IMPACT OF NUTRITIONAL INTERVENTION ON GLOBAL DIETARY RECOMMENDATION SCORE AND DIETARY DIVERSITY SCORE OF ADOLESCENTS IN SECONDARY SCHOOLS IN DHARAN, NEPAL

by

Smriti Kumari Yadav

Department of Nutrition and Dietetics

Central Campus of Technology

Institute of Science and Technology

Tribhuvan University, Nepal

2025

Impact of Nutritional Intervention on Global Dietary Recommendation Score and Dietary Diversity Score of Adolescents in Secondary Schools in Dharan, Nepal

A dissertation submitted to the Department of Nutrition and Dietetics, Central Campus of Technology, Tribhuvan University, in partial fulfillment of the requirements for the degree of BSc. in Nutrition and Dietetics

by

Smriti Kumari Yadav

Department of Nutrition and Dietetics

Central Campus of Technology

Institute of Science and Technology

Tribhuvan University, Nepal

April, 2025

Tribhuvan University, Nepal

Institute of Science and Technology

Department of Nutrition and Dietetics

Central Campus of Technology, Dharan

Approval Letter

This **dissertation** entitled ***Impact of Nutritional Intervention on Global Dietary Recommendation Score and Dietary Diversity Score of Adolescents in Secondary Schools in Dharan, Nepal*** presented by **Smriti Kumari Yadav** has been accepted as the partial fulfillment of the requirement for the **BSc. degree** in **Nutrition and Dietetics.**

Dissertation Committee

1. **Head of the Department** _____
   (Mr. Kabindra Bhattarai, Asst. Prof.)
   HEAD OF DEPARTMENT
   NUTRITION & DIETETICS
2. **External Examiner** _____
   (Mrs. Swaichchha Basnet, Lecturer/ HoD, Nutrition and Dietetics, BMCTH)
3. **Supervisor** _____
   (Mr. Kabindra Bhattarai, Asst. Prof.)
4. **Internal Examiner** _____
   (Mr. Devendra Bhattarai, Teaching Asst.)

April, 2025

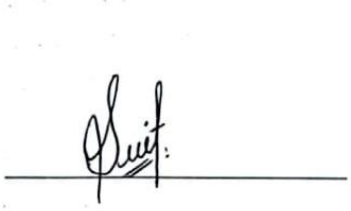
Acknowledgments

I would love to express my deepest gratitude to my dissertation supervisor and Head of the Department, Asst. Prof. Mr. Kabindra Bhattarai, for his invaluable guidance, unwavering support, and constructive feedback throughout this research journey. His expertise and insightful guidance have been vital in shaping this thesis and my academic growth.

I would like to acknowledge Campus Chief Mr. Basanta Kumar Rai, & former Campus Chief Dr. Dil Kumar Limbu, Central Campus of Technology, for providing all the direct and indirect support, for all the administrative and technical support that was provided to me, which was required during my research. I extend my sincere appreciation to the Department of Nutrition and Dietetics and all the teaching and non-teaching staff, for granting me access to their facilities and guidance, which were crucial for this research.

I am also grateful to the Education Institute and all the members of the school, for their administrative support in fostering an environment conducive to the intervention session and research. Finally, I am profoundly grateful to my colleagues, juniors, and family, for their continuous encouragement, companionship, and unwavering belief in my abilities.

Date of submission: April 2025



Smriti Kumari Yadav

Abstract

This study evaluated the impact of a 10-week school-based nutritional intervention program on dietary scores, nutritional status, and behavioral outcomes among adolescents in Dharan, Nepal. The quasi-experimental pre-post intervention study, conducted from May to July 2024, involved 119 students aged 10-16 years. The intervention integrated comprehensive nutrition education with holistic wellness principles, focusing on improving dietary behaviors and nutritional awareness. Data collection integrated the use of a standardized Diet Quality Questionnaire (DQQ), along with structured questionnaires, anthropometric assessments, and dietary assessments. Anthropometric data were analyzed using WHO AnthroPlus software, dietary data using DQQ indicators measurements, and statistical analysis were performed to analyze the impact of the intervention with effect size calculations.

Results demonstrated statistically significant improvements in the dietary quality scores, with the Dietary Diversity Score (DDS) increasing from 6.059 to 6.689 (P=0.001) and the Global Dietary Recommendation (GDR) Score improving from 9.521 to 10.37 (P=0.013). The intervention achieved meaningful effect sizes of 0.34 and 0.31 for DDS and GDR scores respectively. Notable improvements were observed in wholesome food consumption patterns, with an increment in fruits (76.5% to 87.4%), dairy products (67.2% to 78.2%), and whole grains (20.2% to 56.3%), while daily consumption of highly processed food decreased (40.3% to 16.8%). While anthropometric measurements showed positive trends, with normal BMI-for-age increasing from 67.2% to 72.3%, these changes were not statistically significant (P>0.05), expressing the need for prolonged intervention programs. The study demonstrates the effectiveness of structured school-based nutritional interventions in improving dietary and healthy behaviors among adolescents, while highlighting the need for sustainable interventions with collaborative approach to achieve longevity and holistic well-being.

Contents

List of Tables

List of Figures

List of Abbreviations

Abbreviation	Full form
ABCD	Anthropometric, Biochemical, Clinical, Dietary
AND	Academy of Nutrition and Dietetics
APA	American Psychological Association
BCC	Behavior Change Communication
BMI	Body Mass Index
BMI/A	Body Mass Index-for-Age
CDC	Centers for Disease Control and Prevention
CED	Chronic Energy Deficiency
CI	Confidence Interval
CNP	Comprehensive Interventions
DAME	Digestion, Absorption, Metabolism & Elimination
DDQ	Diet Quality Questionnaire
DDS	Dietary Diversity Score
DoHS	Department of Health Services
FAO	Food and Agriculture Organization
FFQ	Food Frequency Table
GDR	Global Dietary Recommendation
GMP	Growth Monitoring and Promotion
H/A	Height-for-Age
HPS	Health Promoting School
IEC	Information Education Communication

IMAM	Integrated Management of Acute Malnutrition
MDD	Minimum Dietary Diversity
MDD-W	Minimum Dietary Diversity for Women
MDM	Mid-Day Meal
MSNP	Multi-Sector Nutrition Plan
MoHP	Ministry of Health and Population
NCDs	Non-communicable Diseases
NDHS	Nepal Demographic Health Survey
NE	Nutrition Education
NFSNP	Nepal Food Security and Nutrition Project
NPC	Nepal Planning Commission
OR	Odds Ratio
PA	Physical Activity
RKSK	Rasjtriya Kishor Swasthya Karyakram
SCT	Social Cognitive Theory
SDG	Sustainable Development Goal
SHNP	School Health and Nutrition Program
SMP	School Meal Program
SUN	Scaling Up Nutrition
TPB	Theory of Planned Behavior
TTM	Trans-theoretical Model
UN	United Nations

UNESCAP	United Nations Economic and Social Commission for Asia and the Pacific
UNESCO	United Nations Educational, Scientific and Cultural Organization
UNICEF	United Nations Children's Fund, or United Nations International Children's Emergency Fund
USAID	United States Agency for International Development
WASH	Water, Sanitation, and Hygiene
WHO	World Health Organization
3 A’s	Awareness, Amendment, Acceptance

Part I

Introduction

1.1 General introduction

Nepal faces a complex nutritional landscape characterized by the “Triple Burden of Disease”, which encompasses undernutrition, micronutrient deficiencies, and increasing rates of obesity. Recent data from the Nepal Demographic Health Survey (NDHS) reveals that 43% of children suffer from anemia, 25% from stunting, and 19% from being underweight, reflecting chronic energy deficiency (MoHP, 2022). Simultaneously, the country is also dealing with rising obesity rates, affecting 35% of females and 32% of males, accompanied by related health conditions such as hypertension, diabetes, and cancer.

The adolescent population, comprising 23.6% of Nepal's population (Statistics, 2021), represents a critical demographic for addressing these nutritional challenges. With 51.5% females and 48.5% males, this group presents an opportunity for high-impact public health interventions. The median age of marriage for Nepali women at 18 years further emphasizes the urgency of targeting nutritional interventions during adolescence, as it directly impacts maternal and child health outcomes (Statistics, 2021).

Global initiatives, including the World Health Organization's (WHO) Health Promoting School (HPS) approach and the United Nations Educational, Scientific and Cultural Organization (UNESCO's) "Making Every School a Health Promoting School" program, recognize schools as vital platforms for health and nutrition interventions (UNICEF, 2021; WHO, 2024c). These initiatives align with Nepal's commitment to achieving Sustainable Development Goals (SDGs), particularly in reducing stunting to 15%, wasting to 4%, and anemia to 10% among children under five by 2030 (NPC, 2021; UNESCAP, 2024). These initiatives emphasize school-based approaches, combining educational, environmental, and community elements, providing a robust foundation for addressing complex nutritional challenges (Xu *et al.*, 2020; Patimah *et al.*, 2023).

An effective method for evaluating the quality of diets at the population level and directing the creation of focused nutrition interventions and policies to encourage better eating practices is the Global Dietary Recommendations (GDR) score (Herforth et al., 2020). Furthermore, an efficient and useful metric that represents the variety of a person's diet is the Dietary Diversity Score (DDS) (FAO, 2021). As a result, the GDR and DDS scores offer important insights on the diversity and quality of an individual's diet. As per the Global Diet Quality Project, Nepal's DDS score was 5.2 and its GDR score was 11 (Project, 2024).

1.2 Statement of the problem

The nutritional status of adolescents in Nepal presents significant concerns, as highlighted by multiple national surveys. According to MSNP-II, 30% of adolescent females are underweight, and 44% are anemic, indicating poor preparation for potential motherhood (NPC, 2017). The Nepal Micronutrient Status Survey 2016 further revealed that 32% of adolescent girls suffer from stunting, while 23% of adolescent boys experience wasting (MoHP *et al.*, 2016). According to recent studies, 24.7% of non-pregnant females suffer from zinc inadequacy in Nepal (Mehata *et al.*, 2021). Additionally, because of early marriage, a lack of nutritional diversity, and restricted access to healthcare, girls have the high anemia rates (Chalise *et al.*, 2018).

Current dietary practices among the Nepali population reflect concerning trends. The NDHS 2022 dietary survey indicates that only 56% of women achieve adequate Minimum Dietary Diversity (MDD) and only 43% of children aged 6-23 months receive a Minimum Acceptable Diet. Moreover, two-thirds of women consume sweet beverages, and 54% consume unhealthy foods, high in sugar, salt, or unhealthy fats. Simultaneously, 69% of children aged 6-23 months were fed unhealthy foods, high in sugar, salt, or unhealthy fats (MoHP, 2022). These dietary patterns contribute to the triple burden of malnutrition and indicate a critical need for targeted nutritional interventions.

Despite various nutrition-specific and nutrition-sensitive interventions through MSNP-I and MSNP-II, several implementation challenges persist, including poor health-seeking behavior, limited community engagement, weak multi-sectorial coordination, limited technical

expertise, irregular supervision, and feedback mechanisms (Warren *et al.*, 2020). While Nepal has developed comprehensive National Nutrition Policies, significant gaps remain between policy formulation and implementation. These include limited policy awareness, shortages of qualified nutritionists, weak networking, and resource-sharing, as well as low nutrition literacy among communities (Maharjan and Chaudhary, 2021).

Targeted interventions are therefore strongly encouraged. Evidence suggests that adolescent nutrition programs yield high returns: school-based supplementation and nutrition education can reduce anemia by 25% and improve cognitive outcomes by 15% (Bhutta *et al.*, 2013). Integrating nutrition literacy into school curricula, would empower adolescents to make informed dietary choices, breaking the intergenerational cycle of malnutrition and aligning with Nepal's Sustainable Development Goals (UNICEF, 2021; WHO, 2024c).

1.3 Theoretical Framework

The theoretical framework provides a foundational structure based on established theories. These theories focus on broad, established concepts that inform how certain phenomena, like behavior change or health outcomes, are expected to occur. The theoretical framework for this study is grounded in three major behavioral theories and complemented by holistic health concepts:

1.3.1 Social Cognitive Theory (SCT)

The Social Cognitive Theory (SCT) suggests that acquiring knowledge and the development of self-efficacy influence health behaviors and outcomes (Bandura, 2004). This concept focuses on the interplay between personal, behavioral, and environmental factors, which offers the foundational structure for evaluating how educational programs modify attitudes and knowledge about nutrition. Thus, enhances adolescent consumption rates of dietary diversity, along with healthy meal behaviors. Also, improves the clinical and anthropometric indicators.

1.3.2 Theory of Planned Behavior (TPB)

The Theory of Planned Behavior (TPB) suggests that health behaviors are influenced by:

i. Individual attitudes toward the behavior
ii. Subjective norms
iii. Perceived behavioral control

This theory is particularly relevant in understanding and influencing dietary choices among adolescents, as their decisions are heavily influenced by these three factors (Sjoberg *et al.*, 2004).

1.3.3 Stages of Change Model (Trans-theoretical Model)

The trans-theoretical model describes behavior change as a progressive process that undergoes five stages (Prochaska and Velicer, 1997):

i. Pre-contemplation
ii. Contemplation
iii. Preparation
iv. Action
v. Maintenance

1.4 Conceptual Framework

The conceptual framework depicts the pathways linking education-based nutritional interventions for adolescents with dietary scores, and anthropometric indicators, along with behavioral and dietary patterns.

The inputs involve weekly nutrition education sessions focused on building knowledge, attitudes, and skills regarding healthy diets, optimal nutrition, consequences of deficiencies, etc. These interventions target improvements in perceived susceptibility to nutritional inadequacies and self-efficacy to consume a diverse range of foods. Consequently, dietary behaviors and total nutrient consumption are expected to improve. The conceptual framework for the study

integrates all the theories named, SCT, TPB, and Trans-theoretical Model while considering the following key elements during the intervention plan:

1.4.1 Holistic Health Approach

i. Integration of physical, mental, emotional, and social well-being
ii. Recognition of the interconnectedness of various health aspects
iii. Understanding of biological rhythms (Circadian and Infradian)

1.4.2 Clinical and Dietary Indicators

i. Sleep and Bowel movement indicators
ii. Dermatological and menstruation cycle indicators
iii. Screen time and water intake pattern during meal consumption

1.4.3 Assessment Tools

i. Self-assessment tools
ii. Habit Trackers, along with a feedback system
iii. Dietary and anthropometric indicators

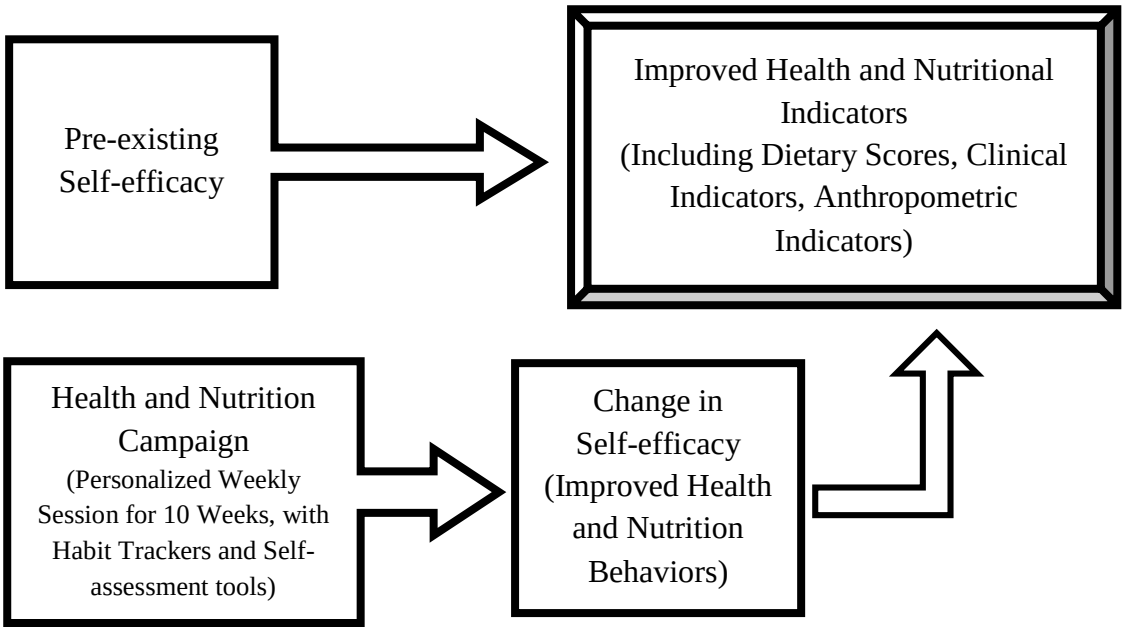


Figure 1. 1 Path of perceived self-efficacy on Health Habits, Based on Social Cognitive Theory

Redrawn from: (Bandura, 2004)

Thereby, nutritional interventions transform knowledge, attitudes, environmental adequacy, and dietary behaviors, ultimately enhancing the dietary scores, anthropometric indicators, and behavioral outcomes.

1.5 Objectives of the study

1.5.1 General objective

i. To analyze the impact of nutritional intervention on Global Dietary Recommendation Score and Dietary Diversity Score of adolescents in secondary schools in Dharan, Nepal.

1.5.2 Specific objectives

i. To assess the impact of tailored nutrition education sessions on global dietary recommendation (GDR) score and dietary diversity score (DDS).

ii. To analyze the shifts in nutritional status parameters, specifically BMI-for-age, and height-for-age, as a result of the intervention.
iii. To examine the alterations in dietary patterns, clinical indicators, and behavioral practices induced by the intervention.

1.6 Research Questions

i. What is the impact of nutritional intervention on global dietary recommendation (GDR) score and dietary diversity score (DDS)?
ii. How does the nutritional intervention influence anthropometric indicators?
iii. How does the nutritional intervention alter the dietary patterns, clinical signs, and behavioral outcomes?

1.7 Significance of the study

This school-based nutritional intervention study holds substantial significance across multiple domains:

i. Contributes to the development of targeted nutrition policies within existing school frameworks
ii. Informs policymakers about the feasibility and impact of school-based nutrition programs
iii. Offers actionable strategies for improving adolescent nutrition and provides evidence for the scalability of similar interventions

1.8 Limitations of the study

Despite its contributions, this study acknowledges several limitations:

i. Reliance on self-reported dietary data without biochemical validation
ii. The relatively short duration of the intervention period constitutes a significant limitation of this study

Part II

Literature Review

2.1. Nutritional Challenges in Nepal

Nepal has been battling with the "Double Burden of Disease" with 43%, 25%, and 19% of children struggling with anemia, stunting, and underweight respectively (MoHP, 2022). However, this double burden, which includes underweight and micronutrient deficiency, is slowly accelerating towards the "Triple Burden of Disease" with the problem of over-nutrition i.e., 35% of females and 32% of males dealing with obesity and its related disease conditions like high blood pressure, diabetes, uric acid, cancer, etc. (Sunuwar *et al.*, 2020; MoHP, 2022).

The target of the sustainable development goals (SDG) for Nepal, along with the government, is to reduce stunting to 15%, wasting to 4%, and anemia to 10% among children under-five and also reduce anemia in women of reproductive age to 10% by the year 2030 (NPC, 2021; UNESCAP, 2024).

2.1.1. Insights from NDHS Data

Based on the trend analysis of NDHS data from 1996 to 2022, Nepal has made incredible progress in the field of nutrition. The trend of stunting, underweight, and wasting has been reduced from 57%, 42%, and 15% in 2001 to 25%, 19% and 8% in 2022. The under-5 mortality has been reduced from 118 deaths per 1000 live births in 1996 to 33 deaths per 1000 live births in 2022 (MoHP, 2022).

Based on Body Mass Index for Age (BMI/A), adolescent females aged 15-19 showed a prevalence of malnutrition with 26% thinness and 10% overweight or obese, whereas adolescent males aged 15-19 showed a prevalence of malnutrition with 41% thinness and 7% overweight or obese (MoHP, 2022).

The prevalence of malnutrition in Women aged 20-49 showed 10% thinness and 35% overweight or obese, whereas in Men aged 20-49, the prevalence was reduced to 7% thinness and 32% overweight (MoHP, 2022).

Appreciating the health and nutrition improvement that Nepal has made in the last few decades, programs like Scale Up-Nutrition (SUN) and Multi-Sector Nutritional Program (MSNP-III) have been created to speed up this growth, reach all the SDG goals, and transform Nepal into a healthy and robust nation.

2.1.2. NDHS Insights about Dietary Practices

The adequate Minimum Dietary Diversity (MDD) was only achieved by 56% of women. Based on the 24-hour dietary recall survey, two-thirds of women consumed sweet beverages, and 54% consumed unhealthy food products, which are high in sugar, salt, or unhealthy fats (MoHP, 2022).

The Breastfeeding-related dietary survey also revealed that only 55% of children were breastfed within 1 hour after birth, and only 56% of children were exclusively breastfed. Based on the 24-hour dietary recall survey, 43% of children aged 6-23 months were fed sweet beverages, and 69% were fed unhealthy foods, high in sugar, salt, or unhealthy fats. Also, only 43% of children were fed a minimum acceptable diet the day before the survey. Whereas, one-third of the children were not given any fruit or vegetables the day before the survey (MoHP, 2022).

The overall dietary practices in Nepal represent the reason behind the “Triple Burden of Disease”. The dietary malpractices and ignorance of daily choices have a direct impact on the high prevalence of malnutrition in Nepal. Women and children are the target group for the SDG goals and government projects, yet the NDHS 2022 dietary survey pinpointed the “lack of adequacy in the amendment” of healthy nutritional choices, directly impacting the health status of the current population and future generations (Sunuwar *et al.*, 2020; MoHP, 2022).

2.2. Nutritional Interventions: A Pathway to Address the Problem

The Academy of Nutrition and Dietetics (AND) states "Nutrition Interventions are defined as purposefully planned actions intended to positively change a nutrition-related behavior, environmental condition, or aspect of health status for an individual, target group or the community at large". The nutrition interventions are one of the prime pathways to tackle the gap between SDG goals and the current health and nutritional status in Nepal (Chitekwe *et al.*, 2021).

2.2.1. Global Frameworks for Nutritional Interventions

Nutritional intervention is a vital pathway leading toward "Holistic Health and a Nutritious World". Understanding the primal nature of nutrition in health, various international organizations have designed and created nutrition-targeted projects. Some of those are discussed below:

2.2.1.1. World Health Organization guidelines and recommendations

The World Health Organization (WHO) has designed various nutrition-targeted programs and initiatives, each with unique importance and a niche audience. Some of them are described as follows:

a. Infant and Young Child Feeding Guidelines (WHO, 2023a)
    - Supports adequate complementary food-feeding practices.

b. Salt Reduction and Hypertension (WHO, 2023e)
    - Prevents hypertension and lowers the risk of strokes, heart disease, and kidney problems.

c. Global Action Plan for the prevention and control of Non-communicable Diseases (NCDs) (WHO, 2013)
    - Aims to implement comprehensive dietary interventions to reduce the intake of sugars, salts, and unhealthy fats.

d. Micronutrient Supplementation (WHO, 2023c, 2023b)
    - Promotes distribution of vital micronutrients such as iron, folic acid, iodine, and vitamin A.

e. Obesity and Overweight Management (WHO, 2023d)
    - Promotes diets rich in fruits, vegetables, whole grains, and lean proteins and discourages the consumption of processed foods high in sugar, fats, and salt.
    - Encourages the physical activity guidelines with at least 150 minutes of moderate-intensity exercise per week for adults.

2.2.1.2. United Nations Sustainable Development Goals related to nutrition

The United Nations (UN) sustainable development goals (SDGs) are a set of 17 interconnected goals and objectives aimed at achieving a sustainable, equitable, and prosperous world by 2030. The SDGs are designed in a holistic way that emphasizes the importance and needs of various sectors like balanced social, economic, and environmental dimensions. Understanding the role of nutrition, the SDGs has five nutrition-related goals, which are discussed below (UN, 2015):

a. SDG 2 – Zero Hunger
    - Promotes food security, food availability, accessibility, and affordability.

b. SDG 3 – Good Health and Well-being
    - Prioritizes the health of mothers, and children, advocating for improved maternal nutrition, breastfeeding, and the reduction of childhood stunting, wasting, and micronutrient deficiencies.

c. SDG 12 – Responsible Consumption and Production
    - Emphasizes the reduction of food and water loss at production, supply chain, and consumption levels to build a more sustainable food system.

d. SDG 6 – Clean Water and Sanitation

2.2.1.3. Scaling Up Nutrition (SUN) movement

The Scaling Up Nutrition (SUN) movement, is a global initiative that recognizes malnutrition as a multi-faceted and complex issue. Thus, the SUN movement has adopted a holistic approach that empowers national governments to take ownership of their nutrition agendas, with the following themes (UN, 2010, 2024):

a. Country-led Approach
    - Advocates national government to take ownership of implementing nutrition policies and interventions.

b. Multi-sectorial Engagement
    - Integrated approach of health, agriculture, education, and social protection to improve nutrition.

c. Nutrition-sensitive Interventions
    - Promotes interventions beyond direct nutrition efforts, including water sanitation and food systems to promote a sustainable food ecosystem.

d. Empowerment of Communities
    - Empower local communities and women to adopt healthier nutritional practices.

e. Monitoring and Accountability
    - Encourages government nutritional targets to regularly monitor progress towards the global targets.

