

Review Article

Evaluation of Childhood Dietary Patterns and Their Impact on Nutrition Status: A Literature Review

Bishnu Kumar Adhikari¹ , Surendra Giri² , Prakash Sharma^{3,*} 

¹Department of Health, Physical and Population Education, Sanothimi Campus, Faculty of Education, Tribhuvan University, Bhaktapur, Nepal

²Research Centre for Educational Innovation and Development, Tribhuvan University, Kathmandu, Nepal

³Department of Education, Butwal Multiple Campus, Faculty of Education, Tribhuvan University, Butwal, Nepal

Abstract

One of the main public health issues in underdeveloped nations like Nepal is malnutrition, which is closely related to dietary practices. Child malnutrition has been one of the major public health issues of the twenty-first century in the world. A search of some electronic databases was conducted to identify research involving nutritional status of children. A total 19 studies were identified in this review. The aim of this study was to assess the nutritional status and dietary pattern of children and its related factors. The study was conducted based on literature review. The search of literature from scholar.google.com, pubmed.com, jstor.com, nepjol.info, tucl.remotexs.co (proquest.com search.ndltd.org) were used for the study. A total of 140 full-text papers were identified from electronic sources. Among 140 full-text papers, irrelevant papers were excluded. Only English medium literature about dietary patterns and nutritional status of children were included in this study. Sixteen studies were related to nutritional status of children and three studies were related to dietary pattern of children. The results of study showed low nutritional status of children of different countries. The result of the study showed that different behaviors related to eating habits promote the nutritional status of children. Dietary behavior strongly correlates nutritional status of children. Similarly, children are facing numerous nutritional problems due to the lack of exclusive breast feeding, maternal education, disease prevalence and low socio-economic condition. Especially the children are suffered from the problem of stunting and wasting in rural area. Most of the studies have been centered in an urban area. The study suggested to conduct appropriate nutritional intervention programs regarding school children and their mothers.

Keywords

Dietary Pattern, Malnutrition, Nutritional Status, School Children

1. Introduction

The dietary pattern is directly related with malnutrition, which is one of the biggest problems of public health in developing countries like Nepal [1]. Malnutrition is caused by a

lack of food intake [2]. Childhood malnutrition has been serious public health issue of the twenty-first century in the world [3]. An estimated 92 million children are at risk of

*Corresponding author: prakash_sharma65@yahoo.com (Prakash Sharma)

Received: 6 April 2024; Accepted: 28 April 2024; Published: 17 May 2024



Copyright: © The Author(s), 2024. Published by Science Publishing Group. This is an **Open Access** article, distributed under the terms of the Creative Commons Attribution 4.0 License (<http://creativecommons.org/licenses/by/4.0/>), which permits unrestricted use, distribution and reproduction in any medium, provided the original work is properly cited.

overweight, with 43 million already overweight or obese, predominantly in developing nations [4]. Since 1990, global obesity rates, particularly among preschool-aged children, have risen significantly, potentially reaching 9% or 60 million individuals if current trends persist [4]. Likewise, childhood obesity correlates with increased risks of various diseases, including hypertension, type 2 diabetes, heart disease, gallbladder issues, sleep disorders, and respiratory problems, indicating the multifaceted health impacts of child malnutrition [4]. Similarly, there were 5.2%, 4.7%, and 3.7% children have been suffered from mild to severe underweight, short height, and slimness, respectively in Iran [5]. Another similar study reported that, the severe malnutrition of child was observed to steadily increased from 11% in 2003 to 18% in 2013 for wasted; 24% in 2003 to 29% in 2013 for underweight, even though there was a decline from 42% in 2003 to 37% in 2013 for stunting children [6]. Childhood is the most nutritionally demanding times of life. They need enough nutrients to support the growth and maintenance of their body which comes through the foods. Foods can be friendly or hostile to us depending on the situation [7].

Therefore, today many parents are struggling to make their children healthy eating habits due to the pressures of modernized lifestyle [8]. A study found that, among the fifty children, 38% were stunted as per height-for-age (10% were severe stunting and 28% were moderately stunting), similarly, 18% were underweight as per weight-for-age (4% were severe underweight, 14% moderately underweight) and 6% were thinned regarding the BMI-for-age (2% were severely thinned and 4% were moderately thinned (p. 45) [9]. In the same way, another study revealed that nearly 37% of Nepalese children are underweight, 41% are stunted and 11% are wasting. They are at significantly higher risk of severe malnutrition and mortality due to inadequate dietary consumption, frequent effect of diarrhea, respiratory disease and various infections which were the contributing factors with malnutrition [10]. Because of low consumption of balanced diets, vegetables, and fruits in developing countries, nutritional deficiencies and associated health problems are prevalent [11]. In addition, another study showed that, the development of child nutrition is being slowed down by inadequate maternal nutrition, poor feeding practices, socioeconomic, cultural, and regional disparities in access to resources and services. Similarly, stunting-related considerable disparities in food habits and nutritional status still exist and have even grown wider. This tendency runs counter to the government's pledge to increase equity and shows that focused activity is required to reach children [12].

In this way, a study showed that there is low level of im-

plementations of law and constitutional supports for the security of food and malnutrition of children. Therefore, policy related to nutrition and legislations may not work in isolation but it needs to coordinate with concerns to improve the situation of exclusive breastfeeding, poor nutrition during pregnancy, bad consumption of vitamins supplement or food fortification, vaccination, poor hygiene, and lack of education of parents in addition [13]. In this backdrop this study aimed to assess the dietary pattern and nutritional status of children through this review.

2. Materials and Methods

Information for this review articles were collected from different published articles i.e. terms searched were 'School children', 'Food pattern', 'Nutritional status'. In the same way, further data was collected through different related books, research articles, and related website. The criteria of inclusion and exclusion were fixed by above mentioned key term.

