ASSESSMENT OF NUTRITIONAL KNOWLEDGE, ATTITUDE AND PRACTICES AND ITS ASSOCIATED FACTORS IN NATIONAL AND PROVINCE LEVEL BOXERS OF NEPAL

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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 *Assessment of nutritional knowledge, attitude and practices and its associated factors of national and province level boxers of Nepal* presented by **Prastut Acharya** has been accepted as the partial fulfillment of the requirement for the **B.Sc. degree in Nutrition and Dietetics**

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Abstract

A cross-sectional descriptive study was conducted in five of the seven provinces of Nepal encompassing several districts and more than 15 boxing institutions throughout the country with a total of 110 participants who were all national and province level boxers. Data was collected through a one-on-one interview and a KAP questionnaire, it explored nutritional KAP of the participants along with other factors associated with nutrition. The collected data was analyzed using SPSSv26 and Microsoft excel. Chi square tests, Fisher's exact test, Pearson's correlation tests were used to assess the association between the variables. Anthropometric measurements (Height, Weight), dietary assessment (24-hour dietary recall) were used as indicators to determine nutritional status and dietary patterns of the respondents.

Results revealed a majority of athletes had poor nutritional Knowledge, Attitude and Practices (KAP), with a majority of participants (52.73%) reporting to have a negative or improper attitude towards nutrition, whereas 47.27% of participants seemed to have a good nutritional attitude. Additionally, over half of participants reported having poor nutritional knowledge (52.73%), while 47.27% of participants seemed to have a good nutritional knowledge. While 40.00% of participants appeared to have strong nutritional practices, over 60% of respondents had poor nutritional practices. There was a significant association between demographic characteristics such as region, religion, socio economic characteristics and sporting characteristics such as training hours with the nutritional KAP of the participants (p value <0.05), Moreover, there seemed to be a fair positive correlation between nutritional knowledge and nutritional practices (p-value < 0.05, r > 03), indicating a rise in nutritional knowledge will lead to overall better nutritional practices. The athletes' dietary intake was below recommended levels, with 95.45% of them not consuming the necessary number of calories; there was a slight tendency toward high protein intake, with about 40% of the athletes consuming an adequate amount of protein in their diet; The athletes' consumption of energy, protein, and carbohydrates was significantly lower. Therefore, there is an urgent need for programs meant to raise athletes' nutritional awareness, which would then result in better eating

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List of abbreviations

Abbreviations	Full form
ACSM	American College of Sports Medicine
ACTH	Adrenocorticotropic hormone
ADA	American Dietetic Association
AIBA	Amateur International Boxing Association
ALT	Alanine aminotransferase
AOR	Adjusted Odds Ratio
AST	Aspartate aminotransferase
AT	Anaerobic Threshold
ATP	Adenosine triphosphate
BIA	Bioelectrical Impedance Analyzer
BM	body mass
BMI	Body Mass Index
CHO	Carbohydrates
CI	Confidence Interval
DFTQC	Department of Food Technology and Quality Control
FAGA	Food and Agriculture Global Analysis.
FAO	Food and Agriculture Organization
FCT	Food Composition Table
GH	Growth hormone
HR	Heart Rate
IBA	International Boxing Association
IBM	International Business Machines
ICMR	Indian Council of Medical Research
IL	Interleukin
ISBN	International Standard Book Number
ISSN	International Standard Serial Number
KAB	Knowledge Attitude Behavior
KAP	Knowledge Attitude Practice
LT	Lactate threshold
MCT	Monocarboxylate transporters
MLSS	Maximal lactate steady state
NAD	Nicotinamide Adenine Dinucleotide
NADH	Nicotinamide Adenine Dinucleotide (REDUCED FORM)
ORS	Oral Rehydration Solution
PCr	Phosphocreatine
PUFA	Polyunsaturated Fatty acids
SD	Standard Deviation
SPSS	Statistical Package for the Social Sciences
SSC	Social Science Citation
TEE	Total Energy Expenditure

TNF	Tumor necrosis factor alpha
TOS	Total oxidant status
VO_2	Oxygen Consumption
WADA	World Anti-Doping Agency
WBA	World Boxing Association
WHO	World Health Organization

Chapter I

Introduction

1.1 Background to the study

Combat sports involve sports in which two fighters compete against one another by employing techniques in accordance with predetermined guidelines. Therefore, depending on the sport, the players attempt to defeat their rival via hitting, kicking, or grappling techniques—the latter of which may involve joint locking, chokes, and throws/takedowns. The traditional arts of taekwondo and judo, jujitsu, karate, sanshou, and muay thai, as well as the more well-known mainstream combat sports of boxing and wrestling, are examples of competitive combat sports that have one or more of these components (Nishime, 2007).

In the individual contact sport of boxing, two opponents spar in a ring and only use their gloved fists to strike blows above the waist (Khanna and Manna, 2006) Boxing is divided into a number of weight classes with the goal of matching opponents of similar size and bulk to encourage fair competition (Morton *et al.*, 2010). Athletes have their body mass (BM) confirmed at a formal "weigh-in" before competition to make sure they satisfy the weight requirements (Reale *et al.*, 2017b). As Boxers often attempt to compete at the lightest weight to get a competitive advantage over their opponents they often achieve their target weight by a combination of acute and chronic measures, including severe energy restriction and dehydration (Morton *et al.*, 2010). Thus Athletes diet and lifestyle can effect their competition readiness, performance, and recovery (Devrim-Lanpir *et al.*, 2021).

According to a joint position statement published by the American Dietetic Association (ADA), Dietitians of Canada, and the American College of Sports Medicine (ACSM), optimum nutrition improves athletic performance and recovery from exercise (Rodriguez *et al.*, 2009). Optimal nutritional understanding and proper nutrient intake have been identified as the primary components that play a critical role in improving athletic performance (Nazni and Vimala, 2010). Eating habits are impacted by attitudes and knowledge about nutrition, and limited information about nutrition may lead to unhealthy eating habits that impair athletic performance (Walsh *et al.*, 2011). Inadequate nutritional knowledge, imparted by coaches, teammates, and family members, also has an unfavorable impact on players' performance (Shifflett *et al.*, 2002). Adequate nutritional understanding is essential for athletes to cope with stressful situations during training and tournaments, leading to peak athletic performance

(Seyhan, 2018). Thus A well-balanced diet is essential for meeting the daily dietary requirements of athletes (Jamaluddin *et al.*, 2014).

Previous research demonstrates that nutrition can influence health, body weight and composition, substrate availability during exercise, recovery after exercise, and, ultimately, athletic performance (Rodriguez *et al.*, 2009). Good nutrition helps athletes train more intensely, recover faster, and adapt metabolically. Adequate energy should come from a diverse range of meals that can be obtained on a regular basis through nutrition management, which includes a controlled consumption of carbs, fats, protein, vitamins, minerals, and water (Potgieter, 2013). Optimal dietary carbohydrate requirements include maintaining blood glucose levels during exercise and replacing muscle glycogen (Rodriguez *et al.*, 2009). High-quality protein is required to promote muscle protein synthesis, decrease muscle protein breakdown, and heal muscle injury, Furthermore, the appropriate timing of protein consumption should also be considered (S. M.Philip 2011).

The ADA and ACSM jointly released a position statement that states that for endurance and strength-trained athletes, the recommended range for carbohydrate and protein intake is 6–10 g/kg body weight and 1.2–1.7 g/kg body weight, respectively. It also states that fat intake should be between 20 and 30 percent of total energy intake and advised against the necessity for extra vitamin and mineral supplements if an athlete consumes wide variety of foods that provide enough energy (Rodriguez *et al.*, 2009).

1.2 Problem statement and justification

Inadequate nutrition contributes to the high rate of injury among athletes. Athletes' lifestyle and diet choices affect their ability to compete, recover, and get ready for competition (Devrim-Lanpir *et al.*, 2021). Nutrition regimens for athletes should include provisions for enough nutrients to aid in both training and competition readiness as well as recovery. Nutritional strategies help athletes perform at their best by minimizing or postponing the things that would otherwise lead to exhaustion (Thomas *et al.*, 2016). There is a complex relationship between nutrition knowledge and dietary behavior that is influenced by a wide range of other personal and environmental factors, including beliefs, culture, experiences, hunger, appetite, and taste (Spronk *et al.*, 2014).

It is crucial to understand the many nutrition-related practices that athletes follow as they have an impact on their hydration levels, energy intake, and nutritional intake.

Comprehending the dietary habits of athletes can aid in devising and executing suitable nutrition instruction, consequently augmenting the understanding and perhaps impacting the dietary practices of athletes. Athletes require adequate macro and micronutrients, fluids, and proper meal timing. Meeting energy demands and maintaining appropriate body mass and fat levels are important nutritional goals. However, lack of knowledge about nutrition can lead to unhealthy eating habits (Thapa *et al.*, 2023).

There has been limited research on sports nutrition in Nepal. A previous study in Nepal examined the impact of nutritional knowledge, practice, supplement use, and nutrient intake on strength performance, but only for Taekwondo players. This study aims to identify knowledge gaps and deficits to inform intervention strategies. This study aimed to evaluate athletes' nutritional knowledge, attitudes, practices, and dietary intake, as well as their relationships.

1.3 Objective of study

1.3.1 General Objective

The main objective of the study is to assess the nutritional knowledge, attitude, practice and its associated factors in boxers of Nepal.

1.3.2 Specific Objective

a) To assess the nutritional knowledge, attitude towards nutrition, and dietary practices of boxers in Nepal
b) To evaluate the nutritional status of boxers.
c) To identify potential correlations and associations between nutritional knowledge, attitudes, practices.
d) To identify factors which might be associated with the KAP of Nepalese boxers.
e) To provide recommendations and interventions for improving novice boxers' nutritional knowledge, attitudes, and practices in order to improve their overall nutritional status and athletic performance.

1.4 Research Questions

a) What is the level of nutritional knowledge, attitude and practices of boxers in Nepal?
b) What is the nutritional status of novice boxers in Nepal?
c) Is there a link between the nutritional knowledge, nutritional attitude and nutritional practices of Nepalese boxers?

d) What are the factors associated with nutritional KAP of boxers in Nepal?
e) To what extent do Nepalese novice boxers' dietary practices contribute to or influence their overall nutritional status?

1.5 Significance of the study

a) This study will help to Assess and identify gaps in nutritional knowledge among boxers in Nepal and explore their current dietary practices, including any unique or prevalent habits they follow
b) This study will also provide valuable information on the nutritional status of Nepalese boxers, and understand how their knowledge, attitudes, and practices affect their overall performance and health.
c) This study will serve as a guideline for policy development at national and organizational levels and help coaches and trainers offer more effective nutritional guidance to enhance athletes' performance.

1.6 Limitations of the study

a) Biochemical and clinical assessment was performed due to limitations of facilities
b) Data cannot be generalized to other population
c) Only 24-hour recall was used to analyze dietary pattern

CHAPTER II

Literature Review

2.1 Nutrition

Nutrition, as a science, explores how food and drinks, along with their nutrients and other components, interact within our bodies and influence our health. It also looks at how these interactions are affected by our social and environmental surroundings(Beauman *et al.*, 2005). Nutrition is the science that deals with foods and their relation to the organism. its components, including nutrients and other related materials, as well as the relations among them. to health and disease. It also comprises the actions within the body such as swallowing, churning, and the processes by which they are absorbed, transported, perform their functions and eliminate their end products; and the social and economic aspects. cultural, and psychological significance of eating (Insel *et al.*, 2014).

2.2 Nutritional Status

Nutritional status refers to the health condition of an individual or population as influenced by their intake and utilization of nutrients. It encompasses the balance between nutritional intake and nutritional demands, which determines the body's ability to maintain health and functionality(Himmelgreen and Miller, 2018). Achieving optimal nutritional status is crucial for athletes to enhance their perfornamnce, support recovery, and maintain overall health. Optimal nutritional status can be achieved by carefully balancing the energy needs, macro and micro nutrients, proper hydration, electrolyte balance and proper timing of nutrient intake. Nutrition education is a must is achieving proper nutritional status of atheles as they require a more meticulous diet to achieve optimal performance(Ennette *et al.*, 2017).

2.3 Nutrition KAP

2.3.1 Nutrition knowledge

The term "nutritional knowledge" describes an understanding of the fundamentals of a healthy diet and the influence of dietary decisions on general health. It has a positive correlation with diet quality and health outcomes and is a significant driver of diet-related behavior(Huang *et al.*, 2021). Recognizing the nutrition-related elements that can impact training, athletic performance, and recovery from sport is known as sport nutrition knowledge. This information goes beyond common nutrition knowledge, which might solely concentrate on dietary types, nutrient sources, and general health requirements without taking into account the unique requirements of high-achieving athletes. An athlete may best support their training needs and maximize their performance and recovery by having a solid understanding of sport nutrition. Studies indicate that a better diet is associated with a greater understanding of nutrition (Spronk *et al.*, 2014). Thus proper sport nutrition knowledge translates to proper understanding of

importance of nutrition for the growth and recovery of the body, energy sources, hydration and electrolyte consumption, pre and post competition meals etc (Trakman *et al.*, 2017).

2.3.2 Nutrition Attitude

Nutrition attitude may be defined as an individual's emotional, motivational, perceptive and cognitive set of beliefs about nutrition and eating habits. These attitudes play a large role in regulating the eating behaviors and the decisions made in regard to food consumption. Nutrition attitudes encompass feelings and motivations that can either positively or negatively impact an individual's dietary choices These are the thoughts and perceptions individuals hold about nutrition, which can shape their understanding and approach to dietary practices(FAO, 2014).

2.3.3 Nutrition Practices

Nutrition practices refer to the behaviors and habits related to food consumption and dietary choices that individuals or groups adopt to meet their nutritional needs. It can be defined as the observable actions of an individual that could affect his/her or others' nutrition, such as eating, feeding, washing hands, cooking and selecting foods.

2.4 Boxing as a combat sport

Boxing stands as an individual contact sport, wherein two opponents engage in combat within the confines of a ring, utilizing solely their gloved fists. The essence of the sport lies in the art of striking, with the permissible target area restricted to regions above the waist. The duration of the match, along with the scoring system and weight classifications, is stipulated by official regulations. These regulations are established by two distinct boxing associations: the Amateur International Boxing Association (AIBA), responsible for overseeing the sport's regulations in the context of the Olympic Games, and the World Boxing Association (WBA), which governs the rules for professional boxing. Each association maintains its set of guidelines and standards(Rodríguez *et al.*, 2017)

The two associations exhibit variations in specific regulations, Differences extend to training methods, with professional boxing embracing a more demanding regimen.the duration of bouts, with professional boxing typically comprising 10 rounds, in contrast to the three rounds in amateur boxing. Age categories are delineated by the Amateur International Boxing Association (AIBA) as junior (15-16 years old), juvenile (17-18 years old), and elite (19-40

years old). In contrast, the World Boxing Association (WBA) encompasses professionals aged 18 to 36 years. Individuals beyond 18 years in amateur boxing can transition to professional status upon fulfilling minimum combat and victory requirements in the amateur domain. Precompetition weighing diverges in timing, occurring 24 hours before a professional bout and 6 hours prior in amateur boxing. Furthermore, professional boxing features a greater number of weight categories (Rodríguez *et al.*, 2017).