2.2.1.4. Global Nutrition Targets 2025

The World Health Assembly designed global nutrition targets 2025, to address critical nutrition challenges worldwide, particularly affecting children and women. The main targets are listed below (WHO, 2024b):

a. Reduce stunting in children under five by 40% by 2025
b. Reduce anemia among women of reproductive age to 50%.
c. Increase the rate of exclusive breastfeeding to at least 50%.
d. Maintain childhood wasting below 5%.
e. Ensure no increase in the rate of overweight and obesity i.e., 1%

2.3. Recent Findings: Evidence-based intervention strategies

Recent studies have demonstrated the effectiveness of various educational and intervention strategies in improving nutritional knowledge, dietary habits, and overall health outcomes among school-aged children and adolescents across different geographical contexts.

2.3.1. School-Based Educational Interventions

Multiple studies have shown that school-based nutrition education programs can significantly impact students' knowledge and behaviors. In Croatia, a comprehensive education-based intervention study, 2,709 school children aged 10-12 years, demonstrated remarkable improvements in nutrition knowledge, with a 75.5% increase in the short term and 66.8% retention at 6-9 months follow-up (Kendel Jovanović *et al.*, 2023). The intervention also led to improved nutritional status, with reductions in underweight (-56.6%), overweight (-22.1%), and obesity (-57.5%) rates.

Similarly, in Ghana, a six-week nutrition education intervention showed significant improvements in nutrition knowledge scores among primary school children (8.8 ± 2.0 vs. 5.9 ± 2.1, $P < 0.001$) (Antwi *et al.*, 2020). The study also noted improved attitudes toward nutrition learning, with 88% of intervention group participants showing strong interest compared to 77% in the control group.

2.3.2. Comprehensive and Holistic Approaches

Research indicates that comprehensive interventions combining multiple components tend to be more effective than single-focus approaches. The Ajyal Salima intervention, implemented across five Middle Eastern countries, utilized a multi-component approach including classroom activities, family programs, and food service adaptation (Habib-Mourad *et al.*, 2023). This comprehensive strategy led to significant improvements in daily breakfast consumption (Odds Ratio, OR = 1.60, 95% Confidence Interval, CI: 1.35, 1.90), healthy food consumption (OR = 1.60, 95% CI: 1.39, 1.84), and reduced unhealthy food intake (OR = 0.70, 95% CI: 0.60, 0.81). The intervention also increased physical activity participation outside school hours by 47%.

2.3.3. Integrated School and Health Services

In Indonesia, a quasi-experimental study comparing school-integrated interventions (combining nutrition-health education with health services) to education-only approaches demonstrated superior outcomes in the integrated model (Patimah *et al.*, 2023). The comprehensive intervention led to significant reductions in anemia (3.4%), Chronic Energy Deficiency (CED, 24.1%), severe stunting (0.8%), and wasting (1.6%) among adolescent girls. Ergo, the integration of school-based education with health services has shown promising results.

2.3.4. Targeted Obesity Prevention

Recent evidence highlights the importance of carefully designed interventions for childhood obesity prevention. A multicenter randomized controlled trial involving 4,846 children aged 7-13 years examined the effects of nutrition education (NE), physical activity (PA), and comprehensive interventions (CNP) on dietary diversity. While the overall daily dietary diversity scores showed minimal changes, significant improvements were observed in breakfast food choices and specific food group consumption patterns, particularly in cereals, meat, and fruit intake (Xu *et al.*, 2020).

2.3.5. Common Success Factors

Across these studies, several key factors emerged as crucial for successful interventions (Bustos *et al.*, 2016; Antwi *et al.*, 2020; Xu *et al.*, 2020; Habib-Mourad *et al.*, 2023; Kendel Jovanović *et al.*, 2023; Patimah *et al.*, 2023):

a. Long-term follow-up and monitoring
b. Integration of multiple components (education, physical activity, and health services)
c. Involvement of various stakeholders (teachers, parents, and health professionals)
d. Focus on both knowledge and practical behavior change
e. Adaptation to local cultural and dietary contexts

These evidence-based interventions demonstrate that well-designed, comprehensive programs can effectively improve nutrition knowledge, dietary habits, and health outcomes among school-aged children and adolescents. The evidence-based studies also emphasize the importance of sustained, multi-component approaches for achieving lasting behavioral changes.

2.4. Nutritional Interventions in Nepal: Local Initiatives and Gaps

Nepal's government has developed various National Nutrition Policies and supports various programs and initiatives, focusing on reducing malnutrition and promoting food security in Nepal. The projects and initiatives that have significantly improved the nutritional and health status of Nepal are discussed below:

2.4.1. Multi-Sector Nutrition Plan (MSNP)

Multi-Sector Nutrition Plan (MSNP) is Nepal's flagship program addressing malnutrition through a holistic and integrated approach involving sectors like health, agriculture, education, and sanitation. Various themes of MSNP are stated below (NPC, 2017):

a. Maintains cross-sectorial accountability
b. Promotes local implementation
c. Emphasizes collaborative and sustainable effort from all levels

2.4.2. Maternal and Child Health Programs

The maternal and child health programs prioritize nutrition during the first 1000 days of childhood, which is the critical period for both the mother's health and the child's growth and development. Other vital themes of this program are (DoHS, 2011):

a. Provides nutrition education for mothers
b. Promotes growth monitoring, immunization, and micronutrient supplementation
c. Aims to reduce infant and child mortality rates and anemia in both child and mother

2.4.3. School Health and Nutrition Strategy

The school health and nutrition program (SHNP) integrates school meal programs and nutrition education into the curriculum, teaching students about healthy eating, hygiene, and the importance of a balanced diet. The main themes of this strategy are listed below (MoHP, 2014):

a. Boosts the local food-sourcing culture
b. Promotes health and balanced diet as a daily habit
c. Aims to improve food diversity and nutrition quality

2.4.4. National Nutrition Policies and Related Initiatives

The national nutrition policy provides the foundational framework for all nutrition-related initiatives in Nepal. There are many other related policies and programs to aid the holistic health and nutrition development in Nepal, some of them are listed below:

a. Integrated Management of Acute Malnutrition (IMAM)
b. *Suaahara* Program
c. Nepal Food Security and Nutrition Project (NFSNP)
d. Vitamin A Supplementation Program
e. Iron-Folic Acid supplementation
f. Micronutrient Supplementation / *Balvita* Distribution
g. Growth Monitoring and Promotion (GMP)
h. Breastfeeding Promotion and Food Fortification

2.4.5. Policy Gaps and Implementation Delays

The government in collaboration with NGOs and INGOs has designed various Health and Nutrition Intervention Programs and initiatives to improve the Holistic Health Status in Nepal. However, there are a few gaps observed in the current intervention strategies, which are listed below (Paudyal *et al.*, 2021):

a. Policy-practice gaps
b. Poor infrastructure and resource constraints
c. Limited policy awareness
d. Shortages of qualified Nutritionists and training opportunities
e. Weak networking and resource-sharing
f. Lack of standardized monitoring Protocols and Supervision
g. Low Nutrition Literacy among communities
h. Research and Innovation Gaps

2.4.6. Implementation Challenges in Nepal

The recent evidence from the School Meal Program (SMP) reveals concerning nutritional inadequacies, with high prevalence rates of malnutrition among school children - 26.7% stunting, 44.2% thinness, and 34.8% underweight. The program's contribution to daily nutritional requirements shows substantial shortfalls, with only 14.37% for calories, 23.2% for protein, 19.8% for fat, 14.3% for iron, and a negligible 0.13% for vitamin A (Niroula, 2024).

Additionally, the mean dietary diversity score of 2.47±0.17 indicates poor variety in meal composition (Niroula, 2024). Furthermore, children receiving less than 50% of energy requirements from SMP showed higher stunting risks, while those with dietary diversity scores below 4 correlated with increased stunting and thinning rates.

These findings emphasize the urgent need for improved implementation strategies in Nepal's nutritional interventions. Priority areas should include enhancing meal planning to ensure adequate nutrient contribution, increasing dietary diversity, and developing targeted interventions for vulnerable groups.

The MSNP-I and MSNP-II along with various other nutrition-specific and nutrition-sensitive interventions demonstrate the government's commitment to addressing malnutrition. However, despite these efforts, several significant implementation challenges persist in the current intervention strategies (Chen *et al.*, 2021):

a. Poor Health-Seeking Behavior
b. Frequent changes in leadership and political instability
c. Limited community engagement
d. Weak multi-sectorial coordination
e. Limited local government capacity
f. Weak evaluation framework
g. Irregular supervision and feedback mechanism
h. Limited technical expertise

The evidence suggests that successful implementation requires a comprehensive approach focusing on improving nutritional quality while considering socio-demographic factors. Regular monitoring and evaluation of nutritional adequacy, dietary diversity, and anthropometric indicators are essential for ensuring program effectiveness and addressing the current nutritional challenges faced by school children in Nepal.

2.5. Adolescents: The Target for Sustainable Nutritional Change

2.5.1. Current Nutritional and Health Status of Adolescents

According to the Census 2021, the adolescent population (10-19 years) consists of 23.6 % of the total population of Nepal. Among these, 51.5% are females, and 48.5% are males (Statistics, 2021). These data represent how adolescents play a huge role in the overall population of Nepal. Based on NDHS 2022, the median age for Nepali women getting married is 18 years, which comes under the adolescent category, representing the need for nutritional and health education from the adolescent age (MoHP, 2022).

Based on MSNP-II, 30% of adolescent females were underweight, and 44% were anemic, representing how poorly prepared adolescent females are for the rigors of motherhood,

which predicts them having low birth weight babies leading to a high prevalence of mortality and malnutrition (NPC, 2017). Nepal Micronutrient Status Survey 2016 revealed that 32% of adolescent girls suffered from stunting, and 23 % of adolescent boys suffered from wasting (MoHP *et al.*, 2016).

2.5.2. Adolescence as a Critical Period for Habit Formation and Nutritional Development

The adolescence period is a turning point for an individual, with tons of physiological and psychological growth processes occurring every day, and tons of opportunities to inherit healthier habits and behaviors. However, with increased opportunities also comes an increased risk of developing undesirable habits with time (Aryal *et al.*, 2014). The enumerable changes that occur within the adolescent body are described below:

2.5.2.1. Physiological Growth (Antwi *et al.*, 2020; WHO, 2024a)

- Hormonal shifts along with metabolic changes and body composition
- Increased tissue and organ maturation, as per the needs of the body
- Higher nutritional requirements (macro and micro)

2.5.2.2. Psychological Development (APA, 2002; UNICEF, 2024)

- Pre-frontal cortex development with rapid decision-making and impulse control
- Heightened reward sensitivity and Independent decision-making
- Highly receptive to dopamine and reward-seeking behaviors

2.5.2.3. Impact on Long-Term Health Outcomes

The habits that are formed during adolescent years become the foundation for lifelong behaviors and related health outcomes (CDC, 2020). Right health and nutrition behaviors developed in this period led to a reduction in the prevalence of obesity, diabetes, and cardiovascular diseases later in life (WHO, 2024a) Further reasons for choosing adolescents as the targeted interventional group are described below: -

a. Behavioral Plasticity

- Adolescents are highly adaptable to new information and behavior modification, making them responsive to nutritional intervention and positive reinforcement (CDC, 2020).

b. Influence of School Environment

- Schools provide a controlled environment for the intervention sessions, promote behavior change through teacher influence, and thus amplify the impact of nutritional interventions within social groups (UNICEF, 2024).

c. Theory of Planned Behavior

- Beliefs, attitudes, and perceived control influence adolescents decision, impacting their health and longevity in long term (Sjoberg *et al.*, 2004).

d. Stages of Change Model

- The intervention sessions and related introspection activities are designed to aid adolescents throughout the process from pre-contemplation to maintenance (Prochaska and Velicer, 1997).

e. Peer Modeling

- Positive health and dietary behaviors modeled by peers can efficiently influence adolescents to adopt to healthy behaviors and eating patterns (Bandura, 2004).

f. Family Mealtime Practices

- The reinforcement in adolescents can also aid in changing the meal habits and patterns within the family members through the flow of information.

2.5.3. Adolescents as Agents of Change in Public Health

Adolescents play a crucial role as agents of change in public health, using their unique position within communities to drive impactful health initiatives. They can efficiently promote healthy behaviors among peers and families, encourage community engagement, and influence social media.

2.5.3.1. School-Based Initiatives

The school provides structured health education, covering nutrition, physical activity, and mental health. The topics of health and nutrition are easily accessible and understandable for adolescents, as health is often integrated into science and physical education classes as an integral part of their curriculum.

The schools even facilitate health clubs, providing additional opportunities for adolescents to engage in health promotion outside the regular classes. Adolescents even lead forums to discuss local health challenges and solutions, engaging the wider communities (UNICEF, 2024).

2.5.3.2. Global School Health Initiative

Understanding the impact school health programs have on the overall nutritional status of the nation in the long term, the World Health Organization (WHO) launched its Global School Health Initiative in 1995, introducing the Health Promoting School (HPS) approach. This initiative strengthens a school's capacity to promote healthy learning, living, and working conditions in conjunction with teachers, school staff, and parents (WHO, 2024c).

In 2020, the regional office developed an NCD intervention tool to motivate students to take corrective measures to lead healthy and blissful lives. Furthermore, on June 22, 2021, WHO and UNESCO launched an initiative titled "Making Every School a Health Promoting School"(UNICEF, 2021).

The recent assessment done in 2021 in Southeast countries, namely Bangladesh, Bhutan, Maldives, Myanmar, Indonesia, Sri Lanka, and Thailand, showed that the implementation of

school health programs in Southeast Asian countries is not yet completely aligned with the health-promoting schools.

Ergo, the seventy-fourth session of the WHO Regional Committee for South-East Asia held, designed a new initiative entitled “Revitalizing School Health Programs and Health Promoting Schools in South-East Asia Region”.

2.5.3.3. International and National School Health Initiatives

Various other School Health Initiatives have been successful and are implemented to bring out positive impacts are listed below:

a. Singapore's Holistic Health Framework (Dr.Kwek and Dr.Ho, 2023)
    - Launched in 2007
    - Incorporates daily physical activity
    - Provides health screening
    - Offers nutrition education

b. Thailand’s Health Promoting Schools (WHO, 2021)
    - A WHO-recognized initiative
    - Emphasizes student initiatives
    - Promotes healthy eating habits
    - Encourages physical activity

c. India’s Peer Educator Program (MoHFW, 2014)
    - Entitled “Rasjtriya Kishor Swasthya Karyakram (RKSK)”.
    - Launched on 7th January 2014.
    - Ensures holistic development of adolescents aged 10-19.
    - Promotes nutrition, reproductive health, mental health, and many other vital topics.

d. Mid-Day Meal (MDM) Scheme (Kapur, 2012)
    - One of the largest School Feeding Programs
    - Provides nutritious meals that incorporate seasonal and local food products.
    - Includes regular health and anthropometric check-ups.

e. Nepal's School Health Programs (MoHP, 2012)
    - Implementation of Iron-Folic Acid Supplementation.
    - Distribution of Deworming Tablets.
    - Includes regular Health Screening.

f. School WASH Program (Foundation, 2019)
    - A collaborative initiative
    - Promotes safe drinking water provision
    - Encourages Hygiene Education
    - Aids Menstrual Health Management

2.6. Techniques for Health Improvement: Behavior Change Communication

Techniques for Health Improvement encompass various evidence-based strategies to enhance individual and community well-being. These techniques integrate various approaches, including behavioral change communication, technological innovations, community engagement, and clinical interventions, all aimed at achieving sustainable health outcomes across diverse populations.

Behavior Change Communication (BCC) represents a comprehensive approach to promoting positive health behaviors through strategic communication and community engagement. BCC integrates various psychological and social theories, including Social Cognitive Theory, and the Health Belief Model, to create more effective health communication strategies (Nancy and Dongre, 2021).

A holistic approach to BCC encompasses not only individual behavior modification but also addresses environmental, social, and systemic factors that influence health choices. The

cultural adaptation and localization of BCC approaches ensure that interventions resonate with niche populations while maintaining scientific validity (Koenker *et al.*, 2014).

2.6.1. Foundational Principles of Intervention Strategy

Foundational principles of intervention strategy represent a systematic approach to designing and implementing health improvement initiatives that are both effective and sustainable. The framework builds upon established theoretical models such as the Social-Ecological Model and Implementation Science, which provide structured approaches to understanding and addressing complex health challenges (Villalobos Dintrans *et al.*, 2019).

Furthermore, the integration of monitoring and evaluation systems from the outset enables continuous improvement and adaptation of interventions based on real-world evidence and community feedback. The key elements include:

a. Theoretical foundation
b. Practical implementation considerations
c. Cultural sensitivity
d. Sustainability focus
e. Evidence-Based Approach
f. Interactive emphasis
g. Monitoring and evaluation importance
h. Resource Management
i. Long-term impact consideration

2.6.1.1. Social Cognitive Theory

The Social Cognitive Theory (SCT) emphasizes the role of self-efficacy, or confidence, in making nutritional choices, which is crucial in overcoming barriers to healthy eating. The combined effect of observational learning from peers, teachers, and parents, along with environmental factors like school, nutrition, and health sessions, leads to positive behavioral changes among individuals. Furthermore, reinforcement strategies, such as habit trackers and

rewards for making healthy food choices, help sustain positive changes over time (Bandura, 2004).

2.6.1.2. Theory of Planned Behavior

The theory of Planned Behavior (TPB) explains that the likelihood of engaging on a specific health behavior is influenced by an individual's attitude toward the behavior, subjective norms, and perceived behavioral control. In dietary choices, perceived behavioral control, and subjective norms, the attitude-behavior, relationship plays a central role, and thus focusing on nutritional intervention and education to generate positive attitude towards holistic health and nutrition becomes vital (APA, 2002; Sjoberg *et al.*, 2004).

Measurement of behavioral outcomes in TPB studies often relies on tools like self-reported questionnaires, food frequency surveys, or even biomarkers, which provide insights into the effectiveness of dietary interventions.

2.6.1.3. Stages of Change Model

The Stages of Change Model, also known as the Trans-theoretical Model (TTM), describes behavior change as a progressive process from pre-contemplation to maintenance (Prochaska and Velicer, 1997). The TTM outlines behavior change as a series of five progressive stages:

a. Pre-contemplation
b. Contemplation
c. Preparation
d. Action
e. Maintenance

2.6.2. Holistic Health Knowledge for Enhancing Nutritional Interventions

Adopting a holistic approach to health and wellness is crucial for the success of nutritional intervention. The "Nutritional Intervention Weekly Outline" in the materials and methods section, outlines several sessions dedicated to cultivating a comprehensive understanding of holistic well-being among individuals.

Holistic well-being involves using the "Wellness Wheel" as a self-assessment tool (Roscoe, 2009). This concept aligns perfectly with the growing recognition that health is multidimensional, encompassing physical, mental, emotional, social, and spiritual aspects (WHO, 1948).

The intricate relationship between diet, disease, and prevention is a vital concept to be shared and understood. Recognition that certain diseases, both chronic and communicable, have strong dietary implications is crucial for developing effective nutritional strategies (Willett *et al.*, 2006).

The concept of our biological clock entitled "Circadian Rhythm" acknowledges the body's natural rhythm and interconnectedness of various aspects of well-being (Huang *et al.*, 2011; Roenneberg *et al.*, 2019). Furthermore, the concept of the female hormonal cycle entitled "Infradian Rhythm" acknowledges the female special biological monthly cycle, representing various seasons/phases that the female body undergoes, and how the nutritional needs change as per each phase (Vitti, 2020).

Finally, the concept of holistic living entitled "Ikigai" ties together the various facets of life, encouraging individuals to adopt a comprehensive, purpose-driven approach to their health and well-being. This concept promotes the integration of personal, professional, and health-related goals (Sone *et al.*, 2008; Mitsuhashi, 2018).

2.6.3. Impact of Clinical Indicators on Health

Recent research has increasingly emphasized the significance of various clinical signs as indicators of overall health status and their implications for long-term well-being. These indicators, ranging from digestive health to sleep patterns, serve as crucial markers for early detection and prevention of various health outcomes. The following information shared various realm of clinical indicators and their health implications:

a. Bowel Movement Patterns

Bowel movement patterns have emerged as a significant indicator of digestive and overall health. A comprehensive population-based cohort study demonstrated the importance of daily

bowel movements and formed stool consistency as optimal indicators of digestive health (Yang *et al.*, 2020). The research also revealed that regular daily bowel movements were associated with reduced risks of major vascular and non-vascular diseases.

A study established strong connections between bowel movement frequency and oxidative stress reduction, emphasizing that regular patterns contribute significantly to disease prevention (Vermorken *et al.*, 2016).

b. Dermatological Indicators

In the realm of dermatological indicators, the recent research has highlighted the intricate relationship between skin health and overall wellness, particularly in adolescents (Łożyńska and Głąbska, 2022). The study found that the absence of acne or, when present, mild manifestations often correlate with better nutritional status and overall health outcomes. Furthermore, the research reveals that skin conditions serve as visible markers of integral health status and nutritional adequacy (Łożyńska and Głąbska, 2022).

c. Sleep Patterns

Sleep patterns have emerged as crucial clinical indicators of health status. Recent studies have demonstrated strong associations between sleep duration and health outcomes, particularly emphasizing the optimal range of 5-9 hours of sleep (Han *et al.*, 2023). A research further expanded on this topic by exploring sleep physiology and its boarder implications for health, highlighting that very good sleep quality is associated with better health outcomes (Baranwal *et al.*, 2023).

Supporting these findings, a research investigated the relationship between sleep quality and various physiological functions, emphasizing the importance of maintaining optimal sleep patterns for overall health (Haarhuis *et al.*, 2022).

d. Menstruation Cycles

Menstruation health is increasingly recognized as a critical clinical indicator of overall health. In the book entitled “In the Flo”, the author emphasizes that a well-regulated menstrual cycle

reflects balanced hormonal health, which is foundational for various physiological functions (Vitti, 2020). Consistent cycles and optimal menstrual health indicate effective communication between the hypothalamus, pituitary, and ovarian axes, key components in reproductive health.

The Book highlights that irregularities in cycle length, flow, or symptoms can signal underlying health issues such as hormonal imbalances, nutrient deficiencies, or chronic stress, which could impact broader aspects of well-being, including energy level, mental health, and metabolic functions (Vitti, 2020).

The interconnectedness of these clinical indicators creates a comprehensive picture of individual health status. These markers not only serve as early warning systems for potential health issues but also provide valuable insights into the effectiveness of current lifestyle and dietary practices. The maintenance of optimal clinical indicators through appropriate lifestyle and dietary choices can contribute to disease prevention and enhanced quality of life. Regular monitoring of these clinical signs enables healthcare providers and individuals to make informed decisions about health interventions and lifestyle modifications.

2.6.4. Impact of Dietary Patterns on Health

Recent research in nutritional science has increasingly focused on the complex interplay between dietary behaviors, screen time, meal patterns, and their collective impact on health outcomes. The examination of these dietary behaviors provides crucial insights into developing effective nutrition interventions and promoting healthier lifestyle choices.

a. Water Consumption Pattern

Water consumption patterns and their timing have emerged as significant factors in dietary behavior research. The researchers, Vij and Joshi conducted pioneering research on “Water Induced Thermogenesis” demonstrating that water consumption timing, particularly 30 minutes before and after meals, has significant implications for body weight management and composition (Vij and Joshi, 2013).

The “Handbook of Non-Drug Intervention Project” Team further supported these findings, emphasizing that pre-meal water consumption can be an effective strategy for weight

management and overall health optimization (Team, 2013). These studies collectively suggest that the timing of water intake, particularly before and after meals rather than during meals, may enhance metabolic benefits.

b. Screen Time during Meal Consumption

Screen time during meals has emerged as a critical factor affecting dietary habits, particularly among young populations. A recent study conducted comprehensive research examining the impact of digital screen time on dietary habits, revealing significant associations between screen use during meals and poor dietary choices (Rocka *et al.*, 2022).

Supporting these findings, research further demonstrated that increased screen time during meals is associated with irregular eating patterns and reduced diet quality (Tambalis *et al.*, 2020). Ergo, the findings suggest that meal consumption without screen time promotes better eating habits and improved nutritional intake.

c. Meal Frequency and Patterns

Recent research emphasizes the importance of structured meal frequency and patterns, particularly the practice of consuming 3-5 meals per day, with structured meal timing, and consumption of homemade food for school lunch rather than highly processed food products, which have been identified as important determinants of dietary quality (Paoli *et al.*, 2019).

Understanding the complex relationships between various dietary behaviors and health outcomes is crucial for developing effective nutritional interventions and promoting healthier dietary practices in diverse populations.

2.7. Anthropometric method of nutritional assessment

Anthropometry is a widely used method for assessing nutritional status by measuring physical dimensions and body composition. Common anthropometric measurements include weight, height, mid-upper arm circumference, and skinfold thickness, which provide insights into nutritional status and growth patterns (de Onis and Habicht, 1996).

Equipment used typically includes stadiometers, weighing scales, and calipers, all of which require regular calibration to ensure accuracy. Techniques must follow standardized protocols to minimize measurement error and ensure reproducibility (Ulijaszek and Kerr, 1999). Data collection in anthropometry often involves trained personnel adhering to specific protocols for age-appropriate measurements, which is especially vital for reliability in field settings (Cogill, 2003).

