before taking measurements with standardized reference one.

Likewise, validity of stadiometer was ascertained by comparing measurements from our stadiometer with UNICEF's stadiometer. The questionnaire was pretested prior to data collection. The one-way ANOVA at 95% confidence level showed that the height and weight among pretest and survey was significantly indifferent from each other.

Validity and reliability of the study was ensured by pretesting of the tools. Questionnaire and the food frequency questionnaire were checked daily for completeness, consistency and clarity. Close supervision was done in the field.

3.11 Data Collection Techniques

Primary data was collected using semi structured questionnaire and anthropometric measurements. Interview was conducted with the respondent to fill the questionnaire. Secondary data was obtained from rural municipality, Nepal demographics health survey, Central bureau of statistics and key informants like female community health volunteers etc.

There were three sets of tools to gather the information one was semi-structured questionnaire, second was FFQ with WDDS questionnaire and 24-hour dietary recall noted down based on

respondents and third was the structured interview schedule to generate data regarding height, weight, waist circumference, hip circumference; which along with physical activity and dietary adequacy and diversity are explained below:

Height

To measure the subject's height, they were instructed to stand on a horizontal platform without shoes, with their heels together and arms hanging loosely. The subject's head was aligned with the Frankfurt plane, while their buttocks and shoulder blades were in contact with the vertical surface of the stadiometer. The subject was then instructed to take a deep breath and stand tall to aid in the straightening of their spine, while keeping their shoulders relaxed. The movable headboard on the stadiometer was lowered until it touched the crown of the subject's head. The height measurement was taken at maximum inspiration, with the examiner's eyes level with the headboard to avoid any parallax error. The reading was taken to the nearest millimeter, and if the reading fell between two values, the lower reading was recorded (CDC, 2023; Lee and Nieman, 2012; NHS, 2013)

Weight

The measurement of body weight was taken after the subject had emptied their bladder and removed heavy clothing. The balance was placed on a hard, flat surface, and the scale was zeroed out. The subject was then asked to stand unassisted in the center of the scale, looking straight ahead while remaining relaxed but still. The body weight was recorded to the nearest 0.1 kg (CDC, 2023; Lee and Nieman, 2012; NHS, 2013).

BMI (WHO, 2000).

BMI was calculated based on the formula $\text{Weight(kg)}/[\text{Height(m)}]^2$. Both Asian BMI cut-offs and International BMI was considered for data analysis and discussion.

Waist circumference

The waist circumference was measured at the midpoint between the lower border of the rib cage and the iliac crest using a non-stretchable tape. The tape was placed halfway between the lower border of the ribs and the iliac crest on a horizontal plane, ensuring that it was level around the body and parallel to the floor. The tape was then tightened around the body without depressing the skin, and two measurements to the nearest 0.1 cm were taken. The mean of the two measurements was recorded as the waist circumference (CDC, 2023; Lee and Nieman, 2012;

NHS, 2013). The cut-offs for waist circumference in South Asian women are 80 cm (WHO, 2008).

Hip circumference

It was measured around the highest point of buttock. Hip circumference was measured using a non-stretchable tape. Two measurements to the nearest 0.1cm were taken and the mean was recorded (CDC, 2023; Lee and Nieman, 2012; NHS, 2013).

Waist Hip Ratio

Waist Hip Ratio was calculated dividing measured waist circumference with measured hip circumference and value ≥ 0.85 was categorized as risk (WHO, 2008).

Dietary adequacy and diversity

24- hour dietary recall was employed to quantify food and drinks consumed in last 24 hours which was then used to find out intakes (of carbohydrate, protein, fat and iron) over the last 24 hours. Recommended dietary allowance given by ICMR (2020) was used to classify the adequacy of protein, fat and iron of the population. Estimated Average Requirement (EAR) was used to classify adequacy of calorie intake. Optimum level of salt intake was used as recommended by ICMR (2020).

The dietary diversity score of the women was calculated based on data collected by asking them to recall all the food items and drinks they had consumed the previous day from the time they woke up until they went to bed.

The data was collected based on the 9 food group score recommended by Kennedy *et al.* (2010) for assessment of Women dietary diversity score which were classified as:

1. Starchy staples
2. Dark green leafy vegetables
3. Other vitamin A rich fruits and vegetables
4. Other fruits and vegetables
5. Organ meat (liver, kidney, heart or other organ meats or blood-based foods)
6. Meat and fish
7. Eggs
8. Legumes, nuts and seeds
9. Milk and milk products

A point was awarded to each food group consumed over a reference period of time by the individual and sum of all was dietary diversity score of an individual.

Physical activity

Physical activity questionnaire was used to collect data on type, frequency, duration and intensity of physical activity during work, transportation and leisure time in a typical week. Data on physical activity were collected using the IPAQ short questionnaire v 2.0. Intensity of physical activity was categorized as inactive, minimally active and HEPA active to the score of each individual calculated following the short IPAQ questionnaire. For this total MET-minutes/week was calculated and physical activity level was determined as shown below:

Total MET-minutes/week = Walk (METs×min×days) + Moderate (METs×min×days) + vigorous (METs×min×days).

Where, MET factors for walk, moderate activity and vigorous activity are 3.3, 4 and 8 respectively. IPAQ categorical score is as follows:

1. Inactive : No physical activity is performed or physical activity with MET values less than 600 MET per week activity (IPAQ, 2004).
2. Minimally active: Physical activity with MET value 600 or greater than 600 per week or 3 or more day of vigorous activity of at least 20 minutes per day activity (IPAQ, 2004).
3. HEPA active : Vigorous-intensity activity on at least 3 days and accumulating MET value at least 1500 per week or 7 or more days of any combination of walking, moderate or vigorous intensity activities accumulating at least 3000 MET-minutes/week activity (IPAQ, 2004).

Adequacy of physical activity was determined using (WHO, 2020d) guidelines, where all adults are recommended to undertake regular physical activity at least 150–300 min of moderate-intensity aerobic physical activity, or at least 75–150 min of vigorous-intensity aerobic physical activity, or an equivalent combination of moderate-intensity and vigorous-intensity activity throughout the week along with muscle-strengthening activities at moderate or greater intensity that involve all major muscle groups on two or more days a week.

3.12 Data Management

Collected data was managed carefully, safety was ensured as raw information is important. Thus, collected data was coded then kept safely and was utilized for the purpose of analysis.

3.13 Data Analysis

Firstly, the data collected was checked for completeness and consistency. It was then edited, organized and entered manually in database using Microsoft excel 2016. Here, the qualitative data were transcribed and coded by assigning label to various categories. The data were then transferred to statistical software IBM Statistical Package for Social Science (SPSS) version 20 for further analysis. The collected data was analyzed by using both descriptive and inferential statistics.