2.5 Making the weight in combat sports

In combat sports, athletes typically compete within specific weight categories, highlighting the critical role of weight management for achieving optimal physical and psychological performance in these disciplines. The International Boxing Association (IBA) has a specific set of weight categories for boxers, which varies for different age and gender groups. For elite men and youth boxers (boys), there are ten weight categories, ranging from 46 kg to 91+ kg, For elite women and youth boxers (girls), there are ten weight categories, with the first four categories having a 2 kg spread, and the rest having a 3 kg spread, For Junior Boxers (boys and girls), there are 13 weight categories, with a wider range of weights to accommodate the diverse age group (AIBA, 2021). . Unfortunately, the negative aspect of this system is the unhealthy methods used by competitors to reach the weight category, Competitors in combat sports often resort to various weight loss methods to meet specific competition weight requirements. These strategies include severe fasting, where individuals undergo extended periods without food to rapidly decrease body weight. Additionally, fluid restriction is commonly employed to limit water intake and shed water weight quickly. Some athletes resort to vomiting to purge food and reduce body weight, while others may turn to the use of laxatives or diuretics to promote bowel movements or increase urine output for temporary weight loss. Extreme dehydration methods, such as training with plastic or rubber suits or in hot environments like saunas, are also utilized to induce rapid weight loss. These techniques, including fluid restriction and extreme dehydration measures, can lead to dehydration, impairing physical performance, cognitive function, and thermoregulation. Additionally, rapid weight loss may induce fatigue, diminished energy levels, and reduced endurance, while also elevating heart rate and increasing stress on the cardiovascular system. Dehydration and electrolyte imbalances resulting from these strategies can provoke headaches and hinder concentration, raising the likelihood of injuries during both training and competition. Furthermore, extreme dehydration methods, such as training in hot environments, can precipitate hyperthermia and heat-related illnesses. Beyond

the physical toll, unhealthy weight loss practices may foster an unhealthy relationship with food and contribute to negative psychological effects (Martínez-Rodríguez *et al.*, 2021).

2.6 Physiological and Nutritional demands in boxing

From a physiological standpoint, combat sports seem to embody an intermittent and physically demanding nature, characterized by brief episodes of maximal or supramaximal intensity interspersed with short recovery periods. Consequently, it is probable that both aerobic and anaerobic energy systems are engaged throughout the course of a match (Crisafulli *et al.*, 2009). As most combat sports such as boxing classify athletes according to their body mass to make matches more balanced in terms of body size, strength and agility, many athletes tend to acutely reduce their body weight in an attempt to get an advantage by competing against lighter, smaller and weaker opponents thus making severe nutritional restrictions in their diet (Langan-Evans *et al.*, 2011).

2.6.1 Physiological parameters of a boxing match

From a physiological standpoint, combat sports seem to embody an intermittent and physically demanding nature, characterized by brief episodes of maximal or supramaximal intensity interspersed with short recovery periods. Consequently, it is probable that both aerobic and anaerobic energy systems are engaged throughout the course of a match (Crisafulli *et al.*, 2009).

2.6.1.1 Anaerobic Threshold (AT)

The anaerobic threshold is the highest exercise intensity that can be sustained for a prolonged period without lactate substantially building up. It is the point during exercise when the body transitions from aerobic to anaerobic metabolism, burning stored sugars to supply additional energy, leading to the production of lactic acid faster than it can be metabolized (Wasserman, 1986).

2.6.1.2 Oxygen Consumption (VO2)

VO2 (oxygen consumption) is closely related to the energetics of the body, particularly in the context of energy expenditure and overall fitness. Research has shown that VO2max, which represents the maximum rate of oxygen consumption during exercise, is associated with measures of energy expenditure. Higher VO2max is linked to greater 24-hour energy expenditure, with every 1 liter of VO2max being associated with an increased daily energy expenditure of 60 kcal (Ando *et al.*, 2019).

2.6.1.3 Blood lactate

Blood lactate is a crucial method for assessing the physiological response during exercise, offering reliability and predictability in evaluating performance and training intensity. The lactate response is consistent under standardized conditions, yet various factors such as blood sampling site, ambient temperature, acid-base balance chaes, prior exercise, dietary adjustments, or pharmacological interventions can influence it. Key aspects include the determination of lactate threshold (LT), indicating the point beyond which blood lactate concentration increases exponentially and proving to be a superior predictor of endurance performance compared to VO2max. Maximal lactate steady state (MLSS) is identified as the highest lactate concentration achieved during exercise, providing a more accurate measure of aerobic capacity than VO2max. Additionally, lactate serves as both an energy substrate and a myokine during rest, transforming into an exerkine during exercise, contributing to various physiological processes. Understanding lactate kinetics, including exchange and removal abilities, aids in comprehending the dynamics of lactate accumulation and removal over the course of exercise and recovery. In essence, blood lactate serves as a valuable tool, offering insights into aerobic capacity, endurance performance, and lactate kinetics during exercise (Jacobs, 1986).

2.6.1.4 Heart Rate (HR)

The heart rate (HR) is widely recognized as a reliable indicator of exercise intensity, exhibiting a strong correlation with an individual's training level. Athletes with superior aerobic fitness typically demonstrate lower resting heart rates and a more modest increase in heart rate at any given level of effort compared to their less trained counterparts. This establishes a foundation for utilizing heart rate monitoring as a valuable tool in assessing exercise intensity (Nassib *et al.*, 2017).

However, caution is warranted when applying heart rate monitoring in certain scenarios. Activities involving repeated bouts of maximal and supramaximal exercise, leading to a substantial recruitment of anaerobic glycolysis, may render heart rate measurements unreliable. In such instances, the metabolic demands and physiological responses may not align with heart rate patterns, undermining the accuracy of intensity assessment. Furthermore, external factors such as heat stress and dehydration can introduce confounding variables, potentially causing disproportionate elevations in heart rate unrelated to metabolic stress. These external influences

underscore the need for careful interpretation when utilizing heart rate data to draw conclusions about the underlying physiology and intensity of exercise (Cappai *et al.*, 2012).

2.6.2 Energy path ways

In sports activities, the replenishment of adenosine triphosphate (ATP) stores is crucial for sustaining energy levels. This process involves a dynamic interplay between aerobic and anaerobic sources, with the specific contribution of each source influenced by various factors, including dietary habits, physical fitness, and the intensity and duration of the sporting activity (Gollnick *et al.*, 1986). The energy requirements during low-intensity sports can primarily be fulfilled through aerobic sources. In contrast, high-intensity sports may result in an insufficient supply of oxygen necessary for aerobic energy production, thereby elevating the dependence on anaerobic energy pathways (Guidetti *et al.*, 2002).

2.6.2.1 Aerobic

Aerobic glycolysis encompasses the decomposition of consumed complex carbohydrates into simpler sugars. Subsequently, these simpler sugars undergo glycolysis in the sarcoplasm to produce ATP (Gastin, 2001). Pyruvic acid serves as the final product of glycolysis. In aerobic glycolysis, the presence of oxygen facilitates the conversion of pyruvic acid through oxidation into acetyl-coenzyme-A within the mitochondria. This acetyl-coenzyme-A is then utilized in the Krebs cycle and electron transport chain to generate subsequent energy provisions (Karlsson and Jacobs, 1982). As the body can store large amount of simple sugars and fats the advantage of aerobic pathway lies in its sustainability when the body is able to get continuous supply of oxygen to meet energy demands However, the rate at which energy can be supplied is limited and thus this system is not able to provide large amounts of energy in a short amount of time (Wilmore *et al.*, 1999).

2.6.2.2 Anaerobic Lactic

In the absence of sufficient oxygen, the production of pyruvic acid from glycolysis in the sarcoplasm surpasses its oxidation to pyruvate in the mitochondria. This imbalance leads to an increased dependence on anaerobic glycolysis to fulfill energy requirements. The insufficient oxygen levels prompt the conversion of pyruvate generated from glycolysis into lactate, which serves as the final product in anaerobic lactic energy provision. Consequently, lactate accumulates in the active muscles. Lactic acid rapidly dissociates, yielding lactate and protons (H+). The generation of lactate becomes crucial for additional energy provision, as it can be

employed to regenerate cytosolic NAD+, sustaining glycolysis and, in turn, facilitating the regeneration of ATP (Robergs *et al.*, 2004).

The generation of H+ from processes such as pyruvic acid production, ATP breakdown, and NADH+ reduction surpasses the usage of H+ from lactate production. This leads to an elevation in H+ levels, causing a decrease in pH both inside and outside cells, potentially leading to acidosis. It has been demonstrated that acidosis adversely affects performance through various pathways. It can hinder the release and absorption of calcium (Ca2+) by the sarcoplasmic reticulum and diminish Ca2+ sensitivity, thereby increasing the amount of Ca2+ needed for muscle tension development Fitts (2008). Additionally, it can hinder the function of critical glycolytic enzymes such as phosphofructokinase and glycogen phosphorylase, thereby decreasing the pace of glycolysis and subsequent glucose utilization (Costa Leite *et al.*, 2007).

The process of returning the body's lactate levels to their pre-exercise state is termed lactate clearance. The speed at which lactate clearance occurs relies on the body's ability to eliminate lactate from the active muscles (Böning *et al.*, 2005). Inside the muscle, carnosine, phosphocreatine, and inorganic phosphate act as buffers, helping to counteract the pH changes caused by lactate Lactate transportation into and out of the muscle occurs along a concentration gradient through passive diffusion, facilitated by carrier-mediated monocarboxylate transporters (MCTs), and via sodium (Na+)/hydrogen (H+) exchangers (Juel, 2001). This mechanism allows lactate to be transported into the bloodstream, where it can be eliminated by the liver, slow-twitch muscle fibers, as well as cardiac and brain tissue. Moreover, hydrogen ions (H+) can also be buffered by sodium bicarbonate in the bloodstream (Böning *et al.*, 2005).

Even after high-intensity exercise ends or during a recovery period between multiple bouts of exercise, there can still be a rise in blood lactate levels because lactate continues to be released from the muscles that were active previously (Fukuba *et al.*, 1999). When exercise stops and the demand for energy and oxygen diminishes, more of the inhaled oxygen becomes available to oxidize the accumulated lactate. The initial step in this process is the conversion of lactate back into pyruvate (di Prampero, 1981). In sports with brief recovery intervals between exercise bouts, there might be insufficient time for lactate levels to decrease significantly before the next bout of exercise begins. This can compromise energy supply in subsequent exercise bouts, Restoration of lactic acid to pre-exercise levels can take up to an hour to be reached (Tomlin and Wenger, 2001).

2.6.2.3 Anaerobic Alactic

The anaerobic alactic system primarily functions as an energy buffer, playing a crucial role in maintaining energy levels as aerobic and anaerobic lactic energy sources progressively contribute towards meeting the required energy demands during exercise. The muscle's storage of phosphocreatine is relatively limited, approximately 30 mmol·Kg wet weight muscle mass, emphasizing its role in rapid energy provision during intense physical activity (Kang, 2008). The anaerobic alactic energy system plays a vital role in combat sports, supplying energy during brief and intense bursts of activity, such as delivering forceful punches or executing rapid takedowns. Operating without reliance on oxygen, this system fuels lightning-fast, maximal efforts (Franchini, 2023).

2.6.3 Energetics and Nutritional Requirements

In a study conducted by Crisafulli *et al.* (2009) on physiological responses and energy cost during stimulation of combat sport match, it seems that combat sports are physically demanding activity that tends to recruit both aerobic and anaerobic energy systems, during the whole stimulation including both active phases and recoveries, VO_2 and HR were above the values of Anaerobic threshold previously assessed and approached the levels of VO_{2max} moreover, the pulmonary ventilation also greatly increased and reached its peak in the second round. Even during the recovery period between the rounds these variables did not decrease to resting values. Thus, suggesting the times in between bouts may not be enough to recover from the work done in previous rounds. The study also fund that the energy expenditure during the stimulation, which lasted 18 min, was on an avg 10.75 ± 1.58kcal/min-1.

From the study it can be concluded that anaerobic glycolysis was recruited during the initial rounds and the following recovery, whereas during the preceding rounds there was a progressive reduction in its utilization as seen by the fact that after initial burst of anerobic metabolism there was a progressive in aerobic energy supply as seen by the increased VO_2 levels during the second and third rounds. This aligns with previous findings suggesting that during intermittent maximal bouts of exercise, the energy expenditure of the first bout is derived mainly from phosphocreatine degradation and anaerobic glycolysis, while the subsequent stages of exercise, there is significant shift to aerobic metabolism and reduced anaerobic energy yield (Ghosh, 2004). Another finding of this study showed that among all the

variables HR was the only one that did not return to resting levels during the 3 minutes of final recovery period after which all the variables were measured. This may suggest that HR may have slower recovery time than VO_2 , Various studies have provided a range of relative maximum oxygen uptake values (VO2max), with differences observed within the same study based on the weight categories of boxers, ranging from 48.0 to 57.0 kg, with a value of approximately 57.9 ml·kg-1·min^{-1}, 60.0–67.0 kg, 56.5 ml·kg-1·min-1; and 70.0–90.0 kg, 49.6 ml·kg-1·min-1 (Ghosh, 2004).

In another study conducted in amateur boxers conducted by Davis (2012) reported a increase in mean HR_{peak} between rounds 1 and 3 from 166 ± 19 in round 1 to 174 ± 13 in round 3. Blood lactate increased between all three rounds with an increase of 1.9 ± 0.5 and 0.9 ± 0.8 respectively between the three round which also coincide with findings of Crisafulli *et al.* (2009). The study discovered that contrary to a previously proposed hypothesis, the overall energy metabolism during 3 rounds of 2-minute amateur boxing is primarily aerobic, with anaerobic contributions ranging from 14% to 28%. These anaerobic contributions primarily stem from high-energy phosphates, the study also reports a full contact bout has a similar energy demand of 603 kJ and fractions if aerobic, anaerobic, and anaerobic alactic sources of 70, 23 and 7 % respectively.

A study conducted by Kılıc *et al.* (2019) on Effects of Boxing Matches on Metabolic, Hormonal, and Inflammatory Parameters in Male Elite Boxers, revealed significant increases in metabolic hormones such as adrenocorticotropic hormone (ACTH), cortisol, ang growth hormone after the boxing match thus reflecting high levels of physiological stress on the athletes during the match, Elevations in inflammatory markers, including interleukin-1β (IL-1β), interleukin-6 (IL-6), and tumor necrosis factor alpha (TNF-α), were observed after the match, suggesting an inflammatory response to the physical demands of the sport. The study reported increases in muscle damage indicators, alanine aminotransferase (ALT) and aspartate aminotransferase (AST), indicating potential tissue trauma during the boxing match. A decrease in total oxidant status (TOS) was noted, indicating a potential shift in the oxidative balance in response to the physical exertion of the match.

2.6.3.1 Energy and carbohydrates

The cornerstone for optimizing sports performance in combat sports lies in maintaining an appropriate energy intake. Athletes engaging in moderate or high-intensity training may require caloric consumption ranging from 40 to 70 kcals/kg/day, contingent upon the intensity and

frequency of their training sessions. For elite athletes, the recommended energy intake may surpass these levels, underscoring the heightened nutritional demands associated with elite-level training (Kerksick *et al.*, 2018).

Athletes primarily derive their energy from carbohydrates. These energy substrates can undergo oxidation through aerobic metabolism, involving processes such as the glycolytic pathway coupled with the Krebs cycle and the electron transport chain. Alternatively, carbohydrates can be converted into lactate through anaerobic metabolism, specifically anaerobic glycolysis. This metabolic activity leads to the synthesis of adenosine triphosphate (ATP), facilitating the transfer of energy. The capacity to sustain exercise is closely linked to the content of muscle glycogen, emphasizing the importance of carbohydrate availability in supporting athletic performance (Artioli *et al.*, 2019).

Glycogen serves as a glucose fuel reserve stored in the cytosol of cells. Skeletal muscle cells contain approximately 1–2% of glycogen, while liver cells have a higher concentration at around 5–6%. During physical activity, both muscle and liver glycogen stores gradually decrease. The duration and intensity of the activity contribute to an overall reduction in glycogen stores (Murray and Rosenbloom, 2018) . The recommended carbohydrate intake in an athlete's diet is intricately linked to the type and intensity of their training regimen, and it should range between 4–5 g/kg to 8–10 g/kg of body mass. Sports characterized by high intensity and endurance generally necessitate higher carbohydrate intake to meet the elevated energy demands associated with these activities (Kerksick *et al.*, 2018).