2.7.1. Height for age

Height-for-age (H/A) is a key anthropometric measure that assesses linear growth and is particularly useful in detecting chronic malnutrition or stunting. z-scores, which indicate deviations from a reference population, are calculated using WHO growth standards to assess how a child's height compares to the median height-for-age in a healthy population (de *et al.*, 2004).

Interpretation guidelines from the WHO define stunting as a height-for-age z-score less than -2 standard deviations below the median. Stunting is a significant indicator of long-term nutritional deficits and is associated with poorer cognitive and physical outcomes (Prendergast and Humphrey, 2014).

Table 2. 1 Classification of Height-for-Age index expressed as z-score

Indicator	**z-score**
Severe stunting	< -3
Moderate stunting	≥ -3 to < -2
Normal	≥ -2

Source: (WHO, 2006)

2.7.2. BMI for age

Body Mass Index (BMI)-for-age is another critical anthropometric tool for assessing underweight, overweight, and obesity in children and adolescents. BMI is calculated by dividing weight (kg) by height squared (m^2) and is plotted against age-specific reference values to account for growth patterns during childhood (Cole *et al.*, 2000). WHO's growth standards provide classification criteria to categorize nutritional status based on z-scores or percentiles.

BMI-for-age (BMI/A) is particularly valuable in field settings due to its ease of measurement, requiring only weight and height data, which can be collected reliably with minimal equipment (deOnis and Lobstein, 2010).

Table 2. 2 Classification of BMI-for-Age index expressed as z-score

Indicator (5 – 19 years)	**z-score**
Severe Thinness	< -3
Moderate Thinness	≥ -3 to < -2
Normal	≥ -2 to < +1
Overweight	> +1 to ≤ +2
Obesity	> +3

Source: (WHO, 2006)

2.8. Dietary method of nutritional assessment

Assessing dietary intake is a cornerstone of nutritional epidemiology, public health nutrition, and clinical practice. Accurate dietary assessment methods are vital for identifying nutrient deficiencies, informing public health policies, and evaluating the efficacy of nutritional

interventions. In this section, various methods of dietary assessments are discussed (Herforth *et al.*, 2020):

2.8.1. Food Frequency Questionnaire (FFQ)

Food Frequency Questionnaires (FFQs) are a widely used dietary assessment tool that evaluates an individual's usual dietary intake over a specific time. FFQs have been widely used in epidemiological studies, dietary interventions, and population-level surveillance to examine the relationship between diet and health outcomes (Herforth *et al.*, 2020; Project, 2023). The strengths and advantages of the FFQ are:

a. Ability to assess usual dietary intake over an extended period, providing insight into long-term dietary patterns.
b. Relatively low cost and ease of administration compared to other dietary assessment methods.
c. Flexibility in the mode of administration, allowing for self-administration or interviewer-administration.

2.8.2. Global Dietary Recommendations (GDR)

The Global Dietary Recommendations (GDR) score is a comprehensive indicator that reflects an individual's adherence to international dietary guidelines for the prevention of non-communicable diseases (NCDs). The score is based on the consumption of food groups and nutrients associated with both protective and risk factors for NCDs. A higher GDR score indicates a greater alignment with global dietary recommendations, suggesting a healthier overall dietary pattern (Herforth *et al.*, 2020).

The GDR score provides a practical tool for assessing population-level diet quality and guiding the development of targeted nutrition interventions and policies to promote healthier eating habits. The strengths and advantages of the GDR are (Project, 2023):

a. Comprehensive assessment of adherence to international dietary guidelines for the prevention of non-communicable diseases (NCDs).

b. Practical application as a population-level indicator of diet quality, guiding the development of targeted nutrition interventions and policies.
c. Potential to monitor trends in dietary patterns and the effectiveness of strategies aimed at promoting healthier eating habits.

2.8.3. Non-Communicable Diseases (NCD) – Protect Score

The NCD-Protect score is a component of the GDR score that specifically focuses on dietary factors with protective effects against the development of NCDs. It captures the consumption of food groups such as fruits, vegetables, whole grains, pulses, and nuts, which are associated with a lower risk of chronic diseases (Herforth *et al.*, 2020; Project, 2023). A higher NCD-Protect score indicates a greater inclusion of these health-promoting foods in the diet.

The NCD-Protect score can be used to monitor population-level trends in the consumption of protective dietary factors and guide the implementation of prevention strategies, such as public awareness campaigns, food-based dietary guidelines, and policies targeting the food environment. The strengths and advantages of the NCD- Protect Score are (Project, 2023):

a. Focuses specifically on dietary factors with protective effects against the development of non-communicable diseases (NCDs).
b. Informs the development and implementation of prevention strategies, including public awareness campaigns, food-based dietary guidelines, and policies targeting the food environment.
c. Captures the consumption of health-promoting food groups, such as fruits, vegetables, whole grains, pulses, and nuts, which are associated with lower NCD risk.

2.8.4. Non-Communicable Diseases (NCD) – Risk Score

The NCD-Risk score is another component of the GDR score that reflects dietary factors associated with an increased risk of non-communicable diseases (NCDs). It captures the consumption of food groups and items, such as free sugars, saturated fats, sodium, and processed meats, which have been linked to a higher risk of chronic diseases (Herforth *et al.*, 2020). A higher NCD-Risk score indicates a greater intake of these dietary risk factors.

The NCD-Risk score can be used to identify high-risk population groups, monitor the effectiveness of prevention strategies, and guide the development of targeted interventions to address dietary risk factors and reduce the burden of NCDs. The strengths and advantages of the NCD-risk are (Project, 2023):

a. Identifies dietary factors associated with an increased risk of non-communicable diseases (NCDs), such as free sugars, saturated fats, sodium, and processed meats.
b. Guides the development of tailored interventions and policies to address population-specific dietary risk factors and reduce the burden of NCDs.
c. Enables the early detection of high-risk population groups, allowing for targeted interventions to address dietary risk factors.

2.8.5. Dietary Diversity Score (DDS)

The Dietary Diversity Score (DDS) is a simple and practical indicator that reflects the diversity of an individual's diet. It is calculated as the sum of the number of unique food groups consumed over a specific time, typically the previous day or 24 hours. The DDS is based on the consumption of 10 food groups, including grains, pulses, nuts and seeds, dairy, meat/poultry/fish, eggs, dark green leafy vegetables, other vitamin A-rich fruits and vegetables, other vegetables, and other fruits (FAO, 2021).

A DDS of 5 or more out of 10 food groups is considered a marker of a higher likelihood of micronutrient adequacy. The DDS can be used in field settings to assess dietary quality and guide the development of nutrition interventions aimed at improving dietary diversity. The strengths and advantages of the DDS are (Project, 2023):

a. Simplicity and practicality of calculating the score, making it a user-friendly tool for field settings and community-based assessments.
b. Provides a proxy indicator for micronutrient adequacy, as a higher dietary diversity is associated with a higher likelihood of meeting micronutrient requirements.
c. Ability to guide the development of nutrition interventions aimed at improving dietary diversity and quality.

2.8.6. Minimum Dietary Diversity for Women (MDD-W)

The Minimum Dietary Diversity for Women (MDD-W) is a dichotomous indicator that reflects the proportion of women of reproductive age (15-49 years) who consume at least 5 out of 10 defined food groups during the previous day or night. The MDD-W is a proxy indicator for micronutrient adequacy, as women who meet this threshold are more likely to have adequate micronutrient intake (FAO, 2021). The measurement of MDD-W involves collecting data on the consumption of the 10 food groups using a standardized questionnaire.

The MDD-W has been widely used in nutrition programs and interventions to assess the dietary quality of women and guide the development of targeted nutrition interventions to improve their nutritional status. The strengths and advantages of the MDD-W are (Project, 2023):

a. Ability to assess usual dietary intake over an extended period, providing insight into long-term dietary patterns.
b. Provides a proxy measure for the likelihood of micronutrient adequacy, which is particularly important for women's health and fetal development.
c. Ease of data collection using a standardized questionnaire, enabling comparisons across populations and over time.
d. Wide application in nutrition programs and interventions, guiding the development of targeted strategies to improve the dietary quality of women.

2.8.7. Diet Quality Questionnaire (DQQ)

Diet quality assessment tools have evolved significantly over recent decades as crucial instruments for evaluating dietary patterns and nutritional adequacy in population-based studies (Alkerwi, 2014; USAID, 2023). The Diet Quality Questionnaire (DQQ) has emerged as a comprehensive tool that assesses both the quantity and quality of food consumption patterns while considering adherence to dietary guidelines.

A study concluded that the DQQ is an efficient tool for collecting population-level food group consumption, especially for diet quality and diet diversity estimation (Uyar *et al.*, 2023).

The DQQ is an easy and effective method especially suitable for pre-post intervention studies focusing on dietary behavior modification. The strengths and advantages of the DQQ are (USAID, 2023):

a. Relatively low respondent burden
b. Cost-effectiveness in large-scale studies
c. Ability to capture both quantitative and qualitative aspects of diet
d. Flexibility for cultural adaptation

2.9. Impact Analysis with Effect Size

Effect size is a critical measure in research that quantifies the magnitude of a treatment effect or difference between groups, offering a clearer interpretation of statistical findings. Unlike p-values, which only indicate whether a result is statistically significant, effect size provides insight into the practical significance of the result, helping researchers and practitioners understand the impact of an intervention (Cohen, 1998).

In impact analysis, particularly in fields like education, psychology, and public health, the effect size is indispensable for assessing the research finding's real-world relevance and making informed decisions based on study outcomes (Ellis, 2010).

The **"Cohen's d"** is commonly used to compare mean differences between two groups. Values around 0.2 indicate a small effect, 0.5 a medium effect, and 0.8 a large effect (Cohen, 1998). Studies that report both statistical significance and effect size provide a more complete understanding of their results, helping to avoid the over-reliance on p-values, which can be influenced by sample size (Sullivan and Feinn, 2012).

2.9.1. Calculating and Interpreting Effect Sizes in Different Fields

The interpretation of effect size values varies by context, as the benchmarks of what constitutes a small, medium, or large effect differ across fields. In educational research, effect sizes above 0.40 are often considered meaningful, as demonstrated in meta-analyses on teaching interventions (Hattie, 2008). In psychology, Cohen's thresholds are commonly applied, though

newer guidelines suggest that even small effects can be meaningful in high-impact studies (Funder and Ozer, 2019).

In public health, even modest effect sizes can have substantial implications at a population level, particularly in large-scale studies on interventions like smoking cessation or exercise programs (Glasziou *et al.*, 2004). Thus, the research emphasizes the importance of context-specific interpretation, cautioning against rigidly applying universal benchmarks without considering the practical implications of the effect size in each research area (Lakens, 2013). The formula used to calculate Cohen d is provided below: -

$$\text{Cohen's d} = \sqrt{\frac{X1 - X2}{Sp}}$$

Where,

X1 = Mean of Pre-Intervention Data

X2 = Mean of Post-Intervention Data, and

S_p stands for "Pooled standard deviation", which is calculated as

$$Sp = \sqrt{\frac{(n1 - 1)\ s1^2 + (n2 - 1\ )\ s2^2}{n1 + n2 - 2}}$$

Where,

n1 = Sample size of Pre-Intervention group

n2 = Sample size of Post-Intervention group

s1 = Standard Deviation of Pre-Intervention Data

s2 = Standard Deviation of Post-Intervention Data

Finally, effect size not only contributes to the transparency and reproducibility of research but also helps bridge the gap between statistical findings and real-world applications.

Part III

Materials and methods

3.1. Study settings and target population

The intervention study was conducted at a secondary educational institution in Dharan, a sub-metropolitan city in eastern Nepal. The target population consisted of adolescent (10-16 years) students enrolled in grades 6 through 10 during the academic year 2024/2025.

The study implementation, including baseline assessments, intervention, and follow-up evaluation, was carried out over a "ten-week" period from May 14th, 2024 to July 22nd, 2024.

3.2. Selection criteria

Study participants were recruited based on eligibility criteria to ensure appropriate sample selection and minimize potential confounders.

3.2.1. Inclusion criteria

a. Current enrollment in grades 6-10 at the selected secondary school
b. Regular attendance during the intervention period
c. Age within the specified range of adolescent (10-16) years

3.2.2. Exclusion criteria

a. The presence of any acute or chronic medical conditions that could interfere with study participation
b. Unwillingness to participate or lack of informed consent/assent

3.3. Research design

A quasi-experimental "pre-post intervention" design was employed to evaluate the effectiveness of the intervention. The study was carried out using the census method, which involved all the students who met the inclusion criteria during the study implementation, including baseline

assessments, intervention, and follow-up evaluation, which was carried out over a “ten-week” period from May 14th, 2024 to July 22nd, 2024.

3.4. Sampling Technique

The Secondary Education Institute was chosen through purposive sampling because it aligned with the intervention study’s goals and objectives. Among the various schools approached, this institute demonstrated a strong commitment to the study’s mission.

Educational Institute facilitated the research by organizing 10 educational sessions per grade, from class 6 to 10, throughout the intervention period and provided essential support to ensure effective implementation of the intervention.

3.5. Study population size

The sample size for this study is calculated using the Daniel Sample Size Formula (Charan and Biswas, 2013):

$$n = \frac{\mathrm{Z}^2\,\mathrm{P}(1-\mathrm{P})}{d^2}$$

Where,

n = required minimum sample size

Z = Z statistic for confidence level (1.96 for 95% confidence interval)

P = Expected prevalence of the outcome in the population

d = Precision/acceptable margin of error

As per research (Piryani *et al.*, 2016), overweight prevalence is 12% (P = 0.12). Thus using P = 0.12.

Input values:

Z = 1.96

P = 0.12

d = 0.06 (6% acceptable margin of error)

Calculations:

$$n = \frac{1.96^2\ 0.12\ (1 - 0.12)}{0.06^2}$$

$$n = 113$$

This provides the minimum required sample size.

Accounting for ~ 5 % attrition rate during the study,

the final sample size is:

$$n = 113 + \frac{5}{100} \times 113$$

$$n \sim 119$$

Thus, the total sample size of 119 participants was obtained. The sample size is also supported by similar nutrition intervention research (Singh *et al.*, 2021; Rimbawan *et al.*, 2023).

3.6. Research instruments

The following equipment was used in the interventional study (see Appendix-H)

a. A digital weighing machine (seca) with a capacity of 250 kg and having the least count of 0.1 kg was used.
b. Stadiometer (ShoorBoard®) with a maximum height capacity of 206 cm and a precision of 0.1 cm.

All measurements were performed following WHO standardized protocols (WHO, 2008).

3.7. Study variables

3.7.1. Dependent variables

The dependent variables of the intervention study are presented in **Table 3. 1**

Table 3. 1 Dependent variables of the intervention study

S.N.	Variable	Description
1.	Global Dietary Recommendation (GDR) Score	This composite index serves as a measure of dietary quality, helping to evaluate how well a person's diet aligns with globally recognized health standards (Project, 2023).
2.	Dietary Diversity Score (DDS)	This index measures the number of food groups consumed over a specific period, reflecting a diet's variety and nutrient adequacy (FAO, 2021).
3.	Thinness	This index is assessed by Body Mass Index (BMI)-for-age in children and adolescents, which refers to a condition where body weight is significantly below the expected weight for a given height and age (WHO, 2006).
4.	Stunting	This index is defined as a height-for-age below -2 standard deviations from the WHO growth standard median and is associated with long-term adverse effects on physical and cognitive development (WHO, 2006).

3.7.2. Independent variables

The Independent Variables under interventional study were:

a. Nutritional Intervention (Primary Independent Variable):
    - The specific dietary and educational sessions introduced as part of the 10-week program aimed at improving health outcomes.

b. Socio-Demographic Factors:
    - Socio-economic Status: Household income, parental education, and occupation influence food access and choices.
    - Child Characteristics: Age, gender, initial nutritional status, and any relevant health history that may affect response to the intervention.

c. Baseline Health and Dietary Practices:
    - Baseline Dietary Diversity: Initial dietary habits or variety in food choices before the intervention.
    - Baseline Nutritional Knowledge: Participants' nutritional knowledge level before receiving educational sessions.

d. Educational Institution Parameters:
    - Food Service Infrastructure
    - Access to nutrition-related healthcare service

3.8. Pretesting

A preliminary pilot study was conducted two weeks before the main intervention to assess the feasibility and reliability of research instruments. The pretesting phase involved a representative subset of 10% of the intended sample size, comprising students from the same age group but from a different educational institution to avoid contamination of the main study population. This process helped identify potential challenges, validate the comprehensibility of questionnaires, and optimize the time allocation for various assessment procedures.

3.9. Validity and reliability of the study tools

Anthropometric measures, including height and weight, were collected as per the standardized WHO protocols to determine BMI/A and H/A classifications (WHO, 2006). These measurements are well-validated indicators of nutritional status and health, and to enhance reliability, all measurements were taken using calibrated equipment, ensuring consistency across assessments. The questionnaire reliability was supported by pre-testing to confirm the clarity and ease of understanding, ensuring participants consistently interpreted the questions.

3.10. Data collection techniques

Data collection was executed systematically in three phases:

3.10.1. Baseline Assessment (Pre-intervention)

a. Administration of Diet Quality Questionnaire (DQQ)
b. Anthropometric measurements following standardized WHO protocols
c. Socio-demographic data collection through a structured questionnaire
d. Documentation of existing clinical indicators, behavioral characteristics, and dietary patterns through FFQ and structured questionnaire

3.10.2. Intervention Monitoring

a. Regular attendance tracking at educational sessions
b. Continuous assessment of participant engagement
c. Monitoring habit tracker sheets
d. Recording of participant feedback and concerns

3.10.3. Post-intervention Assessment

a. Repeat administration of all baseline measurements
b. Collection of participant feedback information
c. Documentation of clinical indicators, behavioral changes, and dietary practices through questionnaires

3.11. Data analysis

The statistical analysis was conducted using SPSS version 25.0 with a significance level set at $P < 0.05$. The analytical approach included:

3.11.1. Descriptive Statistics

a. Measures of central tendency and dispersion for continuous variables
b. Frequency distributions and proportions for categorical variables
c. Graphical representations of key outcomes

3.11.2. Inferential Statistics

a. Paired t-tests for comparing pre and post-intervention continuous variables
b. Effect Size Analysis

3.11.3. Nutritional Indicators

a. GDR, DDS, MDD, NCD-Protect and NCD-Risk, All-5 dietary scores are calculated using the respective calculation method (Project, 2023)

3.12. Nutritional Intervention Study: Comprehensive Methodology

The nutritional intervention program was designed as a 10-week comprehensive educational and data collection initiative, drawing from evidence-based approaches to dietary modification and holistic wellness. The intervention framework encompasses several key components structured to promote sustainable behavioral change and improved nutritional outcomes.

The intervention begins with a crucial introductory phase focusing on participant engagement and consent. During Week 1, the program introduces the concept of Blue Zones and establishes the foundational importance of nutritional intervention research (Buettner and Skemp, 2016; Mitsuhashi, 2018). Following the introduction, Week 2 focuses on comprehensive baseline data collection using the ABCD (anthropometric, biochemical, clinical and dietary) assessment approach. The core educational phase (Weeks 3-10) implements a structured curriculum addressing multiple aspects of nutrition and wellness:

3.12.1. Holistic Wellness and Self-Assessment

The program incorporates the wellness wheel concept and self-assessment tools, encouraging participants to maintain regular food journals. This approach along with the implementation of "Habit Trackers" is supported by Roscoe's wellness theory, which emphasizes the importance of comprehensive health awareness (Roscoe, 2009). Participants engage in regular self-assessment activities and habit tracking, creating a foundation for sustainable behavioral change (Duhigg, 2012; Clear, 2018).

3.12.2. Nutritional Education and Practical Application

The major weekly focus was on practical nutritional knowledge, including:

a. Differentiation between wholesome and processed foods
b. Understanding food labeling and nutrient content
c. Implementation of the healthy plate concept
d. Exploration of macro and micronutrient sources

These components were drawn from a research that focused on disease prevention through dietary modifications (Willett *et al.*, 2006).

3.12.3. Circadian Rhythm and Lifestyle Integration

The program addresses the crucial relationship between eating patterns and circadian rhythms, supported by a researches (Huang *et al.*, 2011; Roenneberg *et al.*, 2019). This section emphasizes:

- Optimal meal timing
- Sleep patterns and their impact on nutrition
- Sustainable dietary habits
- Integration of healthy eating patterns into daily routines

3.12.4. Specialized Components

The intervention includes focused sections on holistic living (Sone *et al.*, 2008; Mitsuhashi, 2018):

a. Female health through "Infradian Rhythm" understanding (Vitti, 2020)
b. Brain-food relationships and mindful eating practices
c. Holistic living principles, incorporating the concept of "Ikigai"

Table 3. 2 Intervention Outline (Weekly Theme, Objective)

Week	Main Theme	Objective
1	Introductory Session	Providing Clarity about the Importance of Attending & participating in the Research
2	**Base Line Data Collection with Consent of both Parents & Students**	
3	Holistic Wellbeing and Self-Assessment	Providing Clarity on the concept of Holistic Health & Wellbeing
4	Wholesome v/s Packaged Food Items & Myth Bursting	Providing Clarity of the Quality of the Foods & Diet they already consume
5	Disease & Preventions	Providing clarity on how our daily choices have long-term effects on our longevity
6	Circadian Rhythm	Provide the power of timings & body's natural rhythm in relation to health & longevity
7	Healthy Diet Principles	Providing Practically Applicable Health & Nutrition Principles

8	Infradian Rhythm	Providing clarity on the unique system of a female hormonal cycle
9	Super Foods, Food for Brain Power & Mindful Eating	Providing Access to Authentic Knowledge on Nutrition
10	Holistic Living	Providing inclusive guidance on purposeful living with holistic health & nutrition
11	**Conclusion & End Line Data Collection Feedback Collection**	

3.12.5. Assessment and Evaluation

The program concludes with a final assessment in Week 10, replicating the ABCD data collection process to measure intervention effectiveness. This structured approach to evaluation allows for a comprehensive analysis of the intervention's impact on participants' nutritional status and overall wellness.

The methodology integrates continuous feedback mechanisms throughout the program, allowing for adaptive responses to participant needs while maintaining scientific rigor in data collection and analysis. This approach aligns with current best practices in nutritional intervention research while emphasizing practical, sustainable lifestyle modifications.

3.13. Ethical consideration

The study protocol received institutional approval from the Department of Nutrition and Dietetics, Central Campus of Technology, and administrative clearance from Dharan Sub-metropolitan Municipality. Additional permissions were obtained from the municipality section of the school administration and the health department.

3.14. Informed consent

A structured informed consent process was implemented following ethical guidelines for research involving minors (WHO, 2018). The process included:

a. Detailed orientation sessions for potential participants were conducted. Including the whole intervention plan, which outlined the study's purpose, procedures, significance, and measures to ensure confidentiality.
b. Written information sheets describing the study objectives, procedures, and confidentiality measures were provided.
c. Obtained written informed consent from both:
    i. Participating students
    ii. Parents/legal guardians
d. Participants were informed of their voluntary participation rights and the option to withdraw at any time without consequences.

Part IV

Result & Discussion

The school-based nutritional intervention study conducted in Dharan examined the impact on dietary patterns and nutritional status among adolescents. The study analyzed various parameters including demographic characteristics, anthropometric measurements, clinical signs, behavioral factors, and dietary patterns.

4.1 Demographic and socio-economic characteristics

4.1.1 Gender and Grade Distribution

The study included 119 participants, with a gender distribution of 43.7% female (n=52) and 56.3% male (n=67). Students were distributed across grades 6-10, with the majority in classes 6-8 (71.5%), further details can be noted from Table 4. 1.

Table 4. 1 Gender and Grade Distribution of the study participants (n=119)

Variable	Frequency	Percentage
Gender		
Female	52	43.7
Male	67	56.3
Class		
6	27	22.7
7	29	24.4
8	29	24.4
9	16	13.4
10	18	15.1
Total	**119**	**100**

4.1.2 Age Frequency Distribution

The age frequency distribution demonstrates that the majority of the participants were aged 12-14, with the range starting from 10 years and ending at 16 years, further details are represented in Figure 4. 1.

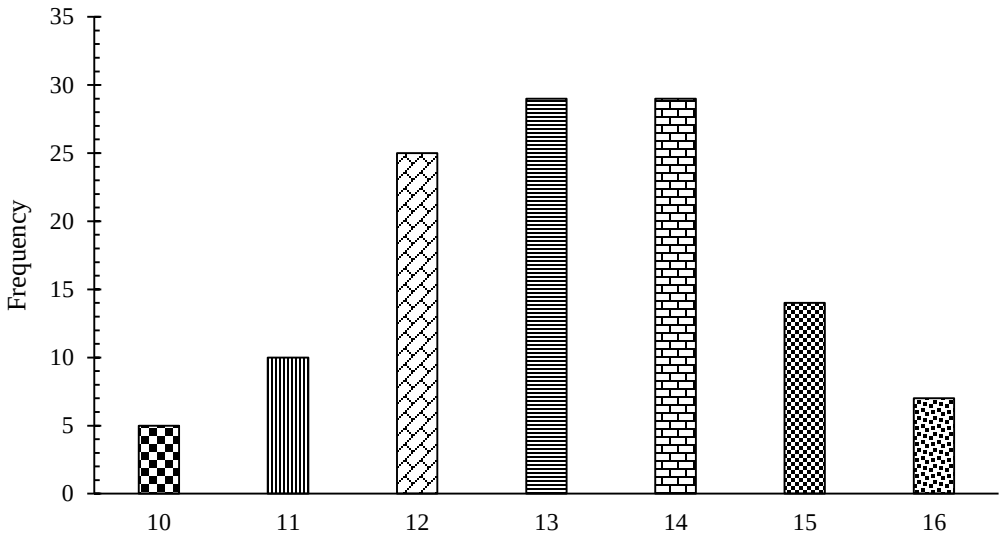


Figure 4. 1 Age Frequency Distribution of the study participants (n=119)

4.1.3 Ethnicity of the study population

The ethnic composition showed a predominance of Janajati (79.8%), followed by Chhetri (8.4%) and Dalit (7.6%), further details can be noted from Table 4. 2.