Literatures were reviewed purposively for getting insight with the meaning to dietary pattern as well as nutritional status of children. The published literatures were obtained from different databases including scholar.google.com, pubmed.com, jstor.com, nepjol.info, tucl.remotexs.co (proquest.com search.ndltd.org). Most of the databases were taken by the access of Tribhuvan University, Graduate School of Education. Approximately 140 full-text papers were identified from different sources of electronic media. Among them, irrelevant papers were excluded in this study. Only English medium literature about dietary patterns and nutritional status of school children were included.

Other relevant literatures were also used to analyze and discuss the situation of dietary pattern and nutritional status. Selected articles were examined and results of them were synthesized in sub-topics by using thematic analysis. The details processes to identify the eligible articles for review are presented in figure 1.

Inclusion and Exclusion criteria

Articles related to dietary patterns and nutritional status of children less than 14 years, published in English language are included in this review. Similarly, the related factors such as food habit, nutritional supplementary practice, socio-economic factors, maternal education, and nutritional status of urban and rural children were considered while appraising the articles. But the articles unable to obtain dietary habit and nutritional status related information, specific malnutrition issues and the articles other than in the English language were excluded in this review.

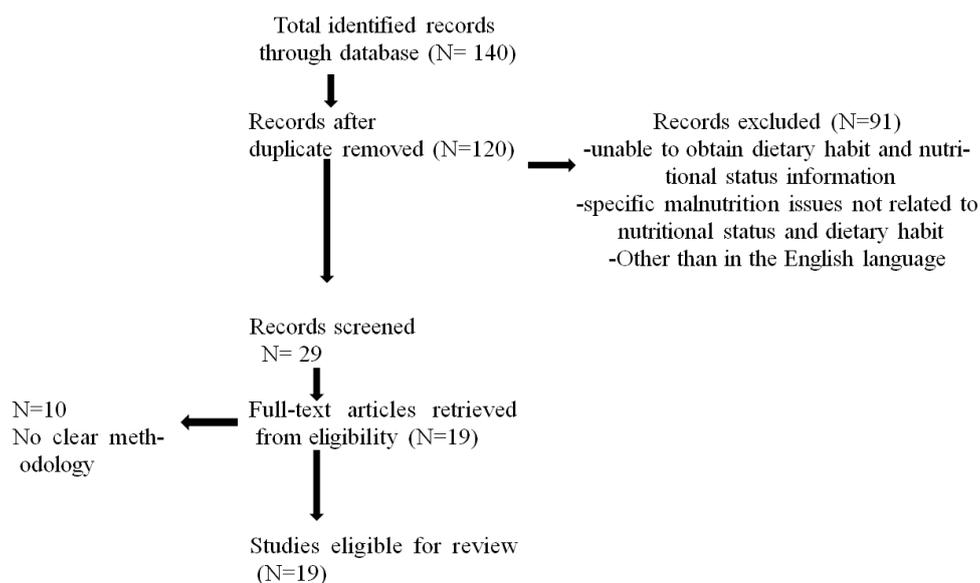


Figure 1. Flow diagram of the study.

3. Result

The searched articles were based on quantitative and qualitative as well as mixed method research approach. Nineteen studies met these criteria for inclusion in this review. The studies were found in the Nepal (9), India (3), Egypt (2), Mexico (1), Nigeria (1), Bangladesh (1) Bhutan (1) and the China (1). Among them, sixteen studies were included related

to nutritional status of children and three studies were related to dietary habits/food intake linked with malnutrition of children. The 19 studies were reviewed from different aspects of the nutrition status and dietary patterns of children. Their aims were mainly to identify food intake/dietary patterns and nutritional status of children as well as its related factors. The details of the review are presented in [table 1](#).

Table 1. Descriptions of the Main Components of the Studies Reviewed.

Author/Year	Title	Objective	Research method/Design	Results/findings
(Cuanalo de la Cerda et al., 2014)	Food consumption and nutrition status in children 1–4 years in Yucatan, Mexico	To identify the main causes of malnutrition in preschool children in the Yucatan.	Methods: A human ecology approach as well as life history theory	The height and weight of children were significantly correlated with age and intake of food. Consumption of calorie and protein for different levels of HAZ showed a remarkable proportion (20.7%) of the selected children to be stunted. Study also found that, of the stunting rate 19.3% represented rural area similarly, 61% were found overweight in rural area.
(Abdulhamid et al., 2017)	The micronutrients adequacy from complementary foods among infant under 2 years in Alexandria, Egypt	To find out the dietary habits and micronutrients adequacy from complementary foods among infant under 2 years.	Cross-sectional study design	Study revealed the rate of stunting, wasting, underweight for age, overweight and obesity of children were 37%, 12.8%, 16.7%, 19.5% and 18.1% respectively.
(El-kader et al., 2019)	Dietary Habits and Nutritional Knowledge among Primary School Children in Fayoum Governorate, Egypt	To examine the dietary intake and nutritional knowledge in primary school children of Fayoum Governorate, Egypt.	A cross-sectional descriptive design	Out of total 69.3% children were underweight, 36.3% stunting, and 6.7% and 3.3% were overweight and obesity, respectively. In total, 45% children had reasonable knowledge, where as 34% had a good knowledge about nutrition. More than fifty percent children had unhealthy eating food