From the data, collected from dietary recall, gram equivalents of those food consumed were first calculated which were converted into nutrient intake by using 'Food composition table for Nepal 2017'. Energy and nutrient intake of the female were compared with requirements for females as provided by ICMR (2020). Nutrient intake data was analyzed by using Microsoft Excel 2016. The chi square test was applied to test the association between the nutritional status and its associated factors. Mann-Whitney U and Kruskal-Wallis test was used to test the dietary diversity for significant difference among variables, including a post-hoc analysis.

3.14 Ethical Considerations

This research was conducted with the permission received from the Department of Nutrition and Dietetics, Central Campus of Technology along with verbal approval obtained from Chichila rural municipality administration. The objective of the research was explained on simple language and informed consent was obtained from the respondents. Privacy and confidentiality of the data was ensured at all levels.

PART IV

Result and Discussion

The cross-sectional study to assess the nutritional status and dietary habits of reproductive aged (15-49 years) females was conducted in Chichila rural municipal of Sankhuwasabha district. It examined the influence of a range of factors, including socioeconomic and demographic aspects, individual characteristics, dietary behaviors, and environmental conditions, on their nutritional health. The results obtained are elaborated upon under the subsequent headings:

4.1 Demographic and socio-economic characteristics

The information on demographic and socio-economic characteristics are shown below:

4.1.1 Age distribution

While analyzing the age demographics of the study participants, it was observed that the largest percentage, 34.6%, consisted of females aged between 20 to 29 years. The next prominent group was females aged 30 to 39 years, comprising 32.7% of the participants. A smaller proportion, 8.2%, was represented by study subjects aged 15 to 19 years, as detailed in Table 4.1. The mean age was found to be 31.57 ± 9.14 .

Table 4.1: Percentage distribution of age group of study population (n=196)

Age (in years)	Frequency	Percentage
15-19	16	8.2
20-29	71	36.2
30-39	64	32.7
40-49	45	22.9
Total	196	100

4.1.2 Ethnicity and religion distribution

Table 4.2 shows the ethnicity and religion distribution of participants. Most of the participants were *Janajati* followed by *Khas-Arya* and *Dalit*. The surveyed population was predominantly Kirats followed by Hindus, Buddhists and others. CBS (2021a) stated majority of female population residing in Chichila rural municipal were *Janajati* contributing 92.6% of total female

population while *Dalit* and *Khas-Arya* contributed 4.95% and 2.98% respectively. 8.8% of population in Chichila rural municipal were Hindus, 25.8% were Buddhist, 52% were Kirats rest were Christians and others (CBS, 2021b).

Table 4.2: Percentage distribution of religion and ethnicity of study population (n=196)

Variables	Frequency	Percentage
Ethnicity		
<i>Khas-Arya</i>	13	6.6
<i>Janajati</i>	165	84.2
<i>Dalit</i>	18	9.2
Religion		
Hindu	38	19.4
Kirat	123	62.8
Buddhist	30	15.3
Others	5	2.6

4.1.3 Marital status and parity

The participants in the study were categorized based on marital status, with the majority being married. Significant portion 58.2% of them reported having one to two parities. On the other hand, a considerable proportion 31.6% of females had zero parity. Additionally, a smaller segment 10.2% of the participants had a parity of more than or equal to three, as shown in Table 4.3.

Table 4.3: Percentage distribution of marriage and parity of study population (n=196)

Variables	Frequency	Percentage
Marital status		
Married	140	71.4
Unmarried	56	28.6
Parity		
0	62	31.6
1-2	114	58.2
≥3	20	10.2

4.1.4 Socio-economic factors

Table 4.4 summarizes the frequency and percentage distribution of socio-economic factor of the study population where, a significant proportion 56.6% of the respondents were engaged in agricultural activities to sustain their livelihoods. This suggests a considerable reliance on agriculture within the studied population.

When examining income distribution, the majority 64.3% of the respondents had a monthly income equal to or exceeding thirty thousand rupees. This indicates a relatively favorable financial situation for a significant portion of the population. Interestingly, more than half of the respondents were found to have a monthly income surpassing the average monthly income of Nepalese families, as established by NRB (2014). This suggests that a considerable segment of the surveyed population enjoys an income level above the national average.

Turning to education, a remarkable trend emerges. Only a small fraction 11.7% of the respondents were identified as illiterate. Analysis of the age-wise literate population in Chichila given by CBS (2021c) showed the literacy rate of reproductive aged female in the local body to be 91.5%. This is particularly due to old aged females who can't read and write. The majority of the surveyed population 88.3% demonstrated literacy, indicating a positive educational landscape. The educational attainment further reveals that a significant proportion pursued formal education up to the secondary level 40.8%, with the next largest group having completed basic education

i.e. 32.7%. This shows drastic improvement is happening in female education along with time in the region.

Table 4.4: Distribution of socio-economic factors (n=196)

Variables	Frequency	Percentage
Occupation		
Agriculture	111	56.6
Service	26	13.3
Business	12	6.1
Labor	3	1.5
Housewife	27	13.8
Student	17	8.7
Monthly Income		
<30,000	70	35.7
≥30,000	126	64.3
Education Level		
Illiterate	23	11.7
Informal	9	4.6
Basics	64	32.7
Secondary	80	40.8
University	20	10.2

4.1.4.1 Type of family

The study revealed that a majority, specifically of the participants, were situated within nuclear family structures, indicating a distinct trend towards smaller family units. In contrast, the

remaining 37.2% of females living in joint families signify a less prevalent but still relevant aspect of family composition.

Furthermore, the study found that family consisting less than 5 family members were prevailing as shown in the Table 4.5. This data underscores the need to consider family size as an influential factor when assessing socio-economic and lifestyle patterns among the respondents.

Table 4.5: Distribution of family type and family size (n=196)

Variables	Frequency	Percentage
Family type		
Nuclear	123	62.8
Joint	73	37.2
Family size		
Less than 5	111	56.6
Equal to or more than 5	85	43.3

According to CBS. (2021b), the average family size of Chichila household was 3.95 per family below the national average of 4.37.

4.1.5 Behavioral factors

The findings related to behavioral factors of the population showed, more than half the of population, slept for less than 8 hours per day. The study also examined the physical activity levels of the female participants. A significant majority of population, engaged in daily exercise, while a smaller portion did not partake in any exercise routine. Remarkably, the findings indicated that a substantial majority of the respondents, exhibited a commendable level of physical activity. This highlights a positive trend of proactive engagement in physical activities among the surveyed females. Conversely, a smaller fraction of the participants, were identified as having insufficient levels of physical activity, suggesting room for improvement in their exercise routines.

A deeper exploration into the intensity of physical activities undertaken by the participants revealed compelling patterns. A significant proportion engaged in activities classified as moderate in intensity, signifying a balanced approach to physical exertion. A relatively smaller cohort of the participants, pursued activities characterized as heavy in intensity, Additionally, 17.4% of the

respondents were associated with a low level of physical activity, suggesting an area where more engagement might be beneficial. For a comprehensive breakdown of these findings, Table 4.6 provides a visual representation of the distribution of physical activity levels.