Table 4. 2 Caste Distribution among the study participants

Caste	Frequency	Percentage
Brahmin	1	0.8
Chhetri	10	8.4
Janajati	95	79.8
Dalit	9	7.6
Madhesi	4	3.4

4.1.4 Religion of the study population

The religious distribution indicates that the majority of the participants were Hindu (62%), as shown in Figure 4. 2.

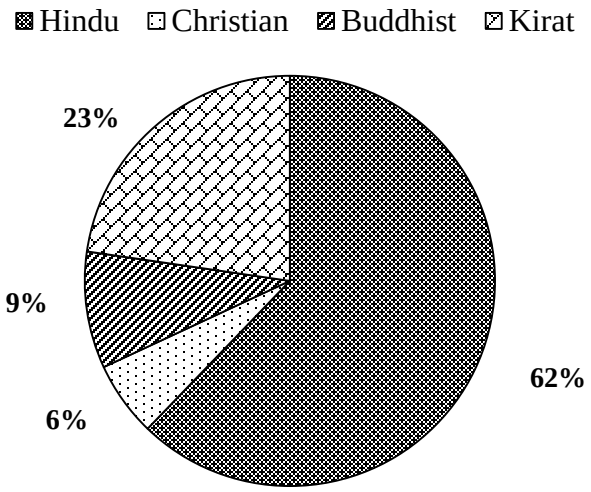


Figure 4. 2 Religion Distribution of the study participants

4.1.5 Family structure

Family structure analysis revealed that 52.9% belonged to nuclear families, and 62.2% had family sizes of five or fewer members, further details can be noted from Table 4. 3.

Table 4. 3 Family Structure and Type of the study participants (n=119)

Variable	Frequency	Percentage
Family Type		
Nuclear	63	52.9
Joint	56	47.1
Family Size		
equal or less than 5	74	62.2
more than 5	45	37.8

4.1.6 Socio-economic characteristics

Regarding socioeconomic status, 73.1% of families reported monthly incomes exceeding NPR 30,000. The majority of fathers were employed in service sectors (43.7%) or foreign employment (29.4%), while most mothers (66.4%) were homemakers/housewives, as shown in Table 4. 4.

Table 4. 4 Socio-economic characteristics of the study participants (n=119)

Variable	Frequency	Percentage
Monthly Income		
equal or less than 30,000	32	26.9
more than 30,000	87	73.1
Father Occupation		
Agriculture	2	1.7
Service	52	43.7
Business	22	18.5
Labor	8	6.7
Foreign Employment	35	29.4
Mother's Occupation		
Home Maker/ Housewife	79	66.4
Service	20	16.8
Agriculture	1	0.8
Foreign Employment	14	11.8
Business	5	4.2

4.1.7 Main Source of Food

The baseline data also revealed that the majority of the participants (73%) were practicing kitchen gardening along with purchasing food products, as shown in Figure 4.3.

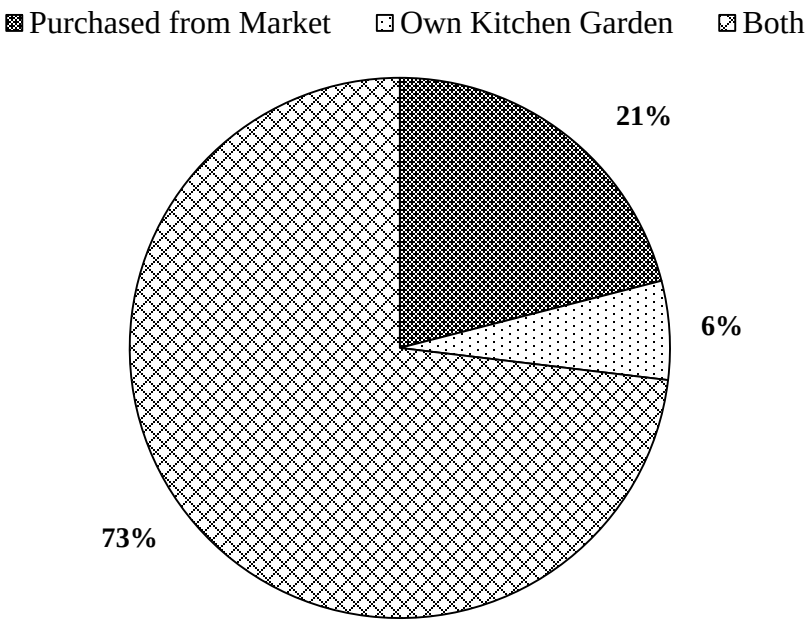


Figure 4. 3 Distribution of Main Source of Food Products

4.2 Anthropometric Measurements

4.2.1 Prevalence of Malnutrition

The prevalence of malnutrition included a minor prevalence of severe and moderate stunting along with severe and moderate thinness, as indicated in Figure 4. 4. However, among the sample size of 119 participants, obesity and overweight noted a higher prevalence of 5.9 % and 17.6%, respectively.

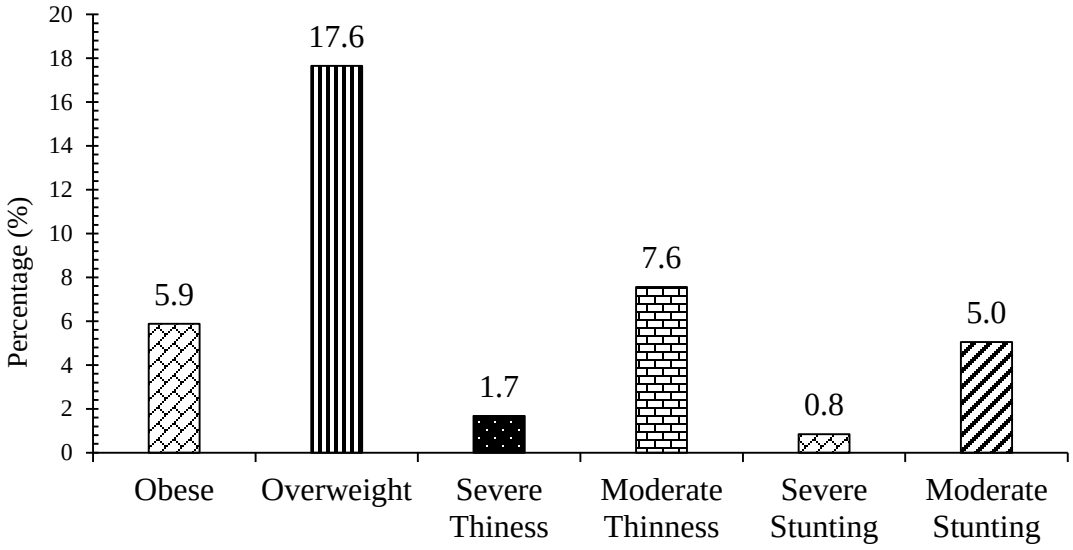


Figure 4. 4 Prevalence of Malnutrition in the Study Participants
(Baseline Health Status, n=119)

The Intervention led to notable shifts in the normal BMI-for-Age from 67.2% to 72.3%, further details can be obtained from Table 4. *5*. However, Height-for-Age Classification remained relatively stable, with approximately 94% of participants showing normal height for age throughout the study period.

Table 4. 5 Distribution of Anthropometric Measurements

Indicators	**Classification**	Frequency (%)	
		Pre - Intervention	**Post - Intervention**
BMI for Age	≥ -2 to ≤ +1 (Normal)	80 (67.2)	86 (72.3)
	≥ -3 to < -2 (Moderate Thinness)	9 (7.6)	7 (5.9)
	< - 3 (Severe Thinness)	2 (1.7)	2 (1.7)
	> +1 (Overweight)	21 (17.6)	16 (13.4)
	> +2 (Obese)	7 (5.9)	8 (6.7)
Height for Age	≥ -2 (Normal)	112 (94.1)	112 (94.1)
	≥ -3 to < -2 (Moderate Stunting)	6 (5.0)	7 (5.9)
	< -3 (Severe Stunting)	1 (0.8)	0 (0.0)

4.2.2 Height for Age and WHO Standard

Baseline H/A: The sample population (dotted line) shows a marked left shift with a peak around -0.5 z-score, indicating generally shorter stature than WHO references (plain line), as shown in Figure 4. 5. The distribution is narrower with a higher peak than the WHO standard, suggesting less height variation in the sample population.

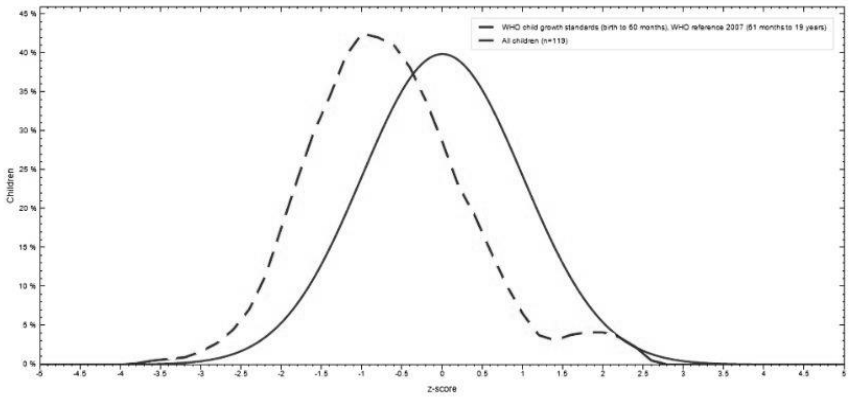


Figure 4. 5 Baseline H/A with reference to WHO standard (n=119)

Endline H/A: The sample population (dotted line) demonstrates a clear left shift compared to WHO standards (plain line), with peak frequency around -1 z-score, as shown in Figure 4. 6. This indicates that most children in the sample are shorter than the WHO reference population. The narrower, higher peak suggests less height variation in the sample.

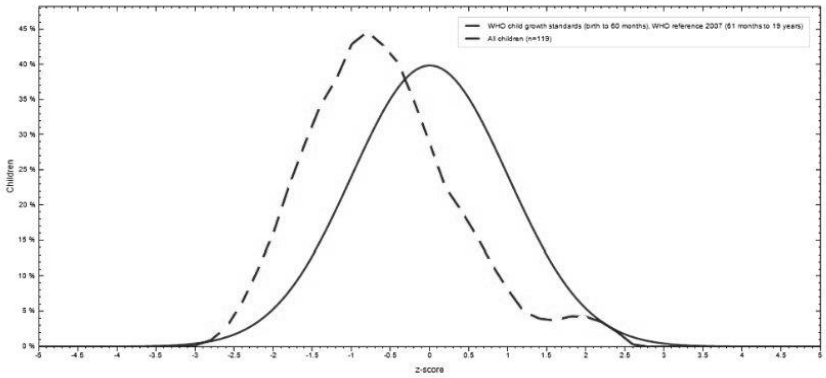


Figure 4. 6 Endline H/A with reference to WHO standard (n=119)

4.2.3 Body Mass Index for Age and WHO Standard

Baseline BMI/A: The sample population (dotted line) represents a wider distribution than the WHO standard (plain line), with a lower peak frequency around z-score 0. There's notable positive skewing, indicating more children with above-average BMI-for-age as indicated in Figure 4. 7. Thus, the distribution suggests a higher prevalence of overweight/obesity compared to WHO references.

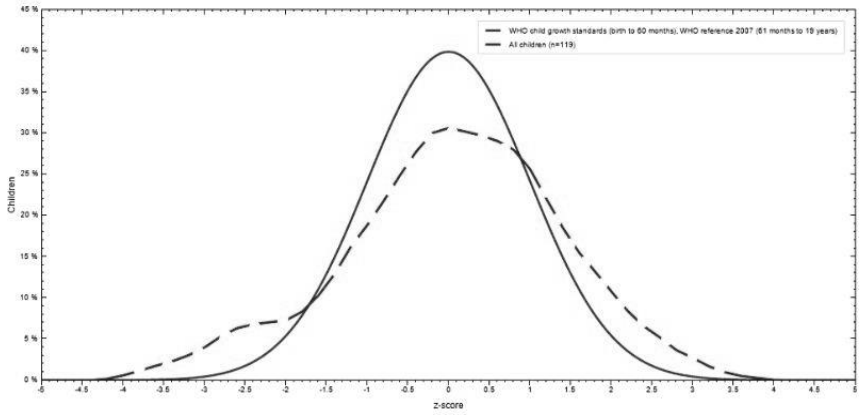


Figure 4. 7 Baseline BMI/A with reference to WHO standard (n=119)

Endline BMI/A: Similar to pre/baseline BMI/A, but with slightly lower peak frequency in the sample population. The positive skewing persists, indicating a continued prevalence of higher BMI-for-age values. The distribution remains wider than WHO standards, suggesting more variability in BMI among the sample.

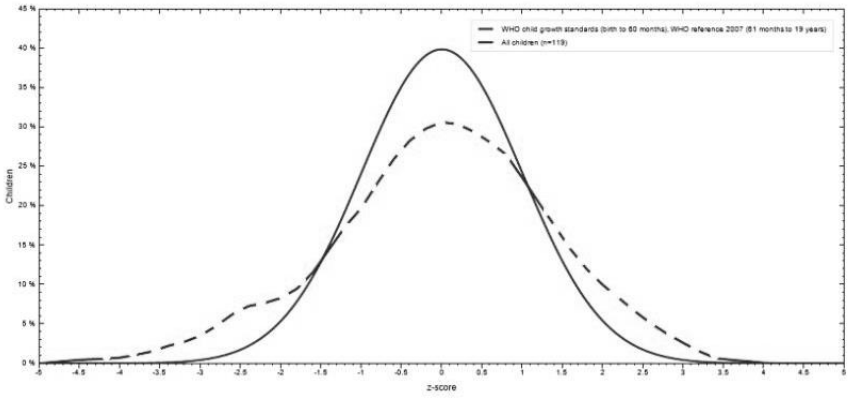


Figure 4. 8 Endline BMI/A with reference to WHO standard (n=119)

4.3 Clinical Signs

4.3.1 Bowel Movement

Significant improvement were observed in the bowel movement patterns, daily bowel movement increased from 61.3% to 85.7%. Similarly, normal stool consistency improved from 84% to 95.8%, further details can be obtained from Table 4. 6.

Table 4. 6 Impact of Intervention on Bowel Movement Frequency and Consistency

(Base-line/Pre versus End-line/Post Data)

Variable	Pre-Intervention (%)	Post-Intervention (%)
Bowel Movement Frequency		
Daily	73 (61.3)	102 (85.7)
In Every 2 Days	35 (29.4)	14 (11.8)
Less than twice a week	11 (9.2)	3 (2.5)
Stool Consistency		
Normal	100 (84)	114 (95.8)
Loose	13 (10.9)	3 (2.5)
Hard	6 (5)	2 (1.7)

4.3.2 Acne Problems

The research shows that nutrition and lifestyle choices have a positive impact on acne and dermatological conditions. However, the acne problem and prevalence didn’t show notable shifts, as shown in Table 4. 7, this might be due to the short intervention duration.

Noticeable improvement in dermatological conditions would also require addressing prolonged intervention and other factors like stress, hormonal imbalances, and skincare routines.

Table 4. 7 Distribution of Acne Problem and Severity

Variable	Pre-Intervention (%)	Post-Intervention (%)
Acne Problem		
No	72 (60.5)	75 (63)
Yes	47 (39.5)	44 (37)
Acne Severity		
Mild	106 (89.1)	110 (92.4)
Moderate	13 (10.9)	7 (5.9)
Severe	6 (5)	2 (1.7)

4.3.3 Menstruation Health

The concept of "Infradian Rhythm" has opened up a whole new world of opportunities for females. However, for the notable changes to occur, the current intervention lacked limited targeting towards the female biological clock and their needs and prolonged intervention time, which led to no notable difference in menstruation health, further details can be obtained from Table 4. 8.

Table 4. 8 Distribution of Menstruation Cycle and Cramps (n=52)

Variable	Pre-Intervention (%)	Post-Intervention (%)
Menstruation Cycle (n = 52)		
Menstruation not Started	17 (14.3)	16 (13.4)
Regular	27 (22.7)	25 (21)
Irregular	8 (6.7)	11 (9.2)
Menstruation Pain (n = 52)		
Menstruation not started	17 (14.3)	16 (13.4)
Mild	17 (14.3)	17 (14.3)
Moderate	9 (7.6)	16 (13.4)
Severe	9 (7.6)	3 (2.5)

4.4 Behavioral Factors

4.4.1 Sleep Quality

The sleep pattern showed notable improvements, the “very-good sleep quality” increased from 45.4% to 65.5%. Simultaneously, optimal sleep duration (5-9 hours) increased from 73.9% to 89.1%, further details are noted in Table 4. 9.

Table 4. 9 Shifts in Sleep Quality and Duration (Pre versus Post Intervention)

Variable	Pre-Intervention (%)	Post-Intervention (%)
Sleep Quality		
Very Good	54 (45.4)	78 (65.5)
Moderate	46 (38.7)	32 (26.9)
Not Good	19 (16)	9 (7.6)
Sleep Duration		
5-9 Hr.	88 (73.9)	106 (89.1)
Less than 5 Hr.	13 (10.9)	9 (7.6)
More than 9 Hr.	18 (15.1)	4 (3.4)

4.4.2 Physical Activity

After understanding the WHO gold standard for Physical Activity, which is 150 minutes of exercise per week, manifesting a minimum of 30 minutes of exercise per day. Participant's physical activity patterns improved substantially, and daily physical activity increased from 46.2% to 57.1%, further details are noted in Table 4. 10.

Table 4. 10 Changes in Physical Activity initiated by the Intervention

Variable	Pre-Intervention (%)	Post-Intervention (%)
Physical Activity		
Daily	55 (46.2)	68 (57.1)
Every Other Day	16 (13.4)	38 (31.9)
Less than Twice a Week	48 (40.3)	13 (10.9)
Daily Walk		
Minimum 30 min.	74 (62.2)	75 (63)
Not much, less than 30 min.	45 (37.8)	44 (37)
Physical Activity Duration		
Minimum 1 Hr.	69 (58)	70 (58.8)
Not much, less than 1 Hr.	50 (42)	49 (41.2)

4.5 Dietary Habits

The participants were provided with the habit tracker (see Appendix-E) to improve meal consumption patterns, which resulted in various notable changes in this category.

4.5.1 Meal Pattern

The participants showed several positive changes, aligned with healthy meal consumption patterns as per various research. Proper water intake timing (30 minutes before/after meals) improved from 22.7% to 43.7%.

Simultaneously, screen time during meals decreased from 52.9% to 43.7%, further details can be obtained from Table 4. 11.

Table 4. 11 Meal Consumption pattern and frequency shifts initiated by the Intervention

Variable	Pre-Intervention (%)	Post-Intervention (%)
Water Intake		
30 min. Before & After Meal	27 (22.7)	52 (43.7)
With Meal	92 (77.3)	67 (56.3)
Screen Time with Meal		
No	56 (47.1)	67 (56.3)
Yes	63 (52.9)	52 (43.7)
Meal Frequency		
3-5 times	67 (56.3)	78 (65.5)
$\leq$ 2 times	46 (38.7)	39 (32.8)
> 5 times	6 (5)	2 (1.7)
School Lunch		
Bring food from Home	55 (46.2)	59 (49.6)
Buy Meal from Cafeteria / Processed food	60 (50.4)	57 (42.8)
Skip Meal	4 (3.4)	3 (2.5)

The Baseline data also revealed that the majority of the participants were non-vegetarian (92%), as indicated by Figure 4. 9.

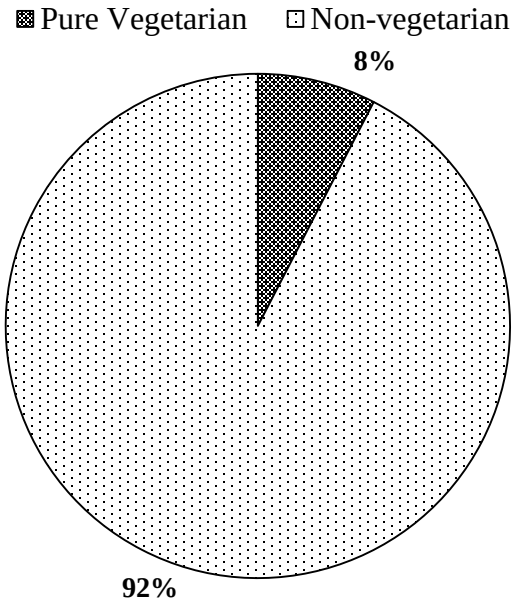


Figure 4. 9 Dietary Preferences of the study participants

4.6 Dietary Patterns

4.6.1 Minimum Dietary Diversity (MDD)

The intervention led to notable shifts in the adequacy versus inadequate frequency. The frequency of the participants who achieved MDD increased from 95 to 103, as indicated in Figure 4. 10.

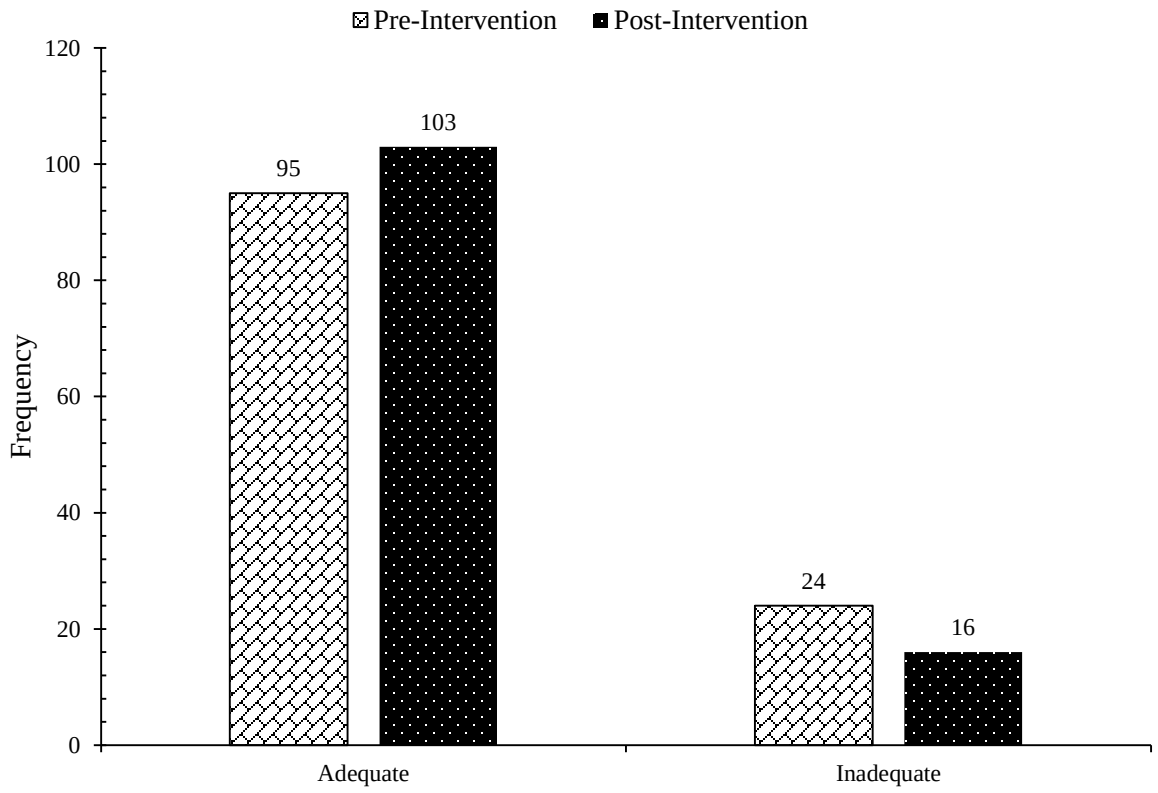


Figure 4. 10 Improvements in Minimum Dietary Diversity (Pre versus Post Intervention)

4.6.2 Dietary Diversity Score (DDS)

The DDS score was increased from 6.059 ± 1.865 to 6.689 ± 1.881, as shown in Figure 4. 11.