Author/Year	Title	Objective	Research method/Design	Results/findings
(Omuemu & Ogboghodo, 2020)	Nutritional Factors as well as Academic achievement in Primary School Children of an Urban City in Southern Nigeria	To observe the association between nutritional factors and academic achievement in primary school children of Benin City	Descriptive design	behaviour. The stunted, underweight, thinness and overweight were found 16.9%, 10.6%, 24.1% and 8.0%, respectively. The children who skipped breakfast (10.9%) had a significantly higher underachievers in comparison with children who did not skip breakfast ($p < 0.001$). About 341 (53.4%) were from public school and 315 (49.3%) of them belonged to a lower socio-economic class. Wasted were higher at public school (28.7%) than in private school (18.8%), whereas obesities were significantly higher at private school 35 (11.7%)
(Haque et al., 2014)	Nutritional status and hygiene practices of primary school children in Bangladesh	To assess the nutritional status and basic hygiene practices in primary school children of Dhaka city, Bangladesh.	A cross-sectional descriptive research design	It is found that most (93.6%) of schoolchildren were underweight (BMI) and few (6.4%) had normal BMI. 66.40% children were boys and 33.60% were girls in this study. Regarding the WAZ, 19.10% were below normal, 79.10% were normal, and 1.80% were above normal. Similarly, in HAZ, 11.80% were below normal, 80% were normal, and 2.70% were above normal. for WHZ, 18.20% were below normal, 55.50% were normal, and 1.80% were above normal.
(Kang et al., 2018)	Nutritional status as well as risk factor for stunting in pre-school children of Bhutan	To identify the anthropometric status and risk factor regarding malnutrition in children of 0–59 month	Descriptive study	The stunting, wasting, underweight, and obese were 21.2%, 2.6%, 7.4%, and 2.6%, respectively. Whereas, 50% of mothers were either no education (35.4%) or in-formal education (15.4%) only.
(Zhao et al., 2017)	Dietary diversity scores: an indicator of micronutrient inadequacy instead of obesity in children of China	To carried out and predict inappropriate micronutrients intake using DDS in the children of china	Descriptive/ Cross-sectional study	The study concluded that, there is no correlation between dietary diversity and obesity in this study population.
(Pal et al., 2021)	Undernutrition and Related Factors in Children Aged 5-10 in West Bengal, India	To examine the child malnutrition and associated risk factor of West Bengal, India	A community-based cross-sectional study	The stunting, underweight, and thinness occurred in 25.48%, 33%, and 26.88% of children, respectively. Among the total 81.5% participants were from rural area and 18.5% were from urban area.
(Pal & Bose, 2017)	The anthropometric characteristic in children of rural primary school at Hooghly District, West Bengal of India	To assess the anthropometric characteristics of primary school children	Cross-sectional study	There were significant sex differences in all anthropometric variables. The F value regarding the girl found that significant age differences were observed in all anthropometric variables. The children had height, weight and BMI lower than the reference value of (WHO, 2006) and (National Centre for Health Statistics, 2012)
(Kumar et al., 2022)	The Assessment of Nutritional Status in Children using Anthropometrics Measurement in India (Rural area of Bihar)	To appraise the nutrition status of 5-12 year using anthropometric measurement	Prospective study	In terms of stunted status, about 101 (50.5%) were observed as normal. About 44 (22%) had mild stunting, 24 (12%) moderate stunting and 31 (15.5%) severe stunting. Similarly, in the wasted status, approximately 130 (65%) were found to be normal. About 30 (15%) had mild wasting, 27 (13.5%) moderate wasting and 13 (6.5%) severe wasting.

Author/Year	Title	Objective	Research method/Design	Results/findings
(Dhungana, 2014)	Nutritional status and associated factor of under-five in Kunchha VDC of Lamjung	To examine the variables that affect young children's nutritional status	Descriptive cross sectional study	Out of total, 60%, were normal, 32%, were mild malnutrition, 4% were moderate malnutrition, and 4% were severe malnutrition on the basis of Gomez classification
(Banstola & Acharya, 2015)	Nutritional status of primary school children in the village of Pumdi Bhumdi in the Kaski district	To carried out nutritional status as well as related socio-demographic factors at primary school children of Pumdi Bhumdi village in Kaski district	A descriptive cross sectional design	The study revealed prevalence rates of 35.4%, 44.2% and 12.3% for underweight, stunting and wasting, respectively
(Joshi et al., 2011)	The determinants of nutritional status of school children in Kaski district	To assess the prevalence of under-nutrition in school children of 4 – 14years and the role of socio-demographic characteristics of mother in their child' nutrition.	A descriptive research design	Among 786 students, 26% were undernourished, 13% stunting, 12% wasting and only 1% both stunting and wasting. More than fifty percent were in the 6-10 age group. The prevalence of malnutrition in the age groups 6-10 and 11-14 years were the same (29.4% and 30.4%, respectively)
(Ruwali, 2011)	Nutritional Status of Children Under 5 and Associated factors in Padampur VDC of Chitwan	To examine the variables that are related to young children's nutritional status	A community based cross-sectional descriptive survey design.	The underweight, stunting, and wasting all had prevalence rates of 22.7%, 37.3%, and 25.7%, respectively
(Shrestha et al, 2020)	Children's Nutritional Status and Its Associated Factors in Earthquake-affected VDCs in Gorkha District,	To assess nutritional status and related factor of 6-10-years in earthquake-affected areas of Gorkha district	Mixed method (quantitative and qualitative)	Research resulted that 31.9% were underweight, 51.9% were stunting and 2.9% were wasting. Similarly, maternal education was significantly associated with child underweight and stunting
(Koirala et al, 2015)	Prevalence Factor associated with obese in private school children of Nepal	To identify the prevalence factor associated with malnutrition in primary school children.	Cross-sectional descriptive design.	Among 986 respondents, 14.6% was overweight and 11.3% was obese. In overall, 25.9% children was revealed to be overweight.
(Warren, 2018)	Nutritional status and Feeding practice of 0-24 months age group of urban and rural area in east-central Nepal	To assess the nutritional status and Breastfeeding practice, complementary feeding practices in 0-24 months of age, of Nepal.	Descriptive, A cross-sectional study	Study revealed that, stunting, wasting, and underweight were discovered in 12.6%, 9.0%, and 20.7% of the children, respectively. Regarding food habits and access to healthcare, there were no significant differences between children living in rural and urban settings.
(Bhandari & Chhetri, 2013)	The Nutritional Status in Under -5 Children and associated Factors of Kapilvastu District, Nepal	To find out the nutritional status of under-five and factor associated with malnutrition in children	The descriptive under cross-sectional design	The study concluded that, 60% of children were suffered malnutrition and nearly 1/4 th were in critical situation.
(Chataut & Khanal, 2016)	The nutritional status of under 5 children in rural Kavre and Dolakha district of Nepal	To find out the nutritional status and factors associated with malnutrition of under 5 year children	Descriptive research design	Out of 243 children, nearly 37% of children are underweight, 41% were stunted and 11% were wasted.