Table 4.6: Distribution of behavioral factors of study population (n=196)

Variables	Frequency	Percentage
Sleep		
< 8 hours	105	53.7
8 hours or more	91	46.3
Exercise		
Yes	125	63.8
No	71	36.2
Adequacy of physical activity		
Adequate	163	83.1
Inadequate	33	16.9
Intensity of Physical activity		
Inactive	34	17.4
Minimally active	150	76.5
HEPA active	12	6.2

4.2 Eating behaviors

Table 4.7 shows the distribution of the eating behavior of the study population. Most of them, ate foods in their kitchen, were non-vegetarians and had habit of eating snacks daily. Most of the females in the area did not smoke but drink alcohol. Majority of females did not fast and ate three meals a day.

Table 4.7: Distribution of eating behavior of study population (n=196)

Variables	Frequency	Percentage
Veg/Non-veg Eating Behavior		
Lacto vegetarian	11	5.7
Ovo vegetarian	10	5.1
Lacto-ovo vegetarian	3	1.5
Non vegetarian	172	87.7
Have Snacks		
Yes	118	60.2
No	78	39.8
Source of Food		
Own Production	37	18.9
Market	38	19.4
Both	121	61.7
Smoking		
Yes	9	4.6
No	187	95.4
Drink alcohol		
Yes	102	52
No	94	48
Fasting		
Yes	35	17.9
No	161	82.1
No of meals		
Two	36	18.4
Three	80	40.8
Four	73	37.2
Five	7	3.6
Skip Meals		
Yes	109	55.6
No	87	44.4

Among the females that had the habit of skipping their meals, breakfast was mostly skipped. Most of the times meal skipped was in 5 or more days as responded by the surveyed females as shown in table 4.8.

Table 4.8: Distribution of study population who skipped meals (n=109)

Variables	Frequency	Percentage
Type of Meal Skipped		
Breakfast	46	42.2
Snacks	36	33.1
Both	27	24.7
Frequency of Meal Skipped		
Once or twice a week	26	23.8
Three, Four Times a week	38	34.8
Five or More days	45	41.4

4.3 Health related factors

Table 4.9 highlights the distribution of health-related factors among females of Chichila. Most of the females said they suffer from menstruation related disorders and out of 71.4 % of females who responded to contraceptive use related questions, most of them said they use contraceptive device as a means of birth control.

Table 4.9: Distribution of health-related factor of study population

Variables	Frequency	Percentage
Menstrual disorder(n=196)		
Yes	104	53
No	92	47
Contraceptives use(n=140)		
Yes	119	85
No	21	15

4.4 Dietary intake

4.4.1 Food consumption pattern

Dietary practices of the respondents were assessed using the FFQ. The consumption of food was considered “regular” if ingested at least once a day or at least 4 times a week, “frequent” when ingested 2-3 times a week and “rare” if ingested once a week or less (Tokudome *et al.*, 2001).

As shown in Table 4.10, the percentage of females who consumed pulses regularly was in the lower side, while most of them consumed it only frequently, with significant percentage of rare consumption. Most of the population did not know about the importance of legumes and pulses in the diet. Green leafy vegetable consumption was either frequent or regular in most of the participants similar was the frequency of other vegetable consumption in the population, while in contrast, rare frequency was in the higher side. The consumption of dairy products, fruits, meat, eggs was very poor on the study population. Also, the consumption of fruits was very poor. They believed that consumption of fruits every day is not necessary which played a role in lower consumption of fruits. The seasonal variations as well as climatic condition influenced their fruit consumption pattern.

While the consumption of tea or coffee was found to be higher in the population. The consumption of products made up of refined flour, cold drinks was also found to be higher.

Table 4.10: Food consumption frequency of study population (n=196)

Food groups	Regular Frequency (%)	Frequently Frequency (%)	Rare Frequency (%)
Pulses	20(10.2%)	102(52%)	74(37.8%)
GLV	70(35.7%)	112(57.1%)	14(7.1%)
Other vegetables	40(20.4%)	112(57.1%)	44(22.4%)
Dairy	26(13.3%)	47(24%)	123(62.8%)
Fruit	11(5.6%)	57(29.1%)	128(65.3%)
Meat	3(1.5%)	64(32.7%)	129(65.8%)
Egg	1(0.5%)	57(29.1%)	138(70.4%)
Tea/Coffee	101(51.5%)	45(23%)	50(25.5%)
Cold drinks	36(18.4%)	54(27.6%)	106(54.1%)
Fast food	44(22.4%)	78(39.8%)	74(37.8%)

4.4.2 Dietary diversity score

The mean dietary diversity score (DDS) was found to be 4.90 ± 1.44 and only 61.2% of the study subjects were found to consume adequate diversified foods (at least 5 different food groups) which is demonstrated in figure 4.1.

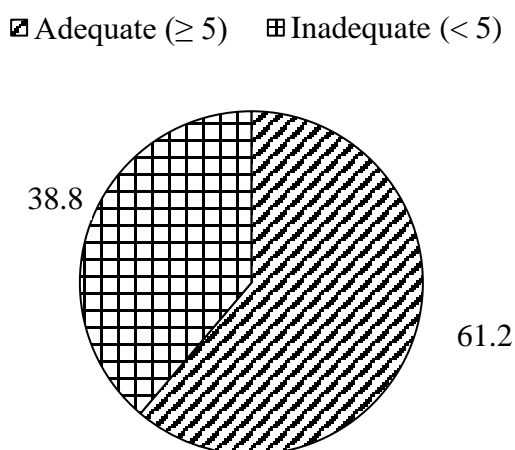


Fig. 4.1 Percentage distribution of adequacy of dietary diversity in study population

Table 4.11 shows distribution of dietary diversity both in terms of frequency and percentage against the variables age, education, income and nutritional status. Comparatively more portion of 20-29 years female had inadequate dietary diversity, which was nearly half among illiterate females. About two fifth of both income group (\geq Rs. 30,000 and $<$ Rs, 30,000) females had inadequate dietary diversity. Adequacy of DDS distribution against BMI showed, normal population had more percentage of people with inadequate dietary diversity. This may be because of the limitation of DDS, where food and drink consumed in last day is only assessed.

Table 4.12 shows factors with significantly differing median dietary diversity score. Since, DDS data was not normal, Shapiro-wilk ($p < 0.05$), Mann-Whitney U test and Kruskal-Wallis test were brought into use. Address, skipping meals, cooking fuel and have snacks demonstrates significant difference in the measured variable. In post-hoc analysis median DDS of Chichila 2 vs Chichila 4 was found to be significantly differing.