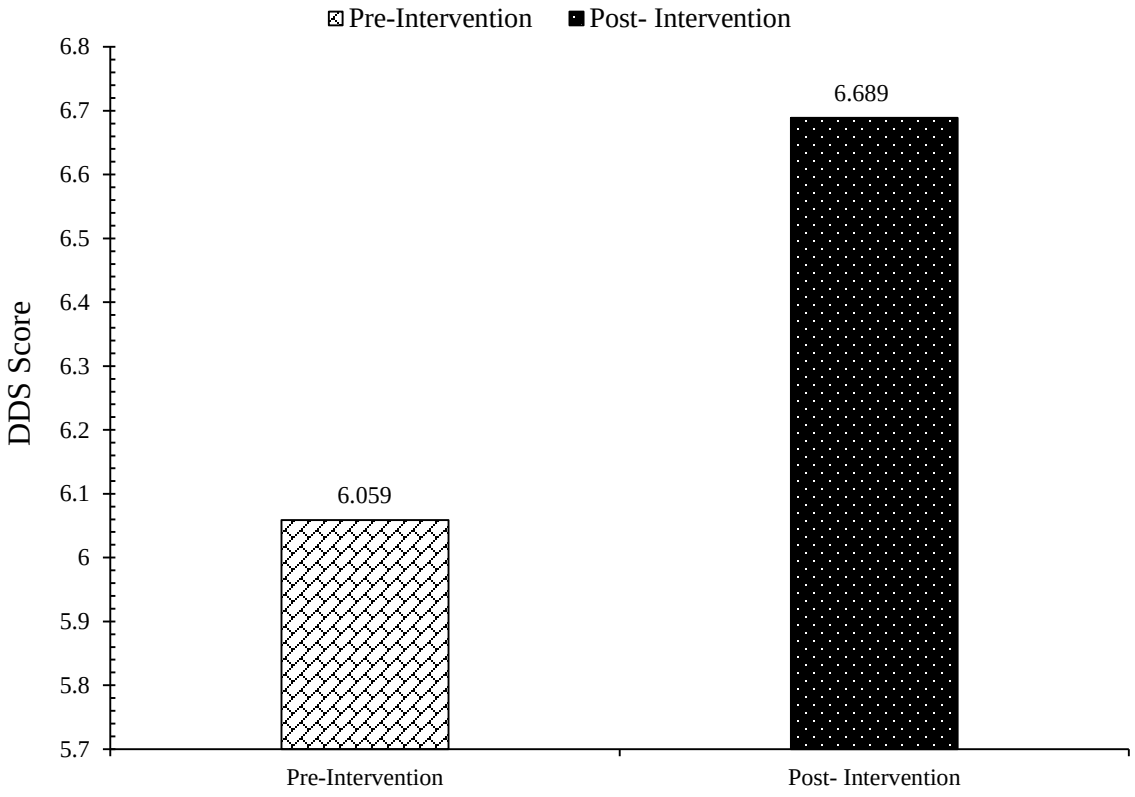


Figure 4. 11 Notable Improvement in Dietary Diversity Score

4.6.3 Global Dietary Recommendation Score (GDR)

The positive shifts occurred in the GDR, NCD-Protect, and NCD-Risk. Global Dietary Recommendation Score (GDR) improved from 9.521 ± 2.463 to 10.37 ± 2.997. Simultaneously, Non-Communicable Disease Protect (NCD-Protect) Score increased from 4.159 ± 1.855 to 4.824 ± 1.943. Similarly, the NCD-Risk Score decreased from 3.639 ± 1.93 to 3.454 ± 2.074, showing positive shifts in the dietary scores, further details can be obtained from Figure 4. 12.

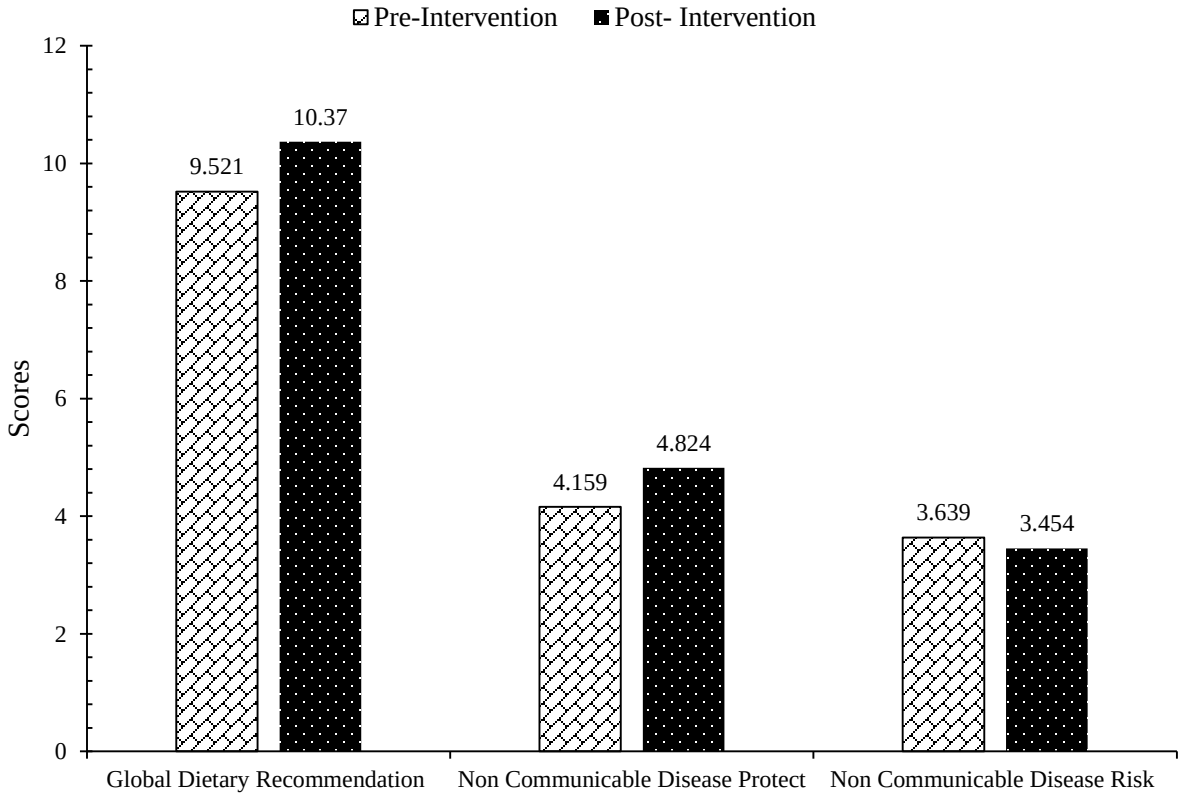


Figure 4. 12 Positive shifts initiated by the Intervention on GDR, NCD Risk, and Protect Scores

4.6.4 All-5 dietary scores

The intervention led to notable shifts in the adequacy versus inadequate frequency. The frequency of the participants who achieved All-5 dietary scores increased from 56 to 61, as indicated in Figure 4. 13. Furthermore, Figure 4. 14 represents the notable shifts in the consumption pattern of the wholesome food products initiated by the intervention.

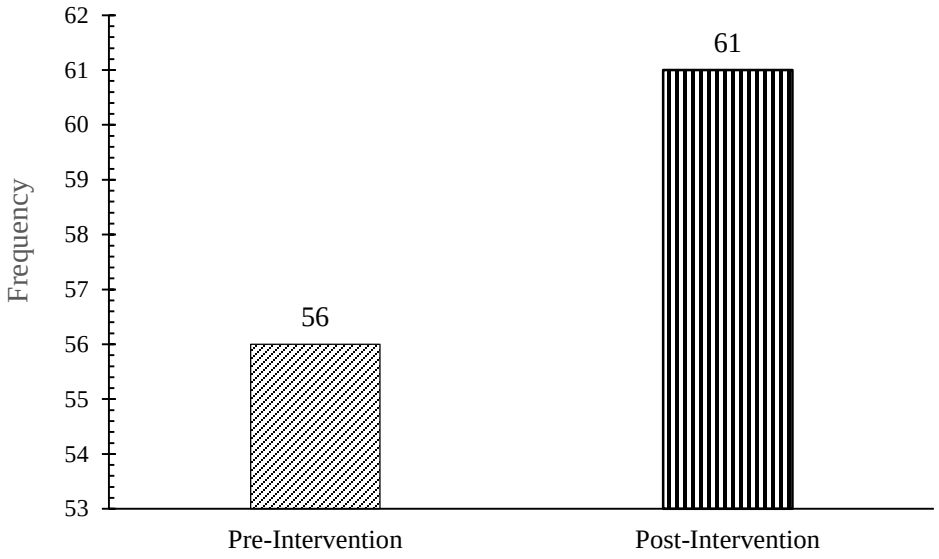


Figure 4. 13 Improvement in the Frequency Distribution of All-5 Dietary Scores

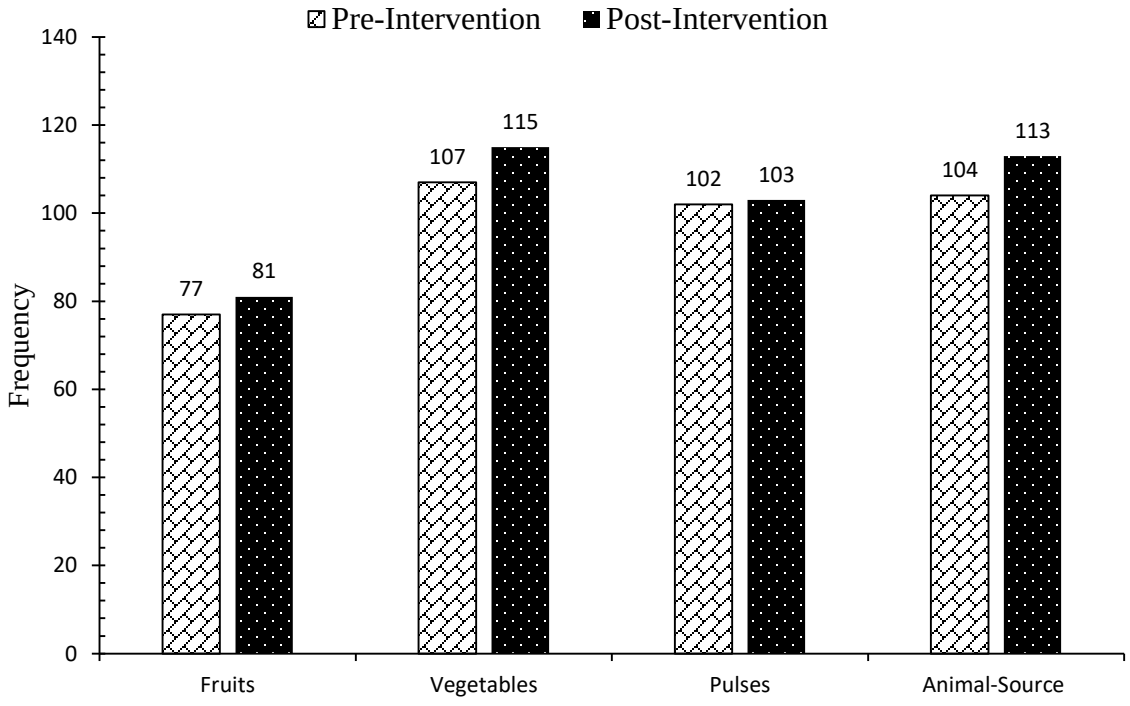


Figure 4. 14 Notable Shifts in the Food Consumption Patterns (based on 24 Hr. Recall, DQQ)

4.6.5 Food Frequency Table

Figure 4. 15 represents the significant increment in the Regular Wholesome Food Consumption Pattern initiated by the intervention. The minor drop in consumption of green leafy vegetables may be explained by the fact that production and availability of these vegetables fall during the wet season in July and August, when end-line data collecting took place (Singh *et al.*, 2019). Simultaneously, Figure 4. 16 denotes the decrement in the Highly Processed Food Consumption Pattern, which is desirable as per the objective of the intervention. Further information on food frequency, can be obtained from Table 4.12 and Table 4. 13.

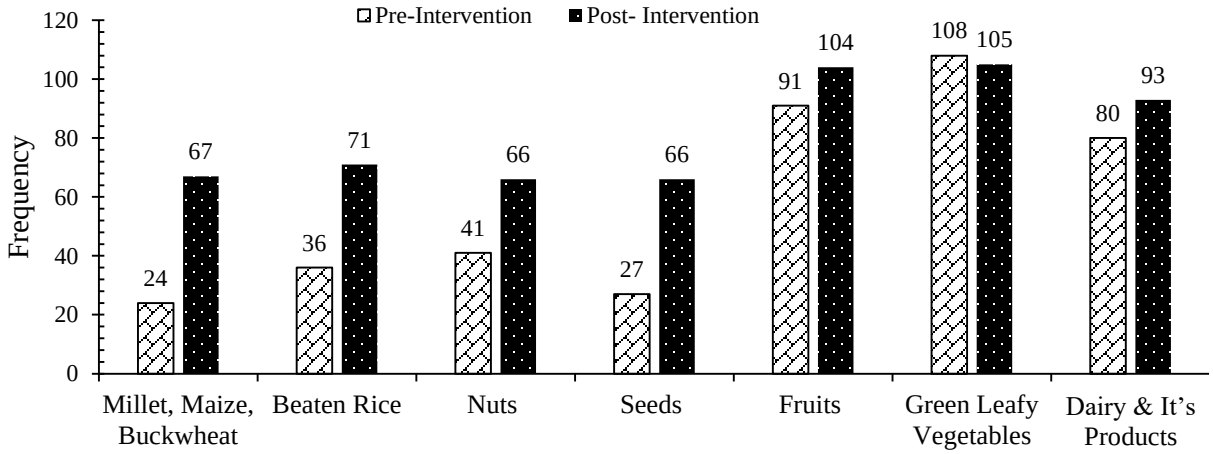


Figure 4. 15 Significant Increment in the Regular Wholesome Food Consumption Pattern

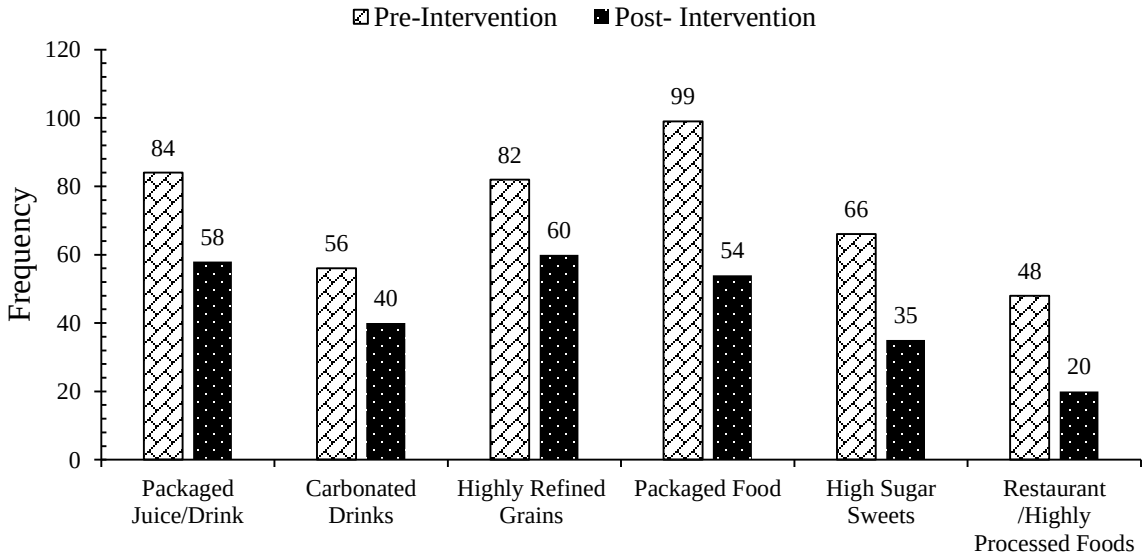


Figure 4. 16 Decrement in the Highly Processed Food Consumption Pattern

Table 4. 12 Food Frequency Distribution **(Base-line)**

Pre Intervention - Food Products	Frequency (%)		
	Regular	**Frequent**	**Rare**
Wholesome Products			
Millet / Maize / Buckwheat	24 (20.2)	25 (21)	70 (58.8)
Beaten Rice	36 (30.3)	34 (28.6)	49 (41.2)
Nuts	41 (34.5)	28 (23.5)	50 (42)
Seeds	27 (22.7)	15 (12.6)	77 (64.7)
Fruits	91 (76.5)	17 (14.3)	11 (9.2)
Green Leafy Vegetables	108 (90.8)	7 (5.9)	4 (3.4)
Dairy & It's Products	80 (67.2)	23 (19.3)	16 (13.4)
Highly Processed Food Products			
Packaged Juice / Drink	84 (70.6)	23 (19.3)	12 (10.1)
Carbonated Drinks	56 (47.1)	37 (31.1)	26 (21.8)
Highly Refined Grains	82 (68.9)	35 (29.4)	2 (1.7)
Packaged Food	99 (83.2)	14 (11.8)	6 (5)
High Sugar Sweets	66 (55.5)	29 (24.4)	24 (20.2)
Restaurant / Highly Processed Foods	48 (40.3)	27 (22.7)	44 (37)

Regular = Daily, minimum 3 times a week

Frequent = Once a week

Rare = Monthly or Never

Table 4. 13 Food Frequency Distribution **(End-line)**

Post Intervention - Food Products	Frequency (%)		
	Regular	**Frequent**	**Rare**
Wholesome Products			
Millet / Maize / Buckwheat	67 (56.3)	40 (33.6)	12 (10.1)
Beaten Rice	71 (59.7)	19 (16)	29 (24.4)
Nuts	66 (55.5)	29 (24.4)	24 (20.2)
Seeds	66 (55.5)	23 (19.3)	30 (25.2)
Fruits	104 (87.4)	15 (12.6)	0 (0.0)
Dark Green Leafy Vegetables	105 (88.2)	7 (5.9)	7 (5.9)
Dairy & It's Products	93 (78.2)	18 (15.1)	8 (6.7)
Highly Processed Food Products			
Packaged Juice / Drink	58 (48.7)	29 (24.4)	32 (26.9)
Carbonated Drinks	40 (33.6)	37 (31.1)	42 (35.3)
Highly Refined Grains	60 (50.4)	42 (35.3)	17 (14.3)
Packaged Food	54 (45.4)	46 (38.7)	19 (16)
High Sugar Sweets	35 (29.4)	49 (41.2)	35 (29.4)
Restaurant / Highly Processed Foods	20 (16.8)	50 (42)	49 (41.2)

Regular = Daily, minimum 3 times a week

Frequent = Once a week

Rare = Monthly or Never

4.7 Significance of the Intervention

4.7.1 Significance of DDS and GDR (paired T-test)

The primary objective of the study was to analyze the impact of intervention on the DDS and GDR scores. Thus, Table 4. 14, shows the related changes along with their significance (P-value), which clearly states that shifts in both DDS and GDR scores are significant ($P < 0.05$).

Table 4. 14 Impact of Intervention on DDS and GDR scores

Variable	Mean $\pm$ SD	P-Value
Dietary Diversity Score		
Pre - Intervention	6.059 $\pm$ 1.865	0.001
Post - Intervention	6.689 $\pm$ 1.881	
Global Dietary Recommendation		
Pre - Intervention	9.521 $\pm$ 2.463	0.013
Post - Intervention	10.37 $\pm$ 2.997	

4.7.2 Significance Test for other variables (paired T-test)

The significance test done on other variables shares valuable insights about the participant's habits and behavior change and the intervention's impact. The significant P-value of NCD-Protect ($P = 0.002$) represents the significant changes in the consumption of wholesome food products.

However, the lack of significance ($P > 0.05$) for NCD-Risk represents, how it was easier to implement healthier food consumption practices rather than letting go of unwholesome products. Furthermore, the non-significant results for BMI/A, and H/A represent that

intervention needs to be prolonged and more targeted to weight maintenance to gain significant shifts. Further information is denoted in Table 4. 15.

Table 4. 15 Significant test of NCD-Protect, NCD-Risk, BMI/A, and H/A

Variable	Mean ± SD	P-Value
Non-Communicable Disease Protect		
Pre - Intervention	4.159 ± 1.855	0.002
Post - Intervention	4.824 ± 1.943	
Non-Communicable Disease Risk		
Pre - Intervention	3.639 ± 1.93	0.434*
Post - Intervention	3.454 ± 2.074	
BMI for Age		
Pre - Intervention	0.069 ± 1.307	0.403*
Post - Intervention	0.022 ± 1.278	
Height for Age		
Pre - Intervention	- 0.677 ± 0.956	0.881*
Post – Intervention	- 0.670 ± 0.930	

* represents not significant (P > 0.05)

4.8 Effect Size of the Intervention

4.8.1 Effect Size for Dietary Diversity Score

Calculation using Cohen's d formula (Cohen, 1998).

$$\text{Cohen's d} = \sqrt{\frac{X1 - X2}{Sp}}$$

Where,

X1 = 6.689

X2 = 6.059

S_p stands for "Pooled standard deviation", which is calculated as

$$Sp = \sqrt{\frac{(n1 - 1)\ s1^2 + (n2 - 1\ )\ s2^2}{n1 + n2 - 2}}$$

Where,

n1 = 118

n2 = 118

s1 = 1.881

s2 = 1.865

$$\text{Cohen's for DDS} = \ 0.34$$

Ergo,

Computing the values the final Cohen's d for DDS equals: 0.34

The comprehensive school-based intervention done in China revealed that the DDS improved significantly in the intervention group (Xu *et al.,* 2020). Similarly, primary school

nutrition education intervention done in Ghana, reported significant improvements in dietary knowledge (Antwi *et al.*, 2020). Ergo, the effect size of this intervention is 0.34 showing a small to moderate effect size (Dulal *et al.*, 2021; Margolies *et al.*, 2022), which aligns with similar intervention research done in China and Ghana.

4.8.2 Effect Size for Global Dietary Recommendation Score

Calculation using Cohen's d,

$$\text{Cohen's d} = \sqrt{\frac{X1 - X2}{Sp}}$$

Where,

X1 = 10.37

X2 = 9.521

S_p stands for "Pooled standard deviation", which is calculated as

$$Sp = \sqrt{\frac{(n1 - 1)\ s1^2 + (n2 - 1\ )\ s2^2}{n1 + n2 - 2}}$$

Where,

n1 = 118

n2 = 118

s1 = 2.463

s2 = 2.997

$$\text{Cohen's d for GDR score} = \ 0.31$$

Ergo,

Computing the values the final Cohen's d for GDR score equals: 0.31

The multi-country school-based intervention demonstrated comparable improvements in dietary habits (Habib-Mourad *et al.*, 2023). Similarly, research in Croatia showed improvements in diet quality (Kendel Jovanović *et al.*, 2023). Thus, the effect size of 0.31 in GDR represents a significant effect size (Dulal *et al.*, 2021; Margolies *et al.*, 2022).

4.9 Overall Impact of the Intervention

4.9.1 Real-World Impact

The DDS and GDR shifts showed significant values with a small to medium effect size of 0.34 and 0.31, respectively. Simultaneously, research on nutritional interventions has shown similar effect sizes in the range of 0.22-0.33 (Dulal *et al.*, 2021; Margolies *et al.*, 2022), indicating that the intervention's effect size is desirable and within an expected range.

The research study demonstrated that longer interventions can yield larger effects; thus, short-term interventions are bound to show smaller effect sizes, indicating a promising effect size given the intervention timeframe (Margolies *et al.*, 2022). The research framework also suggests that sustained small effects can lead to significant long-term health benefits (Dulal *et al.*, 2021).

4.9.2 Multi-dimensional Impact Analysis

The behavioral changes, improved hydration patterns (22.7% to 43.7%), better physical activity habits (46.2% to 57.1%), bowel movement pattern (61.3% to 85.7%), and enhanced sleep duration (73.9% to 89.1%), which indicates broader positive impacts. The increased consumption of wholesome foods with better hydration habits represents practical significance beyond statistical measures.

4.9.3 Implications

The effect size suggests that the intervention was moderately effective and comparable to successful international programs by considering the specific areas for enhancement. The intervention shares the potential for larger effect sizes with program modification and prolonged intervention timeframe.

Ergo, the effect size observed in the study (d = 0.34 for DDS and d = 0.31 for GDR) represents meaningful improvements in dietary behaviors and nutritional knowledge. While these effects are classified as small to medium according to Cohen's criteria, they are consistent with or slightly better than similar interventions reported in the international literature (Dulal *et al.*, 2021; Margolies *et al.*, 2022). The practical significance of these improvements, particularly in the context of adolescent health behaviors, suggests that the intervention was successful in achieving its primary objectives.

Compared with similar studies worldwide, these results indicate that the intervention achieved comparable effectiveness in improving dietary behaviors and nutritional knowledge among school-going adolescents. The effect sizes, while modest, represent practically significant improvements that could lead to long-term health benefits if maintained and reinforced through continued intervention efforts.