Table 1 showed that, among the total, none of them did the study of correlation between food habits and nutrition status of children. Regarding the research design, out of 19 studies, 16

studies used descriptive cross - sectional research design, one study used mixed method research design and remaining study used perspective and human ecological approach together

with life history theory. In the context of using tools, among the 19 studies, most of them 12 (63%) used questionnaire, few study (10.52%) used interview schedule and remaining study used different database and guideline of different organizations as a tool for data collection. Therefore, interview schedule is also needed to collect the factual data.

The findings of this study were that, the maximum underweight are seen in rural area in different country and thinness is significantly higher in public school students than in private school students. This review found that some studies have been conducted on under 5 children even though very few study have been conducted on late childhood aged of 6-12 years in foreign countries with a notable absence of such studies within the Nepalese context. Among the total, majority of them have used questionnaire as a tool whereas focus group discussion, in-depth interview, phenomenological studies are seemed to be needed to identify the hidden problems of malnutrition and its related factors.

4. Discussion

This review study revealed that in various countries, 93.6% of individuals were underweight, 65.3% were stunted, 29.9% were obese, and 26.88% were wasted. In the specific context of Nepal, among the total population, 51.9% were found to be stunted, 37.87% were underweight, 25.9% were obese, and 25.7% were wasted, as reported in various studies included in this review. Nutritional status of children were affected by different factors which were found in different reviewed articles such as: geographical area, basic hygiene practice, eating behavior/food habits, age and sex, socio-economic factors, maternal education, ANC checkup, exclusive breastfeeding, and disease prevalence.

4.1. Nutritional Status of Children in Urban and Rural Area

Among the 19 studies, 58% studies were conducted in urban area and remaining were conducted in rural area. Although most of the studies conducted in rural area were from outside the country of Nepal in this review. A study found that, the stunting, underweight, and thinness occurred in 25.48%, 33%, and 26.88% of children, respectively. The study also reported that most of the participants (81.5%) were from rural area and 18.5% from urban area. This study clearly indicates that maximum underweight is seen in rural area [14]. However, another study revealed that, stunting, wasting, and underweight were discovered in 12.6%, 9.0%, and 20.7% of the children, respectively. Even though the study also found in contrast that, regarding the food habits and access to healthcare, there were no significant differences between children living in rural and urban setting [15]. Contradictorily, a study identified that 22% mild stunting, 12% moderate stunting and 15.5% severe stunting. Similarly, in the wasted status, 15% had mild wasting, 13.5% moderate wasting and

6.5% severe wasting found in rural area [16].

Our study resulted that, the height and weight of children was significantly correlated with age group and total food consumption. The calorie and protein consumption to different levels of height for age Z-Score showed about 20.7% of the children to be stunting. Study also found that, of the stunting rate 19.3% represented rural area, among them, 61% were found overweight in rural area. Furthermore, study resulted that area of living of child is crucial to decide food habits. Comparatively, the percentage of pupils who lived in metropolitan area had lunch at home was 84.8 percent, compared to 86.7 percent of those who lived in a non-metropolitan area. These percentages of lunch at home were 92.1 and 50.9 in the metropolitan and non-metropolitan region respectively [17]. Another similar study found that most of the school children (93.6%) were underweight (BMI) and few (6.4%) had normal BMI. Out of total, 66.40% were boys and 33.60% were girls. Regarding the weight for age Z-score, 19.10% were below the normal, then 79.10% were normal range and 1.80% was above the normal range. This study also found that, 11.80% were below normal height for age Z-score, 80% were normal, and 2.70% was above normal height for age Z-score. Regarding the weight for height Z-score, 18.20% were below normal range, 55.50% were normal, and 1.80% were above the normal range [18].

Regarding the personal hygiene, study showed that schoolchildren consistently practiced good hygiene. Every single respondent cleansed their hands with soap before and after eating and after using the restroom. When coming inside from the outside, 98.67% cleansed their hands. When it comes to brushing their teeth, guys brushed their teeth an average of 77.78%, 17.78%, and 4.44% times per day. Whereas girls brushed their teeth an average of 66.67%, 20%, and 13.33% times per day.

Similarly, 93.33% of girls and 97.78% of boys were sandals all day. But the majority of the children were underweight; from class 1 to class 5. It was 80%, 73.33%, 86.67%, 80%, and 77.33% respectively [19].

4.2. Dietary Pattern and Nutritional Status of Children

In our investigation, one study concluded that 60% of children were suffering from various forms of malnutrition, with a quarter of them being in severe situations requiring immediate treatment [20]. Conversely, another study concluded that, there is no correlation between dietary diversity and obesity in the research population [21].

A cross-school descriptive study conducted to investigate the association between cereal-based diets and nutritional status found that the prevalence of stunting among Higher Secondary School and Primary School students was 26.73% and 23.47%, respectively [22]. In this regard, a study revealed that 16.9% were stunted, 10.6% were underweight, 24.1% were wasted, and 8% were overweight; additionally, children

who had skipped breakfast (10.9%) exhibited significantly ($p < 0.001$) higher rates of underachievement compared to those who did not [23]. In the same way, food and nutrition related study tabulated that, eating foods containing animal sources was linked to a lower risk of stunting and underweight. In addition, eating foods derived from animals reduced stunting and improved other anthropometric measures that contributed to a decline in morbidity and death among undernourished children [11].

