COMPARATIVE STUDY ON NUTRITIONAL STATUS BETWEEN BRITISH GURKHA TRAINEES AND COLLEGE STUDENTS BETWEEN THE AGE OF 17-21 YEARS IN DHARAN SUB-METROPOLITAN CITY

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Comparative Study on Nutritional Status between British Gurkha Trainees and College Students between the Age of 17-21 Years in Dharan Sub-Metropolitan City

A dissertation submitted to Department of Nutrition and Dietetics, Central Campus of 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 ***Comparative Study on Nutritional Status between British Gurkha Trainees and College Students between the Age of 17-21 Years in Dharan Sub-Metropolitan City*** presented by **Kiran Gadtaula** has been accepted as the partial fulfillment of the requirement for the **B.Sc. degree in Nutrition and Dietetics**

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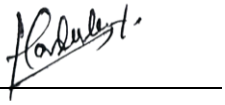

(Kiran Gadtaula)

Abstract

A community based cross-sectional descriptive study was conducted in Dharan sub-metropolitan city, Nepal to assess the nutritional status of British Gurkha trainees and college students with 110 participants each and aged between 17-21 years. Data was collected through self-administered questionnaire. Collected data was analyzed using SPSSv26 and Microsoft Excel. T-test, Chi-square test and Fisher's exact test were used to test the association between the variables. Anthropometric measurements (height, weight, body mass index, waist-hip-ratio), body composition and dietary assessments (24-hour dietary recall, food frequency questionnaire) were used as indicators to determine and differentiate the nutritional status of participant groups.

Results revealed a higher prevalence of underweight students (21.82%) compared to trainee participants (8.18%). No trainee participants were overweight or obese, while 14.55% students were overweight and 4.55% students were obese. College students had lower physical activity level and higher sedentary time than trainee participants (p-value <0.001). Factors like family income, eating outside the house, skipping meals, late night snacks, fat adequacy and consumption of legumes and pulses, fish, eggs, fruits, carbonated drinks and packaged food were associated with nutritional status among trainee participants (p-value <0.05). Similarly, factors like religion, family occupation, number of siblings, place to eat at home, skipping meals, late night snacks, body weight satisfaction, sedentary time, fat adequacy and consumption of packaged food and carbonated drinks were associated with nutritional status among college students (p-value <0.05). Strategic implementation of nutritional interventions at both individual and community levels can significantly improve the nutritional status of both the participant groups.

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List of Abbreviations

Abbreviations	Full form
ACSM	American College of Sports Medicine
ASPEN	American Society for Parenteral and Enteral Nutrition
BIA	Bio impedance analysis
BMI	Body mass index
CDC	Centers for Disease Control and Prevention
CI	Confidence interval
CT	Computed tomography
CVD	Cardiovascular disease
DALY	Disability adjusted life year
DEXA	Dual – energy X-ray absorptiometry
DFTQC	Department of Food Technology and Quality Control
FAO	Food Agricultural Organization
FBS	Food balance sheet
FCT	Food composition table
FFM	Fat free mass
FFQ	Food frequency questionnaire
GHI	Global hunger index
GLVs	Green leafy vegetables
HCES	Household consumption and expenditure survey
IBM	International Business Machines
ICMR	Indian Council of Medical Research
IEG	Independent Expert Group
IPAQ	International physical activity questionnaire
IQR	Inter quartile range
LBM	Lean body mass
LEA	Low energy availability
MET	Metabolic equivalent
MoFAGA	Ministry of Federal Affairs and General Administration
MoHP	Ministry of Health and Population
MPI	Multi – dimensional poverty index

MRI	Magnetic resonance imaging
NCD	Non – communicable disease
NSO	National Statistics Office
RDA	Recommended dietary allowance
REE	Resting energy expenditure
SD	Standard deviation
SDG	Sustainable development goal
SPSS	Statistical package for the social sciences
TEE	Total energy expenditure
UNDP	United Nations Development Programme
UNICEF	United Nations Children's Fund
WHO	World Health Organization
WHR	Waist hip ratio

Part I

Introduction

1.1 General introduction

Adolescence to early adulthood is a transitional period of life (Viner *et al.*, 2015). Although the degree of changes may seem less than the changes that occurred during adolescence, young adulthood is also a period of maturation and changes (Bonnie *et al.*, 2015). As a result of the significant biological and psychosocial changes experienced during adolescence, various aspects of the lives of adolescents are impacted, leading to a shift in the prevalence of diseases and health-related behaviors from infectious to non-communicable conditions (WHO, 2014). The dietary choices made in childhood and adolescence can have long-lasting effects on adult health, fitness, and nutritional status making it crucial to maintain good nutrition practices to support metabolic functioning, repair and regeneration, and also prevent chronic conditions (Medicine, 2023).

The nutritional status of an individual can be defined as the result between the nutritional intake received and the nutritional demands, and should allow for the utilization of nutrients to maintain reserves and compensate for losses (Fernández-Lázaro and Seco-Calvo, 2023). Physical activity is any bodily movement produced by skeletal muscles that requires energy expenditure (WHO, 2022b). Exercise is a subset of physical activity that is planned, structured, repetitive, and purposive in the sense that improvement or maintenance of one or more components of physical fitness is an objective (Caspersen *et al.*, 1985). Regular exercise reduces the risk of cardiovascular morbidity and mortality by up to 44% (Lee *et al.*, 2011) and also lessens all-cause mortality (Paffenbarger *et al.*, 1994). Physical activity can balance the energy input and energy expenditure (Hill *et al.*, 2013) and can reduce the prevalence of overweight and obesity thereby improving the nutritional status (Jakicic *et al.*, 2018).

World Health Organization (WHO) (2020b) recommends that adolescents aged less than 18 years accumulate at least an average of 60 minutes per day of moderate-to-vigorous intensity physical activity focusing more on aerobic exercises, whereas people aged 18 years and above should accumulate at least 150-300 minutes of moderate-intensity physical activity or 75-150 minutes of vigorous-intensity physical activity per week. However,

27.5% (1.4 billion) adults and 81% adolescents worldwide do not meet the recommended level of physical activity to improve and protect their health (WHO, 2022a).

The Brigade of Gurkhas is a distinctive institution within the British Army, renowned for its exceptional and formidable soldiers. Presently, the Brigade of Gurkhas employs more than 4000 Gurkhas across various occupations. On an annual basis, numerous young Nepalese men undergo arduous physical training and rigorous evaluation in pursuit to become a Gurkha soldier in the British Army (Army, 2023a).

1.2 Statement of the problem

With rising urbanization and globalization, overweight and obesity has been major health problem among the people (Mendez and Popkin, 2004; Fox *et al.*, 2019). Overweight and obesity are linked to more deaths worldwide than underweight. Once considered a high-income country problem, overweight and obesity are now on the rise in low- and middle-income countries with urban–rural overweight differential is shrinking in many countries (Ford *et al.*, 2017). This prevalence of overweight and obesity in late adolescents and young adults can have dreadful impact on the later stages of their life as it contribute to chronic diseases like diabetes, cardiovascular disease (Anil *et al.*, 2019), chronic kidney diseases and musculoskeletal disorders (Collaborators, 2017).

College going students are unduly prone to consume fast food (Banik *et al.*, 2020) and also have poor eating habits (Pokharel and Dhungel, 2023; Thi *et al.*, 2024). Such habits can contribute to weight gain and obesity among college students (Abraham *et al.*, 2018). Skipping meals with low consumption of fruits, vegetables and high consumption of fat and sodium (Rodrigues *et al.*, 2017) can result in micronutrient deficiencies including vitamin D, vitamin E, selenium, phosphorus (Louzada *et al.*, 2015; Falcão *et al.*, 2019), folate, calcium (Falcão *et al.*, 2019; Mediratta *et al.*, 2023), niacin, zinc (Louzada *et al.*, 2015; Mediratta *et al.*, 2023), vitamin B12, iron, magnesium, copper (Louzada *et al.*, 2015), vitamin A, riboflavin and calcium (Mediratta *et al.*, 2023).

Similarly, low physical activity levels in adolescence significantly increase the risk of obesity in young adulthood (Guddal *et al.*, 2020). The lack of physical activity is due to a precarious knowledge of the benefits associated with practicing physical activity, low motivation, time constraints, and, in many cases, the lack of adequate facilities (Carrasco-

Luna *et al.*, 2018). Sedentary lifestyle (Alahmadi *et al.*, 2024) along with consumption of carbonated /soft drinks and fast foods have also been the cause of overweight and obesity among adolescents in Nepal (Singh *et al.*, 2021).

Dharan, a sub-metropolitan city in Sunsari district of Koshi province, in eastern Nepal, is the initial (phase 1) selection site for British Gurkha Army (Army, 2023b). Moreover, no any studies regarding the nutritional status of the trainees have been conducted in Dharan sub-metropolitan city. Gurkha trainees are also engaged in intense physical training, likely requiring higher energy and specific nutrient intakes compared to college students thus making them ideal group for comparison. College students might face convenience-driven or budget-restricted food choices, while Gurkha trainees might have access to controlled or structured meals focused on physical performance. Furthermore, the high energy and nutrient demand of the trainees may not be fulfilled due to their intense physical activity.

1.3 Objectives of the study

1.3.1 General objective

The main objective of the study is to assess and compare the nutritional status between British Gurkha trainees and college students between the age of 17-21 years in Dharan sub-metropolitan city.

1.3.2 Specific objectives

a) To determine the nutritional status of British Gurkha trainees and college students aged between and 17-21 years in Dharan sub-metropolitan city and explore the difference in their nutritional status.
b) To assess the body composition of both the participant groups.
c) To identify the difference in demographic, socioeconomic, lifestyle and dietary factors between both the participant groups.
d) To compare the nutritional status between these participant groups.
e) To identify the associated factors affecting the nutritional status of both the participant groups.
f) To determine the nutritional adequacy or inadequacy through their dietary habits.

1.4 Conceptual framework

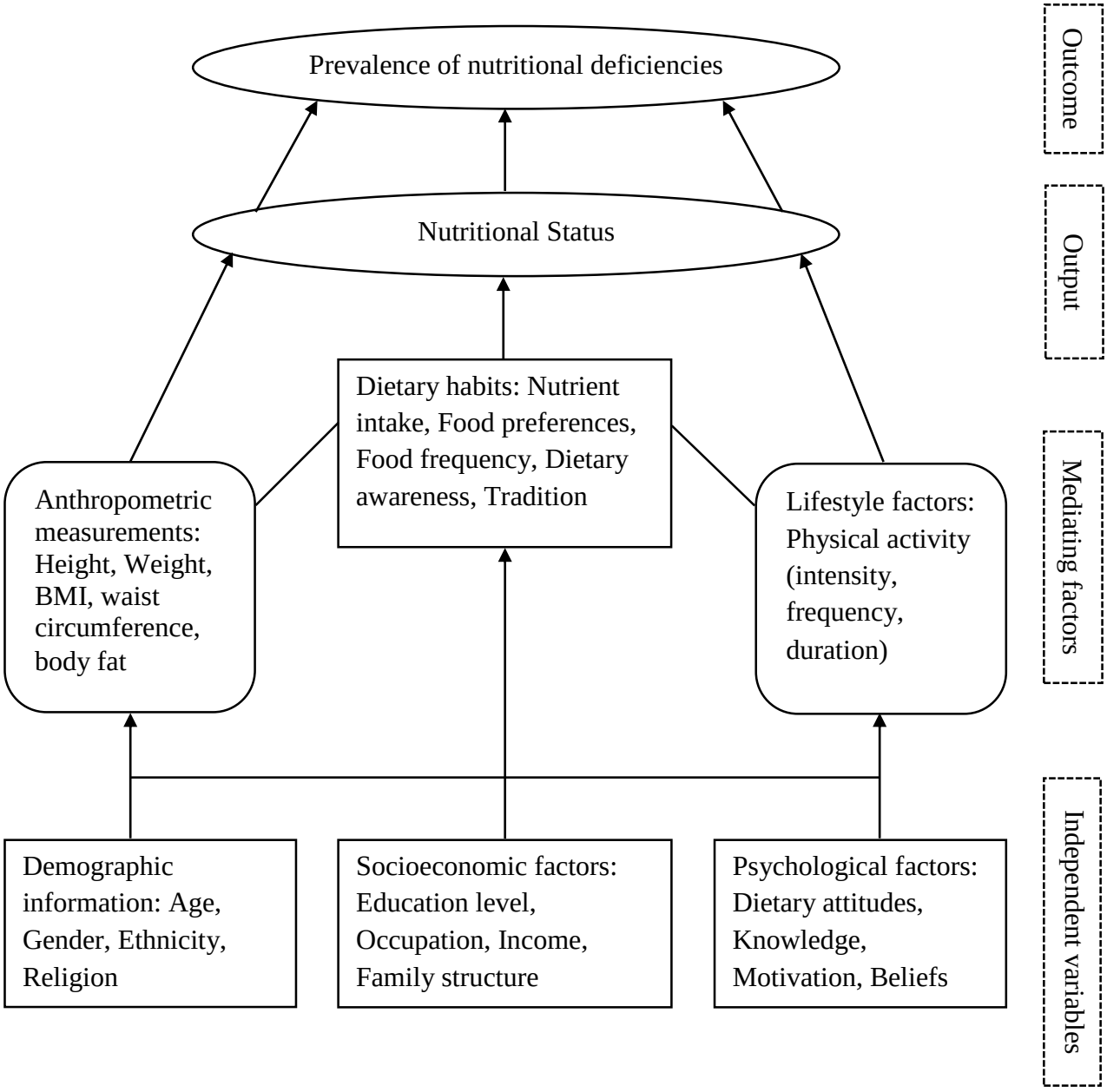

Fig. 1.1 Conceptual framework for the study

Adapted from: (UNICEF, 2003; Barakat *et al.*, 2022)

1.5 Research questions

a) What is the nutritional status of British Gurkha trainees and college students aged between 17-21 years in Dharan sub-metropolitan city?
b) How does nutritional status vary between these two participant groups?
c) What are the factors affecting their nutritional status?
d) Are there significant differences in body composition between British Gurkha trainees and college students?
e) Are there significant difference in demographic, socioeconomic and lifestyle factors between these two groups?
f) What are the difference in food preference and dietary intake patterns between these two groups?

1.6 Significance of the study

There is limited literature about the comparative study on nutritional status among young adults in Nepal who are physically active and those maintaining sedentary lifestyle. These studies are crucial for implementing prevention of the early occurrence of chronic diseases. The findings of the study will have following implications:

i. Provide information on the nutritional status of British Gurkha trainees and college going students and present the current situation of nutrition among young adults in Dharan sub-metropolitan city.
ii. Identify the nutritional gap between these two participant groups.
iii. Discover the impact of physical activity on nutritional status.
iv. Contribute to the development of dietary interventions to improve overall health and well-being of young adults.
v. Provide insights into broader public health issues and guide recommendations for improving dietary habits in the general population.
vi. Helpful in the prevention of long term health issues among young adults by recognizing the impact of dietary habits and physical activity on long term well-being.

Part II

Literature review

2.1 Nutrition

Nutrition as a science is the study of food systems, foods and drinks, and their nutrients and other constituents; and their interactions within and between all relevant biological, social and environmental systems (Beauman *et al.*, 2005). Nutrition involves the study of food and its various constituents (such as nutrients and other substances), along with their connections to health and disease. It also includes processes within the body (ingestion, digestion, absorption, transport, functions, and disposal of end products); and the social, economic, cultural, and psychological implications of eating (Insel *et al.*, 2014).

Good nutrition is associated with improved health outcomes, improved immune function, safer pregnancy and delivery, reduced risk of Non-Communicable Diseases (NCDs) such as Cardiovascular Disease (CVD), type II diabetes and obesity and improved life expectancy (CDC, 2021; WHO, 2024).

2.2 Nutritional Status

Nutritional status has been defined as an individual's health condition as it is influenced by the intake and utilization of nutrients (Todhunter, 1970). Nutritional status of an individual is the result between the nutritional intake received and the nutritional demands, and allowance for the utilization of nutrients to maintain reserves and compensate for losses (Fernández-Lázaro and Seco-Calvo, 2023).

Optimal nutritional status can be achieved by consuming sufficient, but not excessive, sources of energy, essential nutrients, and other food components (such as dietary fiber) and preventing toxins or contaminants (Council, 1989). Adequate nutrition is essential to achieve optimal physical performance, prevent musculoskeletal injuries, and maintain a positive mood state (Chapman *et al.*, 2019). The health and wellness of individuals can be adversely affected by an imbalance in their nutritional status. Thus, the early identification of an individual's nutritional status through the process of nutritional screening and assessment allows for timely intervention, which in turn helps to maintain their health and wellness and enhance quality of life (Kesari and Noel, 2023).

2.3 Factors affecting nutritional status

There are multiple factors that can affect the nutritional status of an individual. Causal factors such as socioeconomic, environmental, biological, psychological factors and health facilities can have significant impact on nutritional status of the individual.

2.3.1 Socioeconomic factors

There has been a historical evidence that various socio economic factors such as, employment, income, education of the household head, household size, family life cycle, race and ethnic origin and geographical location can impact the nutritional status (Morgan, 1986). A study conducted by Acharya *et al.* (2017) in Nepal showed that education level, occupation and income, family type, access to health services as well as poor environmental condition also contributes to malnutrition. Likewise, family type (Hamann *et al.*, 2023; Mahara *et al.*, 2023) ethnicity, maternal educational level, and occupation also affect the nutritional status in Nepal (Hamann *et al.*, 2023).

A vicious cycle exists between poverty and malnutrition which impacts the socio-economic status of the people (Siddiqui *et al.*, 2020). According to Multi-dimensional Poverty Index (MPI) in 2021, 17.5 percent of the population in Nepal is multi-dimensionally poor while an additional 17.8 percent is classified as vulnerable to multidimensional poverty (UNDP, 2023). Similarly 20.27% Nepalese still live below poverty line with 18.34% Nepalese living in urban area (NSO, 2024).