Part V

Conclusions and recommendations

5.1 Conclusion

The intervention study was done in one of the secondary educational institutes in Dharan, a sub-metropolitan city in Nepal. The intervention focused on the nutritional intervention's impact analysis on various indicators of holistic health and longevity. The following conclusion can be drawn from the result and discussion:

a. The nutritional intervention demonstrated statistically significant improvements in dietary scores, with the Dietary Diversity Score increasing from 6.059 to 6.689 ($p=0.001$) and the Global Dietary Recommendation Score improving from 9.521 to 10.37 ($p=0.013$), achieving an effect size of 0.34 and 0.31 respectively, which aligns with successful international interventions.

b. While anthropometric measurements showed some positive shifts, with normal BMI-for-age increasing from 67.2% to 72.3%, the changes in BMI-for-age and Height-for-age were not statistically significant ($p>0.05$), suggesting that longer intervention periods may be necessary for meaningful physical growth impacts.

c. The intervention significantly enhanced wholesome food consumption patterns, with notable increases in fruits (76.5% to 87.4%), dairy products (67.2% to 78.2%), and whole grains (20.2% to 56.3%), while simultaneously reducing the intake of highly processed foods (40.3% to 16.8%).

d. The intervention's effect sizes (0.34 for DDS and 0.31 for GDR) represent meaningful improvements comparable to international standards, suggesting that even short-term interventions can achieve significant positive impacts on dietary behaviors.

e. Physical activity patterns showed substantial improvement, with daily physical activity increasing from 46.2% to 57.1% with a significant decrement in sedentary behavior (those exercising less than twice a week decreased from 40.3% to 10.9%), indicating successful promotion towards an active lifestyle.

f. Sleep quality and duration metrics demonstrated significant positive shifts, with optimal sleep duration (5-9) hours improving from 73.9% to 89.1%, suggesting vital lifestyle modification beyond dietary habits.

g. Meal consumption patterns showed positive transformations with improved water intake timing (22.7% to 43.7%), decreased screen time during meals (52.9% to 43.7%), and increased optimal meal frequency of 3-5 times daily (56.3% to 65.5%), indicating better eating habits.

h. Digestive health indicators represented a significant improvement, with daily bowel movement increasing from 61.3% to 85.7% and normal stool consistency improving from 84% to 95.8%, suggesting better overall digestive system functioning.

i. The NCD-Protect Score showed significant improvement ($p=0.002$), while the NCD-Risk Score changes were not statistically significant ($p=0.434$), indicating that it was easier to implement healthy food practices than to eliminate unhealthy food choices.

j. The baseline nutritional status revealed a mixed profile with concerns of both under and over-nutrition, showing overweight (17.6%), obesity (5.9%), moderate thinness (7.6%), and stunting (5.8%), highlighting the complex nutritional challenges in the study population.

k. Clinical indicators showed varied responses, with significant improvements in digestive health but limited changes in other areas like acne problems and menstruation health, suggesting the need for more targeted and prolonged interventions for specific health conditions.

l. The overall intervention effectiveness demonstrated significant improvements in dietary patterns and behavioral outcomes, though some areas require longer intervention periods, providing a strong foundation for future school-based nutritional interventions in Nepal while highlighting areas for potential enhancement in future programs.

5.2 Recommendation

Based on the findings from this study, several key recommendations are proposed to address the identified challenges and opportunities. These recommendations aim to foster sustainable improvements in adolescent nutrition and health outcomes, contributing to broader public health and developmental goals:

a. A holistic educational framework must be integrated into school curricula, ensuring critical nutrition literacy and promoting healthy lifestyle behaviors, leading the future toward longevity and holistic well-being.

b. Prolonged, targeted interventions with robust systems for feedback, monitoring, and evaluation should be prioritized to achieve Sustainable Development Goals (SDGs) and National Health Goals.

c. Comprehensive Behavior Change strategies should be explored and scaled in real-life settings, with the integrated collaboration of Healthcare, Educational Institutes, and Individuals. This approach will aid to build a culture of health and nutrition, making healthy choices effortless and intuitive.

d. For further studies, researchers should use both Cohen's d and Partial eta-squared in reporting effect sizes for dietary interventions, as they offer a comprehensive view of the intervention's impact.

Part VI

Summary

Nepal faces an urgent public health challenge characterized by a triple burden of malnutrition, namely obesity (affecting 67% of the adult population), micro-nutrient deficiency (anemia 43% in children and 34% in females), and protein-energy malnutrition (children being 25% stunted and 19% underweight), which collectively impacts all demographic groups. This study implemented a comprehensive 10-week nutritional intervention program at an educational institute in Dharan, Nepal, targeting 119 students aged 10-16 years. The intervention was grounded in established behavioral theories, including Social Cognitive Theory, the Theory of Planned Behavior, and the Stages of Change Model, and employed a holistic approach to nutrition education and behavior modification.

The methodology involved systematic pre and post-intervention assessments, incorporating standardized measurements of diet quality, anthropometric indicators, and behavioral outcomes. The intervention demonstrated significant success ($P < 0.05$) in improving holistic behaviors and nutritional choices, as evidenced by enhanced dietary scores (DDS and GDR) and positive shifts in food consumption patterns. Simultaneously, the improvements in wholesome food consumption and reduced processed food intake were noteworthy, suggesting successful behavior modification. While anthropometric changes were modest, the intervention achieved meaningful improvements in various lifestyle factors, namely physical activity patterns, sleep quality, and meal consumption behaviors.

These findings emphasize the effectiveness of school-based nutritional interventions in fostering healthy dietary habits among adolescents, while also underlining the importance of sustained efforts to achieve lasting improvements in holistic health and anthropometric outcomes.

References

Alkerwi, A. (2014). Diet quality concept. *Nutrition*. **30** (6), 613-618. [doi:10.1016/j.nut.2013.10.001].

Antwi, J., Ohemeng, A., Boateng, L., Quaidoo, E. Y. and Bannerman, B. (2020). Primary school-based nutrition education intervention on nutrition knowledge, attitude and practices among school-age children in Ghana. *Global Health Promotion*. **27**, 114 - 122. [doi:10.1177/1757975920945241].

APA. (2002). Developing Adolescents [Report]. American Psychological Association. [Accessed 10 November, 2024].

Aryal, K., Mehta, R., Chalise, B., Mehata, S., Sapkota, F., Dhimal, M., Jha, B. and Karki, K. (2014). Adolescent Nutrition Survey in Nepal [Report]. Nepal Health and Research Council.

Bandura, A. (2004). Health promotion by social cognitive means. *Health Educ Behav.* **31** (2), 143-164. [doi:10.1177/1090198104263660].

Baranwal, N., Yu, P. K. and Siegel, N. S. (2023). Sleep physiology, pathophysiology, and sleep hygiene. *Prog Cardiovasc Dis.* [doi:10.1016/j.pcad.2023.02.005].

Bhutta, Z. A., Das, J. K., Rizvi, A., Gaffey, M. F., Walker, N., Horton, S., Webb, P., Lartey, A., Black, R. E., & Lancet Nutrition Interventions Review Group, the Maternal and Child Nutrition Study Group (2013). Evidence-based interventions for improvement of maternal and child nutrition: what can be done and at what cost?. *Lancet*, 382(9890), 452–477. [doi:10.1016/S0140-6736(13)60996-4].

Budhathoki, L., Shrestha, B., Phuyal, N. and Shrestha, L. (2021). Prevalence of Anemia in Adolescent Girls attending Specific Schools of Kavrepalanchok, Nepal. . *JNMA J Nepal Med Assoc.* **59** (235), 284–287. [doi:10.31729/jnma.6330].

Buettner, D. and Skemp, S. (2016). Blue Zones: Lessons From the World's Longest Lived. *Am J Lifestyle Med.* **10** (5), 318-321. [doi:10.1177/1559827616637066].

Bustos, N., Olivares, S., Leyton, B., Cano, M. and Albala, C. (2016). Impact of a school-based intervention on nutritional education and physical activity in primary public schools in Chile (KIND) programme study protocol: cluster randomised controlled trial. *BMC Public Health*. **16**. [doi:10.1186/s12889-016-3878-z].

CDC. (2020). Division of Adolescent and School Health [Report]. Centers for Disease Control and Prevention. [Accessed 10 November, 2024].

Chalise, B., Aryal, K. K., Mehta, R. K., Dhimal, M., Sapkota, F., Mehata, S. (2018). Prevalence and correlates of anemia among adolescents in Nepal: Findings from a nationally representative cross-sectional survey. PLoS ONE. **13** (12), e0208878. [doi:10.1371/journal.pone.0208878].

Charan, J. and Biswas, T. (2013). How to calculate sample size for different study designs in medical research? **35** (2), 121-126. [doi10.4103/0253-7176.116232].

Chen, N., Raghavan, M., Albert, J., McDaniel, A., Otiso, L., Kintu, R., West, M. and Jacobstein, D. (2021). The Community Health Systems Reform Cycle: Strengthening the Integration of Community Health Worker Programs Through an Institutional Reform Perspective. *Global Health: Science and Practice*. **9**. [doi:10.9745/GHSP-D-20-00429].

Chitekwe, S., Torlesse, H. and Aguayo, V. M. (2021). Nutrition in Nepal: Three decades of commitment to children and women. *Maternal & Child Nutrition*. **18** (1). [doi:10.1111/mcn.13229].

Clear, J. (2018). "Atomic Habits: Tiny Changes, Remarkable Results : An Easy & Proven Way to Build Good Habits & Break Bad Ones". An imprint of Penguin Random House. New York. [ISBN 978-1847941848].

Cogill, B. (2003). "Anthropometric Indicators Measurement, Guide". Food and Nutrition Technical Assistance Project.

Academy for Educational Development. Washington DC. Cohen, J. (1998). "Statistical Power Analysis for the Behavioral Sciences" (2nd ed.). Lawrence Erlbaum Associates. United States of America. [0-8058-0283-5].

Cole, T. J., Bellizzi, M. C., Flegal, K. M. and Dietz, W. H. (2000). Establishing a standard definition for child overweight and obesity worldwide: international survey. *BMJ (Clinical research ed.)*. **320** (7244), 1240–1243. [doi:10.1136/bmj.320.7244.1240].

de, O., M., , Garza, C., Victora, C. G., Onyango, A. W., Frongillo, E., A. and Martines, J. (2004). The WHO Multicentre Growth Reference Study: planning, study design, and methodology. *Food Nutr Bull*. **25** (1), S15–S26. [doi:10.1177/15648265040251S103].

de Onis, M. and Habicht, J. P. (1996). Anthropometric reference data for international use: recommendations from a World Health Organization Expert Committee. *Am J Clin Nutr*. **64** (4), 650-658. [doi:10.1093/ajcn/64.4.650].

deOnis, M. and Lobstein, T. (2010). Defining obesity risk status in the general childhood population: which cut-offs should we use? *Int J Pediatr Obes*. **5** (6), 458-460. [doi:10.3109/17477161003615583].

DoHS. (2011). National Communication Strategy for Maternal, Newborn and Child Health [Report]. Government of Nepal. Nepal. Retrieved from https://dohs.gov.np/wp-content/uploads/chd/SafeMotherhood/National_Communication_Strategy_for_MNCH_2011_2016_EN.pdf. [Accessed 10 November, 2024].

Dr.Kwek, D. and Dr.Ho, J. D. W. H. M. (2023). The Comprehensive Learning Diagnosis [Report]. Center for Universal Education. Singapore. Retrieved from https://www.brookings.edu/wp-content/uploads/2023/03/Brief_Singapores-educational-reforms-toward-holistic-outcomes_FINAL.pdf.

Duhigg. (2012). "The Power of Habit : Why We Do, What We Do, and How to Change It". Random House. United States of America. [ISBN 978-1-4000-6928-6].

Dulal, S., Prost, A., Karki, S., Saville, N. and Merom, D. (2021). Characteristics and effects of integrated nutrition and stimulation interventions to improve the nutritional status and development of children under 5 years of age: a systematic review and meta-analysis. *BMJ global health*. **6** (7). [doi:10.1136/bmjgh-2020-003872].

Ellis, P. D. (2010). The Essential Guide to Effect Sizes: Statistical Power, Meta-Analysis and the Interpretation of Research Results. *Cambridge University Press*. [doi10.1017/CBO9780511761676].

FAO. (2021). "Minimum Dietary Diversity for Women: An Updated Guide for Measurement – From Collection to Action". Food and Agriculture Organization of the United Nations. Rome, Italy. [978-92-5-133993-0].

Foundation, W. (2019). WASH in Schools. The WASH Foundation. Retrieved from https://thewashfoundation.org/wash-in-schools/. [Accessed 10 november, 2024].

Funder, D. C. and Ozer, D. J. (2019). Evaluating effect size in psychological research: Sense and nonsense. *Advances in Methods and Practices in Psychological Science*. **2** (2), 156–168. [doi:10.1177/2515245919847202].

Glasziou, P., Vandenbroucke, J. P. and Chalmers, I. (2004). Assessing the quality of research. *BMJ (Clinical research ed.)*. **328** (7430), 39–41. [doi:10.1136/bmj.328.7430.39].

Haarhuis, J. E., Kardinaal, A. and Kortman, G. A. M. (2022). Probiotics, prebiotics and postbiotics for better sleep quality: a narrative review. *Benef Microbes.* **13**, 169-182. [doi:10.3920/BM2021.0122].

Habib-Mourad, C., Maliha, C., Kassis, A. N., Nguyen, A. T., Ammar, D. F., Haji, E. A., AlTarazi, L., Totah, S. and Hwalla, N. C. (2023). A randomised controlled school-based nutritional intervention in five Middle Eastern countries: Ajyal Salima improved students' dietary and physical activity habits. *Public Health Nutrition*. **26**, 2036 - 2047. [doi:10.1017/S1368980023001489].

Han, H., Wang, Y., Li, T., Feng, C., Kaliszewski, C., Su, Y., Wu, Y., Zhou, J., Wang, L. and Zong, G. (2023). Sleep Duration and Risks of Incident Cardiovascular Disease and Mortality Among People With Type 2 Diabetes. *Diabetes Care*. **46**, 101-110. [doi:10.2337/dc22-1127].

Hattie, J. (2008). Visible learning: A synthesis of over 800 meta-analyses relating to achievement. *routledge*. [doi10.4324/9780203887332].

Herforth, A. W., Wiesmann, D., Martínez-Steele, E., Andrade, G. and Monteiro, C. A. (2020). Introducing a Suite of Low-Burden Diet Quality Indicators That Reflect Healthy Diet Patterns at Population Level [Report]. Vol. 4. Current Developments in Nutrition. Retrieved from https://cdn.nutrition.org/action/showPdf?pii=S2475-2991%2822%2912102-5.

Huang, W., Ramsey, K. M., Marcheva, B. and Bass, J. (2011). Circadian rhythms, sleep, and metabolism. *J Clin Invest*. **121** (6), 2133-2141. [doi:10.1172/JCI46043].

Kapur, A. C., A. (2012). Mid-Day Meal Scheme (MDM) [Report]. Accountability Initiatives. India. Retrieved from https://www.researchgate.net/publication/255698986_Mid-Day_Meal_Scheme_MDM_2012-13.

Kendel Jovanović, G., Jankovic, S. and Pavičić Žeželj, S. (2023). The effect of nutritional and lifestyle education intervention program on nutrition knowledge, diet quality, lifestyle, and nutritional status of Croatian school children. *Frontiers in Sustainable Food Systems*. [Accessed 10 November, 2024].

Koenker, H., Keating, J., Alilio, M. and Acosta, A. L., M.Nafo-Traore, F. (2014). Strategic roles for behaviour change communication in a changing malaria landscape. *Malar J* **13** (1). [doi10.1186/1475-2875-13-1].

Lakens, D. (2013). Calculating and reporting effect sizes to facilitate cumulative science: a practical primer for t-tests and ANOVAs. *Frontiers in psychology*. **4**, 863. [doi:10.3389/fpsyg.2013.00863].

Łożyńska, K. and Głąbska, D. (2022). Association between Nutritional Behaviours and Acne-Related Quality of Life in a Population of Polish Male Adolescents. *Nutrients*. **14**. [doi:10.3390/nu14132677].

Maharjan, K. and Chaudhary, D. (2021). Scenario and Policy of Decent Nutrition and Food Security in the Post-Covid-19 in Nepal. *Journal La Sociale*. **2**, 10-17.

Margolies, A., Kemp, C. G., Choo, E. M., Levin, C., Olney, D., Kumar, N., Go, A., Alderman, H. and Gelli, A. (2022). Nutrition-sensitive agriculture programs increase dietary diversity in children under 5 years: A review and meta-analysis. *J Glob Health*. **12**. [doi:10.7189/jogh.12.08001].

Mehata, S., Tamang, M. K., Parajuli, K. R., Rayamajhee, B., Yadav, U. N., Mehta, R. K., & Singh, D. R. (2021). Serum zinc status is a matter of concern among children and non-pregnant women in a nationwide survey of Nepal. *Sci Rep.* **11** (1), 1-14. [doi:10.1038/s41598-021-94344-9].

Mitsuhashi, Y. (2018). "Ikigai". Kyle Books. England. [978-0-857-83491-1].

MoHFW. (2014). Rashtriya Kishor Swasthya Karyakram (RKSK) [Report]. Government of India. India. Retrieved from https://nhm.gov.in/images/pdf/programmes/RKSK/RKSK_Operational_Framework.pdf.

MoHP. (2012). Joint Action Plan (2071/72 – 2076/77) School Health and Nutrition [Report]. Government of Nepal. Nepal. Retrieved from https://km.mohp.gov.np/sites/default/files/2018-07/5%20SHNP_Joint%20Action%20Plan_2071-72%20to%20076-77_English.pdf.

MoHP. (2014). School Health and Nutrition [Report]. Government of Nepal. Nepal. Retrieved from https://km.mohp.gov.np/sites/default/files/2018-07/5%20SHNP_Joint%20Action%20Plan_2071-72%20to%20076-77_English.pdf. [Accessed 10 November, 2024].

MoHP. (2022). Nepal Demographic and Health Survey 2022 [Report]. Ministry of Health and Population Kathmandu, Nepal.

MoHP, UNICEF and WHO. (2016). Nepal national micronutrient status survey report [Report]. UNICEF. Nepal. Retrieved from https://www.unicef.org/nepal/reports/nepal-national-micronutrient-status-survey-report-2016. [Accessed 10 November, 2024].

Nancy, S. and Dongre, A. R. (2021). Behavior Change Communication: Past, Present, and Future. *Indian journal of community medicine : official publication of Indian Association of Preventive & Social Medicine*. **46** (2), 186–190. [doi:10.4103/ijcm.IJCM_441_20].

Niroula, S. (2024). Assessment of Nutrient Adequacy and Dietary Diversity of Mid-Day Meal.in Public School at Barahakshetra Municipality. B. Nutrition and Dietetics Thesis. Tribhuvan Univ., Nepal.

NPC. (2017). Multi-Sector Nutrition Plan: 2018–2022 [Report]. Nepal Planning Commission Kathmandu, Nepal, Nepal.

NPC. (2021). SDGs baseline report 2021. [Report]. Government of Nepal. Retrieved from https://www.npc.gov.np/images/category/SDGs_Baseline_Report_final_29_June-1(1).pdf.

Paoli, A., Tinsley, G., Bianco, A. and Moro, T. (2019). The Influence of Meal Frequency and Timing on Health in Humans: The Role of Fasting. *Nutrients*. **11**, 719. [doi:10.3390/nu11040719].

Patimah, S., Sundari, S., Idrus, H. H. and Noviasty, R. (2023). Effect of School-Integrated Interventions on Improvement of Nutrition-Health Knowledge and Nutritional Status among Adolescent Girls: A Quasi-Experimental Study. *Current Research in Nutrition and Food Science Journal*. [doi:10.12944/crnfsj.11.2.35].

Paudyal, N., Parajuli, K. R., Larsen, V. G., Adhikari, R. K., Devkota, M. D., Rijal, S., Chitekwe, S. and Torlesse, H. (2021). A Review of the Maternal Iron and Folic Acid

Supplementation Programme in Nepal: Achievements and Challenges. *Maternal & Child Nutrition*. **18**. [doi:10.1111/mcn.13173].

Prendergast, A. J. and Humphrey, J. H. (2014). The stunting syndrome in developing countries. *Paediatr Int Child Health*. **34** (4), 250-265. [doi:10.1179/2046905514Y.0000000158].

Prochaska, J. O. and Velicer, W. F. (1997). The Transtheoretical Model of Health Behavior Change. *American Journal of Health Promotion*. **12** (1), 38-48. [doi:10.4278/0890-1171-12.1.38].

Project, G. D. Q. (2023). DQQ -Indicators. Retrieved from https://www.dietquality.org/indicators/definitions. [Accessed 12 November].

Project, G. D. Q. (2024). DQQ Data. Retrieved from https://www.dietquality.org/countries/npl. [Accessed 22 February].

Piryani, S., Baral, K. P., Pradhan, B., Poudyal, A. K. and Piryani, R. M. (2016). Overweight and its associated risk factors among urban school adolescents in Nepal: a cross-sectional study. *BMJ Open.* **6** (5). [doi:10.1136/bmjopen-2015-010335].

Rimbawan, R., Nurdiani, R., Rachman, P. H., Kawamata, Y. and Nozawa, Y. (2023). School Lunch Programs and Nutritional Education Improve Knowledge, Attitudes, and Practices and Reduce the Prevalence of Anemia: A Pre-Post Intervention Study in an Indonesian Islamic Boarding School. *Nutrients*. **15** (4). [doi10.3390/nu15041055].

Rocka, A., Jasielska, F., Madras, D., Krawiec, P. and Pac-Kożuchowska, E. (2022). The Impact of Digital Screen Time on Dietary Habits and Physical Activity in Children and Adolescents. *Nutrients*. **14**, 2985. [doi:10.3390/nu14142985].

Roenneberg, T., Pilz, L. K., Zerbini, G. and Winnebeck, E. C. (2019). Chronotype and Social Jetlag: A (Self-) Critical Review. *Biology*. **8** (3), 54. [doi:10.3390/biology8030054].

Roscoe, L. J. (2009). Wellness: A review of theory and measurement for counselors. *Journal of Counseling & Development*. **87** (2), 216-226. [doi:10.1002/j.1556-6678.2009.tb00570.x].

Singh, D. R., Sunuwar, D. R., Dahal, B. and Sah, R. K. (2021). The association of sleep problem, dietary habits and physical activity with weight status of adolescents in Nepal. *BMC Public Health*. **21** (1). [doi:10.1186/s12889-021-10985-5].

Singh, J. K., Acharya, D., Gautam, S., Adhikari, M., Park, J.-H., Yoo, S.-J., & Lee, K. (2019). Socio-Demographic and Diet-Related Factors Associated with Insufficient Fruit and Vegetable Consumption among Adolescent Girls in Rural Communities of Southern Nepal. *Int. J. Environ. Res. Public Health* **16** (12), 2145. [doi: 10.3390/ijerph16122145].

Sjoberg, S., Kim, K. and Reicks, M. (2004). Applying the Theory of Planned Behavior to Fruit and Vegetable Consumption by Older Adults. *Journal of Nutrition For the Elderly*. **23** (4), 35-46. [doi: 10.1300/J052v23n04_03].

Sone, T., Nakaya, N., Ohmori, K., Shimazu, T., Higashiguchi, M., Kakizaki, M., Kikuchi, N., Kuriyama, S. and Tsuji, I. (2008). Sense of life worth living (ikigai) and mortality in Japan: Ohsaki Study. *Psychosom Med*. **70** (6), 709-715. [doi:10.1097/PSY.0b013e31817e7e64].

Statistics, C. B. o. (2021). National Population and Housing Census [Report]. ISBN 978-9937-1-3221-3. Government of Nepal. Nepal, Nepal. Retrieved from https://censusnepal.cbs.gov.np/results/files/result-folder/National%20Report_English.pdf. [Accessed 10 November, 2024].

Sullivan, G. M. and Feinn, R. (2012). Using Effect Size-or Why the P Value Is Not Enough. *J Grad Med Educ*. **4** (3), 279-282. [doi:10.4300/JGME-D-12-00156.1].

Sunuwar, D. R., Singh, D. R. and Pradhan, P. M. S. (2020). Prevalence and factors associated with double and triple burden of malnutrition among mothers and children in Nepal: evidence from 2016 Nepal demographic and health survey. *BMC Public Health*. **20**, 405. [doi:10.1186/s12889-020-8356-y].

Tambalis, K. D., Panagiotakos, D. B., Psarra, G. and Sidossis, L. S. (2020). Screen time and its effect on dietary habits and lifestyle among schoolchildren. *Cent Eur J Public Health*. **28**, 260-266. [doi:10.21101/cejph.a6097].

Team, H. o. N. D. I. H. P. (2013). Pre-meal water consumption for weight loss. *Aust Fam Physician*. **42**, 478.

Ulijaszek, S. J. and Kerr, D. A. (1999). Anthropometric measurement error and the assessment of nutritional status. *The British journal of nutrition*. **82** (3), 165–177. [doi:10.1017/s0007114599001348].

UN. (2010). SUN Government Focal Points. Retrieved from https://scalingupnutrition.org/about/who-we-are/sun-government-focal-points. [Accessed 10 November, 2024].

UN. (2015). Sustainable Development Goals. Retrieved from https://sdgs.un.org/goals. [Accessed 10 November, 2024].

UN. (2024). The Scaling Up Nutrition Movement. Retrieved from https://scalingupnutrition.org/about/who-we-are. [Accessed 10 November 2024].

UNESCAP. (2024). Asia-Pacific SDG progress report 2024: Progress at risk [Report]. UNESCAP. Retrieved from https://www.sdgbrunei.gov.bn/media/t30fl2ph/escap-2024-fs-ap-sdg-progress.pdf. [Accessed 10 November, 2024].