In relation to behavior, more than 50% of the children had unhealthy eating behaviors and appearance. Among them, 69.3% of the children were underweight, 36.3% were stunted, and 6.7% and 3.3% were overweight and obese, respectively. This study also claimed that dietary habits among school children represented a major health concern as they were suffering from different types of malnutrition such as stunting, wasting especially in rural area.

Most of the studies were centered in an urban area in this review. Dietary habits of children were affected by different factors, as identified in various reviewed articles, such as living area, infection, food items, and feeding of extra milk and milk products [24].

In the study of non-metropolitan pupils, it was reported that 52% of them were eating homemade foods in either the classroom or the garden, and 36% in the school canteen. Whereas in metropolitan children, they did not take lunch from home; 19.5% of children made their own sandwiches, nearly 41.5% went to restaurants, and 39.5% ate at the school cafeteria. Similarly, in the non-metropolitan area, 98.2% of pupils reported eating chips, 91.8% reported eating hamburgers, and 54.2% reported that they were drinking Coke and soda [17]. However, in the metropolitan area, 48.9% of the children consumed chocolate, wafer, and candy, 96.8% of students ate chips, and 83.5% of students ate hamburgers and bread [25].

Regarding the consumed food items and infection, out of 243 children, nearly 37% were underweight, 41% were stunted and 11% were wasted in Kavre and Dolakha district of Nepal. In addition, study also revealed that, infection susceptibility and sensitivity might be increased by undernutrition and a compromised immune system. Malnutrition in children is mostly brought by insufficient food intake and recurrent respiratory and diarrheal illnesses. Even mild to moderate malnutrition puts children's health at risk and causes a variety of infections, in addition to severe malnutrition p. 76 [10]. This study was focused on the factors associated with malnutrition of children in rural Nepal. The factors were inadequate food habits, diarrhea and respiratory disease and various infections. They were related with malnutrition and dietary habits of the children.

4.3. Nutritional Status, Age and Sex of the Children

A study observed significant sex differences in all anthropometric variables.

Likewise, the analysis revealed a significant F value denoting substantial age differentials in anthropometric measures such as height, weight, and BMI, all registering values below the reference standards outlined by WHO 2006 and NCHS 2012 [26]. Similar to this, a study portrayed that, stunted, wasted, underweight in terms of age, overweight and obese were 37%, 12.8%, 16.7%, 19.5% and 18.1% children respectively in the age of 6- 24month [27]. In contrast, an additional investigation focusing on adults revealed prevalence rates of underweight at 10% and stunting at 53.2%; further analysis within this study identified a higher prevalence of underweight among males (3%) compared to females (2.2%), while conversely indicating a higher prevalence of stunting among females (65.3%) as opposed to males (59.9%) [11]. Conclusively, the collective findings from these studies underscored a higher prevalence of underweight among children, with a parallel observation indicating that boys exhibited a greater prevalence of underweight while girls demonstrated a higher incidence of stunting.

A study using multistage, stratified, random cluster sampling design on 1555 (806 boys and 749 girls) students aged 6 to 17 through anthropometric measurement guideline and survey questionnaire which found that the overweight and obesity were 15.43% and 11.06%, respectively, together with 26.2% students were in intra-individual double burden of malnutrition [28]. In this regard, another study found almost same kind of nutritional problem that out of total, 26% were undernourished, 13% were stunting, 12% wasting, and only 1% were both stunting and wasting. The prevalence of malnutrition in the age groups 6-10 and 11-14 years was almost the same 29.4% and 30.4%, respectively [29]. Similarly, there were underweight (30.85%), stunting (24.54%) and wasting (10.05%) in rural school students in Kavre district of Nepal. The finding further indicated that 37.87% were underweight, 29.59% stunted and 11.25% thin among the boys, while 26.27% were underweight, 21.24% stunted and 9.27% wasted in girls. A higher rate of underweight, stunted and wasted was seen in boys than girls [30].

4.4. Nutritional and Socio-Economic Status of the Children

The prevalence rates of stunted, underweight, wasted, and overweight were found to be 16.9%, 10.6%, 24.1%, and 8.0%, respectively. Those who skipped breakfast (10.9%) exhibited a significantly higher proportion of underachievement compared to those who did not. Among the total students in public schools, 49.3% had a low socio-economic status in this study. Additionally, the study noted a significantly higher proportion of wasting among public school students (28.7%) compared to private school students (18.8%), while obesity was more prevalent among private school students (11.7%) than public school students (4.7%) [23]. These findings showed that most of undernourished children are seen in public schools, which were linked with lower socio-economic class.

A similar study revealed that, prevalence rates of 35.4%, 44.2% and 12.3% for underweight, stunted and wasted, respectively. Stunting was higher in primary school children which were from the low socio-economic class [31]. However in contrast, another study reported that among 986 children, 14.6% and 11.3% were overweight and obese respectively. In total, (25.9%) children were found obese in the age of 6-13 year. The result showed that the greater prevalence of malnutrition both underweight as well as overweight in Nepal that push further researcher to study. The study observed that children born in family with high socio-economic status, they were 3.5 times more overweight compared to lower socio-economic status of the family [32].

4.5. Nutritional Status, Maternal Education and Feeding Practices of Extra Milk

A study found that the prevalence of stunting was 21.2%, while wasting, underweight, and overweight were reported at 2.6%, 7.4%, and 2.6%, respectively. Meanwhile, half of the mothers of the children had either no education or informal education only [33]. Similarly, more than 68% mothers of malnourished students were illiterate compared to (56%) normal child. The percentage of undernourished children's mothers in low socio economic category were nearly double than normal children. Literacy of mother, occupation, monthly income and knowledge regarding food habits of mother were found highly significant association ($p < 0.005$) with the status of child malnutrition [29]. Likewise, another study revealed that 31.9%, 51.9%, and 2.9% underweight, stunted and wasted respectively. This study also claimed that, maternal education was significantly associated with child underweight and stunting [34].