2.3.2 Psychological factors

Important and life-changing transitions typically occur during the late adolescence and young adulthood which are characterized by adaptation to changing physical and social contexts, increase in independence and development of one's individuality, identity and competence, (Arnett and Jensen, 2010; Medicine (US) and Council, 2011). Along with these changes, unhealthy behavior and making unhealthy food choices also increases (Deforche *et al.*, 2015). Lack of motivation, male apathy towards diet (Munt *et al.*, 2017), loneliness, boredom, nervousness, upset or happiness (Ganasegeran *et al.*, 2012), coping strategies, impulsivity, self-restraint, craving and habit strength (Kombanda *et al.*, 2022) are the psychological factors that drives young adults' health behaviours. Similarly, socio-

psychological determinants such as socialization, social norms and pressure (Kombanda *et al.*, 2022), unhealthy diet of family and friends, widespread presence of unhealthy foods and expected consumption of unhealthy foods in certain situations are found to be associated with the poor nutritional status among young adults (Ganasegeran *et al.*, 2012).

2.3.3 Behavioural factors

Many unhealthy behaviours usually starts in adolescence such as tobacco use, alcohol consumption and physical inactivity (Sawyer *et al.*, 2012). Unhealthy food consumption is common during adolescence which includes excessive consumption of soft drinks (Reppas *et al.*, 2022), fatty and salty snacks with reduced consumption of fruits, vegetables, and milk/dairy products and these habits are concerning because of their close association with increased risks for obesity and cardiovascular disease (Rodrigues *et al.*, 2017). Poor eating habits is also prevalent among military trainees (Kitunen *et al.*, 2020). A study conducted by Mahara *et al.* (2023) in Kanchanpur district of Nepal showed that factors like, consumption of sugar, chocolate, sweetened drink and untreated drinking water can lead to malnutrition.

Similarly, habit of skipping meals have negative impact on nutritional status (Kumari *et al.*, 2019; Sönmez and Nazik, 2019). Alcohol (Lieber, 2000) and smoking (Ortega Anta *et al.*, 2021) also have detrimental effect on nutritional status which is prevalent among college students (Pradhan *et al.*, 2013; Shriprasad and Kallihal, 2021). Modern lifestyle behaviors have contributed towards a decrease in the duration of sleeping hours among individuals and short sleeping hours among adolescents is associated with increased body mass index (BMI) and central adiposity and poor physical and mental health (Bruce *et al.*, 2017; Gupta *et al.*, 2022). Lower level of physical activity with increased sedentary behaviour also have higher risk of having abnormal nutritional status (Deforche *et al.*, 2015; Munawar and Lontoh, 2021).

2.3.4 Dietary Inadequacy

Adolescents and young adults have been described as having poor diet choices that are associated with obesity, meal skipping and snacking (Isa and Masuri, 2011). Micronutrient deficiencies due to lifestyle is prevalent where overweight and obese individuals seemed to have higher inadequacies than normal weight individuals (Farhat *et al.*, 2019). College

students tend to make their own food choices based on cost of food and availability of fast food. The lack of knowledge of healthy food choices affects eating habits and nutritional status negatively. Failure to meet the recommended intakes of fruits and vegetables and frequent snacking habits with a higher frequency of fast food consumption leads to compromised nutritional status (Ganasegeran *et al.,* 2012). Similarly, inadequate protein intake can also lead to insufficient micronutrient intake especially by those who enter the military training (Gwin *et al.*, 2019).

Apart from this, physiological factors such as age, sex, body status and pathological factors like genetics, infections, medical and surgical illness, surgery, trauma, malignancies and medications can also affect the nutritional status (Kesari and Noel, 2023).

2.4 Assessment of nutritional status

Nutritional assessment can be defined as the interpretation of information from dietary, laboratory, anthropometric and clinical studies. The information can be used to determine the nutritional status of the individual or population as influenced by intake and utilization of nutrients (Gibson, 2005). Nutritional assessment provides timely, high quality and evidence based information for setting goals, strategizing, monitoring and evaluating interventions targeted to eradicating hunger and reducing the burden of all forms of malnutrition (FAO, 2024). It can also be used to identify high-risk groups and to assess the role of different epidemiological factors in nutritional deficiencies (Shrivastava *et al.*, 2014).

According to American Society for Parenteral and Enteral Nutrition (ASPEN), a comprehensive nutritional assessment involves a thorough clinical examination (history and physical examination), anthropometric measurements, diagnostic tests, and dietary assessments (Mueller *et al.*, 2011). These components are used in the forms of survey, surveillance, screening or intervention to identify the nutritional problems and also to formulate effective nutritional intervention programs (Gibson, 2005).

2.4.1 Anthropometric measurements

Anthropometry is the measurement of the variations of the physical dimensions and gross composition of the human body at different age levels and degrees of nutrition. Anthropometric measurements are widely used to assess body size and body composition

for the assessment of nutritional status and health, at both the individual and population levels (Gibson, 2024). The advantages of anthropometric measurements according to Gibson (2002a) are:

i. The procedures use simple, safe, non-invasive techniques which can be applicable to large sample sizes.
ii. Equipment required is inexpensive, portable, and durable and relatively unskilled personnel can perform measurement procedures.
iii. Information is generated on past long-term nutritional history, which cannot be obtained with equal confidence using other techniques.
iv. The methods are precise and accurate, provided that standardized techniques are used.
v. Secular trend can be evaluated by using these methods.

The core elements of anthropometry are height, weight, head circumference, body mass index (BMI), body circumferences to assess for adiposity (waist, hip, and limbs), and skinfold thickness (Casadei and Kiel, 2022).

BMI

BMI is a simple and widespread indicator for the diagnosis of underweight and obesity. It is calculated as the ratio between body mass (in kilograms) and height squared (in meters). The cutoff point of BMI to classify individuals is shown in **Table 2.1**.

Table 2.1 Categorization of BMI

BMI	Nutritional status
Below 18.5	Underweight
18.5–24.9	Normal weight
25.0–29.9	Overweight
30.0–34.9	Obesity class I
35.0–39.9	Obesity class II
Above 40	Obesity class III

Source: WHO (2010)

Waist–hip ratio (WHR)

WHR, which is waist circumference divided by the hip circumference is another anthropometric tool to identify individuals at increased risk of obesity-related morbidity due

to accumulation of abdominal fat. **Table 2.2** shows the cut-off point for WHR and risk of metabolic complications as given by WHO (2008).

Table 2.2 Cut – off point for WHR and risk of metabolic complications

Indicator	**Cut-off points**		**Risk of metabolic complications**
	Men	**Women**	
Waist Circumference	>94 cm	>80 cm	Increased
Waist Circumference	>102 cm	>88 cm	Substantially increased
WHR	≥0.90	≥0.85	Substantially increased

2.4.2 Biochemical Assessment

The biochemical investigations are extremely helpful in detecting early changes in body metabolism and nutrition before the appearance of overt clinical signs. In addition, the results obtained are precise, accurate and reproducible (Shrivastava *et al.*, 2014). Both static and functional tests can be used to detect subclinical deficiency states or to confirm a clinical diagnosis. Static biochemical tests measure either a nutrient in biological fluids or tissues or the urinary excretion rate of the nutrient or its metabolite whereas functional biochemical tests measure the extent of the functional consequences of a specific nutrient deficiency, and hence have greater biological significance than the static laboratory tests (Gibson, 2002a).

2.4.3 Clinical examination

Clinical examination is the estimation of nutritional status on the basis of recording a medical history and conducting a physical examination to detect signs (observations made by a qualified observer) and symptoms (manifestations reported by the patient) associated with malnutrition (Combs, 2012). Medical history such as description of the patient, environmental, social, and family factors and food allergies is taken. Physical examination is conducted to investigate the physical signs and symptoms related to malnutrition. In community surveys, only signs indicating a probable deficiency of one or more nutrients should be looked for in the physical examination (Gibson, 2002a).

2.4.4 Dietary assessment

Dietary assessment involves the collection of information on the quantity, and usually frequency of foods and drink consumed over a specified time, and using food composition table (FCT) for the calculation of energy and nutrient intakes. It aims to measure food consumption or to estimate the intake of nutrients or non-nutrients in individuals or groups (Bates *et al.*, 2017). It is one of the four approaches in nutrition assessment to evaluate the nutritional status of individuals comprehensively. The other three are anthropometrics, biochemical parameters and clinical examination. Dietary assessment methods are usually categorized according to the nature of the method used as indirect methods and direct methods. Indirect methods utilize secondary data for assessing diets, while direct methods collect primary dietary data from individuals. (FAO, 2018).

Indirect methods use secondary information (e.g. food supply, agricultural statistics, food expenditure) to estimate food available for consumption at the national and household levels. Food Balance Sheet (FBS) provides food consumption information at national level where food consumption is estimated from the point of domestic food production and total food availability (Bates *et al.*, 2017; FAO, 2018). At household level, Household Consumption and Expenditure Survey (HCES) is used to provide food consumption information (FAO, 2018). Food accounts, inventories, household recall, and list recall are the techniques used to assess food consumption at the household level (MacIntyre, 2009; Bates *et al.*, 2017).

On the other hand, direct method uses individual-based dietary assessment to obtain the report of all the foods consumed by each individual 3 quantifying the portion sizes. The data is then further used for measuring food and nutrient intake by specifying detailed food descriptions, portion sizes, consumption frequency, and nutrient analysis from food tables (MacIntyre, 2009). Estimates obtained from direct methods are used to identify trends in food consumption, food and nutrient intakes, eating patterns, and to evaluate diet–disease associations (FAO, 2018).

There are two main approaches to individual dietary assessment, prospective and retrospective. In the prospective methods, diet, including all food and beverages consumed is recorded at the time of consumption, therefore allowing for current food intake to be recorded. These methods include a weighed food record, an estimated food record and a

duplicate meal method. Prospective methods can be more labor intensive and rely heavily on respondents having good literacy and numeracy skills. In contrast, retrospective methods collect information on foods and beverages already consumed. These methods greatly depend on the memory of the respondent and their ability to recall all foods and portion sizes consumed over a reference period of time (FAO, 2018). The retrospective methods are the 24-hour recalls, food frequency questionnaire (FFQ) and diet histories (Thompson and Subar, 2017; FAO, 2018). The identification of dietary patterns may be helpful for understanding their relation to diet-related chronic diseases (Tao *et al.*, 2022).

24 hour dietary recall

24 hour dietary recall is an easy method of dietary assessment of nutritional status based on the recall capabilities of the individual over a period of the past 24 hour (John *et al.*, 2020). It involves a trained interviewer asking respondents to recall and describe every item of food and drink consumed over the previous 24 hours (usually midnight to midnight) (Bates *et al.*, 2017). The recall typically is conducted by interview, in person or by telephone, either computer-assisted or using a paper-and-pencil form (Thompson and Subar, 2017). Although it highly relies on respondent's memory, interviewers as well as seasonality differences (FAO, 2018), is considered the least biased self-report instrument, and thus is useful for most research purposes (Thompson and Subar, 2017).

FFQ

Food frequency questionnaires consist of a list of foods and options to indicate how frequently each food is consumed. Respondents indicate the frequency of consumption during a specified period by marking the appropriate option column (MacIntyre, 2009). It also relies heavily on memory and does not give precise information on the estimated portion size consumed (FAO, 2018). However, The short-list FFQ can assess nutrient values of a population for analytic research purposes (Rockett *et al.*, 2007). Similarly, FFQ was found to be reliable and valid for ranking the intake of food groups for Nepalese dietary intake (Shrestha *et al.*, 2017).

Food Diary

In food diary or food record, the respondent records the foods and beverages and the amounts of each consumed over one or more days. Ideally, the recording is done at the time of the eating occasion in order to avoid reliance on memory. The dietary record method has the potential for providing quantitatively accurate information on food consumed during the recording period. The major disadvantage is its biasness, both in the selection of the respondent and in the respondent's completion of the number of days recorded (Thompson and Subar, 2017).

Dietary History

The dietary history technique was developed by Burke in 1947 as an interview method consisting initially of 24-hour recall of actual food intake, a questionnaire on the frequency of consumption of specific food items and three-day estimated food record (Gibson, 2002b; MacIntyre, 2009; Bates *et al.*, 2017). It provides details of meal patterns and also quantitative estimates of energy and nutrient intakes but it is labour intensive, time consuming, and higher respondent burden. Additionally, it also requires trained personnel and literate respondents and thus may not be suitable for young children and elderly respondents (FAO, 2018).

2.4.5 Body Composition

Body composition is the proportion of fat, muscle, and bone of an individual's body. It is most often expressed as percentage of body fat and percentage of lean body mass (LBM) (Messiah, 2020). The accurate and valid assessment of body composition is essential for the diagnostic evaluation of nutritional status, identifying relevant outcome measures and for determining the effectiveness of current and future nutritional interventions (Smith and Madden, 2016).

Different methods have been developed to determine the body composition with different physical principles, using different models and assumptions (Kuriyan, 2018). The different body composition analysis techniques that can be used include Bio-impedance Analysis (BIA), Dual-Energy X-ray Absorptiometry (DEXA), Computed Tomography (CT), Magnetic Resonance Imaging (MRI), densitometry, muscle ultrasonography etc.

(Serón-Arbeloa *et al.*, 2022). Tomographic imaging techniques such as CT and MRI are also available which involve in vivo measurements of different fat depots and fat infiltration in organs and are considered to be the gold standard for body composition analysis (Kuriyan, 2018).

Similarly, the various methods available for assessing body composition are based on two-compartment (2C), three-compartment (3C), four-compartment (4C) or multi-compartment models. The simplest approach in body composition is the 2C model, dividing body weight into fat mass and fat-free mass (FFM). The 3C model of body composition includes a third component where FFM is further divided as lean tissue mass and bone mineral content. Likewise, the 4C model of body composition is obtained by combining many methods to partition body mass into fat, mineral, total bone mineral and protein (residual). Atomic models of body composition require the direct analysis of the major elements of the body (Kuriyan, 2018).

BIA

BIA is a simple, inexpensive, and non-invasive method for estimating body composition. It is based on the conduction of an alternating electrical current through the human body (Serón-Arbeloa *et al.*, 2022). It involves measuring the impedance to the flow of a low-electrical current (800 μA) at a fixed frequency 50 kHz (Kuriyan, 2018). Body impedance depends on the frequency of the current used and on body water distribution between the extracellular and intracellular space and between the different geometrical body compartments (Deurenberg, 2009).

BIA is considered to be safe, straightforward, minimally invasive, relatively inexpensive, and more reproducible (<1%) than skinfold measurements (Smith and Madden, 2016). BIA is a recommended method for field studies because it facilitates evaluation of a large number of individuals in a short period of time (Böhm and Heitmann, 2013). With optimal standardization of methods, instruments and preparation of the individuals, the BIA can provide quick and easy estimates of FFM and total body water in healthy populations and in obese individuals (Kuriyan, 2018; Vasold *et al.*, 2019). However, in the study of south Indian adults, BIA showed a 5.5% lower estimation of body fat compared to the 4C method. Therefore, meticulous use of the estimate of the body fat from BIA machines is needed

(Kuriyan *et al.*, 2014). The classification of information on body composition for male is shown in **Table 2.3**.

Table 2.3 Classification of information on body composition for males

Body Composition	Classification (%)			
	Low	**Normal**	**High**	**Very High**
Body fat	<10	≥ 10 - < 20	≥ 20 - < 25	≥ 25
Visceral fat	-	0.5 – 9.5	10.0 – 14.5	15.0 – 30.0
Skeletal muscle	5.0 – 32.8	32.9 – 35.7	35.8 – 37.3	37.4 – 60.0

Source: Omron (2021)

2.5 Malnutrition

Malnutrition refers to deficiencies, excesses or imbalances in a person's intake of energy and/or nutrients (WHO, 2020a). It is a sub-acute or chronic state of nutrition, in which a combination of varying degrees of under- or over-nutrition and inflammatory activity has led to changes in body composition, diminished function and clinical outcome (Soeters *et al.*, 2016). Malnutrition is a prevalent issue that impacts individuals at various life stages, with the most vulnerable groups being impoverished individuals, young children, adolescents, lactating and pregnant women, older people, as well as those with compromised immune system (Natisha, 2020).

There is no single cause of malnutrition. Causes of malnutrition may range from individual, families, district, country, regions, and global level (Ersado, 2023). Inadequate dietary intake and diseases due to food insecurity, inadequate care for women and children, insufficient health services, and unsanitary environments (Sablah, 2019), reduced dietary intake, reduced absorption of macro and/or micronutrients, increased losses or altered requirements, and increased energy expenditure (in specific disease processes) can be a cause for immediate malnutrition (UNICEF, 2003; Saunders and Smith, 2010).

Malnutrition consists of both over and undernutrition. Undernutrition includes wasting, stunting, underweight, micronutrient deficiencies whereas over-nutrition includes overweight and obesity (Natisha, 2020). Stunting results from chronic undernutrition, which retards linear growth, whereas wasting results from inadequate nutrition over a shorter period, and underweight includes both stunting and wasting (Caulfield *et al.*, 2006). Wasting

is a nutritional deficiency resulting from either inadequate energy (caloric) or protein intake (Ngo *et al.*, 2016).

Early nutrition and lifestyle have significant impact on nutritional status of an individual in adulthood (Li *et al.*, 2023). Undernourished children are more likely to become short adults, to have lower educational achievement, and to give birth to smaller infants. Undernutrition is also associated with lower economic status in adulthood (Victora *et al.*, 2008). Low birth weight followed by underweight and stunting in infancy and rapid weight gain later in life during adolescence and adulthood can lead to cardiovascular disease and metabolic diseases like obesity and type 2 diabetes (Bhargava *et al.*, 2004; Barker *et al.*, 2005; Prentice and Moore, 2005). A study conducted by Monika *et al.* (2021) showed that persistent undernutrition during adolescence was also associated with poor learning skills such as reading, and math solving skills. Therefore, it's crucial for adults to monitor their dietary choices and ensure their calorie intake meets their energy needs, avoiding both under-consumption and over-consumption (Zimmerman and Snow, 2012).