Table 4.11: Distribution of dietary diversity score among reproductive age female (n=196)

Variable	Frequency	Dietary diversity in range	
		Adequate(%)	Inadequate(%)
DDS	196	120 (61.2)	76 (38.8)
Age			
15-19	16	10 (62.5)	6 (37.5)
20-29	71	41 (57.8)	30 (42.2)
30-39	64	42 (65.6)	22 (34.4)
40-49	45	27 (60)	18 (40)
Education			
Illiterate	23	12 (52.1)	11 (47.9)
Literate	173	108 (62.4)	65 (37.6)
Income			
<30,000	70	42 (60)	28 (40)
≥30,000	126	78 (62)	48 (38)
BMI			
Underweight	18	12 (66.7)	6 (33.3)
Normal	111	62 (55.9)	49 (44.1)
Overweight	67	46 (68.7)	21 (31.3)
Waist Circumference			
Normal	97	54 (55.7)	43(44.3)
Overweight/Obesity	99	66 (66.7)	33 (33.3)
Waist Hip Ratio			
Normal	79	50 (63.3)	29 (36.7)
Risk	117	70 (59.8)	47 (40.2)

Table 4.12: Factors with significantly differing median dietary diversity score (n=196)

Variables	Mean±SD	p-value	Post-hoc	**p-value
Address				
Chichila 1	5.1±1.4	<0.01	Chichila 2 vs Chichila4	<0.01
Chichila 2	4.3±1.5			
Chichila 3	5.04±1.2			
Chichila 4	5.4±1.6			
Chichila 5	4.9±1.2			
Skips meal				
Yes	4.7±1.4	0.010		
No	5.2±1.4			
Fuel				
Firewood	4.8±1.3	0.006		
LPG	5.6±1.7			
Have snacks				
Yes	5.1±1.4	0.028		
No	4.6±1.5			

p value was calculated using Mann-Whitney U and Kruskal-Wallis test and **p-value of Posthoc analysis was done using Dunn's test . <0.05 is statistical level of significance.

4.4.3 Nutrient intake

Table 4.13 shows mean nutrient intake of study population while table 4.14 shows distribution of intake of nutrients namely carbohydrate, protein, fat, iron and salt intake of the study population. The result of this study showed that majority of females had adequate calorie intake. This study also concluded that all study population had adequate carbohydrate intake. Intake of total carbohydrate should be 45-65% of the total energy (ICMR, 2020). Most of the female had inadequate protein and iron intake while fat intake in most of them were adequate. Most of the study subjects had salt intake below prescribed optimum levels.

Table 4.13: Mean nutrient intake of study population (n=196)

Nutrient	Mean±SD
Calorie	2348.14±694.63
Carbohydrate	444.52±150.11
Protein	56.15± 20.43
Fat	38.80 ±19.38
Iron	22.55 ±6.37

Table 4.14: Adequacy of nutrient intake of study population (n=196)

Variables	Frequency	Percentage
Calorie		
Adequate	169	86.2
Inadequate	27	13.8
Carbohydrate		
Adequate	196	100
Inadequate	0	0
Protein		
Adequate	58	29.6
Inadequate	138	70.4
Fat		
Adequate	154	78.6
Inadequate	42	21.4
Iron		
Adequate	84	42.9
Inadequate	112	57.1
Salt Intake		
Optimum <5 gm	116	59.2
Excess >5 gm	80	40.8

4.5 Nutritional status of the study population

Table 4.15 shows most of the females had height of greater than 145 cm and weight of greater than 45 kgs, the categorization of which is done based on MoHP *et al.* (2022) categorization of height and weight.

Table 4.15 Anthropometric status of women of reproductive age (n=196)

Variables	Frequency	Percentage
Height (in cm)		
≤ 145	37	18.9
> 145	159	81.1
Weight (in kg)		
≤ 45	33	16.8
> 45	163	83.2

4.5.1 Nutritional status based on International BMI classification

The result of this study was analyzed according to International BMI categorization as given by WHO. Figure 4.2 illustrates the fact that significant percentage of the women of reproductive age in Chichila are malnourished. Out of total population, 9.2% were underweight, 56.6% were normal and remaining 34.2% were overweight/obese with 4.6% of total population being obese.

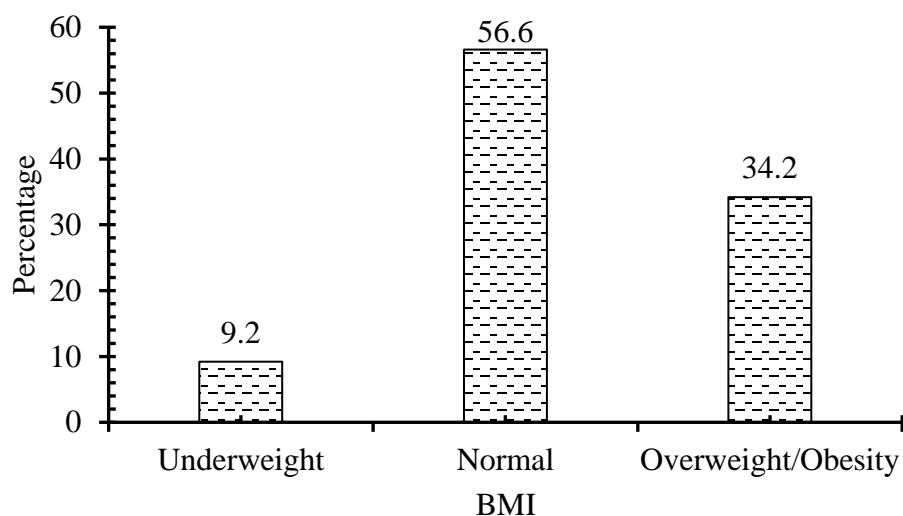


Fig. 4.2 Nutritional status based on BMI

According to MoHP *et al.* (2017), a total of 17% women are thin, with 11% mildly thin and 6% moderately and severely thin. Further, 22% are overweight or obese, with 17% being overweight and 5% obese in Nepal. Underweight percentage among females in Chichila was found out to be lower than nationwide prevalence, meanwhile it was in the higher end in regards to overweight/obesity prevalence.

4.5.2 Nutritional status based on Asian BMI classification

The result of this study was analyzed according to Asian BMI categorization. Figure 4.3 illustrated the fact that significant percentage of the women of reproductive age in Chichila were overweight.