Regarding the feeding practice of extra milk, it was reported that underweight (22.7%), stunting (37.3%), and wasting (25.7%) were observed, all revealing a higher percentage of stunting among children under the age of 10. This study also found a significant association between the feeding practice of extra milk and the number of antenatal check-up with nutritional status at a 5% significance level. Similarly, feeding extra milk were associated with nutritional status. The mother who did not visit for ANC check-up had 7.54 times more likely to be malnutrition than the mother who visited more than four times. Most of the children (61.9%) were normal and 38.1% were malnourished from exclusive breastfeeding (≥ 6 month) and among the total, 50% were suffered from malnutrition whose mother who skipped exclusive breast feeding (< 6 month) [35]. However, in contrast, breastfeeding and children with complementary foods were not statistically significant ($p > 0.05$) [36].

Regarding the prevalence of malnutrition, a study conducted in government schools in Nepal revealed that 61% of the children were malnourished, with 21.5% exhibiting stunting and 10.4% experiencing wasting. Additionally, only 5.4% children were both wasted and stunted. The study also

found that parasite infestation was present in 65.8% of cases and anemia was present in 58%, skin disorders (20%), dental decay (19.8%), and lymphadenopathy (10.5%) were the most prevalent illnesses in those schools. Among the skin diseases, parasite infestations account for 65.8% of cases of anemia. In such schools, dental caries (19.8%), skin infections (20%), and lymphadenopathy (10.5%) were the most prevalent illnesses. This article posited that counseling plays a pivotal role in enhancing positive dietary behaviors [37]. In this way, another study of Iran revealed that, risk of malnutrition has been decreasing after complementary food combined with nutritional education and counseling intervention in the category of weight for age Z-score, weight for height Z-score, and height for age Z-score. This study also concluded that, appropriate counseling can be the key to promote nutritional status of children [38]. Likewise, another study of Nigeria resulted that dietary counseling was linked to nutritional status; those who received it were more likely to be of a normal weight and less likely to be obese than those who did not [39]. Another study also concluded that school children consumed an excessive amount of ultra-processed meals, which was linked to bad eating habits. This demonstrates the requirement for nutritional counseling and educational initiatives that encourage children to eat well [40].

Another reviewed study in Nepal revealed that, based on the Gomez's classification of under-five malnutrition, 60% exhibited mild malnutrition, 32% moderate malnutrition, and 4% severe malnutrition. Regarding the consumption of extra milk or milk products, the study found significant correlations between nutritional status and factors such as breastfeeding history, consumption of fast food, and intake of canned or bottled beverages. Furthermore, the study highlighted a robust association between the practice of providing additional milk and the nutritional status of children, underscoring its impact on their overall nutritional well-being. Additionally, the findings of this study underscored a greater vulnerability of school children to malnutrition [41]. Regarding the food habits, picky eaters consumed more milk and dairy products than non-picky eaters. Picky eaters were normal weight status in terms of weight-for-age, height-for-age and BMI-for-age compared to non-picky eaters ($p < 0.05$). Picky eater came from a household with other picky eater in the family and their parents tend to use an instrumental feeding style. Picky eater had a poorer cognitive function compared to non-picky eater ($p = 0.03$) [42]. In the context of maternal education, a study showed that, (83.3%) mother were playing good role and (16.7%) mothers were playing poor role with regard to the nutritional status of their infant and toddler. However, this study concluded that there were no significant associations between the education of the mother and good nutritional status of their infant and toddler [43]. Contrary to this finding, mother's education in promoting child nutrition status was found to be significant in a study conducted in Nepal [44].

5. Conclusion

The collective findings of various studies underscore the prevalence of low nutritional status among children. Varieties

of behaviors promote certain dietary habits and affect the nutritional status of children and, consequently, the nutritional well-being of children. Strong correlations exist between dietary behaviors and nutritional status. Moreover, factors such as maternal education, availability of counseling, disease prevalence, and socioeconomic conditions significantly impact the nutritional status of children, leading to health issues like stunting and wasting. The effective utilization of nutrients is influenced by multiple factors. Thus, it is vital to prioritize healthy eating patterns and ensure adequate nutrient intake to address malnutrition problem comprehensively. This review underscores the critical nature of malnutrition among the school children, emphasizing the urgent need for dietary habits and nutritional status focused research and interventions tailored to their needs.

Author Contributions

Bishnu Kumar Adhikari: Conceptualization, data curation, investigation, methodology, project administration, software, validation, visualization, writing – original draft, writing – review and editing

Surendra Giri: Conceptualization, formal analysis, project administration, resources, supervision, validation, visualization, writing - review and editing

Prakash Sharma: Conceptualization, formal analysis, methodology, project administration, supervision, validation, visualization, writing - review and editing

Funding

This study did not receive any funding.

Conflicts of Interest

The authors declare no conflicts of interest.