In high-intensity sports, particularly combat sports, the recommended carbohydrate intake may escalate to around 10–12 g/kg of body mass per day. This elevated level accounts for the increased energy demands associated with the intense and physically demanding nature of combat sports (Artioli *et al.*, 2019). Scientific evidence supports the notion that consuming carbohydrates with a low glycemic index can enhance training endurance when compared to the intake of high glycemic index products (Stevenson *et al.*, 2005). Athletes engaging in multiple high-intensity training sessions per day are advised to opt for carbohydrates with a high glycemic index. This choice facilitates the acceleration of muscle glycogen synthesis, particularly beneficial before the commencement of the second training session (Bean and Wojtczak, 2014).

2.6.3.2 Protein

Protein stands out as a crucial macronutrient in combat sports. The recommended protein intake in an athlete's diet is higher compared to individuals who are not engaged in regular training. This elevated protein consumption is essential for promoting consistent muscle protein synthesis. Loss of muscle mass can detrimentally impact strength, power, and overall athletic performance (Tang and Phillips, 2009). The current protein recommendations for athletes advocate an intake ranging from 1.2 to 2 g/kg of body mass. This protein range is considered optimal to support the dietary needs of athletes, aiding in muscle protein synthesis and overall athletic performance (Artioli *et al.*, 2019). The consumption of essential amino acids, either in free form or as part of a protein bolus ranging from 20 to 40 g following exercise, is recognized for its ability to stimulate muscle protein synthesis. This post-exercise nutritional strategy has been associated with potential improvements in strength, as well as enhancements in body composition, characterized by an increase in lean body mass (Kerksick *et al.*, 2017). Whey and soy proteins are characterized by rapid digestion, resulting in a substantial increase in the concentration of amino acids in the bloodstream. In contrast, casein exhibits a tendency to precipitate and coagulate in stomach acid, leading to slower absorption and digestion rates compared to whey and soy proteins (Artioli *et al.*, 2019). Moreover, studies suggest that whey and milk protein, the latter containing both whey and casein, exhibit a superior ability to stimulate muscle protein synthesis when compared to soy or casein proteins (Wilkinson *et al.*, 2007).

2.6.3.3 Fats

The recommended fat intake in athletes' diet range from 25 to 30% of their total energy intake which should mostly be comprised of unsaturated fatty acids, particularly omega-3 polyunsaturated acids (Puglisi, 2019). PUFAs are known to reduce oxidative stress, inflammation and the risk of cardiovascular diseases as well as reduce soreness and improve muscle protein synthesis (Gammone *et al.*, 2018). The requirements for fats should be mostly covered by vegetable oils, sea fish, nuts and seeds (Puglisi, 2019). In sports, cellular energy is derived through the metabolism of glycogen or triglycerides. The oxidative energy system involves the utilization of oxygen in the mitochondria of cells, leading to the production of adenosine triphosphate (ATP). This process serves as a key mechanism for providing energy during physical activity, In light and moderate exercises, the energy requirements of muscles are fulfilled through the utilization of carbohydrates and free fatty acids. Through the process

of lipolysis, triglycerides stored in muscles and adipose tissues undergo metabolism, resulting in the production of glycerol and free fatty acids. The peak fat oxidation is typically achieved at around 47–52% of VO2 max in untrained individuals and 59–64% of VO2 max in endurance-trained athletes (Hoffmann, 2014).

2.6.3.4 Water and electrolytes

Water serves as a crucial ergogenic aid for athletes, and maintaining an adequate level of hydration is essential to preserve exercise capacity. Proper hydration plays a vital role in optimizing performance and supporting overall athletic well-being. Scientific evidence indicates that a 2% level of dehydration can negatively impact sports performance. A more severe dehydration of 4% poses a significant risk, potentially resulting in serious health consequences such as heat exhaustion, heat stroke, or other heat-related illnesses. Therefore, maintaining proper hydration is critical for both performance and the overall well-being of athletes (Kerksick *et al.*, 2018). Intentionally inducing dehydration for weight loss may elevate the risk of acute cardiovascular issues, including ischemic heart disease and stroke. Additionally, substantial dehydration has been suggested to potentially alter brain morphology and increase the susceptibility to brain injury associated with head trauma induced by strikes. These considerations underscore the potential serious health consequences of dehydration practices in the context of weight management and athletic performance (Barley *et al.*, 2019). The sweating level and fluid requirements during physical training are influenced by factors such as the duration of the workout, heat acclimatization, prevailing weather conditions, and genetic predisposition. These variables collectively play a crucial role in determining the extent of sweating and the corresponding hydration needs for individuals engaged in physical activities (von Duvillard *et al.*, 2008). Maintaining an appropriate balance between sodium and potassium is crucial for sustaining adequate fluid balance and ensuring the proper functioning of the cardiovascular and nervous systems. This balance is essential for various physiological processes, including the regulation of blood pressure, nerve signal transmission, and overall fluid homeostasis in the body (Dymkowska-Malesa and Walczak, 2011). In the realm of sports, magnesium and calcium play a pivotal role in regulating muscle function. Additionally, these minerals contribute to stabilizing enzymatic reactions, governing energy production, and facilitating the transport of other nutrients. Their involvement in these physiological processes underscores their importance for athletes in maintaining optimal performance and overall well-being (Carvil, 2010). To compensate for water loss during training, athletes are recommended to consume approximately 0.5–2 liters per hour of water or

glucose-electrolyte solutions during exercise. A practical strategy to monitor changes in fluid balance involves weighing athletes before and after a training session. This approach enables the assessment of dehydration levels and aids in providing the appropriate hydration interventions, ultimately contributing to enhanced sports performance (Kerksick *et al.*, 2017).

2.6.3.5 Supplements

Sports supplements can significantly impact strength, endurance, and body composition. Various substances have demonstrated efficacy in enhancing training effectiveness. Incorporating supplements may delay the onset of fatigue, enabling athletes to sustain higher-intensity training sessions (Artioli *et al.*, 2019). The Australian Institute of Sports categorizes supplement ingredients into four groups to assess their safety and effectiveness in enhancing sports performance. Group A substances are scientifically proven to support and enhance sports performance while also preventing or treating clinical issues. Examples include sports foods, vitamin D, calcium, iron, caffeine, and creatine. Group B substances are based on emerging scientific support and warrant further research. Examples include food polyphenols, fish oils, carnitine, vitamin C and E, and Branched-Chain Amino Acids. Group C contains supplements deemed not beneficial for athletes, while Group D includes substances banned for use by athletes.(Sport, 2022). Substances such as stimulants, prohormones, hormone boosters, growth hormone (GH) releasers, and peptides are included on the World Anti-Doping Agency (WADA) list of prohibited substances. Athletes should refrain from using or injecting these substances as they are banned by WADA regulations.(Agency, 2024). In combat sports, the use of supplements can offer benefits through two distinct strategies: acute supplementation and chronic supplementation. An acute supplementation strategy involves consuming supplements that can optimize performance improvements when taken in the minutes to hours leading up to training or competition. These supplements are designed to have an immediate impact on performance. On the other hand, a chronic supplementation strategy entails consuming sports supplements over a longer period, spanning several days or weeks. This approach is aimed at gradually enhancing sports performance over time through consistent use of the supplements (Campbell *et al.*, 2011).

One of such ergogenic substances proven to effect athletes ability is caffeine, caffeine has been ranked in the list A of the Australian Institute of Sport (Sport, 2022). Ingesting 3–6 mg/kg of caffeine through supplementation could boost the glycolytic contribution to energy metabolism. Additionally, caffeine consumption may lead to enhancements in power, strength, and upper arm muscular endurance levels(López-González *et al.*, 2018). Consuming caffeine approximately 60 minutes prior to training or competition may be sufficient, as plasma levels of caffeine typically peak around one hour after ingestion (Campbell *et al.*, 2011). Another ergogenic supplement that has evidence-based benefits for performance in combat sports is sodium bicarbonate. Sodium bicarbonate acts as an alkalizing agent, which can enhance extracellular buffering capacity. This augmentation can help combat sports athletes

by potentially delaying the onset of fatigue and improving performance during high-intensity bouts (Campbell *et al.*, 2011). During high-intensity exercises, carbon dioxide (CO2) and hydrogen ions (H+) accumulate in the blood and muscles. The body utilizes the bicarbonate system to eliminate hydrogen ions and CO2 by converting them into bicarbonate through both renal and respiratory mechanisms. This process helps regulate pH levels in the body and enables athletes to sustain high-intensity exercise for longer durations (Kerksick *et al.*, 2018). Sodium bicarbonate has been classified in group A in the list of the Australian Institute of Sports (Sport, 2022).

Creatine is likely one of the most effective dietary supplements for enhancing high-intensity exercise performance in combat sports. Supplementing with creatine can increase intramuscular phosphocreatine (PCr) levels, serving as an energy buffer that helps maintain ATP concentration during intense physical activity. Research has demonstrated that creatine supplementation effectively increases strength, power, lean body mass, and performance in high-intensity, short-duration exercises (Butts *et al.*, 2018). The most common dosing protocol for creatine supplementation involves a loading phase followed by a maintenance phase. During the loading phase, individuals typically consume high doses of creatine, around 20 grams per day or 0.3 grams per kilogram of body weight per day, divided into four doses, for a duration of five days.Following the loading phase, athletes transition to a maintenance phase where they consume smaller amounts of creatine, typically 2–5 grams daily or 0.03 grams per kilogram of body weight per day, for an extended period ranging from several weeks to months (Campbell *et al.*, 2011). One of the most challenging aspects of creatine supplementation for combat sports athletes is the potential for muscle water retention, which can result in an increase in body mass. This poses a concern for athletes who need to adhere to weight limits for competition. To address this issue, athletes may choose to cease creatine supplementation approximately four weeks before weigh-in, as this is the average wash-out time for creatine. This allows them to minimize the effects of water retention and better manage their weight for competition (Harris *et al.*, 1992).

2.6.4 Recovery Practices

While combat sport athletes acknowledge the significance of replenishing fuel stores and rehydrating after weigh-in, it appears that many do not adhere to optimal guidelines for post-weigh-in recovery and the optimal recovery strategy depends upon the weight loss method used(Reale *et al.*, 2017a).

2.6.4.1 Rehydration

While effective in reducing body mass (BM), decreases in total body water can detrimentally affect performance in different ways, depending on factors such as the magnitude, method, and source of water loss, noticeable effects on motor skills, cognitive performance, and sports-specific movement patterns can occur even with a 2% loss in body mass following acute weight loss through dehydration.

Therefore, in theory, fighters should strive to replenish fluid losses to within approximately 2% of their pre-hypohydration body mass (Dougherty *et al.*, 2006). Sufficient opportunities for recovery following moderate hypohydration are probable when weigh-ins occur the day before competition. However, this scenario differs for boxers who weigh in on the morning of competition. Additionally, successful progression through a tournament necessitates repeated morning weigh-ins. Since repeatedly shifting large fluid volumes is not recommended, boxers should manage their body mass chronically to avoid the necessity of losing more than 3% of their body mass through dehydration to make weight (Reale *et al.*, 2017c).

For fluid to be assimilated into the body water pool, it must be ingested, emptied from the stomach, and absorbed from the small intestine into the bloodstream. These processes are influenced by factors such as the volume and composition of the fluid, as well as the rate of consumption (Shirreffs and Maughan, 1997). An increase in gastric volume accelerates gastric emptying, reaching a plateau at around 600 mL, while volumes exceeding approximately 1000 mL may potentially slow down emptying(Leiper, 2000) Therefore, fighters should aim to consume an initial bolus of approximately 600–900 mL (with around 600 mL immediately following weigh-in if dehydration exceeds 3% of body mass), followed by additional boluses at regular intervals to sustain increased gastric volume (Leiper, 2000). General sports nutrition guidelines for rehydration typically recommend consuming 125–150% of the fluid deficit to compensate for ongoing urine losses after dehydrating activities (Maughan and Shirreffs, 2015). Such advice may be difficult to implement in many cases as such large volumes may be impractical to consume during limited recovery time.

Sweat losses incurred during thermoregulation and/or exercise result in the depletion of electrolytes, primarily sodium and chloride Therefore, it is necessary to replenish these electrolytes to facilitate the restoration of plasma osmolality and volume (Maughan and Shirreffs, 2015). Electrolyte replacement can be achieved through the consumption of salty foods alongside fluids or ORS (Ray *et al.*, 1998) ORS typically contain 50–90 mmol/L of sodium which is significantly higher than the sodium content in standard sports drinks (<30 mmol/L) Therefore, if hypohydration is substantial and the recovery period is short, ORS can be an effective strategy for simultaneous fluid and electrolyte replacement. Additionally, fluid restriction leads to a decrease in net body water without electrolyte losses so aggressive electrolyte replacement is not necessary. Low-sodium fluids such as water or commercial sports drinks will suffice and are well retained. (James and Shirreffs, 2013).

2.6.4.2 Glycogen Restoration

Continuous participation in exercise that heavily relies on glycolytic and carbohydrate-oxidative pathways, combined with a low intake of carbohydrates, will lead to a reduction in body mass (BM) due to the depletion of muscle glycogen and bound water. Combat sports

demand persistent high-intensity outputs. While moderate glycogen stores may not necessarily limit performance, anaerobic exercise lasting around 5 minutes may be compromised after glycogen depletion, and performance enhancements are observed following glycogen loading(Pizza *et al.*, 1995). Therefore, post weigh-in recovery strategies should incorporate adequate carbohydrate intake to replenish liver and muscle glycogen stores, considering the fuel requirements for competition. General recommendations for glycogen restoration typically range from 5 to 7 g/kg/day for athletes involved in moderate volume training. However, higher intakes of 7–10 g/kg/day may be necessary to fully saturate glycogen stores (Porr, 2012).

In boxing, where weigh-ins occur every morning of a tournament and recovery time is limited, achieving supercompensation of glycogen stores is neither desirable nor feasible. Therefore, boxers should focus on optimizing glycogen restoration within the available recovery time while also prioritizing gut comfort before competition. Strategies may include selecting carbohydrates with a high glycemic index (Wee *et al.*, 2005) the use of carbohydrate-rich fluids to simultaneously address hydration goals and alleviate the gut discomfort often associated with consuming solid foods close to competition. Additionally, incorporating protein into recovery meals or snacks can enhance glycogen storage, particularly when carbohydrate intake is sub-optimal (Ivy *et al.*, 2002). It's important to note, however, that hypertonic fluids (such as those with a carbohydrate content exceeding 10%) may delay gastric emptying, which can slow down the process of rehydration and potentially lead to gastrointestinal discomfort (Evans *et al.*, 2009). Intestinal absorption of large amounts of carbohydrate (exceeding 60 g per hour) may be facilitated by incorporating foods containing varied carbohydrate sources i.e glucose and fructose to take advantage of multiple gut transport mechanism (Jeukendrup and Moseley, 2010). Nevertheless, due to the difficulty of aggressive glycogen replacement in boxing scenarios and potential for low glycogen to compromise performance in multi day competitions boxers should chronically manage body mass to prevent the need to severely restrict carbohydrates before weigh in (Pizza *et al.*, 1995).