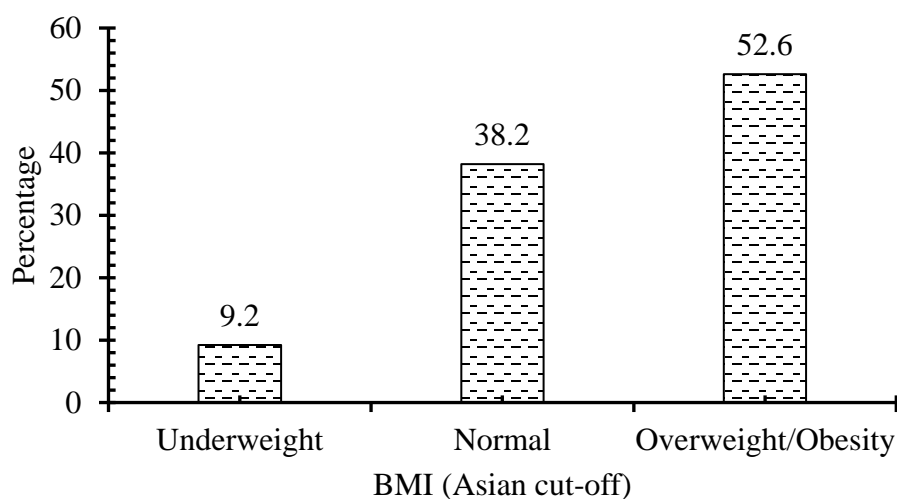


Fig. 4.3 Nutritional status based on Asian BMI

Findings of MoHP *et al.* (2017) when analyzed by Al Kibriya (2019), according to Asian BMI cut-off revealed, prevalence of underweight in females to be 17.1% , overweight and obesity to be 25.6% and 13.3% respectively i.e. 38.9% of females were overweight/obese and rest were normal. Underweight as in the case of International BMI classification, was found out to be lower among Chichila females in comparison to national data, while overweight/obesity was found to be higher than national data.

4.5.3 Nutrition status based on waist circumference

While classifying the population based on waist circumference, it was observed out of total population, 49.5% were normal and 50.5% were centrally obese as illustrated in figure 4.4.

Non-Communicable Disease risk factors: STEPS survey 2019 by Dhimal *et al.* (2020), found out 19.5% of women were overweight according to waist circumference. This is lower than what was found out in Chichila rural municipal, one of the reasons for this may be because the cutoff of WC in Dhimal *et al.* (2020) was taken >88cm as risk of metabolic complication was the matter

of prime focus in that study, but this study being focused around nutrition status primarily, the cut-offs for WC is taken to be >80 cm. In the similar type of study, the prevalence of abdominal obesity among adult residing in North-West Ethiopia was 36.36% in men and 54.81% in women (Mekonnen *et al.*, 2020).

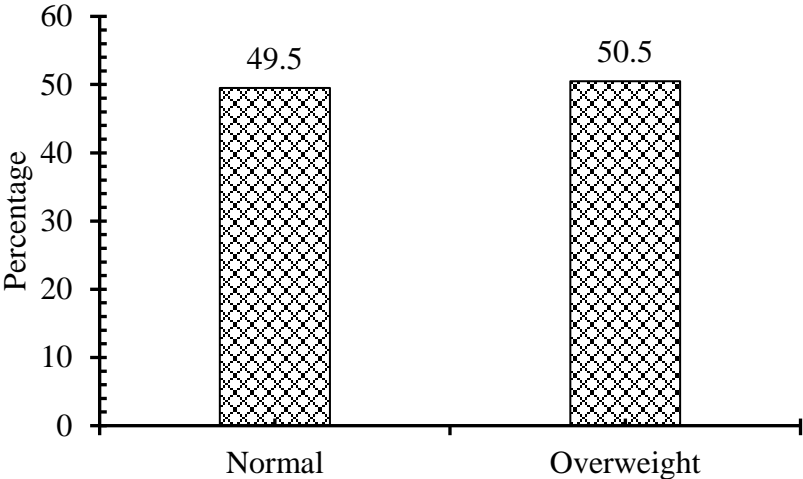


Fig. 4.4 Nutritional status based on waist circumference

4.5.4 Nutritional status based on WHR

The result of this study was analyzed according to International WHR categorization as given by WHO. Out of total population, 40.3% were normal and 59.7% were at risk which is pictured in figure 4.5.

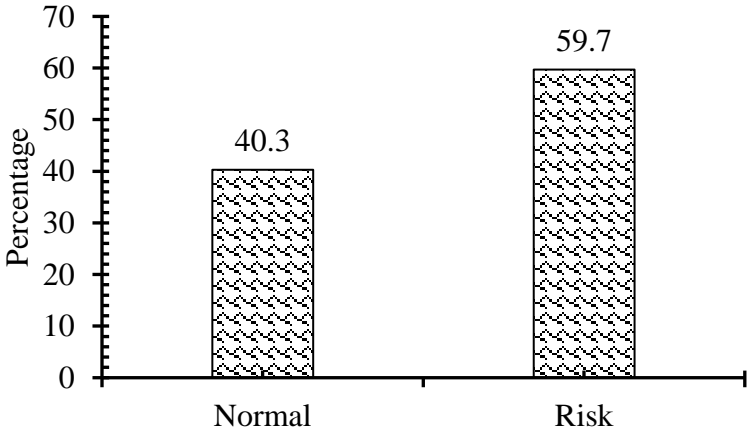


Fig. 4.5 Nutritional status based on WHR

The study by Dhimal *et al.* (2020), found 70.2% of females in Nepal were at risk under WHR criteria. In a study by IIPS and ICF (2021) in India, it was observed 57% of females had higher WHR. Another study by Ahmad *et al.* (2016), found higher WHR in 54.2% of Malaysian females.

4.6 Factors associated with nutrition status

4.6.1 Factors associated with nutritional status based on BMI

The chi-square analysis showed that variables such as marital status ($p=0.005$), alcohol consumption ($p=0.037$), adequacy of physical activity ($p=0.019$), nutrition awareness ($p=0.012$) were found to be significantly associated with nutritional status based on BMI as shown in table 4.16.

Table 4.16: Factors associated with nutritional status based on BMI (n=196)

Factors	Underweight Frequency (%)	Normal Frequency (%)	Overweight/Obese Frequency (%)	Chi- Square	p-value
Marital status					
Married	7 (38.9)	81 (73)	52 (77.6)	10.724	0.005
Unmarried	11 (61.1)	30 (27)	15 (22.3)		
Drink alcohol					
Yes	5 (27.8)	56 (50.5)	41 (61.2)	6.607	0.037
No	13 (72.2)	55 (49.5)	26 (38.8)		
Intensity of physical activity					
Inactive	2 (11.1)	26 (24.8)	6 (8.2)	11.780	0.019
Minimally active	14 (77.8)	76 (72.3)	60(82.2)		
HEPA active	2 (11.1)	3 (2.9)	7 (9.6)		
Nutrition awareness					
Yes	5 (27.7)	27 (22.8)	5 (7.4)	8.782	0.012
No	13 (72.2)	84 (77.2)	62 (92.5)		

A similar type of survey conducted by Verma *et al.* (2021) in India has also shown that marital status, older age, higher education, richest wealth quintile could most probably affect the BMI of female of reproductive age. It stated that the prevalence of overweight and obesity was high in married women than never married women (39.4% and 17.8%).