2.6 Trend of malnutrition

Over the last four decades, there has been a significant rise in childhood overweight and obesity across most high-income countries. Similarly, low and middle-income countries have experienced comparable trends, with persistent high levels of undernutrition (Lobstein *et al.*, 2015). Worldwide, 149.2 million children under 5 years of age are stunted, 45.4 million are wasted and 38.9 million are overweight. Over 40% of all men and women (2.2 billion people) are now overweight or obese. In 2016, the number of overweight adults aged 18 and above exceeded 1.9 billion, with over 650 million being categorized as obese. The prevalence of overweight and obesity in children and adolescents aged 5-19 years has significantly increased from 4% in 1975 to exceeding 18% in the year 2016 (WHO, 2021).

The consumption of fruits and vegetables remains significantly below the recommended daily level, with only 60% and 40% of the recommended five servings per day, respectively, and intake of legumes and nuts is less than one third of the recommended two servings per day. In sharp contrast, the intake of red and processed meat is nearly five times higher than the recommended maximum of one serving per week. The consumption of sugary drinks is also increasing despite their lack of recommended consumption. Such poor diets are

responsible for more than 12 million NCD deaths in adults which is 26% of all adult deaths each year (IEG, 2021).

Globally, in 2015, Disability-Adjusted Life Year (DALY) due to iron deficiency ranged between 200-600 per 100,000 people and 200-500 per 100,000 people for 15-19 years and 20-24 years males respectively. Similarly, DALY due to iodine deficiency ranged between 0-80 for both 15-19 years and 20-24 years males with the highest level found in South Asia region. Burden of vitamin A deficiency and other nutritional deficiencies is also highest in this region. Among 15-19 years and 20-24 years males, DALY due to vitamin A deficiency in this region ranged from 6-7 per 100,000 people (Akseer *et al.*, 2017).

The double burden of malnutrition has been documented in many developing countries, including countries in South Asia such as Nepal (Kolčić, 2012; Pradhananga *et al.*, 2022). In Nepal, 7% of men are thin, while 26% are overweight and 6% are obese. Similarly, 41% of adolescent men aged 15–19 are thin, 4% are overweight, and 3% are obese. The proportion of these adolescent men who are thin is higher in urban areas (45%) than in rural areas (32%). Also, men in the highest wealth quintile have a 50% overweight or obesity rate, while those in the lowest wealth quintile have a 13% rate (MoHP, 2022). Nepal ranks 69th in global hunger index (GHI) with the score of 15.0 in 2023 progressing from the score of 21.3 in 2015 (von Grebmer *et al.*, 2023).

Similarly, inadequate attention to nutritional needs and energy requirements can compromise the health and performance of young athletes, making them more vulnerable to injuries and also impairing their physical capabilities (Peklaj *et al.*, 2023). The same study showed that low energy availability (LEA) was detected in 36.8% of adolescent male athletes. The prevalence of micronutrient deficiencies are also high among young male athletes and those who perform vigorous training exercises (Constantini *et al.*, 2010; Aerenhouts *et al.*, 2012; Ercan, 2018).

2.7 Physical Activity

The increasing levels of physical inactivity and availability of high calorie foods are bringing an increasing number of people developing pathological conditions and chronic diseases (Gaetano, 2016). Around 6% of the burden of coronary heart disease, 7% of type 2 diabetes, 10% of breast cancer, and 10% of colon cancer can be attributed to physical

inactivity. Moreover, 9% of premature mortality worldwide, equivalent to over 5.3 million deaths in 2008, is linked to lack of physical activity (Lee *et al.*, 2012). Worldwide, 31.1% of adults (aged 15 years or older) are physically inactive and the proportion of physically inactive adults is 17.0% in Southeast Asia (Hallal *et al.*, 2012). This high level of sedentary behavior especially among university students is associated with increased risk of negative health outcomes (Castro *et al.*, 2020).

Regular physical activity is effective in the primary and secondary prevention of cardiovascular disease, type 2 diabetes mellitus, cancer (particularly breast and colon cancer) and osteoporosis and is effective in attenuating the risk of premature death among men and women (Warburton *et al.*, 2006). If physical inactivity is decreased by 10% or more significant, at 25%, it could prevent more than 533,000 deaths or it could avert over 1.3 million deaths each year respectively (Lee *et al.*, 2012). The result of meta-analysis by Haverkamp *et al.* (2020) showed that immediate interventions on physical activity have beneficial impact on attention, processing speed and inhibition. Moreover, the study also indicated that long-term interventions with physical activity can also result in positive impacts on processing speed, attention, cognitive flexibility, working memory, and language, with the most significant effects observed in working memory. Similarly in the uniformed services, a high level of physical fitness is essential for optimal performance in various professional duties and tasks (Tomczak *et al.*, 2022).

Thus, reducing sedentary can not only support individuals to increase incrementally their levels of physical activity towards achieving the recommended levels for optimal health but also notably contribute to achieving many of the Sustainable Development Goals (SDG) (WHO, 2018).

Physical activity can be classified as light, moderate or vigorous depending upon the intensity which is given by Metabolic Equivalent (METs). A MET is the amount of energy (calories) a body uses each minute while resting quietly (Haskell *et al.*, 2007). MET minutes per week is used for determining classifications. It is calculated by multiplying the MET level for the type of activity by the number of minutes that activity was performed per day by the number of days per week the activity was performed. Walking is scored as 3.3 METs, moderate intensity activities are scored as 4 METs and vigorous intensity activities are scored as 8 METs (ACSM, 2013).

2.8 Literature review of determinants of nutritional status

There has been association between socio cultural and economic factors such ethnicity, religion, parent's education, family occupation and low economic status with stunting and thinness among adolescents in Nepal (van Tuijl *et al.*, 2021). With rise in technology, the use of mobile devices during meals is also increasing since young age which interferes with eating behavior contributing to more calorie consumption (La Marra *et al.*, 2020). Similarly, increased sedentary time with low physical activity level have been causing increased fat mass among young adults (Silva *et al.*, 2019). A study by Bhavani and Devi (2020) showed that both physical inactivity and eating energy dense food during watching television become reasons for increased BMI and waist circumference among the college age population.

The rapid socio-economic changes and urbanization have significant effects on lifestyle and food habits among the people as society trends towards a more Western diet (Hamam *et al.*, 2017). Lack of proper nutritional knowledge has also found to be associated with unhealthy dietary pattern among young adults (Abraham *et al.*, 2018; Belogianni *et al.*, 2022; Rawcliffe *et al.*, 2024). The regular consumption of high-salt, oil-rich, fried and sugary foods has been identified as a major contributor to overweight and obesity, subsequently increasing the risk of hypertension and other cardiovascular diseases (Mishra *et al.*, 2014). Similarly, unhealthy snacking habits and the consumption of low quality snacks have also emerged as additional risk factors for cardiovascular disease (Bermingham *et al.*, 2024). Furthermore, individuals with both low intake of legumes and pulses (Fernandes Gomes *et al.*, 2020) and high consumption of sugar-sweetened beverages (Ma *et al.*, 2014) face a substantial risk of increased body fat and abdominal adiposity. Additionally, overconsumption of eggs (Garrido-Miguel *et al.*, 2022) and excessive fat intake can also result in fat deposition and abdominal adiposity (Bailey *et al.*, 2010; Hooper *et al.*, 2020).

Apart from nutrient inadequacy and unhealthy dietary pattern, the other contributing factors are frequent infections, poor health care, inadequate sanitation and low agricultural production. In addition, population living in the backward and drought-prone rural areas, tribal communities, labourers and destitutes are also highly susceptible to undernutrition (ICMR, 2011).

Part III

Materials and methods

3.1 Study design and setting

A community based cross-sectional descriptive study was conducted in six different colleges and five different training centers of Dharan sub-metropolitan city of Sunsari district of Koshi province, Nepal to assess the nutritional status of British Gurkha trainees and college students. The study area was selected as Dharan is the initial selection site of eastern region for British Gurkha army. Anthropometric measurements namely height, weight, BMI, body composition and WHR of the participants were taken. Dietary assessments viz. 24 hour dietary recall and FFQ were also taken to access and compare the nutritional status of both the participant groups.

3.2 Target population

The target population of the study was British Gurkha trainees who were striving for the recruitment and college going students both aged between 17-21 years. While participants aged between 17-21 years were included in the study, any participants out of the age range were excluded. Participants who were ill, who were not present on the day of data collection, and those who were not willing to participate were also excluded from the study.

3.3 Study variables

1. Dependent variables: BMI, WHR, body composition

2. Independent variables

i. Demographic: Age, ethnicity, religion,
ii. Socio-economic: family type, family income, family occupation, education of parents, number of siblings, internet usage
iii. Nutritional knowledge
iv. Behavioural: dietary attitudes, food habits, physical activity
v. Diet: nutrient intake, food frequency, food preferences

3.4 Sampling technique

Comparative cross-sectional descriptive study was conducted in Dharan sub-metropolitan city. Stratified purposive sampling technique was used for the selection of the institutions and simple random sampling was used to select the samples from the respective institutions.

3.5 Sample size calculation

Since there was no previous record on nutritional status, sample size was determined by assuming the difference in the proportion of nutritional deficiency to be 60% in college students and 40% in British Gurkha trainees. The sample size was then calculated by using two proportion formula which is given by (Sathian *et al.*, 2010):

$$n=2\left(Z_{\alpha/2}+Z_{\beta}\right)^2 \frac{P(1-P)}{(P_1-P_2)^2}$$

where,

n = sample size

$Z_{\alpha/2}$ = 1.96 at 95% Confidence Interval (CI)

Z_{β} = 0.842 at 80% power

P_1 = estimated proportion of population (British Gurkha trainees) with malnutrition

P_2 = estimated proportion of population (college students) with malnutrition

$P = \frac{P_1+P_2}{2} = \frac{0.4+0.6}{2} = 0.5$ (equals to 50% prevalence)

Then, sample size can be calculated as,

$Z_{\alpha/2}$ = 1.96, Z_{β} = 0.842, P = 0.5, P_1 = 0.4, P_2 = 0.6

Hence,

$$n = 2(1.96+0.84)^2 \frac{0.5(1-0.5)}{(0.4-0.6)^2}$$

$$= 98$$

Calculated sample size was further adjusted for non-response. Considering non-response rate as 10%, the adjusted sample size was calculated to be 98 + 9.8 = 107.8 ≈ 108.

Thus, the 110 sample was taken for convenience from each of the group by maintaining 1:1 allocation ratio.

3.6 Data collection tools and technique

Data was collected through a self-administered questionnaire with the help of data collectors. Data collection tool was developed in English language and then translated into Nepali language to maintain inclusivity. The objective of the study was briefed to the participants and verbal consent was taken. The instruments used in the study were:

i. A digital weighing balance, measuring up to 180 kg with least count of 0.1 kg.
ii. A well calibrated stadiometer to measure the height.
iii. Questionnaire to collect information on demographic socio-economic condition, behavioral information, nutrition knowledge, physical activity, dietary habits, dietary intake and food consumption pattern.
iv. A flexible measuring tape to measure the waist and hip circumference.
v. A potable Omron HBF-375 model BIA machine to measure the body composition of the participants.

3.6.1 Nutritional knowledge

The knowledge section had 22 statements which could be answered as 'Yes', 'No' and "don't know". Each correct response was coded as '1' and the incorrect one as '0'. To decide the individual as having a good or bad knowledge towards nutrition, the median score was used as the cutoff point (Bakhtiar *et al.*, 2021; Sunuwar *et al.*, 2022; Thapa *et al.*, 2023). Although criticized, the median split is effective when the variable is continuous and normally distributed, (DeCoster *et al.*, 2011). The questionnaire on nutrition knowledge had Cronbach alpha of 0.77 which is of acceptable consistency (Hajjar, 2018).

3.6.2 Height

Stadiometer was used to measure the height. Height of the participant was measured barefoot with minimal clothing and unbraided hair to facilitate correct positioning of the body. The participant was made to stand with heels together, arms to the side, legs straight, shoulders relaxed, and head in the Frankfort horizontal plane. Heels, buttocks, scapulae (shoulder blades), and back of the head as possible, was made against the vertical surface of the stadiometer. The measurement was then read to the nearest 0.1 cm with the eye level (John *et al.*, 2020; Casadei and Kiel, 2022).

3.6.3 Weight

Weight was measured by a reliable electronic weighing scale with the nearest 0.1 kg reading. Proper calibration was done before the usage of the machine. Participant was asked to remove shoes and heavy clothing and was made to stand still in the middle of the scale's platform without touching anything with the body weight equally distributed on both the feet (WHO, 2017). After measuring both height and weight, BMI was calculated by dividing the weight of the participant by square of the height in meters (Casadei and Kiel, 2022)

3.6.4 Waist and hip circumference

The circumferences were measured to the nearest centimeters using a flexible tape with the participant standing. Waist circumference was measured at the level of the umbilicus. The participant's hip circumference was measured as the maximum circumference around the buttocks posteriorly at the level of greater trochanters (hip bones) (Fauziana *et al.*, 2016). Circumferences were measured with least clothing to avoid measurement error. WHR was then determined by dividing waist circumference by hip circumference (WHO, 2008)

3.6.5 Body composition

Omron model HBF-375 BIA machine was used to access the body fat, visceral fat and skeletal muscle of the participants. Participant was told to dry clean his leg and measurement was taken barefooted after clean the main unit. The participant was then made stand straight stepping on foot electrodes with horizontally raised and elbow extended straight at 90 degree angle to the participant's body (Omron, 2021). Likewise, the measurements were also taken as recommended by the manual of Omron (2021).

3.6.6 Physical activity

The International Physical Activity Questionnaire (IPAQ) short form was used to access the level of physical activity of the participants (WHO, 2004). The volume of activity was computed by weighting each type of activity by its energy requirements defined in METs to yield a score in MET minutes. The level of physical activity was analyzed in Microsoft excelsheet provided by Cheng (2016) and categorized as low, moderate and high based on MET minutes per week. The short IPAQ form was used for its validity, reliability and applicability (Craig *et al.*, 2003).

3.6.7 Food frequency and dietary recall

A well-designed FFQ along with 24-hour dietary recall was used to study the food consumption pattern and nutrient intake of the participants. Adequate time and assistance were provided to the participants so that to recall properly and estimate the portion sizes. From dietary recall, total calories, protein, carbohydrate and fat was calculated using portion size estimation by following Indian Council of Medical Research (ICMR) guidelines (ICMR, 2011). For other foods which did not come under the foods groups, the amount of ingredients required to prepare those foods were estimated by asking with the local restaurants in Dharan and total nutrient was calculated by using Nepalese FCT (DFTQC, 2017). Household measures including cups, plates, spoons or solid foods in pieces or slices were used to estimate the portion size (Dao *et al.*, 2019; Mediratta *et al.*, 2023). The nutrient content of packaged foods consumed was estimated by using nutritional information provided by manufacturer.

3.6.8 Nutritional requirements

The total energy requirement for all the participants was determined by calculating the total energy expenditure (TEE). TEE was calculated as the sum of resting energy expenditure (REE), energy expenditure of activity (activity factor) and diet-induced energy expenditure (thermic effect of food) (Miles, 2007). REE (kcal/day) for male was obtained through Mifflin-St Jeor equation (Mifflin *et al.*, 1990) which is given by:

$$REE = 10 \times \text{weight (in kg)} + 6.25 \times \text{height (in cm)} - 5 \times \text{age (in years)} + 5$$

Mifflin-St Jeor equation was used because of its reliability and narrower margin of error compared to other equations (Frankenfield *et al.*, 2005). Activity factor was obtained based on physical activity level of the participants. Activity factor for various physical activity level is shown in **Table 3.1**. Diet-induced energy expenditure was calculated as 10% of total calories consumed in a day (Du *et al.*, 2014). Protein, carbohydrate and fat intake of college students were determined on the basis of RDA (Recommended Dietary Allowances) as recommended by ICMR (2020). For British Gurkha trainees, protein and carbohydrate requirements were calculated as 1.6 g/kg/d per body weight and 8 g/kg/d per body weight of a participant. Similarly, 25% of total calories was taken as requirement for dietary fat (Amawi *et al.*, 2024).

Table 3.1 Scale factor for activity level

Activity level	Multiplier
Sedentary	1.2
Lightly active	1.375
Moderately active	1.55
Active	1.725
Very active	1.9

Source: (Wildman, 2018; Medscape, 2024)

3.7 Pre – testing

The prepared questionnaire and anthropometric measurements were tested among 10 college students and 5 trainee participants. Pretesting was done to check clarity of the question, accuracy and consistency in the interpretation and to identify the ambiguous ones. After pretesting, the prepared questionnaire was translated into Nepali language. The ambiguous and wrongly interpreted questions were removed and the questionnaire were revised as per the findings of pretesting.

3.8 Validity and reliability

The validity of the instruments and techniques were ascertained. Priority was given to reduce the bias and mistakes of both researcher and participant so that reliability can be attained to its maximum. Test-retest reliability was assessed to ensure the stability and consistency of measurements over time.

3.9 Data analysis

Before entering data for analysis, data were manually checked, compiled, categorized and coded to ensure completeness and accuracy. The collected data were entered into Statistical Package for the Social Sciences (IBM SPSS version 26) for further analysis. Descriptive statistics was used to characterize the demographic and socio-economic information, nutritional knowledge, dietary habits and preferences, physical activity, dietary intake and prevalence and distribution of malnutrition. Associations between variables were tested using Chi-square, Fischer's exact tests. Independent sample t-test was used for comparison of normally distributed continuous data. Correlation was used to see and measure the

association between the numerical variables (Akoglu, 2018). The statistical significance was considered at p-value <0.05 and 95% CI (Hazra, 2017).

3.10 Ethical consideration

Approval letter was taken from the Dharan Sub-metropolitan city office for the conduction of the study. Formal permission was obtained from the respective management team of colleges and training centers. The objectives of the study were explained to participants, teachers as well as physical trainers of training centers and oral and written consent was obtained from the participants of the survey. Confidentiality was upheld throughout all phases of the research process by maintaining the anonymity of participant data.