2.6.4.3 Pre and Post Event meals

To allow for digestion, the pre-competition meal should be eaten three to four hours prior to the event. It should be low in fat and fiber to prevent stomach problems during exercise, but high in carbohydrates to supply energy. Pre-event meals that are high in carbohydrates include grilled chicken with pasta, peanut butter sandwiches with bananas, porridge with berries, and other similar dishes. It is advised to stay away from fried, high-fat, and high-fiber foods. 4 g/kg

of body weight four hours prior to the event, 2-3 g/kg two hours prior, and 1 g/kg one hour prior to the event are the recommended amounts of carbohydrates to be ingested in the pre-event meal. A well-planned pre-event diet can boost energy, postpone exhaustion, and shield competitors from hunger and gastrointestinal distress. The goal of the post-exercise meal is to repair muscle damage, replace energy stores, and rehydrate between 30 minutes to 2 hours of the activity. Turkey sandwiches, protein shakes with fruit and cheese, and grilled salmon with sweet potatoes are suggested post-event meals since they offer a variety of carbs, proteins, and fluids. Athletes that follow a proper post-exercise diet are better able to heal their muscles, resynthesis glycogen, and generally get ready for the next training session or competition (Keith *et al.*, 2001).

Nutrition, intricately linked to physical activity, holds sway over body composition, sports performance, and post-workout recovery. Athletes, due to their heightened physical demands, often require elevated levels of various nutrients compared to the general population. In combat sports, the prescribed nutritional and energy intake may surpass the levels recommended for individuals not engaged in regular training (Hoffman, 2011).

PART III

Materials and methods

3.1 Research Method

A descriptive cross-sectional study was conducted among national level boxing players of five of the seven provinces in Nepal due to the of absence of Madesh and Karnali province in any of the major province and national level tournaments held recently. This involved collection of data to determine the nutritional knowledge, attitude and practices among these players. A face-to-face interview was conducted, questions regarding Socio-demographic information, behavioral information, anthropometric measurements, nutritional knowledge, attitude and practices and 24-hour dietary recall was collected using a semi structured questionnaire derived from previous literature of similar works in Nepal.

3.2 Target population

The target population of this study consisted of national-level boxers who are either currently competing or have previously competed in national and provincial-level competitions or were preparing to compete for national and provincial level tournaments within the country. Participants who were preparing for national tournaments younger than 15 years of age were excluded from the study, participants who were not present on the day of data collection, those who had systemic diseases and who were not willing to participate were also excluded from the study.

3.3 Study variables

1. Outcome variables: Nutritional Knowledge, Nutritional Attitude and Nutritional Practices

2. Predictor variables

    i. Demographic: Age, ethnicity, religion, region
    ii. Socio-economic: Family monthly income, education qualification
    iii. Others: Sources of nutrition information, duration of involvement in sport, daily training hours, previous history of attending nutrition related classes.

3.4 Sampling technique

A cross-sectional descriptive study was conducted throughout the province training centers of the country, Purposive sampling or judgmental sampling was used for the selection of institutions which send their players for national and provincial tournaments, 18 boxing clubs from all over Nepal were selected, namely ABC Dharan, Sunsari Boxing, Udaypur Boxing, Sweet Science Boxing, Vibe Boxing, Jhapa Boxing, Iron Boxing, Tulsipur Boxing, Bajura Boxing, Bhojpur Boxing, Dhangadi Boxing, Dhankuta boxing, Ex Boxing, H2O Boxing, Kailali Boxing, Kanchanpur Boxing, RDS Boxing and

Sudurpaschim Boxing. Criterion sampling was used to select samples from the respective institutions i.e all of the national and province level players from those institutions were selected for this study.

3.5 Sample size calculation

Since there was no previous record on number of national level players in the country, the sample size was calculated to represent the entire boxers in Nepal, In order to reach this statistical inference, the sample size was determined using a single proportion formula and given the relatively small population of national level boxers in Nepal, a larger margin of error was used for a smaller sample size, which can be beneficial in resource-limited situations while still providing useful data(Suresh and Chandrashekara, 2012). Thus 10% margin of error was used to calculate the sample size in order attain a more manageable sample size while still providing meaningful insights on the population and considering the unknown proportion of national level boxers in the area, the proportion was assumed to be 50% for maximum variability; Thus, the sample size was calculated using a single proportion formula

$$N = \frac{z^2 p \cdot q}{e^2}$$

Where,

N= Sample size

Z= Confidence interval at 95% (standard value of z is 1.96)

p= estimated proportion of the population

q= proportion of population that does not have characterstic of interest i.e 1-p

e= margin of error (10%)

Then, the sample size can be calculated as,

Z= 1.96, p= 0.5, q= 0.5, e= 0.1

Hence,

$$N = \frac{(1 \cdot 96)^2 \times 0 \cdot 5 \times 0 \cdot 5}{(0 \cdot 1)^2}$$

$$= 96$$

Calculated sample size was further adjusted for non-response. Considering non-response rate as 10%, the adjusted sample size was calculated to be 96 + 9.6 = 105.6 ≈ 106.

Thus, 110 samples were taken.

3.6 Data collection tools and techniques

Data was collected through a self-administered questionnaire with the help of data collectors. Data collection tool was developed in English language. 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 upto 180 kg with a least count of 0.1 kg
ii. A well calibrated stadiometer to measure height
iii. Questionnaire to collect information on demographic, socio economic conditions, behavioral information, nutritional KAP, and diet history.

3.6.1 Nutritional knowledge, Attitude and Practice

The knowledge, attitude and practice (KAP) questionnaire were adapted from previously published literature conducted on athletes of a different sport in Nepal (Sunuwar *et al.*, 2022). The knowledge section had 30 statements which could each be answered as 'Agree', 'Disagree' and 'Don't know'. Each correct answer was coded as '1' and incorrect and don't know responses were coded as '0'. In the attitude section there were a total of 16 statements which could be answered as 'Agree', Disagree', and 'Undecided', each positive answer was coded as '1' and each negative and don't know response was coded as '0'. The practice section included 14 questions each to be answered with 'Yes' or 'No', each correct response was coded as 1 and incorrect response and those with don't know responses were coded as '0'. To decide the individual having a good or poor nutritional KAP, the median score was used as the cutoff point (Sunuwar *et al.*, 2022), since the median split is considered effective when the variable is continuous and normally distributed (DeCoster *et al.*, 2011).

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(Suresh and Chandrashekara, 2012).

3.6.3 Weight

Weight was measured using a reliable electronic weighing scale, accurate to the nearest 0.1 kg. The scale was properly calibrated before use. Participants were asked to remove their shoes and heavy clothing, and to stand still in the center of the scale's platform without touching anything, ensuring their body weight was evenly distributed on both feet(WHO, 2017).

3.6.4 Dietary assessment

A 24-hour dietary recall was used to assess the food consumption patterns and nutrient intake of the participants. Adequate time and assistance were provided to help participants accurately recall and estimate portion sizes. Using this recall method, total calories, protein, carbohydrates, and fat were calculated, following portion size estimation guidelines set by the Indian Council of Medical Research (ICMR) (Longvah *et al.*, 2017). 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 and total nutrient was calculated by using Nepalese FCT (DFTQC, 2017) Portion sizes were estimated using cups, bowls, spoons, pieces and slices and the nutrient content of packaged food was estimated using nutritional information provided by the manufacturer.

3.6.5 Nutrient requirements

The total energy requirements for the participants was determined by calculation g their total energy expenditure, the TEE was calculated by multiplying the required amount of calories per kg body weight with the body weight of the individual, the required carbohydrates and proteins were also estimated using the same method (Kerksick *et al.*, 2018).

3.7 Pre-Testing

The prepared questionnaire was tested among 12 national level boxers in koshi province of Nepal, Pre testing was done to check clarity of the questions, accuracy and consistency in the interpretation of questions and to identify ambiguous items. The ambiguous and wrongly interpreted questions were removed and revised as per the findings of pretesting.

3.8 Data analysis

The data before entering was checked manually, compiled, categorized and coded to ensure accuracy. The collected data was 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 KAP, dietary habits and preferences and dietary intake. Associations between variables were tested using Chi-square, Fischer's exact tests. 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)

3.9 Ethical consideration

Approval from the province national boxing federation was acquired for the conduction of the survey, formal permissions were obtained from the respective institutions and boxing schools. The objective of the study was explained to the participants and verbal consent was obtained from them in order to conduct the survey, individuals who refused to participate were not included. Confidentiality was maintained throughout all the phases of research process by maintain anonymity of participant data.

PART IV

Result and Discussion

The research investigated the knowledge, attitude and practices and assosicated factors of national level boxers of Nepal. The study analyzes various factors such as socio-econimic characterstics and demographic variables, training characteristics of boxers, their nutitional knowledge, attitude and practices and their dietary intake. Detailed discussions on the findings are presented in the sections below

4.1 Age and Gender distribution

The following table represents the gender distribution of the participants in the study, as shown in **table 4.1**, of the 110 samples in the study 78.18% were males and only 21.82% of the participants were females, indicating the predominance in number of males over females in the sport. From the 110 participants in the study more than half (50.91%) of individuals were between 18 to 25 years of age, followed by individuals ranging from 15 to 18 years (32.73%) and only (16.36%) of individuals were aged older than 25 years of age.

Table 4.1 Gender distribution of national level boxers in Nepal

Variable		Frequency (n)	Percentage (%)
Gender	Male	86	78.18%
	Female	24	21.82%
Age	15 to 18	36	32.73%
	18 to 25	56	50.91%
	25 and above	18	16.36%

4.2 Demographic Characteristics

Table 4.2 shows the demographic characteristics of the participants. Most of the participants belonged to the janajati (49.09%) followed by Brahmins/ Chettri (38.18%), a minimal number of participants belonged to Dalit (4.55%), Terai caste (4.55%) and Other (3.63%) ethnic groups. Out of these most of the participants were Hindu (67.27%), followed by kirat (13.64%),

Buddhist (12.73%), while the number of Muslim and Christian participants were quite low (2.73%).

Table 4.2 Frequency distribution of demographic characteristics of participants

Variables		Frequency (n)	Percent (%)
Ethnicity	Brahmin or Chettri	42	38.18%
	Janajati	54	49.09%
	Dalit	5	4.55%
	Terai Caste	5	4.55%
	Others	4	3.64%
Province	Koshi	35	31.82%
	Bagmati	43	39.09%
	Lumbini	7	6.36%
	Gandaki	10	9.09%
	Sudurpaschim	15	13.64%
Religion	Hindu	74	67.27%
	Muslim	3	2.73%
	Kirat	15	13.64%
	Christian	3	2.73%
	Buddhist	14	12.73%
	Others	1	0.91%
Marital Status	Married	9	8.18%
	Unmarried	101	91.82%

The participant of the study belonged from five of the seven provinces of Nepal namely Koshi province (31.82%), Bagmati province (39.09%), Lumbini province (6.36%), Gandaki province (9.09%) and Sudurpaschim province (13.64%). While a small portion of the the participants were married (8.81%), the majority of individuals were unmarried (91.82%).

4.3 Socio-economic characteristics

Table 4.3 Frequency distribution of socio-economic characteristics of participants

Variables		Frequency (n)	Percent (%)
Monthly Income	< 10,000	1	0.91%
	10,000 to 20,000	28	25.45%
	20,000 to 50,000	54	49.09%
	50,000 to 100,000	23	20.91%
	>100,000	4	3.64%
Occupation	Job	20	18.18%
	Agriculture	1	0.91%
	Business	7	6.36%
	Unemployed	9	8.18%
	Student	73	66.36%
Educational Qualification	Primary (1-5)	0	0.00%
	Secondary (6-10)	14	12.73%
	Higher Secondary (11-12)	58	52.73%
	Bachelors and above	38	34.55%

The majority of participants were students (66.36%), almost 20% of the individuals reported to have a job of some kind, 6.36% of individuals reported to be engaged in business while only 8.81% of individuals reported to be unemployed and practicing boxing full time. Most of the participants had an educational qualification till higher secondary level (52.73%), followed by individuals were pursuing / completed bachelors and above levels (34.55%) while a small percentage of individuals had a qualification till secondary level (12.73%).

4.4 Sport related information

The participants of the study belonged to different boxing schools across the country as shown in **Table 4.4**

Table 4.4 Frequency distribution of boxing schools the participants belonged to

Variables		Frequency (n)	Percent (%)
Boxing Club	ABC Dharan	4	3.64%
	Sunsari Boxing	10	9.09%
	Udaypur Boxing	5	4.55%
	Sweet Science Boxing	32	29.09%
	Vibe Boxing	8	7.27%
	Jhapa Boxing	10	9.09%
	Iron Boxing	2	1.82%
	Tulsipur Boxing	7	6.36%
	Bajura Boxing	3	2.73%
	Bhojpur Boxing	1	0.91%
	Dhangadi Boxing	3	2.73%
	Dhankuta Boxing	3	2.73%
	Ex Boxing	10	9.09%
	H2O boxing	1	0.91%
	Kailali Boxing	2	1.82%
	Kanchanpur Boxing	4	3.64%
	RDS boxing	2	1.82%
	Sudurpaschim Boxing	3	2.73%

As shown in **Table 4.5** The majority of participants had trained in the sport for around two years (39.09%), followed by individuals who were involved in the sport for a year (19.09%), 4.55% of individuals had only trained in the sport for six months, 10.91 % for 3 years, 11.82% for 4 years and only a small number of individuals were involved in the sport for more than 4 years.

Table 4.5 Frequency distribution of participants involvement in sport

Variables		Frequency (n)	Percent (%)
Years in boxing	0.5	5	4.55
(years)	1.0	21	19.09
	1.5	7	6.36
	2.0	43	39.09
	3.0	12	10.91
	4.0	13	11.82
	5.0	1	.91
	6.0	4	3.64
	8.0	2	1.82
	10.0	2	1.82

The majority of individuals (81.82%) engage in 2 to 3 hours of training daily, indicating a substantial commitment to their regimen. A small proportion (8.18%) train for less than one hour, while slightly more (10.00%) dedicate more than 3 hours to daily training.

Table 4.6 Frequency distribution of daily training hours of the participants

Variable		Frequency (n)	Percent (%)
Daily Training Hours	Less than one hour	9	8.18%
	2 to 3 hours	90	81.82%
	More than 3 hours	11	10.00%

4.5 Nutrition Related Information

Table 4.7 Frequency distribution of Nutrition related information of the participants

Variable		Frequency (n)	Percent (%)
Have you ever attended classes related to nutrition?	Yes	7	6.36%
	No	103	93.64%
Do you follow diet plan?	Yes	20	18.18%
	No	90	81.82%
	Social media	6	5.45%
Is there any difference in food intake during off and on season of sports?	Yes	85	77.27%
	No	25	22.73%

Bases on **Table 4.7** Majority of participants (93.63%) had not attended any sort of classes related to nutrition prior to the study, while a small number (6.36%) of the individuals reported to have attended classes prior to the time this survey was carried out. The table 4.7 also suggests that most of the participants did not follow a diet plan (81.82%), while a handful of participants reported following a diet plan (18.18%), of the individuals who tend to follow a diet plan, a majority of individuals get it from online and social media sources (5.45%) , 4.55% people made their own diet plan, while others reported to get it from books (0.91%), Health workers such as doctors and local health posts (2.73%), coaches and trainers (3.64%), while only 0.91% of the participants got their diet plan from a dietitian. A majority of the participants (77.2%) reported to have a difference in their food intake/ dietary pattern on and off season.

Out of all the participants of the study only 6.36% were reported to consume dietary supplements. The majority of the individuals who consumed dietary supplements reported to consume creatine (2.73%), and Fish Oil (2.73%), while others reported to consume whey protein supplements (0.91%).

From the **Table 4.9**, social media appears to be the most frequently used information source (72.38%), followed by coaches (43.81%) and friends (31.43%) while sources like books (16.19%), articles (12.38%), Health workers (11.43%), Newspaper (4.76%) seem to be less frequent source of information while the least frequent sources seem to be Dietitian and other sources such as family members (1.90%).