Acharya *et al.* (2017), found education level, nutrition knowledge, marital status, caste, household size and income were the factors associated with nutritional status of reproductive age women in rural Nepal. Marital status may affect overweight and obesity due to the excessive gestational weight gain (GWG) and post-partum weight retention (PPWR) and being less conscious to their figures (Farpour-Lambert *et al.*, 2018). Al Kibriya (2019), in an analysis of Nepal demographic and health survey 2016 showed the association between age and BMI among Nepalese adults. Shrestha *et al.* (2016), in their study among Nepalese adults found out that the refined grains-meat-alcohol pattern was significantly associated with high BMI among females, revalidating the fact that excess sugar intake makes us fat (Yu *et al.*, 2022).

4.6.2 Factors associated with nutritional status based on Waist Circumference

Concerned to abdominal obesity based on the waist circumference measurement; age ($p=0.002$), marital status ($p=0.021$), parity ($p=0.003$), nutrition awareness ($p<0.001$), cold drinks (0.017) and protein intake ($p=0.009$) were found to be significantly associated with surveyed females as shown in Table 4.17

Literatures with study of factors associated with waist circumference among reproductive aged female in Nepal are either limited or inaccessible. However, in international level an study conducted by Faridah *et al.* (2015) in South Asian population reported that waist circumference increased with age. Likewise, another study conducted in Nigeria, reported that waist circumference exhibited significant positive correlation with age in both sexes with a more stronger correlation in females compared to males (Adegoke *et al.*, 2022). A similar type of study conducted by Gupta *et al.* (2022) found that individuals aged 30–49 years and 50–69 years and being ever married were associated with higher prevalence abdominal obesity. Such obesity increases with increase in parity and higher at late menopausal age (Amiri *et al.*, 2023). Our findings suggests association of protein intake and meat (protein rich food) with less adiposity around waist which is rightly aligned to the conclusion drawn by Santesso *et al.* (2012). Beverage consumption is associated with all kind of obesity (Bosire, 2020).

Table 4.17: Factors associated with nutritional status based on Waist Circumference (n=196)

Factors	Normal Frequency (%)	Overweight Frequency (%)	Chi- Square	p-value
Age				
15-19	12 (12.4)	4 (4.1)	14.913	0.002
20-29	43 (44.4)	28 (28.3)		
30-39	21 (21.6)	43 (43.4)		
40-49	21 (21.6)	24 (24.2)		
Marital Status				
Married	62 (63.9)	78 (78.8)	5.309	0.021
Unmarried	35 (36.1)	21 (21.2)		
Parity				
0	41 (42.2)	21 (21.2)	11.352	0.003
1-2	50 (51.5)	64 (64.6)		
≥3	6 (6.3)	14 (14.2)		
Nutrition awareness				
Yes	29 (29.9)	8 (8.0)	15.227	<0.001
No	68 (70.1)	91 (92.0)		
Protein intake				
Adequate	37 (38.1)	21 (21.2)	6.742	0.009
Inadequate	60 (61.9)	78 (78.8)		
Consumption of cold drinks				
Regular	11 (11.3)	25 (25.2)	8.136	0.017
Frequent	25 (25.7)	29 (29.3)		
Rare	61 (63.0)	45 (45.5)		

4.6.3 Factors associated with nutritional status based on WHR

The chi-square test showed that age (p=0.047), parity (p=0.05), nutrition awareness (p= 0.008), adequacy of physical activity (p= 0.041), consumption of fast foods (p=0.006) and consumption of cold drinks (p=0.004) was significantly associated with waist hip ratio which is shown in Table4.18

Table 4.18: Factors associated with nutritional status based on WHR (n=196)

Factors	Normal Frequency(%)	Risk Frequency(%)	Chi- Square	p-value
Age				
15-19	10 (12.6)	6 (5.1)	7.961	0.047
20-29	32 (40.5)	39 (33.3)		
30-39	18 (22.7)	46 (39.3)		
40-49	19 (24.0)	26 (22.2)		
Parity				
0	31 (39.2)	31 (26.5)	5.988	0.05
1-2	44 (55.6)	70 (59.8)		
≥3	4 (5.2)	16 (13.7)		
Nutrition awareness				
Yes	22 (27.8)	15 (12.8)	6.954	0.008
No	57 (72.2)	102 (87.2)		
Intensity of physical activity				
Inactive	19 (24.1)	15 (12.8)	6.383	0.041
Minimally active	58 (73.4)	92 (78.6)		
HEPA active	2 (2.5)	10 (8.6)		
Consumption of fast foods				
Regular	9 (11.4)	35 (29.9)	10.331	0.006
Frequent	39 (49.4)	39 (33.3)		
Rare	31 (39.2)	43 (36.8)		
Consumption of cold drinks				
Regular	6 (7.6)	30 (25.6)	11.051	0.004
Frequent	22 (27.8)	32 (27.3)		
Rare	51 (64.6)	55 (47.1)		

Information related to WHR and its associated factors in reproductive age females waits for the optimum explorations and research in Nepal, data regarding this is poorly accessible. According to findings by Bhattarai *et al.* (2018), parity was the factor associated with WHR among reproductive aged female residing in Dharan whereas marital status and age had near correlation. In another study by S. Subedi *et al.* (2020), factors associated with WHR among reproductive aged females in Bharatpur was age, marital status, parity, physical activity, calorie and carbohydrate intake.

PART V

Conclusions and Recommendations

5.1 Conclusions

The study focused on dietary diversity and nutritional status of the reproductive age(15-49 years) females of Chichila, Shankhuwasabha. Following conclusions can be drawn from the study.

1. The percentage of regular consumption of pulses, dairy, meat and egg were low and the consumption of protein and iron were inadequate.
2. The mean dietary diversity score (DDS) was found to be 4.9 ± 1.4 and only 61.2% of the study subjects were found to consume adequate diversified foods (at least 5 different food groups).
3. Significant difference in dietary diversity of females was found among different wards, skipping of meals, fuel source and having snacks.
4. A significant portion of the study population showed malnutrition based on BMI, while more than half had central obesity, and close to 60% were at risk according to waist-to-hip ratio (WHR).
5. Marital status, alcohol, physical activity, and nutrition awareness were associated with BMI; age, marital status, parity, nutrition awareness, protein intake, and cold drinks were associated with waist circumference; and age, parity, nutrition awareness, physical activity, fast food, and cold drinks were associated with WHR in females.

5.2 Recommendations

Based on the results of this study following recommendations could be made:

1. The prevalence of poor nutritional status, particularly prevalence of obesity points towards the necessity of interventional programs related to nutrition, dietary practices and lifestyle improvement.
2. As more numbers of female were found to be overweight and obese, concerned agency need to formulate appropriate policy to combat this.
3. As protein intake was found to be inversely associated with overweight and obesity people should be recommended to consume protein rich diet less in fat.