Part IV

Results and discussion

The cross – sectional descriptive study was conducted to compare the nutritional status among participant groups i.e. British Gurkha trainees (trainee participants) and college students. Detailed discussions on the findings are presented in sections below.

4.1 Age distribution

Table 4.1 Frequency distribution of participant groups by age

Age	British Gurkha Trainees (n =110)		College Students (n =110)		p-value
	Frequency	Percentage	Frequency	Percentage	
17	12	10.91%	17	15.45%	0.006*
18	46	41.82%	25	22.73%	
19	28	25.45%	20	18.18%	
20	14	12.73%	20	18.18%	
21	10	9.09%	28	25.45%	

*p-value significant at <0.05

The mean ± SD (Standard Deviation) age of the British Gurkha trainees was 18.67 ± 1.11 years with the highest number of these participants being aged 18 years. The mean ± SD age of college students was 19.15 ± 1.43 years among which participants aged 21 were the highest. The frequency distribution of age of the participants is shown in **Table 4.1**.

4.2 Demographic characteristics

Table 4.2 shows the demographic characteristics of the participants. The trainee participants mostly came from Rai community followed by Limbu while Brahmin trainee participants were nil. In contrast, one fourth of the college students were Brahmins. Majority of the participants from both the groups were Hindu. Most of the participants of both the groups lived in nuclear family. However, nearly two third of the participants of both the groups had 5 or more family members. One sibling was also common in both the participant groups. There was significant difference in ethnicity (p-value <0.001) and religion (p-value <0.001) between trainee participants and college students.

Table 4.2 Frequency distribution of demographic characteristics of participant groups

Variables	British Gurkha Trainees (n =110)		College Students (n =110)		p-value
	Frequency	Percentage	Frequency	Percentage	
Ethnicity					
Brahmin	0	0.00%	32	29.09%	<0.001*
Chetri	9	8.18%	18	16.36%	
Rai	47	42.73%	17	15.45%	
Limbu	33	30.00%	10	9.09%	
Others	21	19.09%	33	30.00%	
Religion					
Hindu	63	57.30%	86	78.20%	<0.001*
Kirant	34	30.90%	10	9.10%	
Others	13	11.80%	14	12.70%	
Family type					
Nuclear	89	80.91%	93	84.55%	0.476
Joint	21	19.09%	17	15.45%	
Family size					
Less than 5	39	35.45%	47	42.73%	0.269
5 and more	71	64.55%	63	57.27%	
Number of siblings					
0	10	9.09%	12	10.91%	0.433
1	38	34.55%	48	43.64%	
2	29	26.36%	25	22.73%	
3 and more	33	30.00%	25	22.73%	

* p-value significant at <0.05

4.3 Socio-economic characteristics

All the participants (n = 220) were unmarried and none of them were involved in occupation of any kind. One third of the participants' fathers had secondary level education. Almost 30% fathers of college students completed higher secondary level education. More than one third of the mothers of trainee participants were either illiterate or only received informal education whereas nearly one fourth of the mothers of college students received education

of higher secondary level or above. Majority of the participant's family of both the groups relied on agriculture. While business was second major family occupation of college students, foreign employment was the second most common family occupation among trainee participants. The socio-economic characteristics of the participant groups is shown in **Table 4.3**. There was significant difference in father's education, mother's education, family occupation and family income between the trainee participants and college students.

Table 4.3 Frequency distribution of socio-economic characteristics of participant groups

Variables	British Gurkha Trainees (n =110)		College Students (n =110)		p-value
	Frequency	Percentage	Frequency	Percentage	
Fathers' education					
Illiterate	12	10.91%	3	2.73%	0.039*
Informal	16	14.55%	12	10.91%	
Primary	22	20.00%	24	21.82%	
Secondary	42	38.18%	39	35.45%	
Higher-secondary and above	18	16.36%	32	29.09%	
Mothers' education					
Illiterate	18	16.36%	8	7.27%	0.016*
Informal	22	20.00%	15	13.64%	
Primary	24	21.82%	30	27.27%	
Secondary	35	31.82%	31	28.18%	
Higher-secondary and above	11	10.00%	26	23.64%	
Family Occupation					
Business	17	15.50%	25	22.70%	0.003*
Agriculture	49	44.50%	35	31.80%	
Foreign employment	29	26.40%	15	13.60%	
Service	6	5.50%	15	13.60%	
Others	9	8.20%	20	18.20%	
Family income					
<Rs.50,000 per month	84	76.36%	65	59.09%	0.006*
>Rs.50,000 per month	26	23.64%	45	40.91%	

*p-value significant at <0.05

Table 4.4 shows the frequency distribution of internet usage of trainee participants and college students. All the college students used internet daily while 18.18% of trainee participants used only several times a week. Among both the groups, facebook was predominant social media followed by youtube and instagram. Most of the trainee participants (n = 98, 89.10%) used internet less than five hours a day while more than half of the college students used internet five to ten hours a day. There was significant difference in internet usage (p-value <0.001) and time spend on social media (p-value <0.001) between trainee participants and college students.

Table 4.4 Frequency distribution of internet usage of participant groups

Variables	**British Gurkha Trainees (n =110)**		**College Students (n =110)**		**p-value**
	Frequency	**Percentage**	**Frequency**	**Percentage**	
Internet usage					
Daily	90	81.82%	110	100.00%	<0.001*
Several times a week	20	18.18%	0	0.00%	
Social media usage**					
Facebook	102	92.73%	106	96.36%	
Youtube	72	65.45%	91	82.73%	
Instagram	47	42.73%	67	60.91%	
Tiktok	22	20.00%	29	26.36%	
Twitter	7	6.36%	24	21.82%	
Others	11	10.00%	21	19.09%	
Time spent on social media					
<5 hours a day	98	89.10%	32	29.10%	<0.001*
5-10 hours a day	12	10.90%	60	54.50%	
>10 hours a day	0	0.00%	18	16.40%	

*p-value significant at <0.05. **denotes multiple response question.

4.4 Nutritional information

The mean ± Standard Deviation (SD) and median score of nutrition knowledge for the entire participants was 13.13 ± 4.02 and 13 respectively. The highest score for entire participants was 22, while the lowest score was 5. Among British Gurkha trainees, the highest score was

20 and the lowest score was 5 with mean score of 12.57 ± 3.85. Similarly, 22 and 5 were the highest and lowest score respectively for college students with the mean score of 13.68 ± 4.12. Interestingly, 20.91% (n = 23) of trainee participants and 31.82% (n = 35) of college students respecitvely thought that they had at least good level of nutritonal knowledge.

About forty percent of the trainee participants (n = 43, 39.09%) got information about nutrition from the health professsionals followed by social media (n = 37, 33.64%). Meanwhile, nearly one third of the college students (n = 36, 32.73%) relied on social media for nutritional information which was succeeded by health professionals and online resources. Very few of them mentioned other sources such as family, friends and printed materials. Contrary to our expectations, no significant difference was seen in the nutritional knowledge and the source of their nutritional information among the trainee participants and college students The information on nutrition is shown in **Table 4.5**.

Table 4.5 Frequency distribution of nutritional information of participant groups

Variables	**British Gurkha Trainees (n =110)**		**College Students (n =110)**		**p-value**
	Frequency	**Percentage**	**Frequency**	**Percentage**	
Nutritional knowledge					
Poor	54	49.09%	48	43.64%	0.42
Good	56	50.91%	62	56.36%	
Source of information on nutrition					
Social media	37	33.64%	36	32.73%	0.160
Health professionals	43	39.09%	28	25.45%	
Online sources	18	16.36%	27	24.55%	
Printed materials	6	5.45%	9	8.18%	
Family and friends	6	5.45%	10	9.09%	

Note: p-value significant at <0.05

Among all the participants, 46.36% (n = 102) had poor nutritional knowledge whereas, more than half of the participants (n = 118, 53.64%) had good knowledge on nutrition. Only half of the British Gurkha trainees had good nutritional knowledge. This result is similar to the study conducted among the British Army recruits in UK where 52% of the male recruits had good nutritional knowledge (Rawcliffe *et al.*, 2024). Similarly, a study conducted in

Bangladesh among adolescent sports trainee showed similar results where 57.3% had good nutritional knowledge (Bakhtiar *et al.*, 2021). In contrast, 92.1% of the army trainees in public institutions of higher education in Malaysia had good nutritional knowledge. However, the sample of this study also had 50% female participants (Mohd *et al.*, 2011). 56.36% college students had good nutritional knowledge which replicates the study conducted by Belogianni *et al.* (2022) where 57.1 college students aged below 25 years had good nutritional knowledge.

4.5 Dietary habits and preferences

Table 4.6 shows the food preferences and dietary habits of participant groups i.e. British Gurkha trainees and college students. All the trainee participants were non – vegetarian. 13.64% of the college students preferred to eat egg even if they were vegetarian. Almost all the trainee participants (n = 100, 90.91%) of ate their food in kitchen or dining room while 40.00% of the college students consumed their food in front of mobile phones or laptop. Skipping meal was also highly observed in both the participant groups. 76.36% of the trainee participants skipped meals either due to outdoor or training activities. Similar behaviour was found among army trainees in public institutions of higher education in Malaysia (Mohd *et al.*, 2011) and army recruits in Australia (Kitunen *et al.*, 2020). The finding of our study on meal skipping by college students contradicted with the findings of a study conducted by Kumari *et al.* (2019).

Only 6.82% (n = 15) of total participants consumed dietary supplements. None of the participants were daily alcohol consumers. Both smoking and alcohol consumption was higher among college students than trainee participants. College students aged 19-21 years showed higher abuse for both smoking (n = 17, 15.45%) and alcohol consumption (n = 31, 28.18%) which corresponds to the finding by Shriprasad and Kallihal (2021). 29.09% of all the participants had the habit of either daily or occasional smoking which is consistent with the national data reported by MoHP (2022) but moderately lower than the findings by Pradhan *et al.* (2013). Similarly, habit of late night snacking was also higher among college students. 44.55% of trainee participants never had the habit of late night snacking. There was significant difference in food preferences (p-value <0.001) eating outside the house (p-value 0.003), place to eat at home (p-value <0.001), habit of skipping meal (p-value 0.036), and late night snacking (p-value <0.001). However, no significant difference was observed

in smoking (p-value 0.056) and alcohol consumption (p-value 0.157) between the participant groups.

Table 4.6 Frequency distribution of dietary habits and preferences of participant groups

Variables	British Gurkha Trainees (n =110)		College Students (n =110)		p-value
	Frequency	Percentage	Frequency	Percentage	
Food Preference					
Veg	0	0.00%	14	12.73%	<0.001*
Non-veg	110	100.00%	81	73.64%	
Ovo-veg	0	0.00%	15	13.64%	
Eating outside the house					
Frequently	7	6.36%	25	22.73%	0.003*
Sometimes	73	66.36%	62	56.36%	
Rarely	30	27.27%	23	20.91%	
Place to eat at home					
Dining room	100	90.91%	61	55.45%	<0.001*
Bedroom	7	6.36%	5	4.55%	
Anywhere but in front of TV, mobile or laptop	3	2.73%	44	40.00%	
Skipping meal					
Yes	84	76.36%	96	87.27%	0.036*
No	26	23.64%	14	12.73%	
Dietary supplements					
Yes	7	6.36%	8	7.27%	
No	103	93.64%	102	92.73%	
Smoking					
Yes	11	10.00%	21	19.09%	0.056
No	99	90.00%	89	80.91%	
Alcohol consumption					
Sometimes	22	20.00%	23	20.91%	0.157
Rarely	9	8.18%	18	16.36%	
Never	79	71.82%	69	62.73%	
Late night snacks					
Frequently	0	0.00%	10	9.09%	<0.001*
Sometimes	42	38.18%	49	44.55%	
Rarely	19	17.27%	26	23.64%	
Never	49	44.55%	25	22.73%	

*p-value significant at <0.05

4.6 Dietary choices and influences

The various factors influencing the dietary choices among trainee participants and college students is shown in **Table 4.7**. Nearly 80% of the trainee participants (n = 87, 79.09%) didn't have cultural influence on dietary choices while around 60% of the college students (n = 65, 59.09%) weren't affected by culture on their dietary choices and the difference was also statistically significant with p-value of 0.001. 62.73% of college students had influence of mood or emotion on food choices which is almost double than that of the study conducted among IT Undergraduates of Kathmandu Metropolitan City (Pokharel and Dhungel, 2023). Taste was predemoninat factor for the selection of food among college students (n = 53, 48.18%) which was similar to the study conducted among Vietnamese students where 77.88% male participants liked eating based on their tastes (Thi *et al.*, 2024). Nearly half of the trainee participants indicated that nutrients were the primary factor influencing their food choice, ranking it higher than taste and cost respectively. The difference in food choices between the trainee participants and college students was also statistically significant.

Table 4.7 Frequency distribution of factors influencing the dietary choices

Variables	**British Gurkha Trainees (n =110)**		**College Students (n =110)**		**p-value**
	Frequency	**Percentage**	**Frequency**	**Percentage**	
Cultural Influence on dietary choices					
Yes	23	20.91%	45	40.91%	0.001*
No	87	79.09%	65	59.09%	
Influence of mood or emotion on food choices					
Yes	63	57.27%	69	62.73%	0.409
No	47	42.73%	41	37.27%	
Influence on food choices					
Taste	35	31.82%	53	48.18%	0.005*
Cost	12	10.91%	7	6.36%	
Nutrients	47	42.73%	24	21.82%	
Convenience	10	9.09%	17	15.45%	
Social and cultural influences	6	5.45%	9	8.18%	

*p-value significant at <0.05

4.7 Weight management and body satisfaction

Table 4.8 Frequency distribution of weight management program and body satisfaction

Variables	British Gurkha Trainees (n =110)		College Students (n =110)		p-value
	Frequency	Percentage	Frequency	Percentage	
Satisfaction on body weight and shape					
Yes	61	55.45%	38	34.55%	<0.001*
No	49	44.55%	59	53.64%	
Neutral	0	0.00%	13	11.82%	
Weight gain or loss program					
Yes	67	60.91%	65	59.09%	0.783
No	43	39.09%	45	40.91%	

*p-value significant at <0.05

Table 4.8 shows the frequency distribution of weight management program and body satisfaction among trainee participants and college students. More than half of the college students (n = 65, 59.09%) were unsatisfied for their body weight or shape but 66.15% (n = 43) of them were involved in weight gain or loss program. Similarly, 44.55% of trainee participants were unsatisfied of their body weight and shape out of which 75.51% (n = 37) were involved in weight gain or loss program. The study conducted by Thi *et al.* (2024) also showed that 55.77% of the male participants were unsatisfied with their body weight and 68.75% of them wanted to change their weight.

4.8 Physical activity

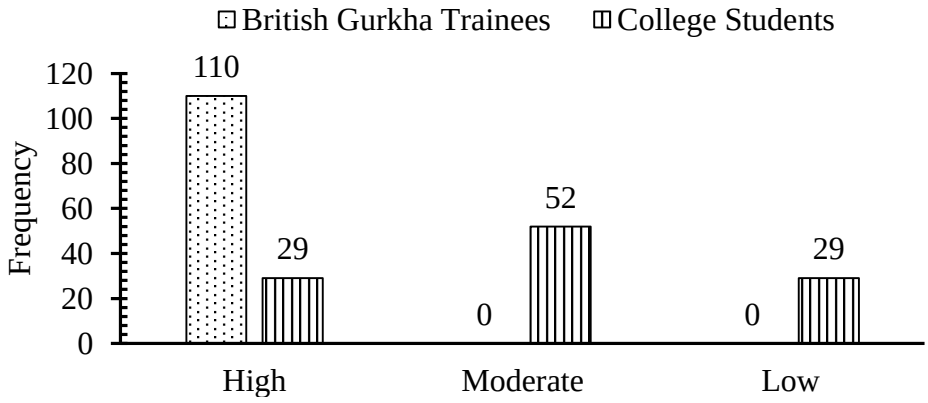

Fig. 4.1 Frequency distribution of physical activity level

The mean MET value for college students was notably lower (mean MET = 2180.35 ± 1969.25) than British Gurkha trainees whose mean MET value was 11307.75 ± 1685.46. The highest and lowest MET value for college students was 6948 and 0 respectively. Similarly, MET value of 15382 was the highest and MET value of 7893 was the lowest for British Gurkha Trainees. Trainee participants exhibited significantly higher physical activity levels compared to college students (p-value <0.001), with very strong effect size indicated by Cramer's V of 0.763 (Akoglu, 2018). **Fig. 4.1** shows the physical activity level of both the participant groups.

The study coducted among soldiers of the Polish air force indicated that 90% of ground staff participants aged 30 years or below had high level of phyisical activity (Tomczak *et al.*, 2022). The same study also showed that the overall MET level in the group of ground staff was 12,333. On the other hand, the study conducted by Munawar and Lontoh (2021) showed that 53.7% students had low physical activity, 35.3% students had moderate physical activity and 11.0% students had high level of physical activity. Similarly, the study conducted among adolescents in Nepal also exhibited similar results where 63.1% adolescents were physically inactive (Singh *et al.*, 2021).

The median sitting time for British Gurkha trainees was 245 minutes, with an interquartile range (IQR) of 150 minutes. Likewise, the median sitting time for college students was 420 minutes with an IQR of 180 minutes. A significant difference in sitting time was observed between trainee participants and college students (p-value <0.001). The frequency distribution of sitting time of both the groups is shown in **Table 4.9**.

Table 4.9 Frequency distribution of sitting time of participant groups

Sitting time	**British Gurkha Trainees (n =110)**		**College Students (n =110)**		**p-value**
	Frequency	**Percentage**	**Frequency**	**Percentage**	
2 – 4 hours	38	34.55%	2	1.82%	<0.001*
4 – 6 hours	52	47.27%	31	28.18%	
6 – 8 hours	20	18.18%	48	43.64%	
> 8 hours	0	0.00%	29	26.36%	

*p-value significant at <0.05

The meta-analysis conducted by Castro *et al.* (2020) indicated that university students spend on average 7.29 hours per day sitting. Similarly, the other study conducted among university students in Saudi Arabia found that that the average daily sedentary time among male was 8.3 hours (Alahmadi *et al.*, 2024).