UNICEF. (2021). "Making every school a health-promoting school: global standards and indicators". WHO. [ISBN 978-92-4-002505-9].

UNICEF. (2024). Adolescent Development and Participation. Retrieved from https://www.unicef.org/adolescence. [Accessed 10 November, 2024].

USAID. (2023). DQQ. Retrieved from https://www.advancingnutrition.org/resources/diet-assessment-tool/diet-quality-questionnaire-dq-

q?field_target_group=704&field_diet_question=702#indicators. [Accessed 12 November, 2024].

Uyar, B. T. M., Talsma, E. F., Herforth, A. W., Trijsburg, L. E., Vogliano, C., Pastori, G., Bekele, T. H., Huong, L. T. and Brouwer, I. D. (2023). The DQQ is a Valid Tool to Collect Population-Level Food Group Consumption Data: A Study Among Women in Ethiopia, Vietnam, and Solomon Islands. *The Journal of Nutrition*. **153** (1), 340-351. [doi:10.1016/j.tjnut.2022.12.014].

Vermorken, A. J., Andrès, E. and Cui, Y. (2016). Bowel movement frequency, oxidative stress and disease prevention. *Mol Clin Oncol.* **5**, 339-342. [doi:10.3892/mco.2016.987].

Vij, V. A. and Joshi, A. S. (2013). Effect of 'water induced thermogenesis' on body weight, body mass index and body composition of overweight subjects. *J Clin Diagn Res.* **7**, 1894-1896. [doi:10.7860/JCDR/2013/5862.3344].

Villalobos Dintrans, P., Bossert, T. J. and Sherry, J. (2019). A synthesis of implementation science frameworks and application to global health gaps. *glob health res policy*. **4** (25). [doi:10.1186/s41256-019-0115-1].

Vitti, A. (2020). "In the flo: Unlock your hormonal advantage and revolutionize your life". HarperOne. New York. [978-0-008-32707-1].

Warren, A. M., Frongillo, E. A. and Rawat, R. (2020). Building Implementation Science in Nutrition. *Advances in Nutrition*. **11** (5), 1392-1398. [doi:10.1093/advances/nmaa066].

WHO. (1948). Constitution of the World Health Organization. World Health Organization. Retrieved from https://www.who.int/about/governance/constitution. [Accessed 10 November, 2024].

WHO. (2006). "WHO Child Growth Standards". Department of Nutrition for Health and Development. [978-92-4-154763-5].

WHO. (2008). "WHO child growth standards". WHO. [ISBN 978-92-4-159507-0].

WHO. (2013). "Global Action Plan for the Prevention and Control of Non-Communicable Disease".[ISBN 978-92-4-150623-6].

WHO. (2018). Research Ethics Review Committee (ERC). WHO. Retrieved from https://www.who.int/groups/research-ethics-review-committee/guidelines-on-submitting-research-proposals-for-ethics-review/templates-for-informed-consent-forms. [Accessed 12 November, 2024].

WHO. (2021). Revitalizing school health programmes and health-promoting schools in the South-East Asia Region [Report]. WHO. Retrieved from https://iris.who.int/bitstream/handle/10665/344391/sea-rc74-11-eng.pdf?sequence=1&isAllowed=y.

WHO. (2023a). Infant and young child feeding Guidelines. Retrieved from https://www.who.int/news-room/fact-sheets/detail/infant-and-young-child-feeding. (Last update 20 December, 2023). [Accessed 10 November 2024].

WHO. (2023b). Multiple micronutrient powders for point-of-use fortification of foods consumed by children 6–23 months of age. Retrieved from https://www.who.int/tools/elena/interventions/micronutrientpowder-infants. (Last update 9 August 2023). [Accessed 10 November 2024].

WHO. (2023c). Multiple micronutrient supplementation during pregnancy. Retrieved from https://www.who.int/tools/elena/interventions/micronutrients-pregnancy. (Last update 9 August 2023). [Accessed 10 November 2024].

WHO. (2023d). New WHO framework available for prevention and management of obesity. Retrieved from https://www.who.int/news/item/17-05-2023-new-WHO-framework-available-for-prevention-and-management-of-obesity. (Last update 17 May 2023). [Accessed 10 November, 2024].

WHO. (2023e). Sodium reduction. Retrieved from https://www.who.int/news-room/fact-sheets/detail/salt-reduction. (Last update 14 September, 2023). [Accessed 10 November, 2024].

WHO. (2024a). Adolescent Health. Retrieved from https://www.who.int/health-topics/adolescent-health#tab=tab_3. [Accessed 10 November, 2024].

WHO. (2024b). Global Targets 2025: To improve maternal, infant and young child nutrition. Retrieved from https://www.who.int/teams/nutrition-and-food-safety/global-targets-2025. [Accessed 10 November, 2024].

WHO. (2024c). Health Promoting Schools. WHO. Retrieved from https://www.who.int/health-topics/health-promoting-schools#tab=tab_1. [Accessed 10 November, 2021].

Willett, W. C., Koplan, J. P., Nugent, R., Dusenbury, C., Puska, P. and Gaziano, T. A. (2006). "Prevention of chronic disease by means of diet and lifestyle changes" (2nd ed.). Disease Control Priorities in Developing Countries.

Xu, H., Ecker, O., Zhang, Q., Du, S., Liu, A., Li, Y., Hu, X., Li, T., Guo, H. W., Li, Y., Xu, G., Liu, W., Ma, J., Sun, J., Chen, K. and Ma, G. (2020). The effect of comprehensive intervention for childhood obesity on dietary diversity among younger children: Evidence from a school-based randomized controlled trial in China. *PLoS ONE*. **15**. [doi:10.1371/journal.pone.0235951].

Yang, S., Yu, C., Guo, Y., Bian, Z., Fan, M., Yang, L., Du, H., Chen, Y., Yan, S., Zang, Y., Chen, J., Chen, Z., Lv, J., Li, L. and Group, C. K. B. C. (2020). Bowel movement frequency and risks of major vascular and non-vascular diseases: a population-based cohort study among Chinese adults. *BMJ Open*. **10**. [doi:10.1136/bmjopen-2019-031028].

Appendixes

Appendix A: Consent Form

"Consent Form for Participation in Thesis"
Central Campus of Technology (Hattisar)
Department of Nutrition & Dietetics
Principal Investigator: Miss Smriti Kumari Yadav

Thesis Topic: - **Impact of Nutritional Intervention on Nutritional Status and Dietary Patterns of Adolescents in Secondary Schools in Dharan, Nepal**

Purpose of Study: You are invited to participate in a 10-week study designed to evaluate the impact of **Nutritional Workshop** on health and wellness. Your participation will involve attending one physical session for 10 weeks and engaging in various virtual challenges and sessions.

Confidentiality: All information collected during this study will be kept confidential and will be used solely for the purposes of this research. Your identity will not be disclosed in any publications or presentations resulting from this study.

Voluntary Participation: Participation in this thesis is voluntary. You may withdraw from the study at any time without penalty. If you choose to withdraw, please notify the principal investigator promptly.

Responsibilities of Participants: Dedication towards Health & Active Participation

Commitment to Participation:

I understand the physical nature of the sessions and accept full responsibility for my health and nutrition. I commit to taking these sessions seriously and dedicating the next few months to improving my life through active participation in both physical and virtual sessions.

By signing below, I acknowledge that I have read and understood the information provided above. I consent to participate in this study and agree to the terms and conditions outlined.

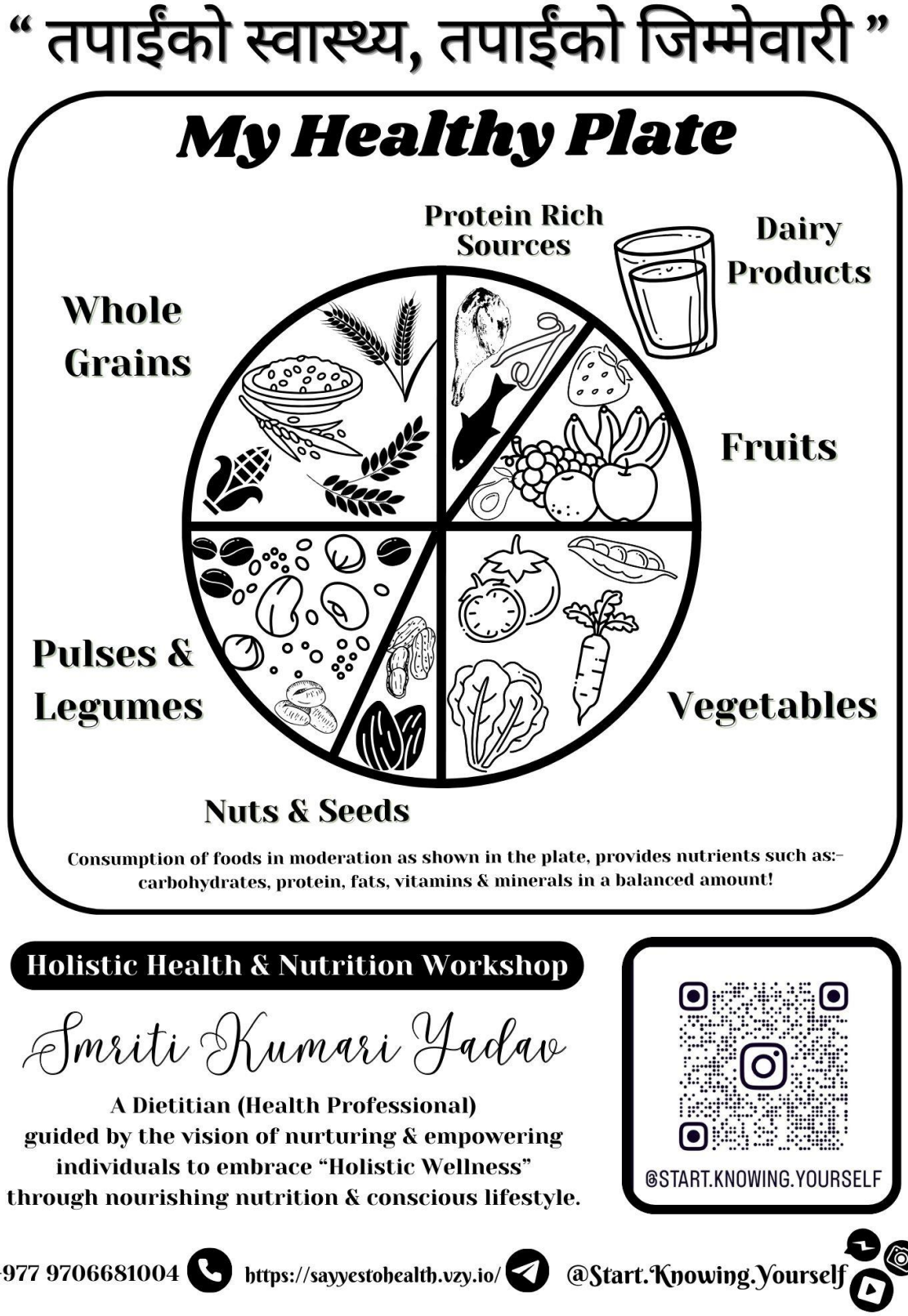
_____ _____

Participant's Signature Participant Parent/Guardian Signature

Participant Name_____ Guardian Name _____

Appendix B: Workshop Information Sheet

Appendix C: ICE Materials Distributed



Appendix D: Food Sources Sheets Provided

भिटामिन र खनिज युक्त खानेकुरा

भिटामिन A (ए) युक्त खानेकुरा:

- अन्न : बाजा, मकै
- दाल/गेडागुडी : चनाको दाल, भट्मास
- सागसब्जी : सुटुनी, फर्सी, लट्टेको साग, गाजर, पालुङगो को साग, गुन्द्रुक, ब्रोकाउली, करेला
- फलफूल : आँप, सुन्तला, मेवा
- अन्य : अन्डा, घिउ, दुधजन्य खानेकुरा, नौनी, घिउ

आइरन युक्त खानेकुरा:

- अन्न : फापर, गहुँ, लिटो, कोदो
- दाल/गेडागुडी : भट्मास, सोयाबिन, कालो दाल, मटर, बेसन, चना
- सागसब्जी : सिस्नु, च्याउ, ब्रोकाउली, गुन्द्रुक, सिमि, चुकंदर, रातो बोडी, फुलकोपी
- फलफूल : भूइकठहर, अनार, स्ट्रबेरी
- नट्स/सिड्स : तिल, काजु, हाडे बदाम, मरिच, किसमिस
- अन्य : कलेजो, पनिर, झिंगि माछा , कुखुराको मासु, माछा, अण्डा, सुगुरको मासु

भिटामिन B (बि) युक्त खानेकुरा:

- अन्न : ओटस, कोदो, जौ, गहुँ, प्रसोधित नगरेको/खैरो चामल
- दाल/गेडागुडी : कालो दाल, मुङ दाल, चनाको दाल, बोडी
- सागसब्जी : च्याउ, हरियो सागपात, ब्रोकाउली, पालुङगो
- फलफूल : केरा, स्ट्रबेरी, किवी, एभोकाडो, अमिलो फलफूल
- अन्य : कलेजो, माछा, अन्डा, दुध, बदाम

क्याल्सियम युक्त खानेकुरा:

- अन्न: कोदो, लिटो, ओट्स, गहुँ, चामल, चिउरा, भुजा
- दाल/गेडागुडी : राजमा, भट्मास, बेसन, कालो दाल, गहत
- सागसब्जी : गुन्द्रुक, लट्टे , सिस्नु , ब्रोकाउली, गाजर
- फलफूल : अमला, कागती, अङ्गुर, केरा, स्ट्रबेरी
- नट्स/सिड्स : जिरा, दालचीनी, मरिच, नरिवल, आलस
- अन्य: चीज, पनिर, दुध, रोहु माछा, सिङी माछा, खसीको मासु

भिटामिन C (सि) युक्त खानेकुरा:

- सागसब्जी : लट्टे, बन्दाकोपी, फुलकोपी, सिमि, मुला, सिमला मिर्च
- प्रकृति अमिला फलफूल : अमला, अम्बा, कागती, सुन्तला, मेवा, खुर्सानी, टमाटर, किवी
- अन्य : माछा, कलेजो

जिङ्क युक्त खानेकुरा:

- फर्सीको बीउ, काजु, तिल, हाडे बदाम, बदाम, एभोकाडो
- अन्न, चना, मुङ दाल, केराउ, च्याउ
- कुखुराको मासु, सुगुरको मासु, भैंसीको मासु
- दुध र दुधजन्य खानेकुरा, अन्डा, डार्क चकलेट

Appendix E: Habit Tracker (Challenge Worksheet)

Challenge Worksheet

Challenge Name	*Day 1*	*Day 2*	*Day 3*	*Day 4*	*Day 5*	*Day 6*	*Day 7*
Hydration							
Food Tracker							
Problem Identification							
Holistic Vision							
System Creation							
Sleep Quality							
Healthy Plate							
Energy Density							
Holistic Living							
Feedback & Journal (Behavior Change)							

Appendix F: Holistic Intervention Workshop In-depth Schedule

Week	Main Theme	Content	Activities	Queries	Purpose
1	Introductory Session	➵ Introducing the Intervention Research ➵ Need for Concern & Approval of Parents (Consent Form for both Parents & Student) ➵ Consent & approval of Attending weekly sessions & both data collection	➵ Distribution of Consent Form (for both data collection & Attending Educational Sessions)	➵ Concept of Blue Zones	Providing Clarity about the Importance of attending & participating in the Research
2	Base Line Data Collection	➵ ABCD **(Anthropometry, Biochemical Data, Clinical Signs, Dietary Patterns)** Data Collection with Consent of both Parents & Students			
3	Holistic Wellbeing In-depth and Self-Assessment	➵ What Does Health Mean to YOU? ➵ Concept of Holistic Well-being & Wellness Wheel ➵ Self-Assessment Tools and Habit Tracking Methods	➵ Maintaining Regular Food Journal ➵ Next Session : Bring most consumed packaged food items	➵ How much Score did you got in self-assessment? ➵ How much are you willing to improve by next week? ➵ How much conscious you are of body?	ProvidingClarity on the concept of Holistic Health & Wellbeing
4	Wholesome v/s Packaged Food Items & Myth Bursting	➵ Food Labeling & Food products Discussion ➵ Macro & Micro Nutrients ➵ Better Food Options ➵ Healthy Plate ➵ Sources of Vitamins & Minerals	➵ Collect most consumed packaged food items ➵ ”CATEGORY DISTRIBUTION” ➵ Foods to Avoid, Eat in Moderation ➵ Next Session: List of Disease in family members and name of disease	➵ What food Products are you going to AVOID, EAT from today	Providing Clarity of the Quality of the Foods & Diet they already consume
5	Disease & Preventions	➵ TYPES/FREQUENCY OF FOOD CONSUMED ➵ HOW FOOD Plays a vital role in both types of Diseases ➵ HOW TO PREVENT & TREAT DISEASES! ➵ General Idea of Healthy Plate in Practical Ways	➵ Disease List Out ➵ Categorization into Chronic/Non-com and Communicable ➵ Adverse Effects of such Diseases ➵ For Next Session: How much do you exercise? & how much do you sleep?	➵ Foods to AVOID, EAT & in Moderation? ➵ What are your weekly health goals	Providing clarity on how our daily choices have long term effects on our health & longevity
6	Circadian	➵ Myths of Weight	➵ TIMING OF FOOD	➵ First drink and	Provide the

	Rhythm & Atomic Habits	Loss Diets, quick and easy fix, skin and aging etc. ➵ Sustainable Diet - ➵ Problems and Diseases caused by unhealthy eating timings and habits ➵ Most preferred eating habits	CONSUMED ➵ UNDERSTAND your natural body ➵ Next Session: Bring a picture of your lunch plate	last meal & it's timing ➵ What changes are you going to bring from today?	power of timings & body's natural rhythm in relation to health & longevity
7	Healthy Diet Principles	➵ Macro & Micro nutrients and its importance ➵ DAME (Digestion, Absorption, Metabolism & Elimination) ➵ Healthy Food Plate and Actual food plate Comparison ➵ Variety & Seasonal Fruits	➵ Next Session: Show your rainbow plate	➵ How much varieties do you eat?	Providing Practically Applicable Health & Nutrition Principles
8	Infradian Rhythm	➵ DIET FOR YOU BASED ON YOUR CYCLE, ➵ LIFESTYLE for your female hormonal system	➵ Next Session: What are super foods? ➵ Next Session: Does Food has an Impact on the Brain and its power? ➵	➵ What changes in your lifestyle would you implement	Providing clarity on the unique system of female hormonal cycle
9	Super Foods, Food for Brain Power & Mindful Eating	➵ Super Foods ➵ Interrelationship of everything in Life ➵ Food for Brain Power ➵ Mindful Eating ➵ Right Time, Quality, Quantity, ➵ Season, Cooking Method	➵ Next Session: Career Goals, Personal Goals, Health Goals?	➵ What super foods would you consume from today ➵ Summarize the growth you experienced after the sessions	Providing Access to Authentic knowledge on Nutrition
10	Holistic Living	➵ Holistic Living ➵ Ikigai (Art of Living a fulfilled life) ➵ 3 A's cycle of growth	➵ Health Goals Career Goals, Personal Goals?	➵ Feedback Session	Providing an inclusive guidance on purposeful living with holistic health & nutrition
11	Conclusion & End Line Data Collection				

Appendix G: Feedback Sheet

Feedback Journal

Week 1	
Week 2	
Week 3	
Week 4	
Week 5	
Week 6	
Week 7	
Week 8	
Week 9	
Week 10	

Appendix H: Research Instruments

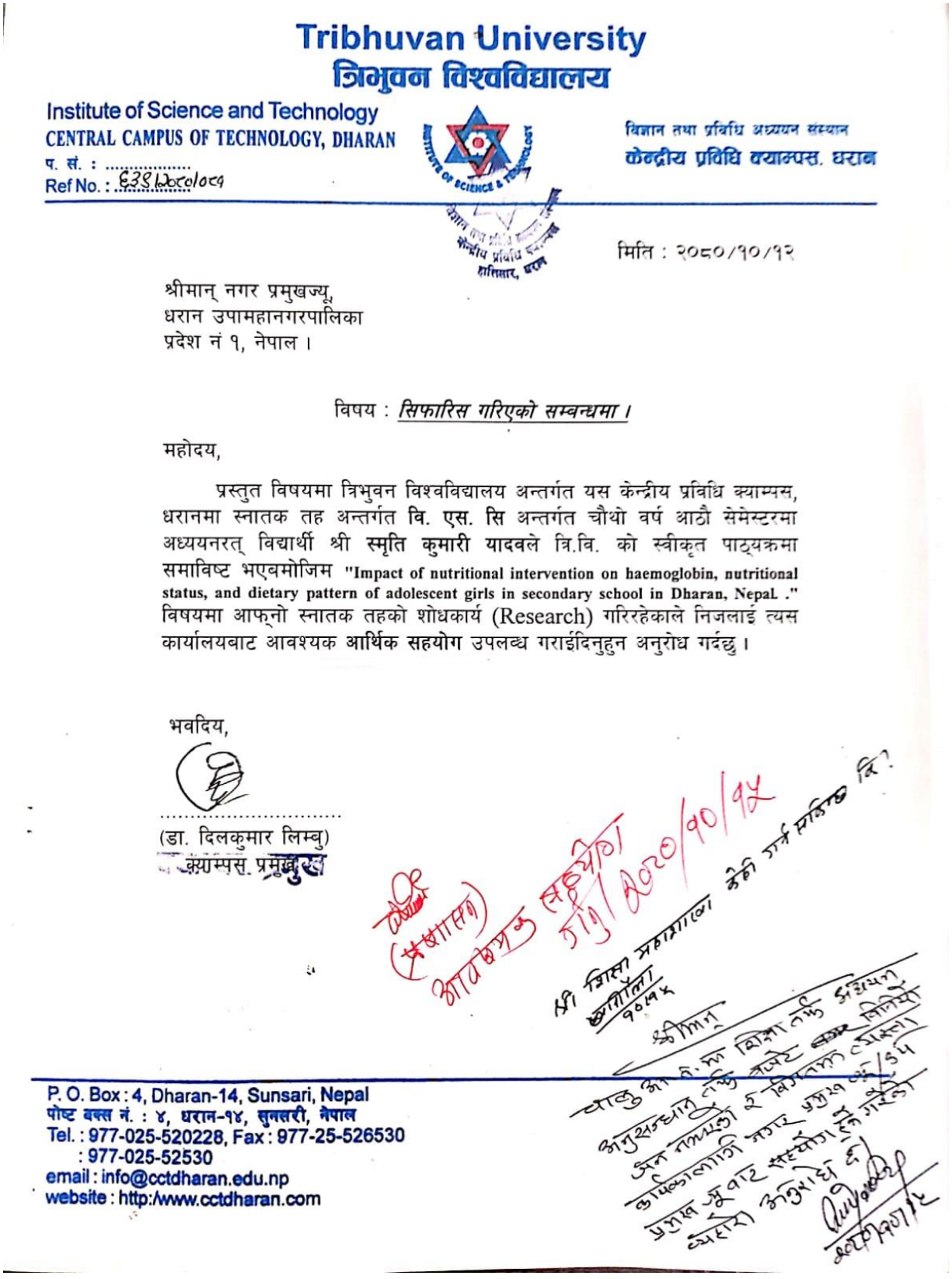
Source: Seca

Seca 876 Weighing Balance

Source: ShorrBoards®

Seca 876 Weighing Balance

Appendix I: Approval Letter from Dharan Sub-metropolitan Municipality



Tribhuvan University
त्रिभुवन विश्वविद्यालय

Institute of Science and Technology
CENTRAL CAMPUS OF TECHNOLOGY, DHARAN
विज्ञान तथा प्रविधि अध्ययन संस्थान
केन्द्रीय प्रविधि क्याम्पस, धरान

प. सं. : .....
Ref No. : 638/2076/077

मिति : २०७०/१०/१२

श्रीमान् नगर प्रमुखज्यू,
धरान उपामहानगरपालिका
प्रदेश नं १, नेपाल ।

विषय : *सिफारिस गरिएको सम्बन्धमा ।*

महोदय,

प्रस्तुत विषयमा त्रिभुवन विश्वविद्यालय अन्तर्गत यस केन्द्रीय प्रविधि क्याम्पस, धरानमा स्नातक तह अन्तर्गत वि. एस. सि अन्तर्गत चौथो वर्ष आठौं सेमेस्टरमा अध्ययनरत् विद्यार्थी श्री स्मृति कुमारी यादवले त्रि.वि. को स्वीकृत पाठ्यक्रमा समाविष्ट भएबमोजिम **"Impact of nutritional intervention on haemoglobin, nutritional status, and dietary pattern of adolescent girls in secondary school in Dharan, Nepal ."** विषयमा आफ्नो स्नातक तहको शोधकार्य (Research) गरिरहेकाले निजलाई त्यस कार्यालयबाट आवश्यक आर्थिक सहयोग उपलब्ध गराईदिनुहुन अनुरोध गर्दछु ।

भवदिय,

.....
(डा. दिलकुमार लिम्बु)
क्याम्पस प्रमुख

P. O. Box : 4, Dharan-14, Sunsari, Nepal
पोष्ट बक्स नं. : ४, धरान-१४, सुनसरी, नेपाल
Tel. : 977-025-520228, Fax : 977-25-526530
: 977-025-52530
email : info@cctdharan.edu.np
website : http://www.cctdharan.com

Letter from Central Campus of Technology

Tribhuvan University
त्रिभुवन विश्वविद्यालय

Institute of Science and Technology
CENTRAL CAMPUS OF TECHNOLOGY, DHARAN
प. सं. : .....
Ref No. : ६४९।२०८०।०८९

विज्ञान तथा प्रविधि अध्ययन संस्थान
केन्द्रीय प्रविधि क्याम्पस, धरान

मिति : २०८०/११/०४

श्रीमान् प्रिन्सिपलज्यू,

धरान उपमहानगरपालिका, नेपाल ।

विषय :- **स्वीकृति प्रदान गरिदिनु हुन बारे ।**

महोदय,

प्रस्तुत विषयमा राष्ट्रिय योजना आयोगले प्राथमिकता तोके बमोजिम यस क्याम्पसमा शैक्षिक सत्र २०६७।०६८ देखि नेपालमै पहिलो पटक स्नातक तहमा बि.एस्सी.न्यूट्रिशन एण्ड डाईटेटिक्स विषयको शैक्षिक कार्यक्रम सञ्चालन भईरहेको व्यहोरा श्रीमान्मा अवगत गराउन चाहन्छु । सो विषयको पाठ्यक्रममा समाविष्ट भए बमोजिम **चौथो वर्ष आठौं सेमेस्टर**मा ३०० पूर्णाङ्कको डिजर्टेशन कार्य गर्नुपर्ने भएकोले हाल बि.एस्सी.न्यूट्रिशन एण्ड डाईटेटिक्स चौथो वर्ष आठौं सेमेस्टरमा अध्ययनरत विद्यार्थी **स्मृति कुमारी यादवले "Impact of nutritional intervention on hemoglobin, nutritional status, and dietary patterns of adolescents in Secondary schools in Dharan, Nepal."** विषयमा शोधकार्य गर्न गईरहेकोले सो कार्यको आवश्यक सर्वेक्षण कार्य गर्नका लागि निजलाई अनुमति प्रदान गरी दिनु भई शोध कार्यमा आवश्यक सहयोग गरिदिनु हुन हार्दिक अनुरोध गर्दछु । यस क्याम्पसको शैक्षिक उन्नयनको लागि त्यस परिषद्बाट प्राप्त हुने सहयोगको लागि हार्दिक धन्यवाद ज्ञापन गर्न चाहन्छु ।

भवदीय,

.....
डा. दिलकुमार लिम्बु
क्याम्पस प्रमुख
के.प्र.क्या., धरान

P. O. Box : 4, Dharan-14, Sunsari, Nepal
पोष्ट बक्स नं. : ४, धरान-१४, सुनसरी, नेपाल
Tel. : 977-025-520228, Fax : 977-25-526530
: 977-025-52530
email : cctdharan14@gmail.com
website : http:/www.cctdharan.edu.np

Letter from Department of Nutrition & Dietetics

Tribhuvan University
त्रिभुवन विश्वविद्यालय

Institute of Science and Technology
CENTRAL CAMPUS OF TECHNOLOGY, DHARAN
प. सं. : .....
Ref No. : .....