Part VI

SUMMARY

Nutrition is the process by which living organisms take in and use food for the maintenance of life, growth, reproduction, the functioning of organs and tissues, and the production of energy. Optimal nutrition is achieved through a balanced diet that provides all essential nutrients, while poor nutrition can result from inadequate or excessive nutrient intake or poor utilization. Poor nutrition can lead to reduced immunity, increased susceptibility to disease, impaired physical and mental development, and reduced productivity. Similarly, an eating pattern is the totality of all foods and beverages consumed. All foods consumed as part of a healthy eating pattern help meet the nutritional needs without exceeding limits

A community based cross sectional study was carried out to assess dietary diversity and nutrition status of reproductive aged (15-49 years) female population of Chichila rural municipality, Sankhuwasabha. Anthropometric measurement was used to calculate BMI, waist circumference and waist-hip ratio. Data on socio-economic, environmental, behavioral and dietary factors and dietary diversity was collected using semi-structured questionnaire. Microsoft excel and SPSS version 20 were used to analyze data, Mann-Whitney U test and Kruskal-Wallis test was used to find difference in dietary diversity in population while chi square test was performed to analyze the factors associated with BMI, WC and WHR cut-offs.

The analysis of the survey revealed, the percentage of females consuming pulses regularly were 10.2%, consuming green leafy vegetables were 35.7%, other vegetable consuming were 20.4%, dairy, fruit, meat and egg consuming were 13.3%, 5.6%, 1.5% and 0.5% respectively. Females who consumed tea/coffee, cold drinks and fast food regularly were 51.5%, 18.4% and 22.4% respectively. Significant difference in dietary diversity of females was found among different wards, skipping of meals, fuel source, gender who earns, having snacks and provision of water purification. Out of total females, 9.2% of females were underweight, 34.2% were overweight/obese and remaining were normal according to international BMI classification. Central obesity was present in 50.5% females and 59.7% had high waist-hip ratio. Nutrition awareness was the common factor affecting BMI, waist circumference as well as waist-hip ratio. Properly planned interventions from authorities would be vital in improving food consumption and nutritional status of the target population.

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Appendix A Consent form

Namaste! I, Miss Manisha Niroula, a graduate student of Nutrition and Dietetics in Central Campus of Technology, Dharan; am going to conduct dissertation work in Chichila rural municipality for the degree of Bachelor of Science in Nutrition and Dietetics. The topic for the study is “DIETARY DIVERSITY AND NUTRITIONAL STATUS OF REPRODUCTIVE-AGED FEMALES IN CHICHILA RURAL MUNICIPAL, SANKHUWASABHA”

Under this study, nutritional status, food consumption, dietary diversity, factors affecting nutrition status and food consumption pattern of reproductive aged females of 15 to 49 years of age will be surveyed.

Congratulations, you have been selected for the survey. You will be asked some general questions related to your family, environment, socio-economic condition, dietary intakes, physical activity and nutritional knowledge. Your height and weight will also be measured. Some questions might be personal. Privacy of the respondent will not be misused. Your participation in the study is important. You may not answer some or all of the questions if you find them personal or sensitive. I hope you will cooperate.

Would you like to participate in the study?

Yes, I provide written consent for the participation in the study and permit to ask necessary questions and take necessary measurements required for the study.

Signature of participant: _____

Signature of surveyor: _____

Date:

Date:

Place:

Place:

Appendix-B Survey questionnaire

DIETARY DIVERSITY AND NUTRITIONAL STATUS OF REPRODUCTIVE AGED (15-49 YEARS) FEMALE

Code no:

Date:

A. General introduction

1. Name of Respondent:

2. Date of birth:

3. Age in years:

4. Address:

5. Ethnicity

6. Religion

a) Hindu b) Buddhist c) Kirat d) Other(specify)

7. Marital status

a) Married b) Unmarried

8. Number of parity

a) 0 b) 1-2 c) ≥ 3

B. Socio economic factors

9. Main occupation:

a) Agriculture b) Service c) Business d) Labor e) Housewife f) Student

10. Other occupation:

11. Place of work:

12. Monthly income

a) <30,000 b) $\geq 30,000$

13. Education level

a) Illiterate b) Informal c) Basics d) Secondary e) University

14. No. of family members:

15. No. of female members: Number of male members:

16. Type of family:

a) Nuclear b) Joint

C. Anthropometry

Category	Reading 1	Reading 2	Reading 3	Final Reading
Height (cm)				
Weight (kg)				
Waist Circumference (cm)				
Hip Circumference (cm)				

D. Preparation of Food

17. Who fetches food from farm?

18. Who buys food from market?

19. Who provide money to buy food?

20. Who fetches the fuel for cooking?

21. Who fetches the water for cooking?

22. Who is involved in preparing food?

23. What is the fuel used for cooking?

E. Distribution of food

24. Who is responsible for distributing food during meal time in each eating group?

25. In what order food is received by the family member?

26. Do members of family eat on same plate and or dish or different?

a) Same b) Different

27. Do you have same eating time every day?

a) Yes b) No

F. Food Frequency

Food groups	Daily	4-5times	2-3times	Once in week	in 15 days or less	Never
Cereals, Roots and Tubers						
Pulses and legumes						
Milk and dairy						
Meat, fish, poultry						
Eggs						
Dark Green Leafy Vegetables						
Vegetables and fruits rich in Vitamin A						
Other Vegetables Other fruits						
Junk foods/Fast Foods						
Tea and Coffee						
Cold drinks						

G. 24hours dietary recall

	Description of food	Brand	Serving
Breakfast			
Lunch			
Snacks			
Dinner			

H. Dietary Diversity Score

Did you eat any of the following food groups yesterday?

Question number	Food Group	YES = 1 NO = 2
1	Starchy staples	
2	Dark green leafy vegetables	
3	Other vitamin A rich fruits and vegetables	
4	Other fruits and vegetables	
5	Organ meat	
6	Meat and fish	
7	Eggs	
8	Legumes, nuts and seeds	
9	Milk and milk products	
Did you eat anything meal or snack outside the home yesterday?		

I. Hygiene and sanitation

28. Which is your main source of drinking water in your family?

a) Sprouts b) Kuwa well (covered/uncovered) c) River d) Drinking water tap

e) Other:

29. Is the water purified?

a) Yes b) No

If yes: method of purification _____

30. Do you have toilet facility in your house?

a) Yes b) No

J. Physical activity

Think about all the vigorous activities that you did in the last 7 days. Vigorous physical activities refer to activities that take hard physical effort and make you breathe much harder than normal. Think only about those physical activities that you did for at least 10 minutes at a time.