4.9 Intake frequency of food groups

Since 26.37% of college students were either vegetarian or ovo-vegetarian as shown in **Table 4.6**, the consumption of egg and meat products by college students was lower than that of British Gurkha trainees. While the frequency of consumption of food groups including cereals, legumes and pulses, milk and its products, green leafy vegetables (GLVs), fruits and nuts and seeds by trainee participants were significantly higher than college students, college students consumed other food products such as carbonated drinks, packaged foods, fast food, tea/coffee and sweets more than that of British gurkha trainees. There was significant difference in consumption of rice, wheat, millet or buckwheat, legumes and pulses, egg, fish, white meat, red meat, milk and milk products, green leafy vegetables (GLVs), other vegetables, fruits, nuts and seeds, carbonated drinks, packaged foods, fast food, tea or coffee and sweets (p-value <0.05) between trainee participants and college students. The strongest association was indicated in egg consumption with Cramer's V of 0.747 followed by fast food consumption with Cramer's V of 0.664.

4.9.1 Consumption of cereals and pulses

Table 4.10 shows the frequency distribution of consumption of cereals and pulses by trainee participant and college students. The study revealed that the almost all the participants (n = 214, 97.27%) regardless of their group incorporated rice into their daily dietary intake. Monthly consumption of wheat was also high among all the participants. Very few college students (n = 5, 4.55%) consumed wheat on daily basis while trainee participants didn't consume wheat on a daily basis. Almost half of the college students (n = 50, 45.5%) never ate millet or buckwheat. 30.90% (n = 34) trainee participants preferred eating millet or buckwheat at least one in fifteen days. All the participants consumed legumes and pulses at least once a week among which 82.73% trainee participants and 73.64% college students preferred eating every day.

Table 4.10 Frequency distribution of consumption of cereals and pulses

Variables	British Gurkha Trainees (n =110)		College Students (n =110)		p-value
	Frequency	Percentage	Frequency	Percentage	
Rice					
Daily	110	100.00%	104	94.55%	0.029*
>3 times a week	0	0.00%	6	5.45%	
Wheat					
Daily	0	0.00%	5	4.55%	0.021*
>3 times a week	12	10.91%	5	4.55%	
<3 times a week	20	18.18%	9	8.18%	
Fortnightly	21	19.09%	22	20.00%	
Monthly	43	39.09%	52	47.27%	
Never	14	12.73%	17	15.45%	
Millet or buckwheat					
>3 times a week	5	4.50%	0	0.00%	0.001*
<3 times a week	11	10.00%	6	5.50%	
Fortnightly	18	16.40%	11	10.00%	
Monthly	52	47.30%	43	39.10%	
Never	24	21.80%	50	45.50%	
Legumes and pulses					
Daily	91	82.73%	81	73.64%	0.001*
>3 times a week	19	17.27%	20	18.18%	
<3 times a week	0	0.00%	9	8.18%	

*p-value significant at <0.05

4.9.2 Consumption of fruits and vegetables

Table 4.11 shows the frequency distribution of consumption of fruits and vegetables by trainee participants and college students. Only half of the trainee participants consumed GLVs and other vegetables on daily basis. Similarly, less than one third of the college students included GLVs in their daily diet and consumption of other vegetables on daily

basis was 60.00%. Only 42.73% (n = 47) of trainee participants and 33.64% (n = 37) of college students consumed fruits more than three times a week.

The findings of our study showed similarities with the study on which 81.8% participants consumed vegetables and 48.5% participants consumed fruits three or more times a week (Ganasegeran *et al.*, 2012). However, the study conducted by Pokharel and Dhungel (2023) showed similar results where the daily consumption of fruits by college students was only 28.2%. Similarly, a survey in the capital city Kathmandu indicated that 76% of young adults aged 18–29 years consumed insufficient quantities of fruits and vegetables (Anil *et al.*, 2019).

Table 4.11 Frequency distribution of consumption of fruits and vegetables

Variables	**British Gurkha Trainees (n =110)**		**College Students (n =110)**		**p-value**
	Frequency	**Percentage**	**Frequency**	**Percentage**	
GLVs					
Daily	57	51.82%	35	31.82%	0.001*
>3 times a week	46	41.82%	58	52.73%	
<3 times a week	7	6.36%	11	10.00%	
Fortnightly	0	0.00%	6	5.45%	
Other vegetables					
Daily	56	50.91%	66	60.00%	0.034*
>3 times a week	36	32.73%	29	26.36%	
<3 times a week	13	11.82%	15	13.64%	
Fortnightly	5	4.55%	0	0.00%	
Fruits					
Daily	32	29.09%	12	10.91%	<0.001*
>3 times a week	47	42.73%	37	33.64%	
<3 times a week	22	20.00%	33	30.00%	
Fortnightly	9	8.18%	19	17.27%	
Monthly	0	0.00%	9	8.18%	

*p-value significant at <0.05

4.9.3 Consumption of animal products

Table 4.12 Frequency distribution of consumption of animal products

Variables	British Gurkha Trainees (n =110)		College Students (n =110)		p-value
	Frequency	Percentage	Frequency	Percentage	
Egg					
Daily	91	82.73%	14	12.73%	<0.001*
> times a week	19	17.27%	34	30.91%	
<3 times a week	0	0.00%	30	27.27%	
Fortnightly	0	0.00%	10	9.09%	
Monthly	0	0.00%	5	4.55%	
Never	0	0.00%	17	15.45%	
Fish					
>3 times a week	10	9.09%	6	5.45%	<0.001*
<3 times a week	26	23.64%	14	12.73%	
Fortnightly	32	29.09%	16	14.55%	
Monthly	36	32.73%	42	38.18%	
Never	6	5.45%	32	29.09%	
White meat					
Daily	6	5.45%	5	4.55%	<0.001*
>3 times a week	38	34.55%	16	14.55%	
<3 times a week	38	34.55%	31	28.18%	
Fortnightly	12	10.91%	11	10.00%	
Monthly	7	6.36%	14	12.73%	
Never	9	8.18%	33	30.00%	
Red meat					
>3 times a week	38	34.50%	19	17.30%	<0.001*
<3 times a week	51	46.36%	30	27.27%	
Fortnightly	14	12.73%	16	14.55%	
Monthly	4	3.64%	11	10.00%	
Never	3	2.73%	34	30.91%	
Milk and milk products					
Daily	77	70.00%	29	26.36%	<0.001*
>3 times a week	17	15.45%	31	28.18%	
<3 times a week	6	5.45%	28	25.45%	
Fortnightly	5	4.55%	8	7.27%	
Monthly	0	0.00%	9	8.18%	
Never	5	4.55%	5	4.55%	

*p-value significant at <0.05

Table 4.12 presents the frequency distribution of consumption of egg, meat, fish as well as milk and milk products by trainee participants and college students. All the trainee participants consumed egg more than three times a week. In contrast, only 43.64% (n= 48) of the college students reported consumption of egg at least three times a week. Majority of the participants incorporated meat into their diet at least once a week. Only 5.00% (n = 11) of all the participants consumed white meat every day. However, a substantial proportion of trainee participants (n = 89, 80.86%) consumed read meat at least one a week. Fish was least preferred by both the participant groups with highest consumption only on monthly basis.

Daily milk consumption was substantially higher among trainee participants (n = 77, 70.00%) than college students (n = 29, 26.36%). The previous study among army recruits showed that the frequent consumption of dairy products was only 25% (Kitunen *et al.*, 2020). In a study examining dietary habits among adolescents in Tanzania, 51.2% reported consuming meat or meat products 1-2 times per week. Conversely, egg consumption was significantly lower in this study, with only 6.7% of participants reporting consumption 1-2 times per week. These findings differ from our study, which observed a higher prevalence of egg consumption.

4.9.4 Consumption of nuts and seeds

Table 4.13 Frequency distribution of consumption of nuts and seeds

Variable	**British Gurkha Trainees (n =110)**		**College Students (n =110)**		**p-value**
	Frequency	**Percentage**	**Frequency**	**Percentage**	
Nuts and seeds					
Daily	20	18.18%	6	5.45%	<0.001*
>3 times a week	24	21.82%	17	15.45%	
<3 times a week	36	32.73%	20	18.18%	
Fortnightly	11	10.00%	26	23.64%	
Monthly	13	11.82%	33	30.00%	
Never	6	5.45%	8	7.27%	

*p-value significant at <0.05

The consumption of nuts and seeds was appreciably lower among college students. 32.73% (n = 36) trainee participants consumed these foods at least once a week while 30% (n = 33) of college students consumed only on monthly basis. 5.45% (n = 6) trainee participants and 7.27% (n = 8) college students reported that they never preferred to eat nuts and seeds. The frequency distribution of consumption of nuts and seeds is shown in **Table 4.13**.

4.9.5 Consumption of processed foods

Table 4.14 Frequency distribution of consumption of processed foods

Variable	British Gurkha Trainees (n =110)		College Students (n =110)		p-value
	Frequency	Percentage	Frequency	Percentage	
Carbonated drinks					
Daily	0	0.00%	6	5.45%	0.016*
>3 times a week	9	8.18%	22	20.00%	
<3 times a week	26	23.64%	25	22.73%	
Fortnightly	34	30.91%	25	22.73%	
Monthly	29	26.36%	23	20.91%	
Never	12	10.91%	9	8.18%	
Packaged foods					
Daily	0	0.00%	21	19.09%	<0.001*
>3 times a week	21	19.09%	35	31.82%	
<3 times a week	35	31.82%	28	25.45%	
Fortnightly	27	24.55%	16	14.55%	
Monthly	21	19.09%	10	9.09%	
Never	6	5.45%	0	0.00%	
Fast food					
Daily	0	0.00%	27	24.55%	<0.001*
>3 times a week	6	5.45%	48	43.64%	
<3 times a week	40	36.36%	17	15.45%	
Fortnightly	41	37.27%	10	9.09%	
Monthly	17	15.45%	8	7.27%	
Never	6	5.45%	0	0.00%	
Sweets					
>3 times a week	12	10.90%	33	30.00%	<0.001*
<3 times a week	26	23.60%	28	25.50%	
Fortnightly	31	28.20%	13	11.80%	
Monthly	25	22.70%	15	13.60%	
Never	16	14.50%	7	6.40%	

*p-value significant at <0.05

The frequency distribution of consumption of carbonated drinks, packaged foods, fast foods and sweets by trainee participants and college students is illustrated in **Table 4.14**. Consumption of fast food was significantly higher within college students among which 24.55% (n = 27) of them reported to consume daily which was followed by consumption more than three times a week. Similarly, high proportion of college students consumed packaged foods at least three times and carbonated drinks at least once a week. Conversely, none of the trainee participants consumed fast foods on daily basis. In fact, trainee participants also avoided daily consumption of carbonated drinks and packaged foods. Sweetings were also favourite among college students where nearly one third of them (n = 33, 30%) consumed more than three times a week.

The study exhibited a higher prevalence of processed food consumption among college students compared to trainee participants. Similarities was seen with the study conducted by Singh *et al.* (2021) which revealed that 53.1% of adolescents drank soft drinks, 46.1% of adolescents consumed packaged food 1–3 times per week and 53.4% of adolescents took fast food 2–3 days per week. Likewise, the study undertaken in Bangladesh observed that 73.9% male students were frequent consumers of fast food (Banik *et al.*, 2020). Similarly, a study in Australia found that 62% of army recruits ingested processed foods alongside lower vegetable intake (Kitunen *et al.*, 2020).

4.9.6 Consumption of tea and coffee

Table 4.15 Frequency distribution of consumption of tea and coffee

Variable	**British Gurkha Trainees (n =110)**		**College Students (n =110)**		**p-value**
	Frequency	**Percentage**	**Frequency**	**Percentage**	
Tea or coffee					
Daily	27	24.55%	56	50.91%	<0.001*
>3 times a week	19	17.27%	25	22.73%	
<3 times a week	19	17.27%	13	11.82%	
Fortnightly	17	15.45%	5	4.55%	
Monthly	12	10.91%	6	5.45%	
Never	16	14.55%	5	4.55%	

*p-value significant at <0.05

The analysis revealed that a majority of college students (50.91%, n = 56) reported daily tea or coffee consumption. This was followed by 22.73% (n = 25) who reported consuming these beverages more than three times per week. Notably, a higher proportion of trainee participants abstained from tea or coffee consumption compared to college students. The frequency distribution of consumption of tea or coffee is shown in **Table 4.15**.

4.10 Dietary intake and nutrient adequacy

Table 4.16 and **Table 4.17** respectively show the nutrient adequacy and dietary intake of trainee participants and college students. The macronutrient contribution to daily energy intake by carbohydrate, fat and protein among trainee participants was 54.06%, 28.02% and 14.98%. Among college students, the contribution of carbohydrate, fat, and protein to the daily energy intake was 54.11%, 28.07%, and 13.31%, respectively. Significant difference was observed in carbohydrate, fat and protein adequacy between trainee participants and college students. Likewise, an independent-samples t-test revealed a significant difference in TEE, energy intake and protein intake but not in carbohydrate and fat intake between trainee participants and college students.

Table 4.16 Adequacy of nutrient intake of participant groups

Variables	**British Gurkha Trainees (n =110)**		**College Students (n =110)**		**p-value**
	Frequency	**Percentage**	**Frequency**	**Percentage**	
Energy adequacy					
Inadequate	108	98.18%	102	92.73%	0.052
Adequate	2	1.82%	8	7.27%	
Protein adequacy					
Inadequate	99	90.00%	46	41.82%	<0.001*
Adequate	11	10.00%	64	58.18%	
Carbohydrate adequacy					
Inadequate	110	100.00%	6	5.45%	<0.001*
Adequate	0	0.00%	104	94.55%	
Fat adequacy					
Inadequate	23	20.90%	43	39.10%	0.003*
Adequate	87	79.10%	67	60.90%	

*p-value significant at <0.05

Table 4.17 Mean nutrient intake of participant groups

Nutrients	British Gurkha Trainees (n = 110)	College Students (n = 110)	p-value
TEE (kcal)	2892.23 ± 163.34	2504.40 ± 392.52	<0.001*
Energy (kcal)	1965.31 ± 367.94	1816.99 ± 503.85	0.013*
Protein (g)	73.61 ± 16.27	60.80 ± 21.66	<0.001*
Carbohydrate (g)	255.84 ± 55.06	244.22± 64.62	0.153
Total fat (g)	61.07 ± 12.81	57.49 ± 22.87	0.155

*p-value significant at <0.05

Nearly all the trainee participants had inadequate energy intake which is consistent with the study conducted among Malaysian army trainees (Mohd *et al.*, 2011) and British Army recruits (Chapman *et al.*, 2019). The existence of a negative energy balance among the trainee participants may be due to the energy expenditure exceeding the energy intake, hectic training schedule and lack of adequate knowledge about diet quantity and quality. Similarly, none of the participants met the recommended daily carbohydrate intake, and protein intake was insufficient for the majority of the trainee participants (n = 99, 90.00%). The result again aligns with the findings of Chapman *et al.* (2019). Same study showed that the fat was also under consumed by male trainees contrasting with our findings where only one fifth of the trainee participants consumed lower than recommended level of fat.

High proportion of the participants reported adequate intake of energy and carbohydrates. In contrast to the trainee participants, a majority of the college students (58.18%, n = 64) consumed adequate protein, but exhibited lower fat intake. Our finding on calorie intake is consistent with those reported in a study of university students of Macao (Tao *et al.*, 2022) but contrary to the findings observed among male college students of Prayagraj city in India (Kumari *et al.*, 2019). A study in Kerala found that 17% of young college students had lower protein intake which is notably higher than our study where 41.82% of the college students had adequate protein intake (John *et al.*, 2020). This trend continued with 84% of the participants having adequate calorie intake, contrasting with our findings. In a study conducted among adults in India, the average contributions of carbohydrates and fats to daily calorie intake were 56% and 33% respectively (Mediratta *et al.*, 2023), which are marginally higher than our study.

4.11 Nutritional status of the participant groups

Among trainees participants, 8.18% (n = 9) were underweight while remaining 91.82% were classified having normal BMI. Among college students, more than one third of the participants (n = 45, 40.92%) were out of the normal range of BMI among which 21.82% were underweight and 19.10% were either overweight or obese. There was significant difference in BMI (p-value <0.001) between trainee participants and college students. **Fig. 4.2** shows the nutritional status of both population groups.

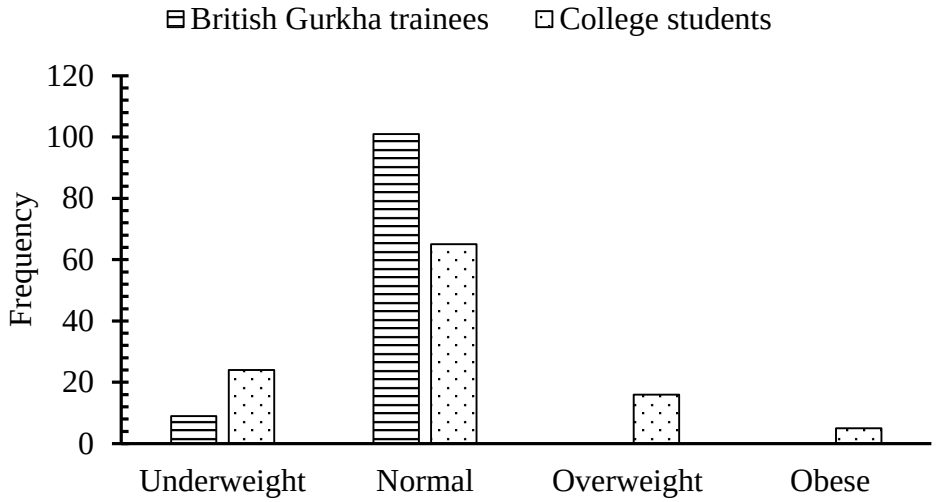

Fig. 4.2 Nutritional status of participant groups

The average BMI among trainee participants was 21.74 ± 1.76 which is similar to the study conducted among young Slovenian athletes whose average BMI was 22.9 ± 2.6 (Peklaj *et al.*, 2023). In a study conducted by Mohd *et al.* (2011), 80.0% of male participants were within the normal range of BMI. Similar to our findings, 49% of the college students in Kerala were either underweight, overweight or obese (John *et al.*, 2020). The study conducted among adult population in Kathmandu also showed that 32.5% adults aged 18-29 years were outside the accepted BMI range among which 11.6% were underweight and 20.9% were either overweight or obese (Anil *et al.*, 2019).