References

- [1] Udash, P. (2017b). Nutritional Status of 5 to10 Years Children of Namje, Vedetar VDC of Dhankuta District [Dissertation, Tribhuvan University] Global.
- [2] WHO. (2013). Essential Nutrition Actions: Improving Maternal, Newborn, Infant and Young Child Health and Nutrition. World Health Organization. <https://www.ncbi.nlm.nih.gov/books/NBK258720/>
- [3] Serón-Arbeloa, C., Labarta-Monzón, L., Puzo-Foncillas, J., Mallor-Bonet, T., Lafita-López, A., Bueno-Vidales, N., & Montoro-Huguet, M. (2022). Malnutrition screening and assessment. *Nutrients*, *14*(12), 2392. <https://doi.org/10.3390/nu14122392>
- [4] Wang, Y., & Lim, H. (2012). The global childhood obesity epidemic and the association between socio-economic status and childhood obesity. *International Review of Psychiatry*, *24*(3), 176-188. <https://doi.org/10.3109/09540261.2012.688195>
- [5] Motedayen, M., Dousti, M., Sayehmiri, F., & Pourmahmoudi, A. A. (2019, Apr). An Investigation of the Prevalence and Causes of Malnutrition in Iran: a Review Article and Meta-analysis. *Clin Nutr Res*, *8*(2), 101-118. <https://doi.org/10.7762/cnr.2019.8.2.101>
- [6] Kalu, R., & Etim, K. (2018). Factors associated with malnutrition among underfive children in developing countries: A review. *Global Journal of Pure and Applied Sciences*, *24*(1), 69-74.
- [7] Moore, H. B. (1957). The Meaning of Food. *The American Journal of Clinical Nutrition*, *5*(1), 77-82.
- [8] Haines, J., Haycraft, E., Lytle, L., Nicklaus, S., Kok, F. J., Merdji, M., Fisberg, M., Moreno, L. A., Goulet, O., & Hughes, S. O. (2019, 2019/06/01/). Nurturing Children's Healthy Eating: Position statement. *Appetite*, *137*, 124-133. <https://doi.org/10.1016/j.appet.2019.02.007>
- [9] Udash, P. (2017a). *Nutritional Status of 5 to10 Years Children of Namje, Vedetar VDC of Dhankuta District*. Institute of Science and Technology Tribhuvan University.
- [10] Chataut, J., & Khanal, K. (2016, Jan-Mar). Assessment of Nutritional Status of Children Under Five years of age in rural Nepal. *Kathmandu Univ Med J (KUMJ)*, *14*(53), 73-77.
- [11] Abdelaziz, S. B., Youssef, M. R. L., Sedrak, A. S., & Labib, J. R. (2015). Nutritional status and dietary habits of school children in Beni-Suef Governorate, Egypt. *Food and Nutrition Sciences*, *6*(01), 54. <https://doi.org/10.4236/fns.2015.61007>
- [12] Chitekwe, S., Torlesse, H., & Aguayo, V. M. (2022). Nutrition in Nepal: Three decades of commitment to children and women. *Matern Child Nutr*, *18* S1, 1-8, e13229. <https://doi.org/10.1111/mcn.13229>
- [13] Prasada, D. V. P. (2016). Impact of Legislature Regarding 'Right to Food' and 'Wheat Fortification' on Child Malnutrition: Cross-country Estimates. *Procedia Food Science*, *6*, 108-112. <https://doi.org/10.1016/j.profoo.2016.02.023>
- [14] Pal, A., Manna, S., Dalui, R., Mukhopadhyay, R., & Dhara, P. C. (2021). Undernutrition and associated factors among children aged 5–10 years in West Bengal, India: a community-based cross-sectional study. *Egyptian Pediatric Association Gazette*, *69*.
- [15] Warren, C. H. (2018). Nutritional status and infant and young child feeding practices among children 0-24 months of age in urban and rural areas of east-central Nepal [Proquest Master's thesis]. *Nutrients*. https://oda.oslomet.no/oda-xmlui/bitstream/handle/10642/6168/warren_maeh2018.pdf?sequence=2&isAllowed=y
- [16] Kumar, A., Gopal, K. V., Prince, K., Srilakshmi, P., Prathana, S., & Manita, G. (2022). A Study on the Assessment of Nutritional Status among Children Using Anthropometric Measurements. *Journal of Clinical and Pharmaceutical Research*, 11-13.