विज्ञान तथा प्रविधि अध्ययन संस्थान
केन्द्रीय प्रविधि क्याम्पस, धरान

मिति : २०८०/११/०४

यो जो संग सम्बन्धित छ

विषय :- स्वीकृति प्रदान गरिदिनु हुन बारे ।

महोदय,

प्रस्तुत विषयमा राष्ट्रिय योजना आयोगले प्राथमिकता तोके बमोजिम यस क्याम्पसमा शैक्षिक सत्र २०६७।०६८ देखि नेपालमै पहिलो पटक स्नातक तहमा बि.एस्सी.न्यूट्रिशन एण्ड डाईटेटिक्स विषयको शैक्षिक कार्यक्रम सञ्चालन भईरहेको व्यहोरा श्रीमान्मा अवगत गराउन चाहन्छु । सो विषयको पाठ्यक्रममा समाविष्ट भए बमोजिम चौथो वर्ष आठौं सेमेस्टरमा ३०० पूर्णाङ्कको डिजर्टेशन कार्य गर्नुपर्ने भएकोले हाल बि.एस्सी.न्यूट्रिशन एण्ड डाईटेटिक्स चौथो वर्ष आठौं सेमेस्टरमा अध्ययनरत विद्यार्थी **स्मृति कुमारी यादवले "Impact of nutritional intervention on hemoglobin, nutritional status, and dietary patterns of adolescent girls in Secondary schools in Dharan, Nepal."** विषयमा शोधकार्य गर्न गईरहेकोले सो कार्यको आवश्यक सर्वेक्षण कार्य गर्नका लागि निजलाई अनुमति प्रदान गरी दिनु भई शोध कार्यमा आवश्यक सहयोग गरिदिनु हुन हार्दिक अनुरोध गर्दछु । यस क्याम्पसको शैक्षिक उन्नयनको लागि त्यस परिषद्बाट प्राप्त हुने सहयोगको लागि हार्दिक धन्यवाद ज्ञापन गर्न चाहन्छु ।

भवदीय,

HEAD OF DEPARTMENT
NUTRITION & DIETETICS

कविन्द्र भट्टराई
सुपरीवेक्षक/उप–प्रध्यापक
पोषण तथा आहार विज्ञान विभाग, के.प्र.क्या., धरान ।

P. O. Box : 4, Dharan-14, Sunsari, Nepal
पोष्ट बक्स नं. : ४, धरान-१४, सुनसरी, नेपाल
Tel. : 977-025-520228, Fax : 977-25-526530
: 977-025-52530
email : cctdharan14@gmail.com
website : http:/www.cctdharan.edu.np

Appendix J: Baseline Survey Questionnaire

Baseline Health & Nutritional Status Questionnaire

General Information

Class Code:	Student's Code:
Name:	
Gender / Age:	Date of Birth (AD):
Phone No.:	Address:

Socio-Ecological Background

1	Religion	a. Hindu b. Muslim c. Christian d. Buddhist e. Other
2	Caste / Ethnicity	a. Brahmin b. Chhetri c. Janajati d. Dalit e. Other _____
3	Type of family	a. Nuclear b. Joint No. of Family Members _____
4	Occupation of Father	a. Agriculture b. Service/Job c. Business d. Labor e. Foreign Employment f. Other
5	Occupation of Mother	a. Home Maker b. Service/Job c. Agriculture d. Labor e. Foreign Employment f. Other
6	Monthly Total Family Income	a. NPR 15,000-30,000 b. NPR 30,000 – 60,000 c. NPR 60,000 – 1,00,000 d. NPR >1,00,000
7	Main Source of Food	a. Purchased from Market b. Own Kitchen Garden c. Both

Anthropometric Measurement (BMI Calculation)

Weight (Kg)	Height (cm)	**BMI** (kg/m²)

BMI-For-Age Classification: a. Very Thin b. Thin c. Normal d. Overweight e. Obese

Clinical Signs

8	Bowel Movement Frequency	a. Daily	b. In Every 2 Days	c. Less than twice a week
9	Stool/feces Consistency	a. Formed/Normal	b. Loose	c. Hard
10	Acne/ Pimple Problems	a. No	b. Yes	
11	Acne Severity	a. Mild	b. Moderate	c. Severe
12	Period Cycle	a. Regular	b. Irregular	
13	Menstrual Pain	a. Mild	b. Moderate	c. Severe

Behavioral Factor

14	Sleep Quality	a. Very Good	b. Moderate	c. Not Good
15	Sleep Duration	a. 5-9 Hr	b. Less than 5 Hr	c. More than 9 Hr
16	Physical Activity (run, swim, yoga, dance)	a. Daily	b. Every other day	c. Less than twice a week
17	Daily Walk Routine	a. Yes, Minimum 20-30 minutes		b. Not much, less than 15 minutes
18	Domestic Activities	a. Yes, Minimum 30 minutes		b. Not much, less than 30 minutes

Dietary Habits

19	Water Intake	a. 30 minutes Before & After Meal		b. With Meal
20	Screen Time with Meal	a. No	b. Yes	
21	Meals per Day	a. 3-5 times	b. 2-times	c. more than 5-times
22	School Lunch	a. Bring Food from Home c. Buy Fast / Processed Food		b. Buy Meal from Cafeteria d. Skip Meal
23	Dietary Preference	a. Pure Vegetarian		b. Non-Vegetarian

Food Frequency Table

Food Products	Daily	3 – 4 Times per week	Once a week	Once a Month	Never
Wholesome Food Products					
Millet / Maize / Buckwheat					
Beaten Rice					
Nuts (Almond, Walnut, Cashew)					
Seeds (Flax, Pumpkin, Sesame)					
Fruits (Raw & Seasonal)					
Dark Green Leafy Vegetables					
Dairy & It's Products					
Highly Processed Food Products					
Packaged Juice / Drink					
Carbonated Drinks					
Refined Grains					
Packaged Food					
High Sugar Sweets					
Restaurant / Fast Foods					

Diet Quality Questionnaire for Nepal

S.N.	Food Products	Yes	No
Yesterday, did you eat any of the following foods:			
1	Rice, paratha, naan, pau roti, or momo?		
2	Roti, whole grain bread, maize, millet, barley, sorghum, buckwheat, or dhindo?		
3	Potato, yam, wild yam, or white sweet potato?		
4	Daal, chickpeas, beans, soybeans, or quanti?		
Yesterday, did you eat any of the following vegetables:			
5	Carrots or ripe yellow pumpkin?		
6	Saag, spinach, mustard greens, fennel greens, pumpkin shoots, taro leaves, or amaranth greens?		
7	Gundruk, chamsur palungo, fenugreek greens, or broccoli?		
8	Tomatoes, cauliflower, cabbage, gourd, or eggplant?		
9	Bitter gourd, bottle gourd, green pumpkin, lady finger, or radish?		
Yesterday, did you eat any of the following fruits:			
10	Papaya, ripe mango, apricots, or persimmon?		
11	Orange, pomelo, grapefruit, or kumquat?		
12	Apple, banana, avocado, watermelon, mulberries, amla, or guava?		
13	Grapes, raisins, peaches, plums, pomegranate, Asian pear, or jackfruit?		
Yesterday, did you eat any of the following sweets:			
14	Cakes, biscuits, cookies, donuts, haluwa, jeri or jalebi?		
15	Mithai, kheer, chocolates, candies, toffees, or ice cream?		
Yesterday, did you eat any of the following foods of animal origin:			
16	Eggs?		
17	Paneer or cheese?		

18	Dahi, butter milk, or lassi?		
19	Sausages, ham, bacon, or canned meat?		
20	Goat, mountain goat, lamb or sheep, buffalo, or yak?		
21	Local pig or hybrid pig?		
22	Chicken, duck, or pigeon?		
23	Fish or dried fish?		
Yesterday, did you eat any of the following other foods:			
24	Almonds, peanuts, cashews, pistachios, or walnuts?		
25	Chips, Kurkure, Chisbal, Dalmoth, or Bhujiya?		
26	Wai Wai *(Chow Chow)?*		
27	Samosa, pakora, sel roti, puri, or tareko khaja?		
Yesterday, did you have any of the following beverages:			
28	Milk, tea with milk, or powdered milk?		
29	Chiya with sugar, coffee with sugar, milk with sugar, Horlicks or Bournvita?		
30	Fruit juice, fruit drinks such as Real or Frooti, or sugar cane juice?		
31	Sweet bottled drinks such as Coke, Fanta, or Sprite, or energy drinks such as Red Bull?		
Yesterday, did you get food from any place like...			
32	KFC, Pizza Hut, or other places that serve pizza or burgers?		

24-hr Recall

Did you have any occasion yesterday: a. Yes b. No

If Yes, What foods did you consumed from yesterday morning to night?

Timing	Food Items Consumed	Serving
Breakfast		
Lunch		
Snacks		
Dinner		
Bed Time		

Thank you for completing the survey.

Signature of respondent _____

Appendix K: Endline Survey Questionnaire

Endline Health & Nutritional Status Questionnaire

General Information & Anthropometric Measurement

Class:	Weight (Kg):
Name:	Height (cm) :

Clinical Signs

Bowel Movement Frequency	a. Daily	b. In Every 2 Days	c. Less than twice a week
Stool/feces Consistency	a. Formed/Normal	b. Loose	c. Hard
Acne/ Pimple Problems	a. No	b. Yes	
Acne Severity	a. Mild	b. Moderate	c. Severe
Period Cycle	a. Regular	b. Irregular	
Menstrual Pain	a. Mild	b. Moderate	c. Severe

Behavioral Factor

Sleep Quality	a. Very Good	b. Moderate	c. Not Good
Sleep Duration	a. 5-9 Hr	b. Less than 5 Hr	c. More than 9 Hr
Physical Activity (run, swim, yoga, dance)	a. Daily	b. Every other day	c. Less than twice a week
Daily Walk Routine	a. Yes, Minimum 20-30 min		b. Not much, less than 15 min
Domestic Activities	a. Yes, Minimum 30 min		b. Not much, less than 30 min

Dietary Habits

Water Intake	a. 30 minutes Before & After Meal		b. With Meal
Screen Time with Meal	a. No	b. Yes	
Meals per Day	a. 3-5 times	b. 2-times	c. more than 5-times
School Lunch	a. Bring Food from Home c. Buy Fast / Processed Food		b. Buy Meal from Cafeteria d. Skip Meal

Food Frequency Table

Food Products	Daily	(3 – 4) times/week	Once a week	Rarely (month)	Never
Millet / Maize /Buckwheat					
Beaten Rice					
Nuts					
Seeds					
Fruits					
Green Leafy Vegetables					
Dairy & It's Products					
Packaged Juice / Drink					
Carbonated Drinks					
Refined Grains					
Packaged Food					
High Sugar Sweets					
Restaurant / Fast Foods					

24 hr Recall

Timing	Food Items Consumed	Serving
Breakfast		
Lunch		
Snacks		
Dinner		

Diet Quality Questionnaire for Nepal

S.N.	Food Products	Yes	No
Yesterday, did you eat any of the following foods:			
1	Rice, paratha, naan, pau roti, or momo?		
2	Roti, whole grain bread, maize, millet, barley, sorghum, buckwheat, or dhindo?		
3	Potato, yam, wild yam, or white sweet potato?		
4	Daal, chickpeas, beans, soybeans, or quanti?		
Yesterday, did you eat any of the following vegetables:			
5	Carrots or ripe yellow pumpkin?		
6	Saag, spinach, mustard greens, fennel greens, pumpkin shoots, taro leaves, or amaranth greens?		
7	Gundruk, chamsur palungo, fenugreek greens, or broccoli?		
8	Tomatoes, cauliflower, cabbage, gourd, or eggplant?		
9	Bitter gourd, bottle gourd, green pumpkin, lady finger, or radish?		
Yesterday, did you eat any of the following fruits:			
10	Papaya, ripe mango, apricots, or persimmon?		
11	Orange, pomelo, grapefruit, or kumquat?		
12	Apple, banana, avocado, watermelon, mulberries, amla, or guava?		

13	Grapes, raisins, peaches, plums, pomegranate, Asian pear, or jackfruit?		
Yesterday, did you eat any of the following sweets:			
14	Cakes, biscuits, cookies, donuts, haluwa, jeri or jalebi?		
15	Mithai, kheer, chocolates, candies, toffees, or ice cream?		
Yesterday, did you eat any of the following foods of animal origin:			
16	Eggs?		
17	Paneer or cheese?		
18	Dahi, butter milk, or lassi?		
19	Sausages, ham, bacon, or canned meat?		
20	Goat, mountain goat, lamb or sheep, buffalo, or yak?		
21	Local pig or hybrid pig?		
22	Chicken, duck, or pigeon?		
23	Fish or dried fish?		
Yesterday, did you eat any of the following other foods:			
24	Almonds, peanuts, cashews, pistachios, or walnuts?		
25	Chips, Kurkure, Chisbal, Dalmoth, or Bhujiya?		
26	Wai Wai *(Chow Chow)?*		

27	Samosa, pakora, sel roti, puri, or tareko khaja?		
Yesterday, did you have any of the following beverages:			
28	Milk, tea with milk, or powdered milk?		
29	Chiya with sugar, coffee with sugar, milk with sugar, Horlicks or Bournvita?		
30	Fruit juice, fruit drinks such as Real or Frooti, or sugar cane juice?		
31	Sweet bottled drinks such as Coke, Fanta, or Sprite, or energy drinks such as Red Bull?		
Yesterday, did you get food from any place like...			
32	KFC, Pizza Hut, or other places that serve pizza or burgers?		

Feedback "How was the 10 week workshop"

Informative & Helpful	Yes	No	**Interactive & Interesting**	Yes	No
Improved your Health	Yes	No	**Want more of such Class**	Yes	No

Suggestion to Improve the Workshop

_____

_____

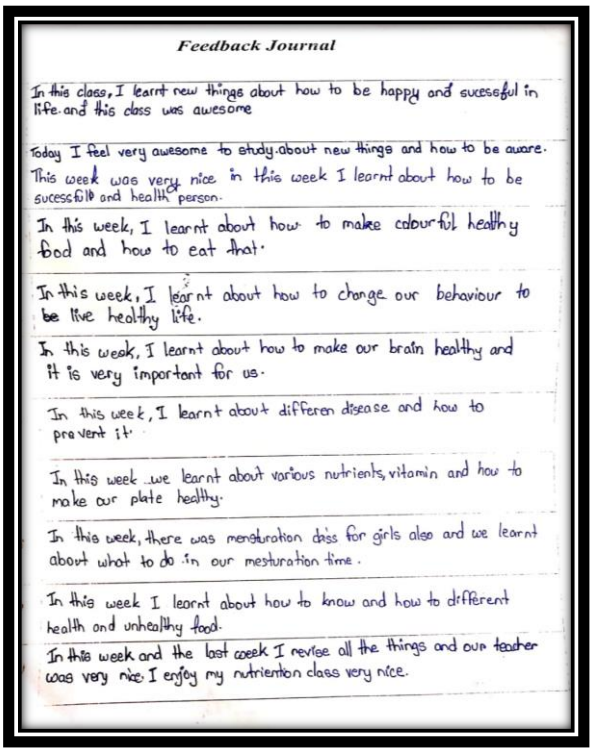
_____

Thank you, Signature of respondent _____

Appendix L: Visual Documentation

1. Orientation and Closure Session

2. Baseline and Endline Data Collection



Feedback Journal

In this class, I learnt new things about how to be happy and sucessful in life and this class was awesome

Today I feel very awesome to study about new things and how to be aware.

This week was very nice in this week I learnt about how to be sucessfull and health person.

In this week, I learnt about how to make colourful healthy food and how to eat that.

In this week, I learnt about how to change our behaviour to be live healthy life.

In this week, I learnt about how to make our brain healthy and it is very important for us.

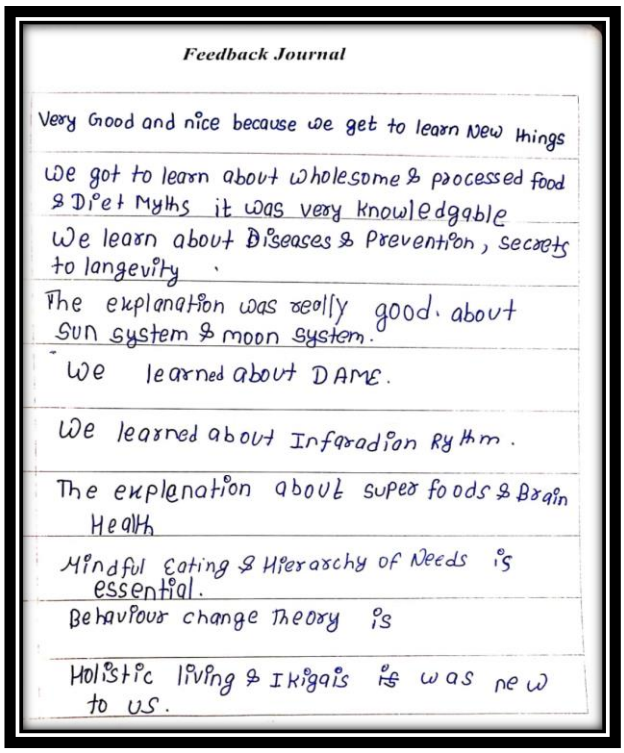
In this week, I learnt about differen disease and how to prevent it.

In this week we learnt about various nutrients, vitamin and how to make our plate healthy.

In this week, there was menstruation class for girls also and we learnt about what to do in our mesturation time.

In this week I learnt about how to know and how to different health and unhealthy food.

In this week and the last week I revise all the things and our teacher was very nice. I enjoy my nutrientan class very nice.



Feedback Journal

Very Good and nice because we get to learn New things

We got to learn about wholesome & processed food & Diet Myths it was very knowledgable

We learn about Diseases & Prevention, secrets to langevity

The explanation was really good about sun system & moon system.

We learned about DAME.

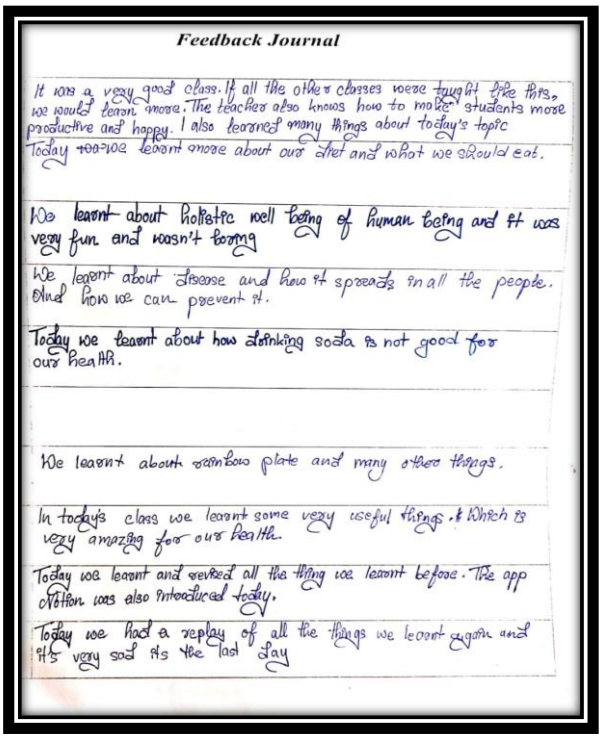
We learned about Infaradian Rythm.

The explanation about super foods & Brain Health

Mindful Eating & Hierarchy of Needs is essential.

Behaviour change theory is

Holistic living & Ikigais is was new to us.



Feedback Journal

It was a very good class. If all the other classes were taught like this, we would learn more. The teacher also knows how to make students more productive and happy. I also learned many things about today's topic

Today we learnt more about our diet and what we should eat.

We learnt about holistic well being of human being and it was very fun and wasn't boring

We learnt about disease and how it spreads in all the people. And how we can prevent it.

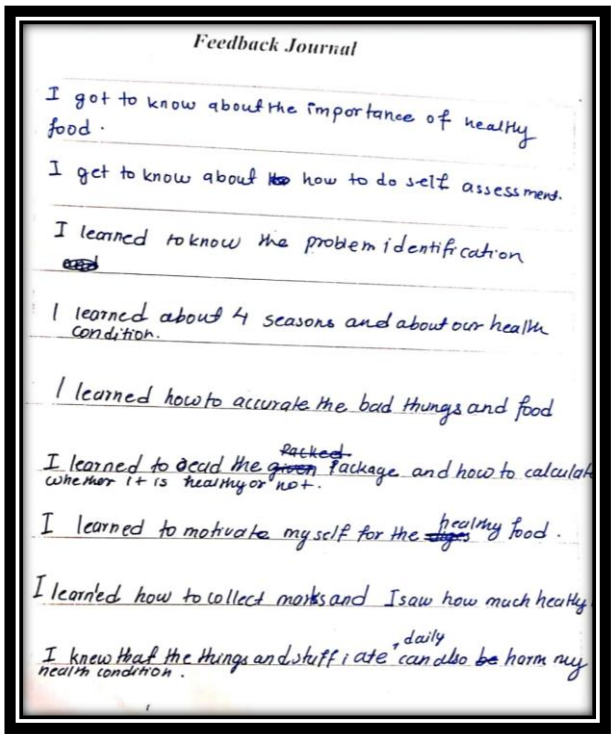
Today we learnt about how drinking soda is not good for our health.

We learnt about rainbow plate and many other things.

In today's class we learnt some very useful things. Which is very amazing for our health.

Today we learnt and revised all the thing we learnt before. The app action was also interactive today.

Today we had a replay of all the things we learnt again and it's very sad its the last day



Feedback Journal

I got to know about the importance of healthy food.

I get to know about ~~how~~ how to do self assessment.

I learned to know the problem identification

I learned about 4 seasons and about our health condition.

I learned how to accurate the bad thungs and food

I learned to acid the ~~green~~ packed package and how to calculate whether it is healthy or not.

I learned to motivate myself for the ~~days~~ healthy food.

I learn'ed how to collect marks and I saw how much healthy

I knew that the things and stuff i ate daily can also be harm my health condition.

3. Feedback Forms

4. Anthropometric Measurements

5. Workshop on Food Labeling

6. Interactive Sessions