Similarly, a large proportion of British Gurkha trainees (n = 94, 85.5%) had normal WHR. For college students, 30% (n = 33) were found to be abdominally obese which is significantly higher than the study by John *et al.* (2020) but lower than the study conducted by Sönmez and Nazik (2019). However, the study considered WHR less than 1.00 as normal

range for men. A study conducted among Vietnamese students showed that 76.92% male participants had WHR less than or equal to 0.95. The difference in WHR between trainee participants and college students of our study was statistically significant with p-value of 0.006.

Table 4.18 Frequency distribution of body composition of participant groups

Body composition	**British Gurkha Trainees (n =110)**		**College Students (n =110)**		**p-value**
	Frequency	**Percentage**	**Frequency**	**Percentage**	
Body fat					
Low	12	10.91%	6	5.45%	<0.001*
Normal	82	74.55%	59	53.64%	
High	16	14.55%	27	24.55%	
Very high	0	0.00%	18	16.36%	
Visceral fat					
Normal	98	100.00%	83	89.25%	0.001*
High	0	0.00%	7	7.53%	
Very high	0	0.00%	3	3.23%	
Skeletal muscle					
Low	7	6.36%	20	18.18%	<0.001*
Normal	33	30.00%	52	47.27%	
High	42	38.18%	19	17.27%	
Very high	28	25.45%	19	17.27%	

*p-value significant at <0.05

Table 4.18 shows the frequency distribution of body fat, visceral fat and skeletal muscle of both the participant groups. The average body fat percentage of British Gurkha trainees and college students was 14.75 ± 4.14% and 18.85 ± 5.91% respectively and the difference was also statistically significant (p-value <0.001). The study by Peklaj *et al.* (2023) found the average body fat percentage of athletes aged 18-21 years was 9.6±3.5% which is marginally lower than our study. The body fat percentage of male participants was 17.98 ± 4.41% in a study conducted among college students of medical students in Kathmandu (Bhaila *et al.*, 2022) which is consistent with our study. Both visceral fat and skeletal muscle differed

significantly between trainee participants and college students with p-value 0.001 and <0.001 respectively for visceral fat and skeletal muscle. Visceral fat data from participants aged 18 years or older were included in the analysis.

4.12 Factors associated with nutritional status among participant groups

4.12.1 Factors associated with BMI

Table 4.19 and **Table 4.20** respectively shows the factors associated with BMI among trainee participants and college students. Factors like eating outside the house (p-value 0.020) and food groups such as legumes and pulses (p-value 0.046) and fish (p-value 0.029) was found to be associated with BMI among trainee participants whereas, among college students, factors like family occupation (p-value 0.044), place to eat at home (p-value 0.049), body weight satisfaction (p-value 0.039) and packaged food (p-value 0.045) were found to be associated with BMI.

Table 4.19 Factors associated with BMI among trainee participants (n = 110)

Factors	Underweight	Normal	χ^2	p-value
Eating outside the house				
Frequently	0 (0.00%)	7 (6.36%)	7.781	0.020
Sometimes	9 (8.18%)	64 (58.18%)		
Rarely	0 (0.00%)	30 (27.27%)		
Legumes and pulses				
Daily	5 (4.55%)	86 (78.18%)		0.046[f]
>3 times a week	4 (3.64%)	15 (13.64%)		
Fish				
>3 times a week	0 (0.00%)	10 (9.09%)	10.764	0.029
<3 times a week	0 (0.00%)	26 (23.64%)		
Fortnightly	6 (5.45%)	26 (23.64%)		
Monthly	3 (2.73%)	33 (30.00%)		
Never	0 (0.00%)	6 (5.45%)		

Note: 'f' denotes the value of Fisher's exact test. Values in parentheses are the percentage distribution of the sample.

Table 4.20 Factors associated with BMI among college students (n = 110)

Factors	Underweight	Normal	Overweight	Obese	χ^2	p-value
Family occupation						
Business	8 (7.27%)	11 (10.00%)	6 (5.45%)	0 (0.00%)	21.446	0.044
Agriculture	8 (7.27%)	22 (20.00%)	2 (1.82%)	3 (2.73%)		
Foreign employment	0 (0.00%)	10 (9.09%)	5 (4.55%)	0 (0.00%)		
Service	4 (3.64%)	9 (8.18%)	1 (0.91%)	1 (0.91%)		
Others	4 (3.64%)	13 (11.82%)	2 (1.82%)	1 (0.91%)		
Place to eat at home						
Dining room	14 (12.73%)	40 (36.36%)	7 (6.36%)	0 (0.00%)	12.640	0.049
Bedroom	2 (1.82%)	1 (0.91%)	1 (0.91%)	1 (0.91%)		
Anywhere but in front of TV, mobile or laptop	68 (7.27%)	24 (21.82%)	8 (7.27%)	4 (3.64%)		
Satisfaction on body weight and shape						
Yes	6 (5.45%)	28 (25.45%)	4 (3.64%)	0 (0.00%)	13.258	0.039
No	14 (12.73%)	29 (26.36%)	12 (10.91%)	4 (3.64%)		
Neutral	4 (3.64%)	8 (7.27%)	0 (0.00%)	1 (0.91%)		
Packaged foods						
Daily	6 (5.45%)	10 (9.09%)	4 (3.64%)	1 (0.91%)	21.407	0.045
>3 times a week	11 (10.00%)	19 (17.27%)	5 (4.55%)	0 (0.00%)		
<3 times a week	2 (1.82%)	19 (17.27%)	4 (3.64%)	3 (2.73%)		
Fortnightly	3 (2.73%)	13 (11.82%)	0 (0.00%)	0 (0.00%)		
Monthly	2 (1.82%)	4 (3.64%)	3 (2.73%)	1 (0.91%)		

Note: values in parentheses are the percentage distribution of the sample.

Almost all the trainee participants (n = 101, 91.82%) had normal BMI despite them eating outside the house. This may be due to their high energy expenditure and relatively lower consumption of processed foods. The study conducted among adolescents in Brazil showed higher BMI among those who eat outside the house (Fernandes Gomes *et al.*, 2020). Our findings on consumption of legumes and pluses and its association with BMI is also consistent with the findings of the same study. The study by Singh *et al.* (2021) showed that the factors like junk and high fat foods (p-value <0.001) were associated with the weight status of adolescents in Nepal. Similarly, Hamam *et al.* (2017) found no link between fast food, soft drinks, and meat consumption with BMI in Saudi university students, aligning with our results. Furthermore, a study among Vietnamese students showed the association between the BMI and their satisfaction with their body weight (Thi *et al.*, 2024).

12.73% (n = 14) of college students who eat in front of mobile phone or laptop were either overweight or obese which is further justified by the study conducted by La Marra *et al.* (2020). Moreover, male sex along with lower household income and family occupation was found to be associated with thinness among adolescents in Nepal (van Tuijl *et al.*, 2021). Similar to the results revealed by Munawar and Lontoh (2021), there was no significant relationship between physical activity and nutritional status in our study.

4.12.2 Factors associated with WHR

Table 4.21 and **Table 4.22** shows the factors associated with WHR among trainee participants and college students respectively. Factors like family income (p-value 0.021) as well as consumption of fruits (p-value 0.022) and carbonated drinks (p-value 0.018) were found to be associated with WHR among trainee participants. Similarly, number of siblings (p-value 0.015), skipping meal (p-value 0.027), body weight satisfaction (p-value 0.028) and packaged food (p-value 0.044) emerged as significant factors influencing WHR among college students.

Except for family income and number of siblings, the socio-demographic characteristics of the participants were not significantly associated with WHR which is consistent with the findings by Hamam *et al.* (2017). Our findings on carbonated drinks agreed with the study conducted by Reppas *et al.* (2022) who revealed that there was significant association between soft drinks with abdominal obesity (p-value < 0.05) but contradicted with rice

consumption and its association with abdominal obesity. Same study also found insignificant association between the consumption of fruits and vegetables particularly with waist circumference.

However, an Indian study on young adults demonstrated a lower WHR in fruit consumers compared to those favoring fast food, aligning with our fruit consumption findings but not those for vegetables (Mishra *et al.*, 2014). Similarly, the study among college students in India showed significant positive association between carbonated drinks, packaged food, sweets and noodles with WHR (Bhavani and Devi, 2020). The study conducted among university students in Turkey indicated the association between WHR and both meal skipping (p-value 0.011) and consumption of snacks (p-value 0.003) (Sönmez and Nazik, 2019).

Table 4.21 Factors associated with WHR among trainee participants (n = 110)

Factors	Normal	At risk	χ^2	p-value
Family income				
<Rs.50,000 per month	76 (69.09%)	8 (7.27%)		0.021[f]
>Rs.50,000 per month	18 (16.36%)	8 (7.27%)		
Fruits				
Daily	23 (20.91%)	9 (8.18%)	9.617	0.022
>3 times a week	45 (40.91%)	2 (1.82%)		
<3 times a week	19 (17.27%)	3 (2.73%)		
Fortnightly	7 (6.36%)	2 (1.82%)		
Carbonated drinks				
>3 times a week	7 (6.36%)	2 (1.82%)	11.973	0.018
<3 times a week	23 (20.91%)	3 (2.73%)		
Fortnightly	32 (29.09%)	2 (1.82%)		
Monthly	26 (23.64%)	3 (2.73%)		
Never	6 (5.45%)	6 (5.45%)		

Note: 'f' denotes the value of Fisher's exact test. Values in parentheses are the percentage distribution of the sample.

Table 4.22 Factors associated with WHR among college students (n = 110)

Factors	Normal	At risk	χ^2	p-value
Number of siblings				
0	6 (5.45%)	6 (5.45%)	10.397	0.015
1	34 (30.91%)	14 (12.73%)		
2	14 (12.73%)	11 (10.00%)		
3 and more	23 (20.91%)	2 (1.82%)		
Skipping meal				
Yes	71 (64.55%)	25 (22.73%)		0.027[f]
No	6 (5.45%)	8 (7.27%)		
Satisfaction on body weight and shape				
Yes	32 (29.09%)	6 (5.45%)	7.154	0.028
No	35 (31.82%)	24 (21.82%)		
Neutral	10 (9.09%)	3 (2.73%)		
Packaged foods				
Daily	11 (10.00%)	10 (9.09%)	9.819	0.044
>3 times a week	29 (26.36%)	6 (5.45%)		
<3 times a week	17 (15.45%)	11 (10.00%)		
Fortnightly	14 (12.73%)	2 (1.82%)		
Monthly	6 (5.45%)	4 (3.64%)		

Note: 'f' denotes the value of Fisher's exact test. Values in parentheses are the percentage distribution of the sample.

4.12.3 Factors associated with body fat

The factors associated with body fat among trainee participants and college students is shown in **Table 4.23** and **Table 4.24** respectively. There was no association between the socio demographic characteristics and body fat in either participant groups, except for religion among college students. Our results align with previous research exhibiting a positive association between higher dietary fat consumption and increased body fat percentage (Hooper *et al.*, 2020). Consistent with our findings among trainee participants, a previous investigation involving young adults reported a link between egg consumption and a lower body fat percentage; however, this association appeared to be mediated by overall protein intake (Garrido-Miguel *et al.*, 2022). Similarly, sedentary time was associated with

body fat among college students in our study contrasting the study conducted among Brazilian young adults Silva *et al.* (2019). The same study also revealed that the effect of sedentary time was smaller compared to the benefits of high moderate-to-vigorous physical activity.

Table 4.23 Factors associated with body fat among trainee participants (n = 110)

Factors	Low	Normal	High	χ^2	p-value
Eating outside the house					
Frequently	0 (0.00%)	4 (3.64%)	2 (1.82%)	13.900	0.008
Sometimes	11 (10.00%)	57 (51.82%)	10 (9.09%)		
Rarely	1 (0.91%)	21 (19.09%)	4 (3.64%)		
Late night snacks					
Sometimes	1 (0.91%)	39 (35.45%)	2 (1.82%)	18.889	0.001
Rarely	6 (5.45%)	11 (10.00%)	2 (1.82%)		
Never	5 (4.55%)	32 (29.09%)	12 (10.91%)		
Legumes and pulses					
Daily	8 (7.27%)	67 (60.91%)	16 (14.55%)	7.933	0.019
> times a week	4 (3.64%)	15 (13.64%)	0 (0.00%)		
Egg					
Daily	10 (9.09%)	65 (59.09%)	16 (14.55%)	6.725	0.035
> times a week	2 (1.82%)	17 (15.45%)	0 (0.00%)		
Packaged foods					
>3 times a week	0 (0.00%)	12 (10.91%)	9 (8.18%)	14.378	0.042
<3 times a week	4 (3.64%)	28 (25.45%)	3 (2.73%)		
Fortnightly	2 (1.82%)	23 (20.91%)	2 (1.82%)		
Monthly	5 (4.55%)	15 (13.64%)	1 (0.91%)		
Never	1 (0.91%)	4 (3.64%)	1 (0.91%)		
Fat adequacy					
Inadequate	7 (6.36%)	11 (10.00%)	5 (4.55%)	11.982	0.003
Adequate	5 (4.55%)	71 (64.55%)	11 (10.00%)		

Note: values in parentheses are the percentage distribution of the sample.

Table 4.24 Factors associated with body fat among college students (n = 110)

Factors	Low	Normal	High	Very high	χ^2	p-value
Religion						
Hindu	6 (5.45%)	46 (41.82%)	20 (18.18%)	14 (12.73%)	12.946	0.044
Kirant	0 (0.00%)	8 (7.27%)	0 (0.00%)	2 (1.82%)		
Others	0 (0.00%)	5 (4.55%)	7 (6.36%)	2 (1.82%)		
Place to eat at home						
Dining room	2 (1.82%)	41 (37.27%)	13 (11.82%)	5 (4.55%)	14.001	0.030
Bedroom	1 (0.91%)	1 (0.91%)	1 (0.91%)	2 (1.82%)		
Anywhere but infront of TV, mobile or laptop	3 (2.73%)	17 (15.45%)	13 (11.82%)	11 (10.00%)		
Sitting time in a day						
2 – 4 hours	1 (0.91%)	0 (0.00%)	1 (0.91%)	0 (0.00%)	17.077	0.048
4 – 6 hours	0 (0.00%)	21 (19.09%)	8 (7.27%)	2 (1.82%)		
6 – 8 hours	3 (2.73%)	26 (23.64%)	12 (10.91%)	7 (6.36%)		
> 8 hours	2 (1.82%)	12 (10.91%)	6 (5.45%)	9 (8.18%)		
Fat adequacy						
Inadequate	0 (0.00%)	28 (25.45%)	8 (7.27%)	7 (6.36%)	8.703	0.034
Adequate	6 (5.45%)	31 (28.18%)	19 (17.27%)	11 (10.00%)		

Note: values in parentheses are the percentage distribution of the sample.

4.12.4 Factors associated with visceral fat

Table 4.25 shows the factors associated with visceral fat among college students. There was insignificant association between socio demographic characteristics, dietary habits or nutrient intake with visceral fat among trainee participants. The study conducted among young adults showed insignificant association between nutrient intake and visceral fat among men (Bailey *et al.*, 2010) which is similar to our study. Similarly, our findings on carbonated drinks is consistent with the findings by Ma *et al.* (2014) where significant association was observed between sugary beverage and visceral fat after the adjustment for subcutaneous fat.

The diet intervention study in UK showed that the group with the highest intake of unprocessed and minimally processed snacks had visceral fat mass (p-value <0.001) compared to the group with the lowest intake (Bermingham *et al.*, 2024). Interestingly, the study also revealed that individuals who snack after 9 pm had higher risk of developing metabolic syndrome. Similarly, distractions from mobile phones during meal times can result in consuming larger portions and making unhealthy food choices (La Marra *et al.*, 2020) ultimately contributing to weight gain and the accumulation of visceral fat (Ma *et al.*, 2014; Bhavani and Devi, 2020; Bermingham *et al.*, 2024).

Table 4.25 Factors associated with visceral fat among college students (n = 110)

Factors	Normal	High	Very high	χ^2	p-value
Place to eat at home					
Dining room	51 (54.84%)	1 (1.08%)	0 (0.00%)	13.232	0.010
Bedroom	2 (2.15%)	1 (1.08%)	1 (1.08%)		
Anywhere but in front of TV, mobile or laptop	30 (32.26%)	5 (5.38%)	2 (2.15%)		
Satisfaction on body weight and shape					
Yes	34 (36.56%)	0 (0.00%)	1 (1.08%)	11.004	0.027
No	39 (41.94%)	7 (7.53%)	1 (1.08%)		
Neutral	10 (10.75%)	0 (0.00%)	1 (1.08%)		
Late night snacks					
Frequently	6 (6.45%)	1 (1.08%)	2 (2.15%)	12.759	0.047
Sometimes	38 (40.86%)	4 (4.30%)	0 (0.00%)		
Rarely	20 (21.51%)	0 (0.00%)	1 (1.08%)		
Never	19 (20.43%)	2 (2.15%)	0 (0.00%)		
Carbonated drinks					
Daily	4 (4.30%)	0 (0.00%)	2 (2.15%)	18.948	0.041
>3 times a week	15 (16.13%)	4 (4.30%)	0 (0.00%)		
<3 times a week	20 (21.51%)	1 (1.08%)	0 (0.00%)		
Fortnightly	20 (21.51%)	0(0.00%)	0 (0.00%)		
Monthly	18 (19.35%)	1 (1.08%)	1 (1.08%)		
Never	6 (6.45%)	1 (1.08%)	0 (0.00%)		

Note: values in parentheses are the percentage distribution of the sample.