- [17] Cuanalo de la Cerda, H. E., Ochoa Estrada, E., Tuz Poot, F. R., & Datta Banik, S. (2014, 2014/01/01). Food intake and nutrition in children 1–4 years of age in Yucatan, Mexico. *Annals of Human Biology*, 41(1), 46-52.
<https://doi.org/10.3109/03014460.2013.824024>
- [18] Haque, M., Arafat, Y., Roy, S. K., Khan, Z. H., Uddin, A. M., & Pradhania, S. (2014). Nutritional status and hygiene practices of primary school children. *Journal of Nutritional Health & Food Engineering*, 1.
- [19] Hakim, M. A., Talukder, M. J., & Islam, M. S. (2015). Nutritional status and hygiene behavior of government primary school kids in central Bangladesh. *Science Journal of Public Health*, 3(5), 638-642.
- [20] Bhandari, T. R., & Chhetri, M. (2013). Nutritional status of under five year children and factors associated in Kapilvastu District, Nepal. *Journal of Nutritional Health & Food Science*, 1(1), 2-6. www.symbiosisonlinepublishing.com
- [21] Zhao, W., Yu, K., Tan, S., Zheng, Y., Zhao, A., Wang, P., & Zhang, Y. (2017). Dietary diversity scores: an indicator of micronutrient inadequacy instead of obesity for Chinese children. *BMC public health*, 17, 1-11. <https://doi.org/10.1186/s12889-017-4381-x>
- [22] Dorji, T. (2013). Nutritional status of students: An anthropometric comparison between Kanglung Higher Secondary School and Rongthung Primary School. *Sherub Doenme: The Research Journal of Sherubtse College*, 12(1), 55-60.
- [23] Omuemu, V. O., & Ogboghodo, E. O. (2020). Nutritional Factors and Academic Performance of Primary School Children in an Urban City in Southern Nigeria. *Journal of Health and Medical Sciences*, 3(3), 310-321.
<https://doi.org/10.31014/aior.1994.03.03.126>
- [24] El-Kader, R. G. A., Mekhamier, H. A., & Hegazy, A. E.-S. A. (2019). Dietary Habits and Nutritional Knowledge among Primary School Children in Fayoum Governorate. *International Journal of Studies in Nursing*, 4(2).
<https://doi.org/10.20849/ijns.v4i2.593>
- [25] Kukul, K., Sarvan, S., Muslu, L., & Yirmibeşoğlu, Ş. G. (2010). Dietary habits, economic status, academic performance and body mass index in school children: a comparative study. *Journal of Child Health Care*, 14(4), 355-366.
- [26] Pal, S., & Bose, K. (2017). Anthropometric characteristics of rural primary school children of Hooghly District. *Human Biology Review*, 6(1), 30-46.
- [27] Abdulhamid, M. M., Tayel, D. I., Hassanin, N. S., & Amin, A. K. (2017). The adequacy of micronutrients from complementary food among infants less than two years in Alexandria, Egypt. *Int. J. Food, Nutrition and Public Health*, 9(1), 55.
<https://www.researchgate.net/publication/318381156>
- [28] Hu, X., Jiang, H., Wang, H., Zhang, B., Zhang, J., Jia, X., Wang, L., Wang, Z., & Ding, G. (2021). Intraindividual Double Burden of Malnutrition in Chinese Children and Adolescents Aged 6–17 Years: Evidence from the China Health and Nutrition Survey 2015. *Nutrients*, 13(9), 3097.
- [29] Joshi, H., Gupta, R. K., JoshiM, C., & Vipul, M. (2011). Determinants of Nutritional Status of School Children - A Cross Sectional Study in the Western Region of Nepal. *National journal of integrated research in medicine*, 2, 10-15.
- [30] Mansur, D. I., Haque, M. K., Sharma, K., Mehta, D. K., & Shakya, R. (2015). A Study on Nutritional Status of Rural School going Children in Kavre District. *Kathmandu University medical journal*, 13 50, 146-151.
- [31] Banstola, S., & Acharya, B. (2015). Nutritional status of primary school children in Pumdri Bhundi village of Kaski district, Nepal. *Int J Health Sci Res*, 5(5), 339-346.
- [32] Koirala, M., Khatri, R. B., Khanal, V., & Amatya, A. (2015). Prevalence and factors associated with childhood overweight/obesity of private school children in Nepal. *Obesity Research & Clinical Practice*, 9(3), 220-227.
<https://doi.org/10.1016/j.orcp.2014.10.219>
- [33] Kang, Y., Aguayo, V. M., Campbell, R. K., Dzed, L., Joshi, V., Waid, J. L., Gupta, S. D., Haselow, N. J., & West Jr, K. P. (2018). Nutritional status and risk factors for stunting in preschool children in Bhutan. *Maternal & child nutrition*, 14, e12653.
<https://doi.org/10.1111/mcn.12653>
- [34] Shrestha, A., Bhusal, C. K., Shrestha, B., & Bhattarai, K. D. (2020). Nutritional Status of Children and Its Associated Factors in Selected Earthquake-Affected VDCs of Gorkha District, Nepal. *International Journal of Pediatrics*, 2020.
<https://doi.org/10.1155/2020/5849548>
- [35] Ruwali, D. (2011). Nutritional Status of Children under Five Years of age and factors associated in Padampur VDC, Chitwan. *Health Prospect*, 14-18.
- [36] Chee Din, M. A., Mohd Fahmi Teng, N. I., & Abdul Manaf, Z. (2023). Maternal depression and child feeding practices: Determinants to malnutrition among young children in Malaysian rural area. *Women's Health*, 19, 17455057221147800.
- [37] Shakya, S. R., Bhandary, S., & Pokharel, P. K. (2004, Oct-Dec). Nutritional status and morbidity pattern among governmental primary school children in the Eastern Nepal. *Kathmandu Univ Med J (KUMJ)*, 2(4), 307-314.
- [38] Shenavar, R., Sajjadi, S. F., Farmani, A., Zarmehrparioury, M., & Azadbakht, L. (2022, 2022-March-02). Improvement in Anthropometric Measurements of Malnourished Children by Means of Complementary Food and Nutritional Education in Fars Province, Iran: A Community-Based Intervention [Original Research]. *Frontiers in Nutrition*, 9.
<https://doi.org/10.3389/fnut.2022.813449>
- [39] Olatona, F., Airede, C., Aderibigbe, S., & Osibogun, A. (2019). Nutritional knowledge, dietary habits and nutritional status of diabetic patients attending teaching hospitals in Lagos, Nigeria. *Journal of Community Medicine and Primary Health Care*, 31(2), 90-103.
- [40] Fonseca, M. d. M., Coimbra, R. V. G., Oliveira, J. S., Soares, A. D. N., & Gomes, J. M. G. (2023). Consumption of ultra-processed foods and associated factors in children from Barbacena (MG), Brazil. *Revista Paulista de Pediatria*, 42, e2022127.

- [41] Dhungana, G. P. (2014). Nutritional Status Of Under 5 Children And Associated Factors Of Kunchha Village Development Committee. *Journal of Chitwan Medical College*, 3(4), 38-42. <https://doi.org/10.3126/jcmc.v3i4.9553>
- [42] Mok, K. T., Tung, S. E. H., & Kaur, S. (2022). Picky Eating Behaviour, Feeding Practices, Dietary Habits, Weight Status and Cognitive Function Among School Children in Kuala Lumpur, Malaysia. *Malaysian Journal of Medicine and Health Sciences*, 18, 10-18.
- [43] Hasibuan, Y., Batubara, A., & Suryani, S. (2019). Mother's role and knowledge in young children feeding practices on the nutritional status of infant and toddler. *Global Journal of Health Science*, 11(6), 158.
- [44] Sharma, P. (2022). Nutritional practices of the preschool-aged children and associated factors: A cross-sectional study in Rupandehi district of Nepal. *Journal of Health Promotion*, 10(1).