Table 4.8 Frequency distribution of participants consuming supplements

Variable		Frequency (n)	Percentage (%)
Do you Consume Dietary Supplements?	Yes	7	6.36%
	No	103	93.64%
if yes name	Creatine	3	2.73%
	Fish Oil	3	2.73%
	Whey Protein	1	0.91%

Table 4.9 Distribution of sources of information for athletes

Variables		Frequency (n)	Percent (%)
Information	Books	17	16.19%
Source	Social media	76	72.38%
	Coach	46	43.81%
	Friends	33	31.43%
	Articles	13	12.38%
	Newspaper	5	4.76%
	Dietitian	2	1.90%
	Health Workers	12	11.43%
	Others	2	1.90%

4.6 Nutrition Knowledge

The mean ± standard deviation (SD) and median scores for nutrition knowledge of the athletes was found to be 15.66 ± 3.75 and 16 respectively. The highest score among entire participants was 24 while the lowest score was 7. Over half of the participants were reported to have poor nutritional knowledge (52.73%) while 47.27% of the participants seemed to have a good nutritional knowledge.

Table 4.10 Distribution of knowledge levels of participants

Variable		Frequency (n)	Percent (%)
Level of Nutritional knowledge	Poor	58	52.73
	Good	52	47.27

The nutritional knowledge of the participants was determined by 30 questions that encompassed different areas related to individual nutrition and sport nutrition, **Table 4.11** highlights the questions and also the frequency and distribution of participants who answered them correctly and incorrectly. As seen from the table, a majority of athletes (9.6.36%) think increasing their nutritional knowledge is the best way to change their food habits for the better which is in line with a similar research conducted in Turkish boxers(Ağirbaş *et al.*, 2018). The majority of the athletes (97.27%) also seem to understand that the type of food they consume will eventually affect their performance and more than half of the athletes (65.45%) seem to know that including a variety of foods in their diet will lead to proper distribution and intake of nutrition (Jalph and Sandhu, 2023). Also, a majority of athletes (75.45%) seem to know that the major source of energy in our diets comes from carbohydrates, while most of the athletes (91.82%) have the misconception that increasing only protein in their diet will lead to muscle gain. From the 110 athletes who participated in this study 87.27% think a course in nutrition would lead to increase in nutrition knowledge and therefore would aid them in making optimal changes in their dietary habits in order to improve their athletic performance.

Around 60% of the athletes think skipping meals is an optimal strategy in order to lose weight quickly while the remaining 40% of athletes have the correct knowledge that skipping meals would not be the optimal way to lose weight. A majority of respondents (57.27%) correctly identified that eggs contain all the essential amino acids needed by the body. This indicates a reasonable level of awareness about the complete protein profile of eggs. However, a significant minority (42.73%) incorrectly believed otherwise, highlighting a need for better dissemination of information about protein sources. Most respondents (60.91%) correctly acknowledged that vegetarian athletes can meet their protein requirements without the use of protein supplements. This suggests an understanding of diverse protein sources available in a vegetarian diet. Nonetheless, 39.09% of respondents believed that supplements are necessary,

reflecting a common misconception that vegetarian diets are inherently deficient in protein(Mariotti and Gardner, 2019).

An overwhelming majority (89.09%) correctly identified milk as a good supplier of calcium for all age groups (Davis *et al.*, 2001). This high percentage indicates strong awareness of milk's nutritional benefits. A significant majority (73.64%) correctly recognized that a lack of iron in the diet can result in fatigue, injury, and illness(Świątczak *et al.*, 2022). This indicates good awareness of the importance of iron in the diet. However, the 26.36% of respondents who answered incorrectly suggests that there is still a need for improved education on the impacts of micronutrient deficiencies.

A majority of respondents (60.91%) correctly identified that females need more iron in their diets than men due to menstruation (WHO, 2011). This indicates a good level of awareness about gender-specific nutritional needs. However, a significant minority (39.09%) did not recognize this. An overwhelming majority (86.36%) incorrectly believed that vitamins provide the body with energy. Only 13.64% correctly understood that vitamins do not serve as a direct energy source. A majority of respondents (77.27%) incorrectly thought that athletes should always take vitamin C tablets. Only 22.73% correctly understood that while vitamin C is important, supplementation is not always necessary if a balanced diet is maintained. Similar to the above statement, 86.36% of respondents incorrectly believed that vitamins are a good source of energy. This redundancy in responses reinforces the significant misunderstanding about the role of vitamins and the need for targeted nutritional education to correct this belief.

A majority of respondents (57.27%) correctly identified that athletes should drink water during activity to maintain plasma volume, moreover an overwhelming majority of respondents correctly identified the link between dehydration and impaired physical performance (84.55%). However, a significant minority (42.73%) were incorrect, indicating a need for better education on the critical role of hydration during physical activity which is even more highlighted by the fact that A substantial proportion of respondents (63.64%) incorrectly believed that sports drinks are the optimal choice for replacing fluids lost during exercise, similarly 50.91% of respondents incorrectly understood the recommendation for athletes to drink according to a plan based on body weight changes during training sessions in a similar climate while only 49.09% answered correctly these misconceptions may lead to suboptimal fluid intake and potential performance decrements thus Further education is needed to clarify the role of sports drinks in hydration strategies.

A slight majority (52.73%) correctly identified that carbonated beverages can negatively affect calcium metabolism (Sampath and V, 2021), while 47.27% were incorrect. This indicates a considerable level of misunderstanding about the effects of carbonated beverages on mineral metabolism. The data also indicates a relatively high level of awareness regarding the negative impact of alcohol consumption on nutrient absorption and utilization (79.09%). While a number of respondents (43.64%) correctly identified that caffeine can increase the risk of dehydration, a significant proportion (56.36%) held incorrect beliefs.

A concerningly high percentage of respondents (75.45%) incorrectly believed that athletes should consume high-fat foods before competition. This misconception can negatively impact athletic performance by delaying gastric emptying and reducing energy availability (Keith *et al.*, 2001). Conversely, the majority (70.91%) were aware of the importance of consuming a pre-event meal 3-4 hours before competition, demonstrating a better understanding of pre-competition meals. The data also indicates a reasonable understanding of the role of carbohydrates during exercise, with 58.18% of respondents correctly identifying their importance in maintaining blood glucose levels.

A substantial proportion of respondents (57.27%) incorrectly believed that all supplements are beneficial for athletes while the remaining 42.73% of respondents identified not all supplements would be beneficial to the athletes moreover 45.45% of respondents correctly identified supplement labels might contain false information as seen in many cases and researches done worldwide(U.S, 2015; Rosenberg, 2022; Cohen *et al.*, 2023), while 54.55% believed in supplements labeling. Misconceptions about banned substances were widespread, with 81.82% incorrectly believing caffeine and bicarbonate were prohibited. The concept of carbohydrate loading was largely misunderstood, with 96.36% of respondents holding incorrect views.

Table 4.11 Distribution of nutritional knowledge answers among the participants

		Frequency	
		(n)	Percent (%)
Learning facts about nutrition is the best way to achieve favorable changes in food habits	Incorrect	4	3.64%
	Correct	106	96.36%

		Frequency	
		(n)	Percent (%)
The type of food an athlete eats affects his/her performance	Incorrect	3	2.73%
	Correct	107	97.27%
sound nutritional practice for athletes is to eat a wide variety of different food types from day to day	Incorrect	38	34.55%
	Correct	72	65.45%
Carbohydrate is the major source of energy followed by fat and protein	Incorrect	27	24.55%
	Correct	83	75.45%
Increasing protein in the diet is the main dietary change needed when only muscle gain is desired	Incorrect	101	91.82%
	Correct	9	8.18%
A course in nutrition would be helpful for the athlete	Incorrect	14	12.73%
	Correct	96	87.27%
Skipping meal is advisable if you need to lose weight quickly	Incorrect	60	54.55%
	Correct	50	45.45%
Eggs contain all the essential amino acids needed by the body	Incorrect	47	42.73%
	Correct	63	57.27%
Vegetarian athletes can meet their protein requirements without use of protein supplement	Incorrect	43	39.09%
	Correct	67	60.91%
Milk is a good supplier of calcium for all age groups.	Incorrect	12	10.91%
	Correct	98	89.09%
Lack of iron in diet can result in fatigue injury and illness	Incorrect	29	26.36%
	Correct	81	73.64%

Due to menstruation females need more iron in their diets than men	Incorrect	43	39.09%
	Correct	67	60.91%
Vitamins provide the body with energy	Incorrect	95	86.36%
	Correct	15	13.64%
Vitamin c tablet should always be taken by athletes	Incorrect	85	77.27%
	Correct	25	22.73%
Vitamins are good source of energy	Incorrect	95	86.36%
	Correct	15	13.64%
Athletes should drink water during activity in order to maintain plasma volume	Incorrect	47	42.73%
	Correct	63	57.27%
Regarding fluid intake during physical activity recommendations encourage athletes to drink to a plan based on body weight changes during training sessions performed in a similar climate	Incorrect	56	50.91%
	Correct	54	49.09%
Carbonated beverages can negatively affect calcium metabolism	Incorrect	52	47.27%
	Correct	58	52.73%
Dehydration can impair physical performance	Incorrect	17	15.45%
	Correct	93	84.55%
Sports drink are the best way to replace body fluids lost during exercise	Incorrect	70	63.64%
	Correct	40	36.36%
Alcohols consumption can affect absorption and utilization of nutrients	Incorrect	23	20.91%
	Correct	87	79.09%
	Incorrect	62	56.36%

Caffeine can increase the risk of dehydration	Correct	48	43.64%
Before competition athletes should consume foods that are high in fat	Incorrect	83	75.45%
	Correct	27	24.55%
Pre event meal should be eaten about 3 to 4 hours before competition	Incorrect	32	29.09%
	Correct	78	70.91%
Consuming carbohydrates during exercise will assist in maintaining blood glucose levels	Incorrect	46	41.82%
	Correct	64	58.18%
All supplements are beneficial to use for athletes	Incorrect	63	57.27%
	Correct	47	42.73%
Supplements label may contain false or misleading information	Incorrect	50	45.45%
	Correct	60	54.55%
The purity and safety of all supplements are tested before sale	Incorrect	73	66.36%
	Correct	37	33.64%
World anti-Doping Agency has banned the use of caffeine and bicarbonate	Incorrect	90	81.82%
	Correct	20	18.18%
Carbohydrate loading is significant method to be practiced by endurance athletes	Incorrect	106	96.36%
	Correct	4	3.64%

4.7 Nutritional Attitude

The mean ± standard deviation (SD) and median scores for nutrition attitude of the athletes was found to be 10.25 ± 2.21 and 10 respectively. The highest score among entire participants was 14 while the lowest score was 5. Over half of the participants were reported to have poor

nutritional attitude (52.73%) while 47.27% of the participants seemed to have a good nutritional attitude.

Table 4.12 Distribution of nutritional attitude level

Variable		Frequency (n)	Percent (%)
Nutrition Attitude	Poor	58	52.73
	Good	52	47.27

The nutritional attitude of the participants was determined by 16 questions that encompassed different areas related to individual nutrition and sport nutrition, **Table 4.13** highlights the questions and also the frequency and distribution of participants who had good and bad nutritional attitude. A majority of athletes (73.64%) reported intending to eat a balanced diet daily, suggesting a positive overall approach to nutrition. Similarly, 60.91% think that they should have a set meal schedule, indicating a structured approach to dietary planning. The overwhelming majority (93.64%) recognize the link between proper nutrition and enhanced physical performance, demonstrating a basic understanding of the importance of diet for athletic success. Additionally, a substantial proportion (69.09%) correctly prioritize pre-event meals, suggesting a growing awareness of the role of nutrition in optimizing performance. Majority of athletes (95.45%) also have a positive attitude concerning the importance of fruits and vegetables in fulfilling their nutrient requirements, demonstrating a positive understanding of balanced nutrition. Additionally, 80% think expert advice is necessary when considering food choices, indicating a willingness to seek professional guidance, moreover a majority of athletes (98.18%) have a positive attitude towards the importance of a balanced diet for athletic success, demonstrating a positive understanding of the role of nutrition in performance. Additionally, a high percentage (89.09%) have a positive attitude on the importance of reading food labels before consumption, indicating a focus on informed food choices. The athletes also show positive attitude towards hydration as they recognized the negative impact of dehydration on their performance.

Despite these positive trends, several areas of concern emerge. A significant proportion of athletes (39.09%) had a negative attitude towards a consistent meal schedule (39.09%), which may negatively impact energy levels and performance. While the majority had a positive attitude towards a balanced diet, 26.36% did not have an overall good attitude towards its importance. Furthermore, 42.73% of respondents had the wrong belief that excessive egg

consumption is the sole method for muscle building, indicating a lack of understanding about protein sources and overall dietary balance. A significant proportion of athletes (54.55%) believe that supplements are necessary to improve performance, highlighting a potential overreliance on external aids rather than focusing on whole food nutrition. Moreover, 49.09% of respondents prioritize meat and eggs as primary protein sources indicating a negative attitude towards diverse plant protein options. A significant proportion of athletes (56.36%) believe that skipping meals is necessary for weight loss, indicating a lack of understanding about healthy weight management strategies. Furthermore, 54.13% believe in consuming heavy meals with high fat and protein before competition, which can negatively impact performance. This misconception highlights the need for education on pre-competition nutrition.

Table 4.13 Distribution of correct and incorrect attitude of the respondents

Variable		Frequency (n)	Percent (%)
I intend to eat balanced diet every day	Bad	29	26.36%
	Good	81	73.64%
I have a set schedule for meals	Bad	43	39.09%
	Good	67	60.91%
I believe that eating proper diet will improve my physical performance	Bad	7	6.36%
	Good	103	93.64%
I always opt for pre-event meal 3 to 4 hours before competition	Bad	34	30.91%
	Good	76	69.09%
Taking more eggs is the only way to build muscles	Bad	47	42.73%
	Good	63	57.27%
I have to take supplements to improve my performance	Bad	60	54.55%
	Good	50	45.45%
	Bad	5	4.55%

Fruits and vegetables are also necessary for me to fulfill my nutrient requirements	Good	105	95.45%
I should consume meat and eggs only to fulfill my protein requirement	Bad	54	49.09%
	Good	56	50.91%
I seek food or nutrition related advice from Nutritionist or Dietitian	Bad	69	62.73%
	Good	41	37.27%
When considering eating any food, I care what my coach thinks I should do	Bad	22	20.00%
	Good	88	80.00%
Balanced diet will help me to be a successful player	Bad	2	1.82%
	Good	108	98.18%
It is my duty to read food labels before consuming it	Bad	12	10.91%
	Good	98	89.09%
I have to skip meals to lose my weight	Bad	62	56.36%
	Good	48	43.64%
I feel that I cannot perform well when I am dehydrated	Bad	98	89.09%
	Good	12	10.91%
Before the competition I should eat heavy meal with high fat and protein	Bad	59	54.13%
	Good	50	45.87%

It Is my responsibility to know items that has been banned	Bad	29	26.36%
	Good	81	73.64%

4.8 Nutritional Practices

The mean ± standard deviation (SD) and median scores for nutrition Practice of the athletes was found to be 7.19 ± 2.14 and 7 respectively. The highest score among entire participants was 12 while the lowest score was 2. Over half of the participants were reported to have poor nutritional practice (60.00%) while 40.00% of the participants seemed to have a good nutritional practice.

Table 4.14 Distribution of nutritional practice level

		Frequency (n)	Percent (%)
Practice	Poor	66	60.00
	Good	44	40.00

The nutritional practice of the participants was determined by 14 questions that encompassed different areas related to individual nutrition and sport nutrition, **Table 4.14** highlights the questions and also the frequency and distribution of participants who had good and bad nutritional practices. A majority of athletes (63.64%) had a good practice of having definite time for meals while the remaining (36.36%) did not. A substantial proportion of the respondents (62.73%) also claimed to check food labelling before consuming or purchasing, this shows a good general awareness about food and labeling and overall good nutritional practice, moreover a considerably high percentage (85.45%) of the respondents reported to consume fruits and vegetables on a daily basis thus diversifying their plate and ensuring a variety of foods in their diet, a vast majority(67.27) of individuals also rported to consume foods rich in simple carbohydrates before the competition and an even higher percentage (76.36%) of respondents consumed high protein and carbohydrates after the competition ends thus signifying a good pre and post competition diet for a majority of the athletes.