4.13 Status of micronutrients

Green leafy vegetables, other vegetables and fruits are rich sources of micronutrients such as vitamins and minerals (Mendez and Popkin, 2004; ICMR, 2011; Aerenhouts *et al.*, 2012; MoHP, 2022; Amawi *et al.*, 2024). Although dietary micronutrient intake wasn't assessed, the low consumption of fruits and vegetables observed in both trainee participants and college students warrants concern about potential micronutrient deficiencies. Only 41.83% (n = 92) and 55.45% (n = 122) of total participants consumed GLVs and other vegetables on daily basis. Worryingly, only one-fifth of total participants (n = 44, 20%) consumed fruits daily. Several studies have shown that inadequate fruits and vegetables intake can result in micronutrient deficiencies (Caulfield *et al.*, 2006; Aerenhouts *et al.*, 2012; Akseer *et al.*, 2017; Farhat *et al.*, 2019; Tao *et al.*, 2022) and also increased risk of non-communicable diseases later in life (MoHP, 2022).

Despite increased nutritional vulnerability due to poor dietary diversity and a lack of nutrient-dense foods, micronutrient deficiencies among adolescents and young adults are often overlooked (Akseer *et al.*, 2017). The study conducted in Brazil showed that processed and ultra-processed foods are associated with excess sodium consumption and high prevalence of inadequate micronutrients including vitamin D, vitamin E, vitamin B6, folate, selenium, phosphorus and zinc (Falcão *et al.*, 2019). Similarly, the previous study on Brazil also had shown the similar results (Louzada *et al.*, 2015). In contrast, high protein density diet was found to be associated with better diet quality and micronutrient intake among healthy young adults, especially among those who were entering initial military training (Gwin *et al.*, 2019).

4.14 Correlation between anthropometric measurements and body composition

The numerical data of BMI, WHR, body fat, visceral fat and skeletal muscle were taken to observe the association between these variables which is shown in **Table 4.26**. Among trainee participants, there was fair association between BMI and WHR while moderate association was observed between BMI and body fat as well as WHR and body fat. Similarly, there was moderate association between BMI, WHR and body fat among college students. In a study conducted by Bhaila *et al.* (2022), the association and BMI and body fat was 0.81 while the association between WHR and body fat was weak with value of 0.30. In other study, significant positive correlation was observed between the BMI and waist

circumference (0.679, p-value <0.001), hip and waist to hip ratio (0.168, p-value <0.001) by Bhavani and Devi (2020).

Similarly, very strong positive association was observed between BMI and visceral fat among both the participant groups. Likewise, body fat and skeletal muscle also had very strong negative association among both the participant groups.

Table 4.26 Correlation between anthropometric measurements and body composition among participant groups

Variables	Correlation coefficient	p – value
British Gurkha trainees		
BMI and WHR	+0.40	<0.001
BMI and body fat	+0.62	<0.001
BMI and visceral fat	+0.89	<0.001
WHR and body fat	+0.61	<0.001
WHR and visceral fat	+0.37	<0.001
Body fat and visceral fat	+0.70	<0.001
Body fat and skeletal muscle	-0.87	<0.001
College students		
BMI and WHR	+0.64	<0.001
BMI and body fat	+0.70	<0.001
BMI and visceral fat	+0.99	<0.001
WHR and body fat	+0.63	<0.001
WHR and visceral fat	+0.61	<0.001
Body fat and visceral fat	+0.70	<0.001
Body fat and skeletal muscle	-0.91	<0.001

Part V

Conclusions and recommendations

5.1 Conclusions

Nutritional status of British Gurkha trainees and college students were accessed and compared in the study. The study aimed to uncover and also explore the significant differences in their socio economic backgrounds, nutritional knowledge, nutritional habits, dietary intake, and overall health markers. The key conclusions from this study include:

1. The prevalence of underweight among trainee participants was 8.18% while rest of them were within the normal range with zero prevalence of overweight or obese. Among college students, 21.82% were underweight, 14.55% were overweight and 4.55% were found to be obese.
2. There was significantly lower consumption of energy, protein and carbohydrate among trainee participants. Almost half of both the participant groups had poor nutritional knowledge. College students had comparatively better nutritional knowledge than trainee participants but low physical activity level. There was significant difference in socio demographic characteristics, food preferences, physical activity, dietary patterns and nutrient intake between trainee participants and college students.
3. Factors like eating outside the house and legumes and pulses consumption was associated with BMI and body fat among trainee participants. Similarly, family income, fruits and carbonated drinks was associated with WHR and late night snacks, egg, packaged food and fat adequacy was associated with body fat among trainee participants. No association was observed with visceral fat among trainee participants.
4. College students exhibited associations between lifestyle factors and body composition. Place to eat at home was correlated with BMI, body fat and visceral fat. Body weight satisfaction was associated with BMI, WHR and visceral fat and packaged food was associated with BMI and WHR. Similarly, family occupation showed association with BMI, while the number of siblings and skipping meals were linked to WHR. Moreover, religion, sedentary time and fat adequacy were associated with body fat, whereas late-night snacks and consumption of carbonated drinks were associated with visceral fat among college students.

5. This study, while informative, might have limitations. Firstly, the sample size may not be sufficiently large to generalize the findings. Status of dietary intake of micronutrients, drinking water, anxiety and sleep quality which may have impact on nutritional status of participant groups was not taken into account. Additionally, the cross-sectional design of the study limits the ability to establish causal relationships.

5.2 Recommendations

1. There is a clear need to enhance nutritional support and education for British Gurkha trainees so that to ensure optimal intake of macronutrients and micronutrients which can further improve their physical performance, recovery times, and reduce the risk of injuries and nutritional deficiencies.
2. Nutritional education programs can be implemented for college students to promote healthy eating habits and encourage healthier dietary choices.
3. Awareness programs can be conducted on importance of balanced diet and physical activity. Initiatives aimed at reducing sedentary behaviours among young adults can be introduced.
4. Further research can be conducted by including unaccounted variables in this study and investigate the factors influencing the differences in nutritional status.

Part VI

Summary

Unhealthy eating behavior, food choices and sedentary life style has been rapidly increasing among late adolescents and adults thereby increasing the global prevalence of malnutrition, especially overweight and obesity, including Nepal. A community based cross-sectional comparative study was conducted in six different colleges and five different training centers of Dharan sub-metropolitan city of Sunsari district of Koshi province, Nepal to assess the nutritional status of British Gurkha trainees and college students each with 110 participants and aged between 17-21 years. Data was collected through a self-administered questionnaire and anthropometric measurements as well as body composition was accessed. The cross sectional study explores the difference in nutritional status between the participant groups and factors associated with them.

The study revealed that the prevalence of underweight among trainee participants was 8.18% while among college students, 21.82% were underweight, 14.55% were overweight and 4.55% were obese. Comparatively, college students had lower level of physical activity with higher sedentary time and nutritional knowledge. There was significant difference in socio demographic characteristics (ethnicity, religion, parent's education, family income, family occupation, internet usage), dietary habits (food preferences, food choices and its influence, skipping meal, consumption of late night snacks), physical activity, dietary pattern and nutrient intake between trainee participants and college students.

Energy, protein and carbohydrate consumption was significantly lower among trainee participants. Factors like family income, eating outside the house, skipping meals, late night snacks, fat adequacy and consumption of legumes and pulses, eggs, fruits, carbonated drinks and packaged food was associated with nutritional status among trainee participants. Similarly, energy intake was inadequate among majority of the college students Factors like religion, family occupation, number of siblings, place to eat at home, skipping meals, late night snacks, body weight satisfaction, sedentary time, fat adequacy and consumption of packaged food and carbonated drinks was associated with nutritional status among college students. Strategic and adequate nutritional interventions across individual to local levels can substantially improve the nutritional status of participant groups.

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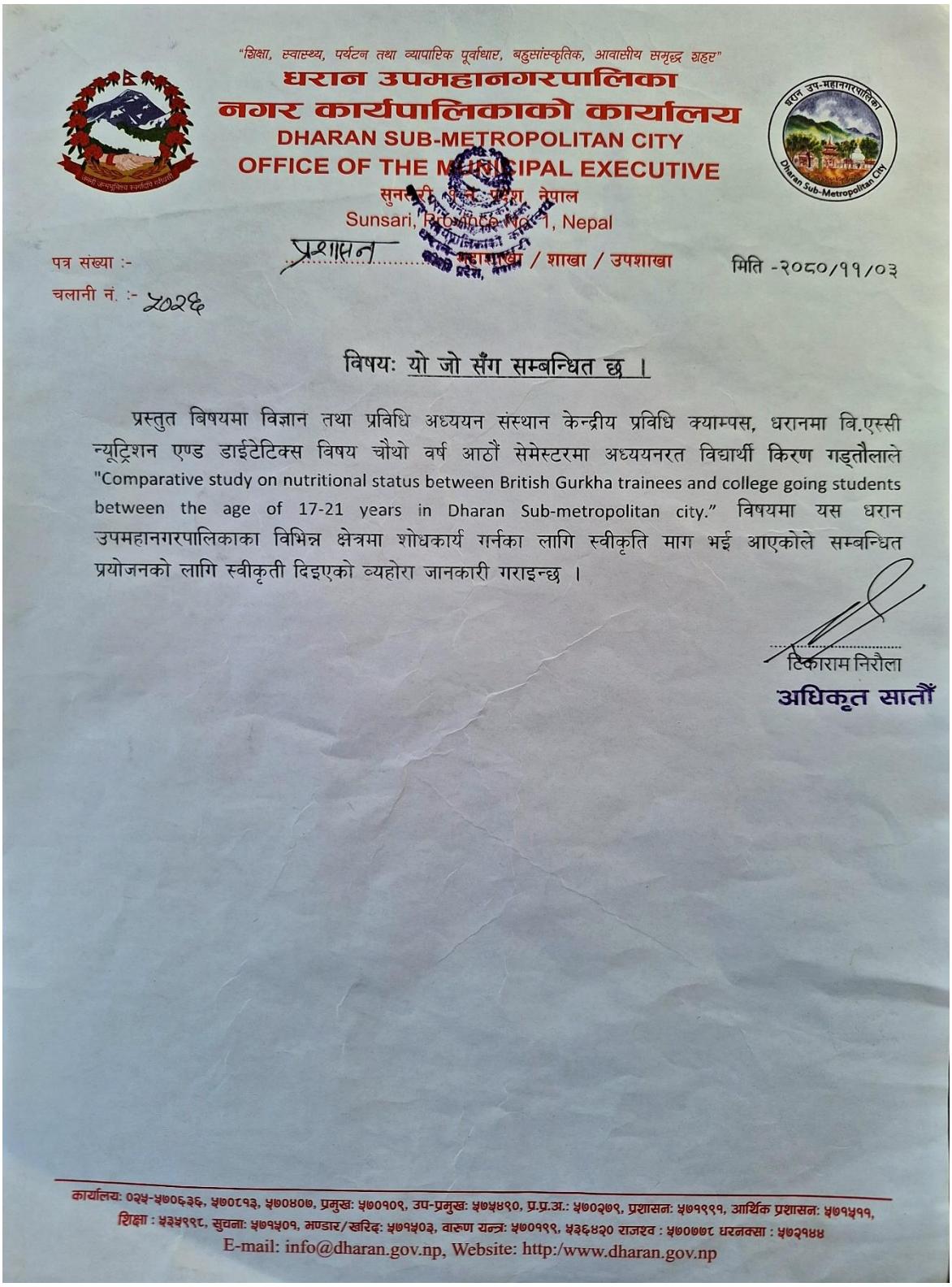
Appendices

Appendix-A: Approval letter from Dharan Sub-Metropolitan City



"शिक्षा, स्वास्थ्य, पर्यटन तथा व्यापारिक पूर्वाधार, बहुसांस्कृतिक, आवासीय समृद्ध शहर"

धरान उपमहानगरपालिका

नगर कार्यपालिकाको कार्यालय

DHARAN SUB-METROPOLITAN CITY

OFFICE OF THE MUNICIPAL EXECUTIVE

सुनसरी, प्रदेश नं. १, नेपाल

Sunsari, Province No. 1, Nepal

प्रशासन महाशाखा / शाखा / उपशाखा

पत्र संख्या :-

चलानी नं. :- २०२६

मिति -२०८०/११/०३

विषयः यो जो सँग सम्बन्धित छ ।

प्रस्तुत बिषयमा विज्ञान तथा प्रविधि अध्ययन संस्थान केन्द्रीय प्रविधि क्याम्पस, धरानमा वि.एस्सी न्यूट्रिशन एण्ड डाईटेटिक्स विषय चौथो वर्ष आठौं सेमेस्टरमा अध्ययनरत विद्यार्थी किरण गड्तौलाले "Comparative study on nutritional status between British Gurkha trainees and college going students between the age of 17-21 years in Dharan Sub-metropolitan city." विषयमा यस धरान उपमहानगरपालिकाका विभिन्न क्षेत्रमा शोधकार्य गर्नका लागि स्वीकृति माग भई आएकोले सम्बन्धित प्रयोजनको लागि स्वीकृती दिइएको व्यहोरा जानकारी गराइन्छ ।

टिकाराम निरौला

अधिकृत सातौं

कार्यालय: ०२५-५७०६३६, ५७०८१३, ५७०४०७, प्रमुख: ५७०१०९, उप-प्रमुख: ५७५४९०, प्र.प्र.अ.: ५७०३७९, प्रशासन: ५७१९९१, आर्थिक प्रशासन: ५७१५११, शिक्षा : ५३५९९८, सुचना: ५७१५०१, मण्डार/खरिद: ५७१५०३, वारुण यन्त्र: ५७०१९९, ५३६४३० राजश्व : ५७०७७८ धरनक्सा : ५७२१४४

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Appendix B: Consent form

मिति: .....

नमस्ते, म किरण गड्तौला, त्रिभुवन विश्वविद्यालयको पोषण तथा आहार बिज्ञान संकाय,चौथो बर्ष आठौँ सत्रको विद्यार्थी हुँ। म मेरो शैक्षिक पाठ्यक्रमको अंशको रूपमा, "Comparative Study on Nutritional Status between British Gurkha Trainees and College Students between the Age of 17-21 Years in Dharan Sub-Metropolitan City" शीर्षकमा अनुसन्धान गर्दै छु। मेरो अध्ययनको मुख्य उद्देश्य ब्रिटिश आर्मीमा भर्ति हुन प्रयास गरिरहेका युवाहरु र त्यहि उमेर समूहका कलेज जाने विद्यार्थीहरुको पोषणको अवस्था र भिन्नता पत्ता लगाउनु हो। यस उद्देश्यका लागि, मैले अन्तर्वार्ता लिदै प्रश्नावली भर्नुपर्छ। यसका साथै उत्तरदाताको शरिरको शारीरिक मापन पनि गर्नुपर्छ। उत्तरदाताहरु द्वारा प्रदान गरिएको सूचना अत्यन्त गोप्यतासँग राखिनेछ र उनीहरुको पहिचान खुलाइने छैन। कुनै आर्थिक लेनदेन गरिने छैन र यस अध्ययनमा तपाईँको सहभागिता स्वैच्छिक हुनेछ। यदि तपाईँ यस अध्ययनमा भाग लिन चाहानुहुन्छ भने कृपया तलको सहमति फारममा हस्ताक्षर गर्नुहोस्। कृपया तलको कथन पढ्नुहोस्।

समय आवश्यक (अनुमानित): २० – ३० मिनेट

वक्तव्य:

१. म यो अन्तर्वार्ताको कारण बुझ्छु र यसमा भाग लिन इच्छुक र खुशी छु।

२. यदि म यो अन्तर्वार्तामा भाग लिन सहमत छु भने म बुझ्छु मैले के गर्नु पर्ने हुन्छ।

३. म मेरो शरिरको नाप लिन सहमत छु र सो गर्दा मलाई कुनै किसिमको हानी हुने छैन।

४. मैले दिएको अन्तर्वार्ता र यसमा समावेश गरिएको जानकारी पूर्ण रूपमा परियोजना द्वारा परिभाषित उद्देश्यहरूको लागि प्रयोग गरिनेछ।

५. मलाई थाहा छ मसँग कुनै पनि समयमा अन्तर्वार्ता छोड्ने वा कुनै प्रश्नको उत्तर दिन अस्वीकार गर्ने अधिकार छ।

६. यदि म यस अन्तर्वार्तामा भाग लिन सहमत भइन भने म बुझ्दछु कि अनुसन्धानकर्ताद्वारा त्यसो गर्दा मलाई दण्ड दिइने छैन।

७. म यस प्रश्नावली भर्न र अन्तर्वार्तामा भाग लिन स्वेच्छाले सहमत छु।

....

सहभागीको हस्ताक्षर सर्वेक्षकको हस्ताक्षर

Appendix C: Survey questionnaire

Participant's code: _____ Institution: _____

क) सामान्य जानकारी

१. उमेर (वर्षमा): ……

२. जाती: क. बाहुन ख. क्षत्री ग. राई घ. लिम्बु ङ. अन्य

३. धर्म: क. हिन्दु ख. किरात ग. अन्य

ख) सामाजिक-आर्थिक जानकारी

४. परिवारको प्रकार: क. एकल (nuclear) ख. संयुक्त (joint)

५. परिवार सदस्यहरुको संख्या: क. ५ भन्दा कम ख. ५ वा सो भन्दा बढी

६. दाजुभाइ दिदीबहिनीहरुको संख्या: क. 0 (छैन) ख. १ (एक) ग. २ (दुई) घ. ३ वा बढी

७. बैबाहिक स्थिति: क. विवाहित ख. अविवाहित

८. बुवाको शिक्षाको स्तर: क. अनपढ ख. अनौपचारिक ग. Primary
घ. Secondary ङ. Higher-secondary वा त्यो भन्दामाथि

९. आमाको शिक्षाको स्तर: क. अनपढ ख. अनौपचारिक ग. Primary
घ. Secondary ङ. Higher-secondary वा त्यो भन्दा माथि

१०. परिवारको मुख्य पेशा: क. Business ख. कृषि ग. बैदेशिक रोजगार (Foreign)
घ. सरकारी वा गैरसरकारी सेवा ङ. अन्य

११. आफ्नो पेशा (यदि गर्नुहुन्छ भने मात्र): _____

१२. परिवारको आम्दानी: क. महिनाको रू. ५०, ००० भन्दा कम
ख. महिनाको रू. ५०,००० भन्दा बढी

१३. Internet को प्रयोग: क. दैनिक ख. हप्तामा केहि पटक ङ कहिल्यै चलाउदिन

१४. Social media को प्रयोग: क. Facebook ख. Instagram ग. TikTok
घ. Twitter ङ. YouTube च. अन्य _____

१५. यस्तो Social media मा खर्चिने समय: क. दिनको 5 घण्टा भन्दा कम ख. दिनको 5 – 10 घण्टा
ग. दिनको 10 घण्टा भन्दा धेरै

ग) पोषणबारे ज्ञान

१६. तपाईँलाई आफ्नो पोषणको ज्ञान कति छ जस्तो लाग्छ?