1. During the last 7 days, on how many days did you do vigorous physical activities like heavy lifting, digging, aerobics, or fast bicycling?

_____ days per week

_____ No vigorous physical activities then Skip to question 3

2. How much time did you usually spend doing vigorous physical activities on one of those days?

_____ hours per day

_____ minutes per day

_____ Don't know/Not sure

Think about all the moderate activities that you did in the last 7 days. Moderate activities refer to activities that take moderate physical effort and make you breathe somewhat harder than normal. Think only about those physical activities that you did for at least 10 minutes at a time.

3. During the last 7 days, on how many days did you do moderate physical activities like carrying light loads, bicycling at a regular pace, or doubles tennis? Do not include walking.

_____ days per week

_____ No moderate physical activities then Skip to question 5

4. How much time did you usually spend doing moderate physical activities on one of those days?

_____ hours per day

_____ minutes per day

_____ Don't know/Not sure

Think about the time you spent walking in the last 7 days. This includes at work and at home, walking to travel from place to place, and any other walking that you have done solely for recreation, sport, exercise, or leisure.

5. During the last 7 days, on how many days did you walk for at least 10 minutes at a time?

_____ days per week

_____ No walking then Skip to question 7

6. How much time did you usually spend walking on one of those days?

_____ hours per day

_____ minutes per day

_____ Don't know/Not sure

The last question is about the time you spent sitting on weekdays during the last 7 days. Include time spent at work, at home, while doing course work and during leisure time. This may include time spent sitting at a desk, visiting friends, reading, or sitting or lying down to watch television.

7. During the last 7 days, how much time did you spend sitting on a week day?

_____ hours per day

_____ minutes per day

_____ Don't know/Not sure

K. Dietary intake and food habits

38. Is your meal size affected by the presence of friends or family members?

a) Yes b) No

39. How many meals do you have in a day?

40. Do you skip any meal?

a) Yes b) No

If yes, which meal do you skip.

a) Breakfast b) Snacks c) Both

41. How often do you skip this meal?

a) Once - twice a week b) Three-four times a week c) Five or more days

42. Do you replace your food with other items?

a) Yes b) No

43. Do you eat left over foods?

a) Yes b) No

44. Do you stay fasting?

a) Yes b) No

45. Do you eat together with your family?

a) Yes b) No

46. Do you have snacks?

a) Yes b) No

47. What is the main source of food for your family?

a) Own production b) Purchased from market c) Both d) Others

48. At home, where do you usually eat?

a) Dining room/Kitchen b) Bedroom c) In front of the TV. d) Other places

49. Are you a vegetarian?

a) Yes b) No

If vegetarian, why are you a vegetarian?

a) Religious causes b) Health consciousness c) To stop cruelty towards animals d) Others

50. How many glasses (300 ml) of water do you drink/day?

a) 1 b) 2-4 c) 5-7 d) 8 or more

51. Do you earn money?

a) Yes b) No c) Other who earns_____

52. Do you buy food from school canteen/ shops /vendor? a) Yes b) No

If yes, what do you usually buy? _____

53. How do you feel about your own weight?

a) Overweight b) Normal c) Thin

54. Have you ever tried losing weight?

a) Yes b) No

55. Have you ever tried gaining weight?

a) Yes b) No

56. Do you watch your figure/weight?

a) Yes b) No

57. Do you smoke?

a) Yes b) No

58. Do you drink alcoholic beverages?

a) Yes b) No

59. What kind of salt do you use?

a) iodized b) non-iodized

60. Amount of salt consumed per month. _____

61. How do you store your salt? _____

62. Which kind of oil do you use for cooking?

a) Vegetable oil b) Animal oil c) Others

63. Amount of oil used per month. _____

64. Have you got any nutritional education from any institution?

a) Yes b) No

65. Do you use any kind of oral contraceptives?

a) Yes b) No

66. Do you have any menstrual disorders?

a) Yes b) No

Appendix-C Photo Gallery



1. Interview with respondent



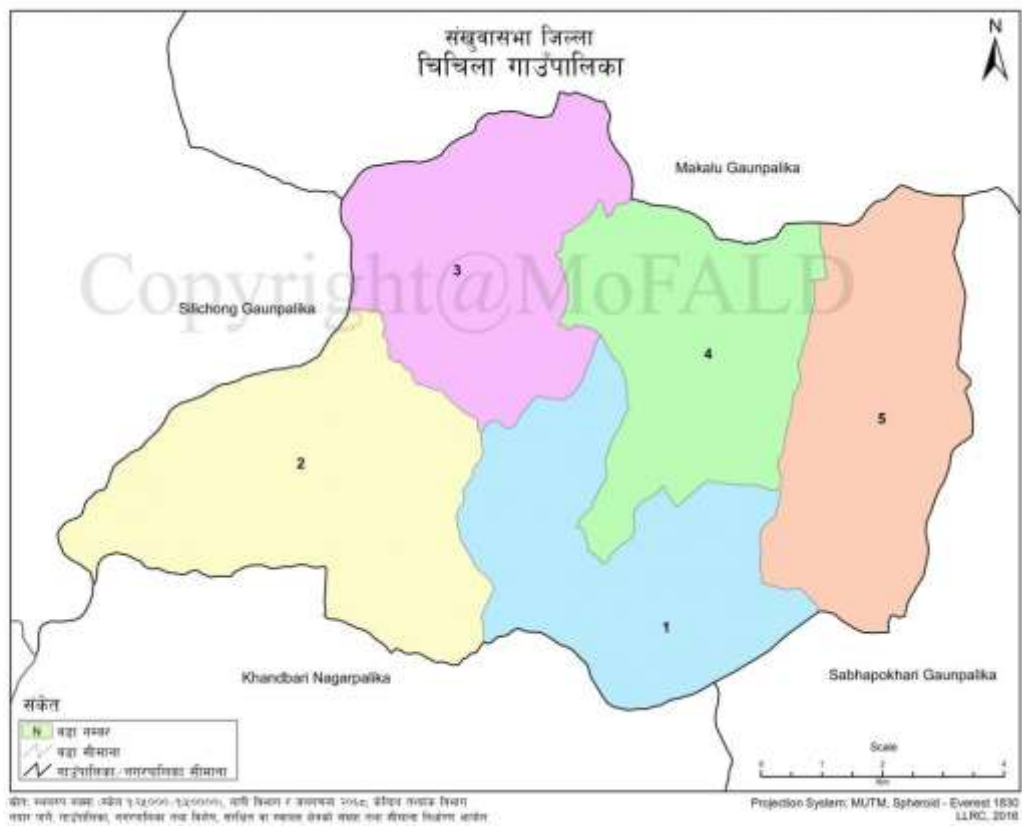
2. Interview with respondent



3. Standardization of portion size

Appendix-D

Survey Site



Survey site is Chichila rural municipality as shown in the image above.

Source: MoFAGA (2023)