Despite all the good nutritional practices followed by the athletes, there seen to be a number of concerning nutritional practices of the respondents, a huge number of the respondents (37.27%) report on having somebody they can ask for nutrition related advice but only 1.82% of respondents reported to ask nutritionist or dietitian for nutrition related information. A huge percentage of the respondents (92.37%) reported to not taking any form of supplements while those who did consume supplements did not get advice from a nutritionist or dietitian to consume them. Moreover more 76.36% of respondents did not consume any sort of electrolytic beverages while exercising or during competeion

which is alarming considering the fact that boxing causes excessive sweating and thus loss of fluids are electrolytes are prominent.

Table 4.15 Distribution of nutrition practices of the respondents

		Frequency (n)	Percent (%)
I have set a schedule for meals	Yes	70	63.64%
	No	40	36.36%
I check labelling of food before purchasing or consuming	Yes	69	62.73%
	No	41	37.27%
I always have someone to ask about what should I eat	Yes	41	37.27%
	No	69	62.73%
I ask Nutritionist or Dietitian for nutrition advice	Yes	2	1.82%
	No	108	98.18%
I eat at least four meals a day	Yes	50	45.45%
	No	60	54.55%
I use supplements to improve my performance	Yes	8	7.27%
	No	102	92.73%
I have been using supplements under the guidance of medical personnel or Nutritionist	Yes	0	0.0%
	No	110	100.0%
I consume fruits and vegetables daily	Yes	94	85.45%
	No	16	14.55%

During exercise training session drink electrolytic beverages	Yes	26	23.64%
	No	84	76.36%
I eat pre-event meal before 3 to 4hours of competition	Yes	76	69.09%
	No	34	30.91%
I eat food high in simple carbohydrates and protein before competition	Yes	74	67.27%
	No	36	32.73%
I consume fluids containing carbohydrate during competition	Yes	58	52.73%
	No	52	47.27%
I consume food high in protein, carbohydrate and protein after competition	Yes	84	76.36%
	No	26	23.64%
I avoid deep fried oily and spicy foods	Yes	49	44.55%
	No	61	55.45%

4.9 Dietary intake and nutrient adequacy

The **Table 4.16** shows the mean macronutrient intake of the respondents during tournament phase, the mean ± SD calorie intake of the respondents was 1459.54 ± 307.9 kcal, while the mean carbohydrate intake was 185.001 ± 46.5 g, the mean protein intake was 69.0817 ± 20.35 g and mean fats consumed was 55.3930 ± 19.49 g respectively.

Table 4.16 Mean nutrient intake of participant

Nutrients	Mean
Energy Consumed (kcal)	1459.54 ± 307.9
Carbohydrates Consumed	185.00 ± 46.5
Fats Consumed	55.39 ± 19.49
Protein Consumed	69.08 ± 20.35
Protein (g/kg/d)	1.10 ± 0.34
CHO (g/kg/d)	2.97 ± 0.86
Fats (%/kg/d)	42.74 ± 11.38
Calories (kcal/kg/d)	23.43± 5.80

The mean calorie consumed per body weight (kcal/bw) was 23.4356 ± 5.80498, the mean carbohydrates consumed gram per body weight was 2.9721 ± 0.86207 while the mean protein consumed g per body weight per day was 1.1064 ± 0.34567 respectively

A majority of the participants (95.45%) had inadequate calorie intake, while only a small fraction (4.55%) met the adequate calorie requirement. All participants (100%) reported inadequate carbohydrate intake, indicating a complete lack of meeting the recommended carbohydrate levels among the sample population. Protein intake was found to be inadequate in 60% of participants, whereas 40% had an adequate protein intake.

Table 4.17 Adequacy of nutrient consumption of participants

		Frequency	Percent
Enough Calories	Inadequate	105	95.45%
	Adequate	5	4.55%
Enough Carbs	Inadequate	110	100%
	Adequate	0	0.00%
Enough Protein	Inadequate	66	60%
	Adequate	44	40%

4.10 Association Between Baseline Characteristics and Nutritional Knowledge

This section explores the association between baseline characteristics of the participants and their nutritional knowledge. The baseline characteristics of the participants included demographic characteristics such as age and gender, socio economic characteristics such as education level and monthly income, nutritional characteristics such as consumption of supplements etc.

Among males, 57% exhibited poor knowledge compared to 37.5% of females. However, the Fisher's exact test yielded a p-value of 0.7, indicating no significant difference in knowledge levels between genders. This suggests that gender does not significantly influence knowledge levels in this sample. This trend was also observed in other researcher studying the factors affecting KAP of national level athletes of other sports (Thapa *et al.*, 2023).

Table 4.18 Association between Nutritional knowledge and Gender

		Knowledge				p-value
		Poor		Good		
		Frequency	**Percentage**	**Frequency**	**Percentage**	
Gender	Male	49	57.0%	37	43.0%	0.7
	Female	9	37.5%	15	62.5%	

p-value significant at < 0.05

Among those aged 15-18, knowledge levels were evenly split, with 50% showing poor knowledge and 50% showing good knowledge. In the 18-25 age group, 53.57% exhibited poor knowledge compared to 46.43% with good knowledge, indicating a slight shift towards poorer knowledge in this group. For those 25 and above, 55.56% demonstrated poor knowledge while 44.44% showed good knowledge, suggesting a further increase in the proportion of individuals with poor knowledge. However, the chi-square test yielded a p-value of 0.9, indicating no significant difference in knowledge levels across age groups. This suggests that age does not significantly influence knowledge levels in this sample, despite the observed trends. This is similar to findings observed in other studies (Alaunyte *et al.*, 2015)

Table 4.19 Association between age and Nutritional Knowledge

		Knowledge				p-value
		Poor		Good		
		Frequency	Percentage	Frequency	Percentage	
Age	15 to 18	18	50.00%	18	50.00%	0.9
	18 to 25	30	53.57%	26	46.43%	
	25 and above	10	55.56%	8	44.44%	

p-value significant at < 0.05

The **Table 4.20** represents the distribution of nutritional knowledge across the provinces of Nepal. The Bagmati province exhibits the highest percentage of poor nutritional knowledge with 72.09% of athletes having poor nutritional knowledge, this is followed by the Koshi province with 51.43% of athletes having poor nutritional knowledge. The Lumbini province stands out with having the highest (100%) of athletes with good nutritional knowledge followed by Gandaki province (70%) and the sudurpaschim province (60%).

Moreover, the likelihood ratio test indicates a significant difference in knowledge levels across regions (p-value < 0.05), suggesting that geographical location is a factor influencing knowledge distribution. This suggests a relationship between geographical variation/ Region and nutritional knowledge, similar results were found on studies examining nutritional knowledge across countries which reported that geography, in terms of rural vs urban settings, may impact nutritional knowledge (Bhawra *et al.*, 2023).

Table 4.20 Association between province/region and Nutritional Knowledge

		Knowledge				**P-value**
		Poor		Good		
		Frequency	Percentage	Frequency	Percentage	
Region	Koshi	18	51.43%	17	48.57%	
	Bagmati	31	72.09%	12	27.91%	
	Lumbini	0	0.0%	7	100.0%	<0.01*
	Gandaki	3	30.0%	7	70.0%	
	Sudurpaschim	6	40.0%	9	60.0%	

*p-value significant at < 0.05

Table 4.21 Association between Educational Qualification and Nutritional Knowledge

		Knowledge				**p-value**
		Poor		Good		
		Frequency	Percent	Frequency	Percent	
Educational Qualification	Secondary (6-10)	9	64.29%	5	35.71%	
	Higher Secondary (11-12)	32	55.17%	26	44.83%	0.3
	≥ Bachelors	17	44.74%	21	55.26%	

p-value significant at < 0.05

As shown in **Table 4.21** At the secondary education level (6-10), a majority (64.29%) of respondents demonstrated poor knowledge, with only 35.71% showing good knowledge. As educational attainment

increased, this gap narrowed. In the higher secondary category (11-12), 55.17% exhibited poor knowledge versus 44.83% with good knowledge, However, among those with bachelor's degrees and above, the trend reversed, with a majority (55.26%) displaying good knowledge compared to 44.74% with poor knowledge, However, a p-value of 0.3 (more than 0.05) indicates there is no statistical association between nutritional knowledge and Education qualification. This finding is in line with tat of research done on the Determinants of nutrition knowledge, attitude and practices of adolescent sports trainee in Bangladesh which showed no significant relationship between education level and nutritional knowledge (Bakhtiar *et al.*, 2021)

The **Table 4.22** on daily training hours and knowledge levels shows a statistically significant difference (p = 0.02). From Individuals who spend less than one hour on daily training 88.9% have good nutritional knowledge. Those who spend more than three hours on training have the lowest percentage of good knowledge (36.4%). Surprisingly, individuals who train for less than one hour daily have the highest percentage of good knowledge, This finding is similar to researches done on the effect of nutritional knowledge on nutritional status in sport science students, the studies indicate that despite the potential for increased training hours to enhance nutritional knowledge, many athletes still exhibit gaps in their understanding of nutrition (Sirgear *et al.*, 2020)

Table 4.22 Association between Daily training hours and Nutritional knowledge

		Knowledge				**p-value**
		Poor		**Good**		
		Frequency	**Percent**	**Frequency**	**Percent**	
Daily Training Hours	Less than one hour	1	11.1%	8	88.9%	0.02*
	2 to 3 hours	50	55.6%	40	44.4%	
	More than 3 hours	7	63.6%	4	36.4%	

* p-value significant at < 0.05

From **Table 4.23** the respondents who checked food labeling before consuming them, a majority (62.3%) had good nutritional knowledge while a majority (78%) of those who did not check the labeling had poor nutritional knowledge, morevover a p-value of 0.00 indicates a strong association between Nutritional knowledge and individuals who check labeling of the food items, this also corresponds with prior researched conducted in athletes of other sports in Nepal (Thapa *et al.*, 2023). Another A study conducted in status of nutrition labeling

knowledge, attitude and practice in a community showed significant relationship between good nutritional KAP and use of nutrition labels when shopping with a p-value of 0.001(Liao and Yang, 2023)

Table 4.23 Association between Nutritional Knowledge and Checking of food labeling

		Knowledge				p-value
		Poor		Good		
		Frequency	Percent	Frequency	Percent	
Do you check food labeling?	Yes	26	37.7%	43	62.3%	0.00*
	No	32	78.0%	9	22.0%	

*p-value significant at < 0.05

The majority of respondents who consumed pre event meals had good nutritional knowledge (53.95%) while 67.65% of respondents who did not consume proper pre event meals had poor nutritional knowledge, moreover, the p-value of 0.041 indicates a significant relationship between nutritional knowledge and consumption of pre event meals, this is also in line with prior studies carried out in Turkish national level boxers, which reported a significant association between pre event meal consumption and nutritional knowledge (Ağirbaş *et al.*, 2018).

Table 4.24 Association between Nutritional Knowledge and Pre event Meal consumption

		Knowledge				p-value
		Poor		Good		
		Frequency	Percent	Frequency	Percent	
I eat pre-event meal before 3 to 4hours of competition	Yes	35	46.05%	41	53.95%	0.041*
	No	23	67.65%	11	32.35%	

*p-value significant at < 0.05

4.11 Association Between Baseline Characteristics and Nutritional Attitude

This section explores the association between baseline characteristics of the participants and their nutritional attitude. The baseline characteristics of the participants included demographic characteristics such as age and gender, socio economic characteristics such as education level and monthly income, nutritional characteristics such as consumption of supplements etc.

Among male respondents, 56.98% exhibited poor attitude, while 43.02% showed good attitude. In contrast, female participants displayed a more balanced distribution, with 37.50% having poor attitude and 62.50% demonstrating good attitude. The p-value for this comparison is 0.09, which is slightly above the commonly used significance threshold of 0.05.

Table 4.25 Association between gender and nutrition attitude

		Attitude				p-value
		Poor		Good		
		Frequency	Percent	Frequency	Percent	
Gender	Male	49	56.98%	37	43.02%	
	Female	9	37.50%	15	62.50%	0.09

p-value significant at < 0.05

As seen in **Table 4.26** Among individuals aged 15 to 18, 66.7% exhibited poor attitude, while 33.3% demonstrated good attitude. In the 18 to 25 age group, the proportion of those with poor attitude decreased to 46.4%, with 53.6% showing good attitude. For those aged 25 and above, the trend continued, with 44.4% having poor attitude and 55.6% displaying good attitude. he Pearson Chi-Square test reveals a non-significant association between age and attitude (p = 0.123). This suggests that there is no significant difference in the distribution of attitudes across the different age groups. These findings corelate with other studies done in similar topics which also suggest no relationship between Nutritional attitude and age and gender (Thapa *et al.*, 2023).

Table 4.26 Association between age and nutritional attitude

		Attitude				p-value
		Poor		Good		
		Frequency	Percent	Frequency	Percent	
Age	15 to 18	24	66.7%	12	33.3%	0.123
	18 to 25	26	46.4%	30	53.6%	
	25 and above	8	44.4%	10	55.6%	

p-value significant at < 0.05

In the Koshi region, 68.57% of respondents exhibited poor attitude, while 31.43% showed good attitude. Similarly, in the Bagmati region, 60.47% had poor attitude compared to 39.53% with good attitude. However, the Lumbini region stood out with a stark contrast, where only 14.29% had poor attitude and a substantial 85.71% demonstrated good attitude. This difference in

attitude distribution across regions was found to be statistically significant, as indicated by the p-value of 0.02 for the Lumbini region. The Gandaki and Sudurpaschim regions also displayed a higher proportion of good attitude, with 60.00% and 80.00% respectively. Moreover, the p-value of 0.02 suggests significant association between region and nutritional attitude similar studies such as a Research in China indicated that diet-related knowledge, attitudes, and behaviors (KABs) were significantly associated with geography and region where the individuals come from (Yang *et al.*, 2020).

Table 4.27 Association between Region and nutritional attitude

		Attitude				
		Poor		**Good**		**p-value**
		Frequency	**Percent**	**Frequency**	**Percent**	
Region	Koshi	24	68.57%	11	31.43%	
	Bagmati	26	60.47%	17	39.53%	
	Lumbini	1	14.29%	6	85.71%	0.03*
	Gandaki	4	40.00%	6	60.00%	
	Sudurpaschim	3	20.00%	12	80.00%	

*p-value significant at < 0.05

From the **Table 4.27** the Chi-Square test indicates that there is a statistically significant association between religious affiliation and attitude levels. Respondents belonging to kirat religion are seen to have relatively poor nutritional attitude (73.33%) as compared to their counterparts, Hindu respondents show a relatively even split between poor (55.41%) and good (44.59%) attitudes. In contrast, Muslim individuals exhibit a more favorable attitude profile, with 66.67% having good attitude compared to 33.33% with poor attitude. while Buddhists have a greater percentage of good attitude (71.43%). The Christian respondents show an interesting pattern, with all of them (100%) demonstrating good attitude.

This significant association between religion and nutritional attitude is also seen in studies conducted in Istanbul which states that Eating attitudes may be influenced by a person's religious perceptions and knowledge, feelings, views and behaviors related to food consumption (Arslan and Aydemir, 2020).