क. एकदम थोरै ख. औसत (average) ग. राम्रो घ. अति धेरै

१७. के तपाईँ प्याकेटका खानेकुरामा भएको पोषणको जानकारीलाई हेरेर अर्थ लगाउन सक्नुहुन्छ?

क. सक्छु ख. सक्दिन

१८. के तपाईँलाई सन्तुलित भोजन (balanced diet) भनेको के हो, थाहा छ?

क. छ ख. छैन

१९. तपाईँलाई आफ्नो उमेर, लिङ्ग(gender) र शारीरिक गतिविधि अनुसार दिनमा कति calorie खान चाहिन्छ, थाहा छ?

क. छ ख. छैन

२०. के प्रोटिन (protein), खेलाडी हरुका लागि मांसपेशी ऊर्जा (muscular energy) को प्राथमिक स्रोत हो?

क. हो ख. होइन ग. थाहा छैन

२१. तल दिइएका कुन-कुन खानाहरु कार्बोहाइड्रेट (carbohydrate)को मुख्य श्रोत हुन् या होइनन्, टिक लगाउनुहोस्।

		Yes	**No**	**थाहा छैन**
Rice	**(भात)**	☐	☐	☐
Curd	**(दही)**	☐	☐	☐
Bread	**(ब्रेड)**	☐	☐	☐
Chicken	**(चिकेन)**	☐	☐	☐
Milk	**(दुध)**	☐	☐	☐

२२. तल दिइएका कुन-कुन खानाहरु प्रोटिन (protein) को मुख्य श्रोत हुन् या होइनन्, टिक लगाउनुहोस्।

		Yes	**No**	**थाहा छैन**
Bengal gram	**(चना)**	☐	☐	☐
Egg	**(अन्डा)**	☐	☐	☐
Bitten rice	**(चिउरा)**	☐	☐	☐
Chicken	**(चिकेन)**	☐	☐	☐
Broccoli	**(ब्रोकाउली)**	☐	☐	☐

२३. के सामान्यतया बाहिर बनेको खाना घरमा बनेको खाना भन्दा राम्रो हुन्छ?

क. हुन्छ ख. हुँदैन ग. थाहा छैन

२४. के सागसब्जी र फलफूलहरु भिटामिन र खनिज (vitamins and minerals) को मुख्य श्रोत हो?

क. हो ख. होइन ग. थाहा छैन

२५. के दुध र दुध बाट बनेका खानेकुराहरु क्यालसियम (calcium) को मुख्य श्रोत हो?

क. हो ख. होइन ग. थाहा छैन

२६. के फास्ट फूड (जस्तै म:म, चाउमिन, पिज्जा, बर्गर आदि) धेरै खानाले मोटोपना हुन्छ?

क. हुन्छ ख. हुँदैन ग. थाहा छैन

२७. तल दिइएका वाक्यहरु ठीकलागे ✓, बेठिक लागे ✘ मा र थाहा नभए "थाहा छैन" मा चिन्ह लगाउनुहोस्।

क. Vitamin C (**भिटामिन सी**) मुख्य गरि दुध र दुधजन्य खानेकुरामा पाइन्छ।	☑	☒	थाहा छैन
ख. राति ढिलो खाना खाँदा पाचन प्रक्रियामा असर गर्दैन।	☑	☒	थाहा छैन
ग. फलफूल र तरकारीहरू फाइबरको उत्कृष्ट स्रोत हुन् ।	☑	☒	थाहा छैन
घ. धेरै नुन खाँदा रक्तचाप (blood pressure) मा नराम्रो असर पर्छ ।	☑	☒	थाहा छैन

घ. खानाको सेवन र बानीहरु

२८. खानाको प्राथमिकता: क. भेज ख. नन् भेज ग. Ovo – भेज (अन्डा खाने भेज)

२९. तपाईँ घरबाहिर कत्तिको खाना खानु हुन्छ?

क. प्रायजसो　　ख. कहिलेकाहिँ　　ग. बिरलै　　घ. कहिल्यै खादिन

३०. के तपाईँको खानेकुराको छनोटलाई तपाईँको धर्म या रितिरिवाजले प्रभाव पार्छ?

क. पार्छ　　ख. पार्दैन

३१. के तपाईँ खाने time (जस्तै breakfast, lunch) छोड्नुहुन्छ?

क. कहिलेकाहिँ छोड्छु　　ख. कहिल्यै छोड्दिन

३२. तपाईँ सामान्यतया घरमा कहाँ खानुहुन्छ?　क. किचन/dining room　　ख. सुत्ने कोठा

ग. TV/laptop/mobile अगाडि　　घ. अन्य _____

३३. के तपाईँलाई मुड (mood), emotion वा तनावले तपाईँको खाना छनोट र उपभोगलाई असर गर्छ जस्तो लाग्छ?

क. लाग्छ　　ख. लाग्दैन

३४. के तपाईँ आफ्नो वर्तमान शरीरको तौल र आकारलाई लिएर सन्तुष्ट हुनुन्छ?

क. छु　　ख. छैन　　ग. तटस्थ

३५. के तपाईँले कहिले तौल घटाउने वा बढाउने योजना वा उपायहरु प्रयास गर्नु भएको छ?

क. छ　　ख. छैन

३६. तपाईँको खानाको छनोटलाई सबैभन्दा बढी कुन कुराले प्रभाव पार्छ? ***(कृपया एउटामा टिक लगाउनुहोस्)***

क. स्वाद　　ख. मुल्य (cost)　　ग. पोषक तत्व (Nutrients)

घ. अनुकूलता/सहजता　　ङ. सामाजिक वा धार्मिक मूल्यमान्यता

३७. के तपाईँ कुनै 'dietary supplements' हरु खानुहुन्छ?　क. खान्छु　　ख. खाँदिन

यदि खानुहुन्छ भने के को **supplement** खानुहुन्छ, **खुलाउनुहोस्** _____

३८. के तपाईँ धुम्रपान गर्नुहुन्छ?　क. गर्छु　　ख. गर्दिन

३९. तपाईँ जाडरक्सी कत्तिको खानुहुन्छ?

क. प्रायजसो　　ख. कहिलेकाहिँ　　ग. बिरलै　　घ. कहिल्यै खाँदिन

४०. तपाईँ पोषण सम्बन्धी जानकारीको लागि कुन स्रोतहरूमा निर्भर हुनुहुन्छ?

क. Social media (facebook, tiktok, आदि)　　ख. Health professionals (डाक्टर, नर्स, डायटिसियन)

ग. अनलाइन स्रोतहरू (वेबसाइटहरू, ब्लगहरू)　　घ. प्रिन्ट भएका सामाग्री (किताब, पोस्टर आदि)

ङ. परिवारजन र साथीहरु

४१. के तपाईँ राति Snacks हरु खानुहुन्छ?

क. प्रायजसो　　ख. कहिलेकाहिँ　　ग. बिरलै　　घ. कहिल्यै खाँदिन

ङ) शारीरिक गतिविधि (Physical Activity) (IPAQ short form)

४२. तपाईँले पछिल्लो ७ दिनमा गर्नुभएका सबै कडा-तीव्रताको गतिविधिहरूको बारेमा सोच्नुहोस् । कडा-तीव्रताको गतिविधिहरू भनेको त्यस्ता कार्यहरु हुन् जुन कार्यहरु गर्न कठिन शारीरिक परिश्रम चाहिन्छ र जसले श्वासप्रश्वास वा मुटुको धड्कन *अति धेरै* बढाउछ । त्यस्ता काम मात्र सोच्नुहोस् जुन तपाईँले लगातार १० मिनेट गर्नुभयो ।

तपाईँले यस्ता कडा-तीव्रताको गतिविधि जस्तै: भारी भार बोक्ने वा उठाउने, खन्ने, छिटो-छिटो साईकल कुदाउने आदि कामहरु पछिल्लो ७ दिनमा कति दिन गर्नुभयो? _____ दिन (days per week)

☐ गरिनँ ⟶ यदि नगरेमा सिधै **प्रश्न ४४** मा जानुहोस् ।

४३. तपाईँले यस्तो कडा-तीव्रताको गतिविधि एक दिनमा कति गर्नुभयो? _____ घण्टा (hours) _____ मिनेट(minutes)

☐ थाहा छैन/अनिश्चित

४४. तपाईँले पछिल्लो ७ दिनमा गर्नुभएका सबै मध्यम-तीव्रताको गतिविधिहरूको बारेमा सोच्नुहोस् । मध्यम-तीव्रताको गतिविधिहरू भनेको त्यस्ता कार्यहरु हुन् जुन कार्यहरु गर्न थोरै मात्र शारीरिक परिश्रम चाहिन्छ र जसले श्वासप्रश्वास वा मुटुको धड्कन *थोरै मात्र* बढाउछ । त्यस्ता काम मात्र सोच्नुहोस् जुन तपाईँले लगातार १० मिनेट गर्नुभयो ।

तपाईँले यस्ता मध्यम-तीव्रताको गतिविधि जस्तै: हल्का भार बोक्ने वा उठाउने, बिस्तारै साईकल कुदाउने आदि कामहरु पछिल्लो ७ दिनमा कति दिन गर्नुभयो? _____ दिन (days per week)

☐ गरिनँ ⟶ यदि नगरेमा सिधै **प्रश्न ४६** मा जानुहोस् ।

४५. तपाईँले यस्तो मध्यम-तीव्रताको गतिविधि एक दिनमा कति गर्नुभयो? _____ घण्टा (hours) _____ मिनेट(minutes)

☐ थाहा छैन/अनिश्चित

४६. तपाईँले पछिल्लो ७ दिनमा एक ठाउँबाट अर्को ठाउँमा यात्रा गर्नको लागि वा कुनै पनि मनोरञ्जन, खेलकुद वा व्यायाम लागि हिँड्दा बिताउनुभएको समयको बारेमा सोच्नुहोस् ।

तपाईँले पछिल्लो ७ दिन मध्ये कति दिन यसरी हिडेर बिताउनुभयो? _____ दिन (days per week)

☐ हिडिनँ ⟶ यदि नहिडेमा सिधै **प्रश्न ४८** मा जानुहोस् ।

४७. तपाईँले यसरि दिनमा कति समय हिड्नुभयो? _____ घण्टा (hours) _____ मिनेट (minutes)

☐ थाहा छैन/अनिश्चित

४८. तपाईँले पछिल्लो ७ दिनमा बसेर बिताउनुभएको समयको बारेमा सोच्नुहोस् । त्यो भनेको आफूले घरमा, कलेजमा वा काममा पढ्दा, खाँदा वा त्यत्तिकै बस्दाको समय हो । पछिल्लो ७ दिनमा तपाईँले एकदिनमा कति समय बसेर वा ढल्केर बिताउनुभयो? _____ घण्टा (hour) _____ मिनेट (minutes)

च) खाना आवृत्ति तालिका (Food Frequency Questionnaire)

खानेकुरा	Daily (दैनिक)	हप्तामा 3 पटक वा सो भन्दा बढी	हप्तामा 3 पटक भन्दा कम	Fortnightly (15 दिनमा)	Monthly (मासिक)	Never
Rice (भात)						
Wheat (गहुँ) (roti)						
कोदो/फापर						
दाल र अन्य गेडागुडी						
Egg (अन्डा)						
Fish (माछा)						
सेतो मासु (जस्तै: कुखुरा, हाँस, परेवा)						
रातो मासु (जस्तै: खसी, राँगा, सुँगुर)						
दुध र दुध जन्य खानेकुरा						
हरियो सागपात						
अन्य सब्जीहरु						
फलफूल						

Nuts र बिउबियाँ (बदाम, ओखर, तिल आदि)						
चिसो पेय पदार्थ (कोक, फेन्टा आदि)						
प्याकेटका खानेकुरा (चाउचाउ, बिस्कुट आदि)						
फास्ट फूड (मम, चाउमिन, पिज्जा, चटपटे आदि)						
Tea/coffee (चिया/कफी)						
चिनी र मिठाईहरु						

छ) पछिल्लो २४ घण्टामा आफुले खाएको खानाको स्मरण गर्नुहोस् ।

Meal	विवरण	मात्रा
बिहानको खाजा		
बिहानको खाना		
दिउसोको खाजा ***(यदि १ पटक भन्दा बढी भए खुलाउनुहोस्)***		
रातिको खाना **(सुत्ने बेलामा खाएको भए, त्यो पनि खुलाउनुहोस्)**		

Anthropometric measurements (कृपया यो आफैँ नभर्नुहोला)

Height (cm): …… Weight (kg): …… BMI (kg/m^2): ……..

Total fat (%): ……. Visceral fat (%): ……. Skeletal muscle (%): ……

Subcutaneous fat (%): …… Waist circumference (cm): ……..

Hip circumference (cm): ……. WHR: …….

Note: .....

.....

तपाईँको अमूल्य समय र धैर्यताको लागि धेरै धेरै धन्यवाद !!!

Appendix D: Photo gallery

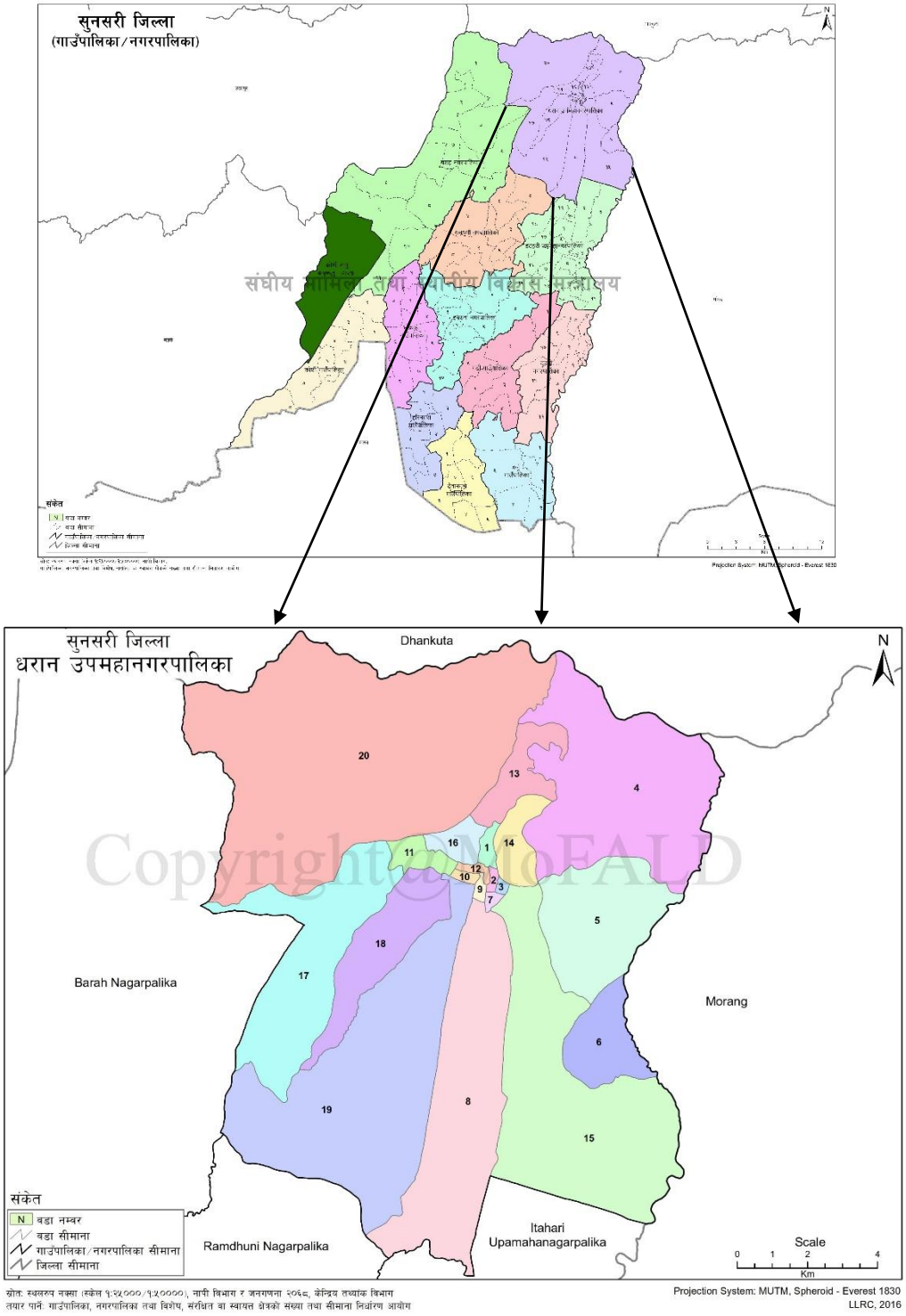
a) Height measurement

b) Filling up questionnaire

c) Measuring body composition

d) Body Fat Monitor HBF 375

Appendix E: Survey site



Location of Dharan Sub-Metropolitan City

Source: MoFAGA (2017)