Table 4.28 Association between religion and nutritional attitude

		Attitude				p-value
		Poor		Good		
		Frequency	Percent	Frequency	Percent	
Religion	Hindu	41	55.41%	33	44.59%	
	Muslim	1	33.33%	2	66.67%	
	Kirat	11	73.33%	4	26.67%	0.029*
	Christian	0	0.00%	3	100.00%	
	Buddhist	4	28.57%	10	71.43%	
	Others	1	100.0%	0	0.00%	

*p-value significant at < 0.05

Table 4.29 Association between Nutriton attitude and classes attended

		Attitude				p-value
		Poor		Good		
		Frequency	Percent	Frequency	Percent	
Have you ever attended classes related to nutrition?	yes	1	14.3%	6	85.7%	
	No	57	55.3%	46	44.7%	0.04*

*p-value significant at < 0.05

Unlike a Similar study of KAP ko athletes in Nepal where there seem to be no significant association between nutritional classes attended and nutritional attitude (p-value=0.17) (Thapa *et al.*, 2023), There seem to be statistically significant association between respondents who have attended nutrition related classes before and nutritional attitude of the individuals (p-value=0.04), of the individuals who have attended classes ma majority (85.7%) had good nutritional attitude while only 14.3% had poor attitude, conversely a majority of individuals who had not attended nutrition classes had poor nutritional attitude (55.3%). The same study also revealed individuals with positive attitude towards nutrition checked food labeling more than those who had poor attitude towards nutrition, signifying association between nutrition attitude and use of food labeling (p-value=0.002), This goes in line with the findings of this

research as shown in the **Table 4.30** where we can see a statistically significant relationship between the two with a p-value of 0.02.

Table 4.30 Association between nutrition attitude and food labeling

	Attitude				p-value
	Poor		Good		
	Frequency	Percent	Frequency	Percent	
Do you Check Yes	31	44.93%	38	55.07%	0.02*
Food labeling? No	27	65.85%	14	34.15%	

*p-value significant at < 0.05

4.12 Association Between Baseline Characteristics and Nutritional Practice

This section explores the association between baseline characteristics of the participants and their nutritional practice. The baseline characteristics of the participants included demographic characteristics such as age and gender, socio economic characteristics such as education level and monthly income, nutritional characteristics such as consumption of supplements etc.

Table 4.31 Association between age and gender with nutrition practice

		Practice				p-value
		Poor		Good		
		Frequency	Percent	Frequency	Percent	
Gender	Male	54	62.80%	32	37.20%	0.18
	Female	12	50.00%	12	50.00%	
Age	15 to 18	22	61.10%	14	38.90%	
	18 to 25	33	58.90%	23	41.10%	0.93
	25 and above	11	61.10%	7	38.90%	

p-value significant at < 0.05

There seems to no significant association between having good nutritional practices with either age or gender (p-value= 0.18, 0.93), this results are similar to studies conducted in national athletes of other sports in Nepal which reported no relation between age or gender and nutritional practices (p-value 0.93 and 0.80 respectively) (Thapa *et al.*, 2023).

Living in different regions can also expose individuals to varying cultural dietary practices and social norms, thus regional variance may cause difference in nutrition practices (Kim *et al.*, 2009). This is in line with the findings of this research which shows a statistically significant relationship between the region the athletes come from with their nutritional practices (p-value=0.00).

Table 4.32 Association between Region and Nutritional practices

		Practice				p-value
		Poor		Good		
		Frequency	Percent	Frequency	Percent	
Region	Koshi	20	57.14%	15	42.86%	
	Bagmati	30	69.77%	13	30.23%	
	Lumbini	0	0.00%	7	100.00%	0.00*
	Gandaki	3	30.00%	7	70.00%	
	Sudurpaschim	13	86.67%	2	13.33%	

*p-value significant at < 0.05

A high majority of individuals from the Sudurpaschim province had poor nutritional practices (86.67%), while only 13.33% of them had good nutritional practices, Majority of individuals from the Koshi (57.14%) and the Bagmati (69.77%) had poor nutritional practices while the athletes from the Gandaki and Lumbini provinces had good nutritional practices with 70.00% of athletes from Gandaki having good nutritional practice, while a 100% of athletes from Lumbini province had good nutritional practices.

Table 4.33 Association between Checking food labeling and nutrition practices

		Practice				p-value
		Poor		Good		
		Frequency	Percent	Frequency	Percent	
Do you check the labelling of food items before purchasing?	Yes	35	49.30%	36	50.70%	
	No	31	79.49%	8	20.51%	0.02*

*p-value significant at < 0.05

The analysis of the association between checking food labeling and nutrition practices revealed a statistically significant relationship ($p = 0.02$). Among respondents who reported checking the labeling of food items before purchasing, there was a relatively even distribution between poor (49.30%) and good (50.70%) nutrition practices. In contrast, among those who do not check food labels, a stark difference was observed. A substantial majority (79.49%) demonstrated poor nutrition practices, while only 20.51% exhibited good practices. This

indicates that failing to check food labels is strongly associated with poorer nutrition habits. A study conducted in status of nutrition labeling knowledge, attitude and practice in a community showed significant relationship between good nutritional KAP and use of nutrition labels when shopping with a p-value of 0.001(Liao and Yang, 2023)

Table 4.34 Association between nutrition practice and following a diet plan

		Practice				p-value
		Poor		Good		
		Frequency	Percent	Frequency	Percent	
Do you follow diet plan?	Yes	5	25.0%	15	75.0%	0.001*
	No	61	67.8%	29	32.2%	

*p-value significant at < 0.05

The analysis of the relationship between following a diet plan and nutrition practices revealed a notable association. Among respondents who reported following a diet plan, a significant majority (75.0%) demonstrated good nutrition practices, while only 25.0% exhibited poor practices. In contrast, among those who do not follow a diet plan, the trend is reversed. A large majority (67.8%) showed poor nutrition practices, while only 32.2% maintained good practices. This suggests that adherence to a structured diet plan is strongly associated with better nutritional habits. This result is in line with previous literature on the nutritional KAP of national level athletes in Nepal (Thapa *et al.*, 2023) which also reveals a significant association between adherence to a diet plan and good nutritional practices (p-value=0.046).

5 Association Between Nutritional Knowledge, Attitude and Practice

The **Table 4.35** shows the association between knowledge and attitude, the results show that among those with poor knowledge, 58.62% had a poor attitude, while 41.38% had a good attitude. Conversely, among those with good knowledge, 46.15% demonstrated a poor attitude, and 53.85% showed a good attitude. However, this relationship was not statistically significant ($p = 0.132$), In contrast, the relationship between knowledge and practice showed a statistically significant association ($p < 0.001$). Among individuals with poor knowledge, a substantial majority (66.67%) exhibited poor practice, while only 33.33% demonstrated good practice. This pattern was reversed for those with good knowledge, where 31.82% showed poor practice, and a majority (68.18%) exhibited good practice.

Table 4.35 Association between Nutritional Knowledge with Nutritional attitude and practices

		Knowledge				p-value
		Poor		Good		
		Frequency	Percent	Frequency	Percent	
Attitude	Poor	34	58.62%	24	41.38%	0.132
	Good	24	46.15%	28	53.85%	
Practice	Poor	44	66.67%	22	33.33%	<0.001*
	Good	14	31.82%	30	68.18%	

*p-value significant at < 0.005

Table 4.36 Association between nutritional attitude with nutritional practice

		Attitude				p-value
		Poor		Good		
		Frequency	Percent	Frequency	Percent	
Practice	Poor	39	59.09%	27	40.91%	0.075
	Good	19	43.18%	25	56.82%	

p-value significant at < 0.05

Even though a majority of respondents who had positive attitude towards nutrition had good nutrition practices (56.82%) while those with poor attitude had poor nutritional practice (59.09%), the **Table 4.36** shows no relationship between nutritional attitude and practice (p-value = 0,075), Furthermore, **Table 4.37** shows fair positive correlation between Nutritional knowledge and nutritional practices, with a correlation coefficient of more than 0.03 and a p-value of < 0.001 while there was no significant association between nutritional knowledge and practice with attitude, thus suggesting as the nutritional knowledge of an individual increases, their nutritional practices will become better, these findings relate perfectly with a study done on Determinants of nutrition knowledge, attitude and practices of adolescent sports trainee in Bangladesh which showed Athletes having good knowledge score were more than 2 times likely to have good practice score (AOR 2.335; 95% CI 1.405, 3.88; p ¼ 0.001). The predicted probability of good practice score of athletes also increased as the knowledge score increased while the attitude score did not show any positive or negative impact on the scores (Bakhtiar *et al.*, 2021).

Table 4.37 Correlation between nutritional KAP

Variables	Pearson Correlation	p-value
Knowledge and Practice	0.342	< 0.001*

Knowledge and Attitude	0.125	0.194
Practice and Attitude	0.156	0.103

*p-value significant at < 0.05

PART V

Conclusions and recommendations

5.1 Conclusions

The Nutritional KAP of National and provincial level boxers of Nepal were assessed and compared in the study. The study aimed to uncover and also explore the nutritional mindset of national level athletes i.e weather they have adequate knowledge, a positive attitude and proper practices related to nutrition or not. It also aimed to explore the significant associations between the demographic, socio economic backgrounds, dietary intake, sporting factors with nutritional KAP of the participants. The key conclusions from this study include:

1. The need of proper nutritional guidance seems eminent from the data A majority of athletes had poor nutritional KAP with over half of the participants reporting to have poor nutritional knowledge (52.73%) while 47.27% of the participants seemed to have a good nutritional knowledge, a majority (52.73%) of the participants had negative or improper attitude towards nutrition while 47.27% of the participants seemed to have a good nutritional attitude. Over (60.00%) respondents had poor nutritional practice while 40.00% of the participants seemed to have a good nutritional practice.
2. A majority (81.81%) of the athletes did not follow a diet plan, the ones that did follow a diet plan did not have a credible source of information. Only 1.81 % of the total respondents reported to consult nutritionist or a dietitian for their source of nutritional information while social media was a major source of information for the athletes (72.38%). A vast majority of the athletes did not consume any dietary supplements (93.63%) while creatine, fish oil and whey protein were supplements used by the athletes. None of the athletes who used supplements took advice from a dietitian or a nutritionist.
3. A vast majority of the athletes did not have an understanding of the basic concepts of sport nutrition such as rehydration, carbohydrate loading, pre and post event meals etc, thus a vast majority of the athletes did not practice these basic and important concepts in their life, which may be an reason Nepal is underperforming in sports internationally.
4. There seems to a positive correlation between good nutritional knowledge and ood nutritional practice, as the knowledge increases the athletes tend to have proper nutritional practices, thus it is crucial to provide athletes with proper guidance on nutrition to enhance their performance. Moreover, factors such as region, religion, duration in sports, adherence

to a diet plan, checking of food labeling, seemed to have a association with the nutritional KAP of the athletes.

5. The dietary intake of the athletes were below the recommended levels with 95.45% of the athletes not consuming enough calories required, a slight lean towards high protein intake was seen in the athletes with around 40% of the athletes consuming adequate amount of protein in their diet, none of the athletes consumed an adequate amount of carbohydrates in their diet.

5.1 Recommendations

1 There is a clear need to enhance nutritional education among the athletes to ensure optimal nutritional practices are being followed. Enhanced proper nutritional practices will lead to improvement in performance, recovery time and reduce the risk of injuries and nutritional deficiencies.

2 Nutritional education programs and campaigns on sport nutrition must be conducted by respective organizations to cater the needs of their athletes along with regular nutritional monitoring of the athletes.

3 The national sport organization committee must provide athletes with necessary supplements and nutritional aids to enhance the performance and recovery of the athletes considering a majority of the athletes did not meet adequate nutrient requirements needed for the sport

4 An even detailed and extensive research should be conducted encompassing all of the unaccounted variables such as calculation of micronutrient consumption food frequency questionnaire, A more technologically advance methods of nutritional assessment such as BIA, can used in order to get detailed information about the nutritional status of the athletes. Moreover, studies on nutritional knowledge of coaches and trainers should also be conducted.

5 The sports institutions must deploy dedicated nutritionist or dietitians for diet planning of their athletes in order to ensure improved performance, recovery and reduce the risk of nutritional deficiencies.

Part VI

Summary

Nutritional plays a vital role in athletic performance of an individual, improper consumption of nutrients may lead to increased risk of fatigue and injury thus, decreasing the performance level of an athlete, proper nutritional practices are necessary in order to ensure a balanced and constant delivery of nutrients and improvement in overall performance and condition of the athlete.. A cross-sectional study was conducted in five of the seven provinces of Nepal encompassing several districts and more than 15 boxing institutions throughout the country with a total of 110 participants who were all national and province level boxers. Data was collected through a one-on-one interview and a KAP questionnaire, it explored nutritional KAP of the participants along with other factors associated with nutrition.

The study revealed that a majority of athletes had poor nutritional KAP, with A majority of participants (52.73%) reporting to have a negative or improper attitude towards nutrition, whereas 47.27% of participants seemed to have a good nutritional attitude. Additionally, over half of participants reported having poor nutritional knowledge (52.73%), while 47.27% of participants seemed to have a good nutritional knowledge. While 40.00% of participants appeared to have strong nutritional practices, over 60.00% of respondents had poor nutritional practices. There was a significant association between demographic characteristics such as region, religion, socio economic characteristics and sporting characteristics such as training hours with the nutritional KAP of the participants, i.e these factors chuld positively or negatively affect the nutritional KAP of the individuals. Moreover, there seemed to be a fair positive correlation between nutritional knowledge and nutritional practices, indicating a rise in nutritional knowledge will lead to overall better nutritional practices.

The athletes' consumption of energy, protein, and carbohydrates was significantly lower; their dietary intake was below recommended levels, with 95.45% of the athletes not consuming the required amount of calories; there was a slight tendency toward high protein intake, with about 40% of the athletes consuming an adequate amount of protein in their diet; none of the athletes consumed an adequate amount of carbohydrates. Thus there is a dire need of interventions aimed to increase the nutritional knowledge of the athletes which in turn will lead to improved dietary practices.

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Appendices

Appendix A: Survey questionnaire

Questionnaire on Research Among players about sports nutrition		
SN	**Questions**	**Details**
1	Date	
2	Name:	
3	Gender	female male
4	years	
5	Height cms	
6	Weight kgs	
7	To which club you are affiliated?	
8	What is your ethnicity?	Brahmin/chhetri Janajati Dalit Terai caste others
9	What is your educational qualification?	primary (1-5) secondary (6-10) higher secondary (11-12) Bachelors and above

10	What is your religion?	hindu Boudhist Muslim kirat Christian Others
11	What is your marital status?	Married Unmarried
12	What is your main occupation?	Job Agriculture Business Unemployed Student
13	Family monthly income	……
14	Which sports do you play?	.....
15	Since how long you have been involved in sports	
16	your daily training hours	Less than 1 hour to 3 hour Above 3 hours
		yes

17	Do you eat any dietary supplements	No
18	If yes, what is its name?	....
19	From where, do you get nutrition related information multi response	Books Articles Social media Coach/trainer Dietitian/nutritionist Health workers Friends Newspaper Others
20	Have you ever attended classes related to nutrition?	Yes No
21	Do you check the labelling of food items before purchasing?	Yes No
22	Do you follow diet plan?	Yes No
23	If yes, from whom you get it.	…….
24	Is there any difference in food intake during off and on season of sports?	Yes No

Sports Nutrition Knowledge questionnaire				
SN	**Statements**	**Agree**	**Disagr ee**	**Don't know**
1	Learning facts about nutrition is the best way to achieve favorable changes in food habits.			
2	The type of food an athlete eats affects his/her performance.			
3	A sound nutritional practice for athletes is to eat a wide variety of different food types from day to day.			
4	Carbohydrate is the major source of energy followed by fat and protein			
5	Increasing protein in the diet is the main dietary change needed when only muscle gain is desired.			
6	A course in nutrition would be helpful for the athlete.			
7	Skipping meal is advisable if you need to lose weight quickly.			
8	Eggs contain all the essential amino acids needed by the body.			
9	Vegetarian athletes can meet their protein requirements without use of protein supplement.			
10	Milk is a good supplier of calcium for all age groups.			
11	Lack of iron in diet can result in fatigue, injury and illness.			

12	Due to menstruation, females need more iron in their diets than men.			
13	Vitamins provide the body with energy.			
14	Vitamin c tablet should always be taken by athletes.			
15	Vitamins are good source of energy.			
16	Athletes should drink water during activity in order to maintain plasma volume.			
17	Regarding fluid intake during physical activity, recommendations encourage athletes to drink to a plan based on body weight changes during training sessions performed in a similar climate.			
18	Carbonated beverages can negatively affect calcium metabolism.			
19	Dehydration can impair physical performance.			
20	Sports drink are the best way to replace body fluids lost during exercise.			
21	Alcohol's consumption can affect absorption and utilization of nutrients.			
22	Caffeine can increase the risk of dehydration.			
23	Before competition, athletes should consume foods that are high in fat.			
24	Pre event meal should be eaten about 3 to 4 hours before			

	competition.			
25	Consuming carbohydrates during exercise will assist in maintaining blood glucose levels.			
26	All supplements are beneficial to use for athletes.			
27	Supplements label may contain false or misleading information.			
28	The purity and safety of all supplements are tested before sale.			
29	World anti-Doping Agency has banned the use of caffeine and bicarbonate			
	Carbohydrate loading is significant method to be practiced by endurance athletes.			

Sports Nutrition Attitude Questionnaire

SN	**Statements**	**Agree**	**Undecided**	**Disagree**
1	I intend to eat balanced diet every day			
2	I have a set schedule for meals.			
3	I believe that eating proper diet will improve my physical performance.			
4	I always opt for pre event meal 3 to 4 hours before competition.			
5	Taking more eggs is the only way to build muscles.			
6	I have to take supplements to improve my performance.			
7	Fruits and vegetables are also necessary for me to fulfill my nutrient requirements.			

8	I should consume meat and eggs only to fulfill my protein requirement			
9	I seek food or nutrition related advice from Nutritionist or Dietitian.			
10	When considering eating any food, I care what my coach thinks I should do			
11	Balanced diet will help me to be a successful player.			
12	It is my duty to read food labels before consuming it			
13	I have to skip meals to lose my weight			
14	I feel that I cannot perform well when I am dehydrated			
15	Before the competition I should eat heavy meal with high fat and protein			
16	It Is my responsibility to know items that has been banned by World Anti-Doping Agency. World Anti-Doping Agency			

Sports Nutrition Practice Questionnaire

SN	**Statements**	**Yes**	**No**
1	I have set a schedule for meals		
2	I check labelling of food before purchasing or consuming		
3	I always have someone to ask about what should I eat		
4	I ask Nutritionist or Dietitian for nutrition advice.		
5	I eat at least four meals a day		

6	I use supplements to improve my performance		
7	I have been using supplements under the guidance of medical personnel or Nutritionist		
8	I consume fruits and vegetables daily		
9	During exercise/training session, I drink electrolytic beverages		
10	I eat pre-event meal before 3 to 4hours of competition		
11	I eat food high in simple carbohydrates and protein before competition		
12	I consume fluids containing carbohydrate during competition		
13	I consume food high in protein, carbohydrate and protein after competition		
14	I avoid deep fried, oily and spicy foods		

24-hour dietary recall

Time	**Food items**	**Ingredients**	**Quantity**	**Household measurement**
Breakfast				
Lunch				

Mid-day snack				
Dinner				

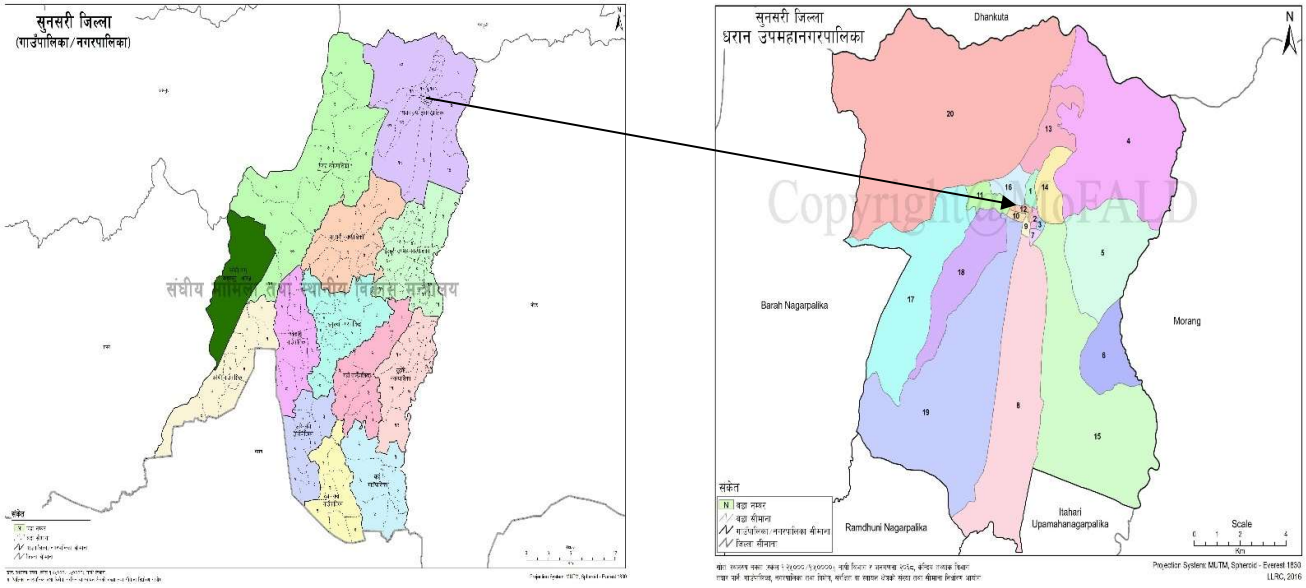
Appendix B: Photo gallery

Anthropometric Measurement (Sunsari)

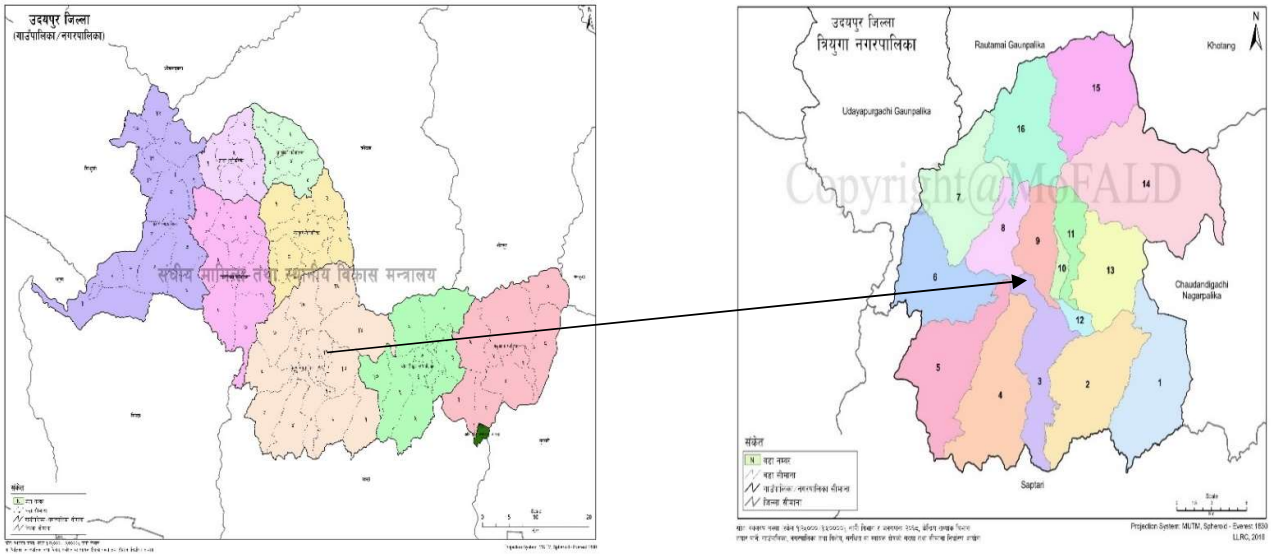
Collecting Questionnaire (Jhapa)

(First inter provincial tournament, Bharatpur Chitwan)

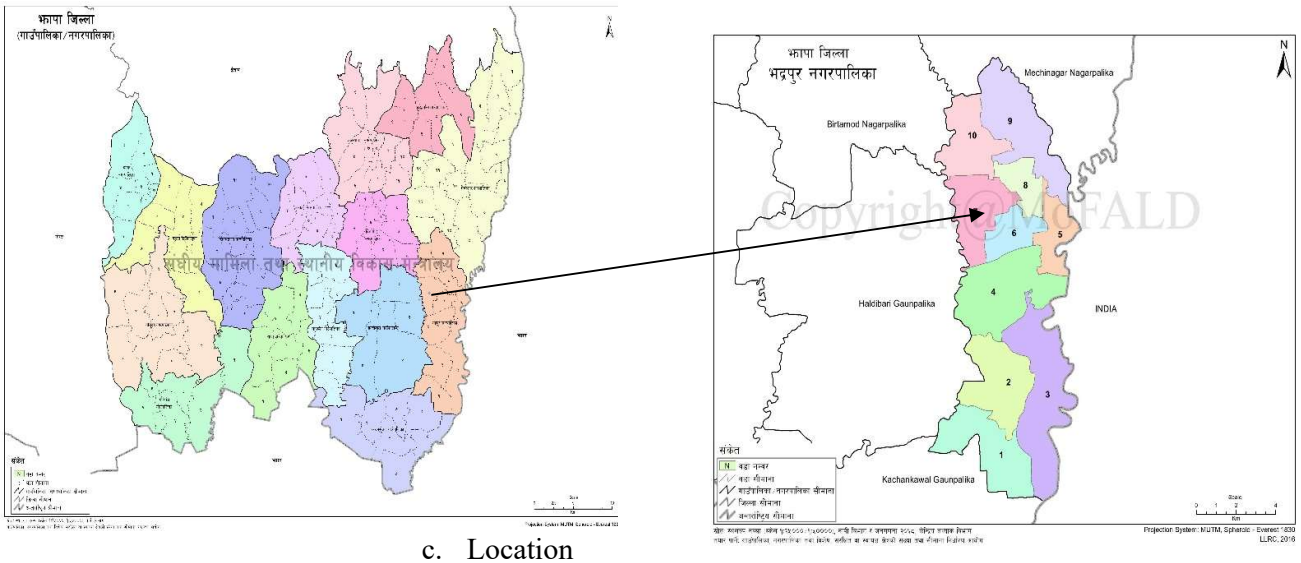
Appendix C: Survey site



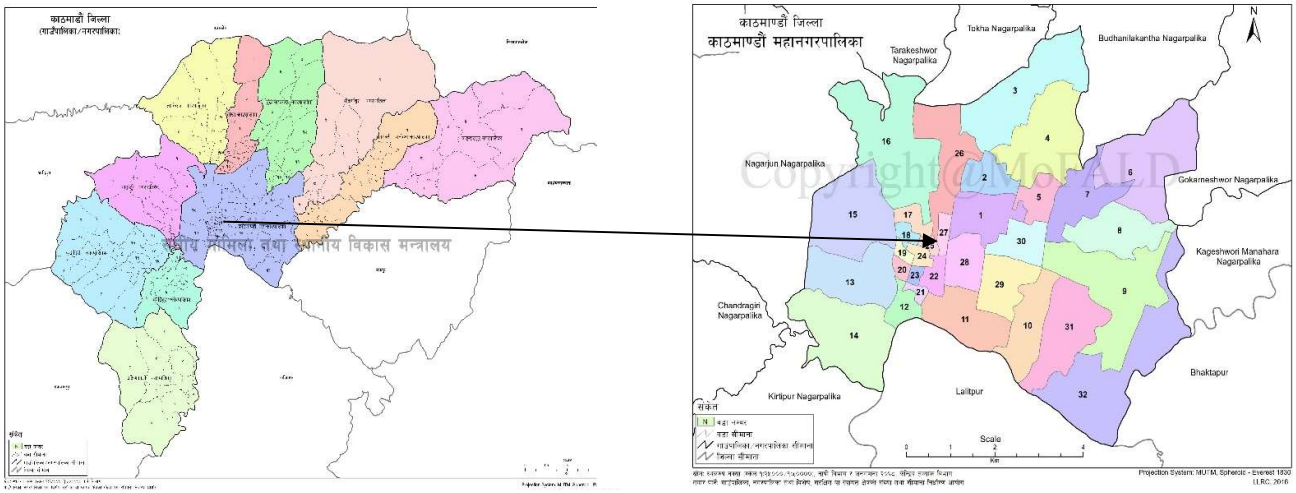
a. Location Dharan Sub- Metropolitan city, Sunsari



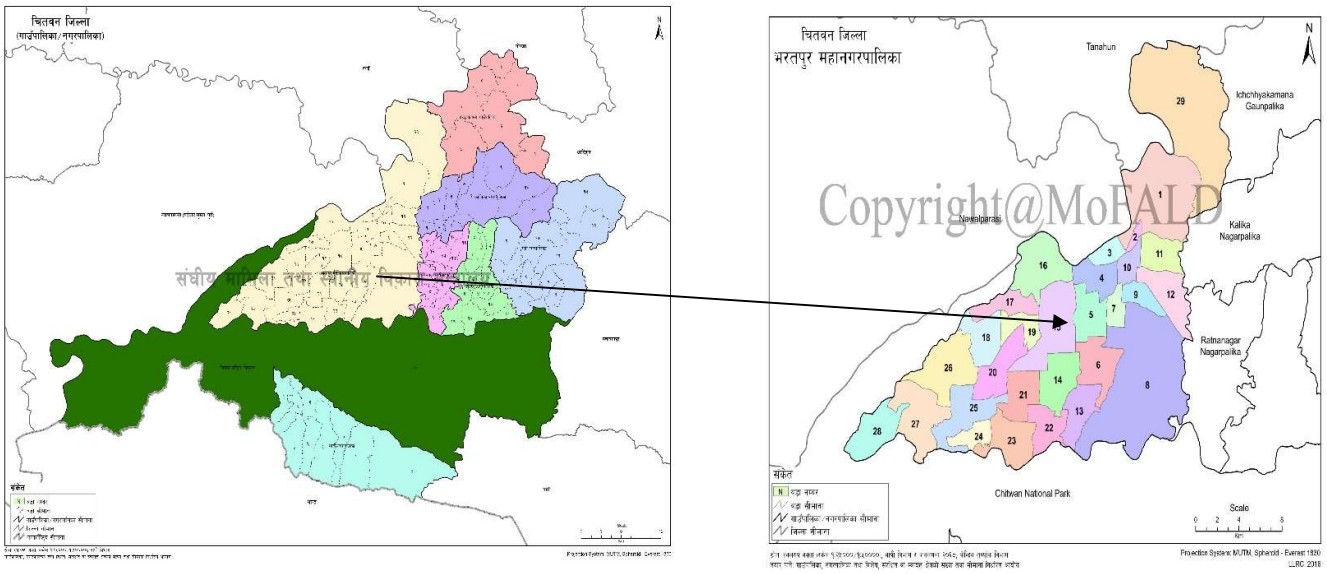
b. Location Gaighat municipality, Udaypur



c. Location
Bhadrapur municipality, Jhapa



d. Location Kathmandu Metropolitan city Kathmandu.



e. Location Bharatpur Metropolitan city, Chitwan

Source: MoFAGA (2O17)