

# Effects of Nutrition Education Intervention on Dietary Habits and Nutritional Knowledge Among Adults in Liberia

J. Nelson Zenegbain

Department Of Public Health, Nimba University Sanniquellie City, Nimba County Liberia

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## ABSTRACT

### Background

This study examined the effects of a nutrition education intervention on dietary habits and nutritional knowledge among adults in Liberia. Six research questions guided the study, which adopted a descriptive survey approach involving adults drawn from five counties in Liberia. Data was collected using a structured questionnaire, and 744 respondents were included in the analysis. The data were analyzed using frequencies, percentages and appropriate inferential statistical techniques. The findings showed that the largest proportion of respondents were aged 20–29 years (46.0%), 56.7% were males, 55.1% were single, 55.4% had tertiary education, and 48.1% were students. Nutritional knowledge improved significantly following the intervention, with the proportion of respondents having good knowledge increasing from 90.9% at pre-intervention to 94.1% at post-intervention and the mean knowledge score increasing from  $13.96 \pm 2.3$  to  $14.37 \pm 1.5$ , although the magnitude of the improvement was small. In contrast, overall dietary practices did not improve after the intervention, as the proportion with good dietary practices decreased from 12.6% to 7.8% and the mean dietary-practice score declined from  $31.12 \pm 3.5$  to  $30.07 \pm 3.4$ . There was also no statistically significant relationship between nutritional knowledge and dietary practices among the respondents. Education level and occupation were significant predictors of nutritional knowledge, while occupation was the major sociodemographic factor associated with dietary practices. Community support, availability of healthy foods, lower food prices and improved cooking skills were significant facilitators of healthier dietary practices, whereas the cost of healthy foods, limited availability, lack of time, family food preferences, lack of motivation, distance to markets, taste preferences and lack of money constituted significant barriers at 0.05 significant levels. The study concluded that the nutrition education intervention produced a modest improvement in nutritional knowledge but did not result in a corresponding improvement in overall dietary practices; therefore, nutrition education programmes should be complemented by measures addressing food affordability, accessibility, practical food-preparation skills and other economic and social barriers to healthy eating.

### Objective:

1. Compare pre- and post-intervention nutritional knowledge among adults in Liberia.
2. Compare pre- and post-intervention dietary practices/habits among adults in Liberia
3. Relationship between nutritional knowledge and dietary behavior changes before and after the intervention among adults in Liberia.

### Methods:

This chapter discussed the research design, study area, study population, sample and sampling process, research instrument, instrument validity, instrument reliability, data collecting method, ethical approval, and method of data analysis.

### Conclusion

This study investigated the effect of a nutrition education intervention on dietary habits and nutritional knowledge among adults in Liberia. The results demonstrated a significant improvement in both areas following

the intervention. Participants showed a marked increase in their understanding of essential nutritional concepts, such as portion control, balanced diets, and the importance of fruits and vegetables.

**Keywords:** Nutrition education, Intervention, Dietary habits, Nutritional knowledge, Adults Healthy eating Liberia.

## INTRODUCTION

Nutrition is defined by the World Health Organization (WHO), as the intake of food in relation to the body's dietary needs (Agedew et al., 2019). Good nutrition provides a mechanism to promote health and prevent disease across all demographic groups, from infancy through childhood to adulthood, male and female alike. Malnutrition is a global public health concern and the largest single contributor to disease in the world. Malnutrition can be in the form of under nutrition, micronutrient deficiency, or over nutrition/obesity. In Sub-Saharan Africa and Africa as a whole, the prevalence of under nutrition has not significantly changed since 2019, whereas the prevalence of global obesity has doubled since 2018; hence, the double burden of malnutrition in this region (Arage et al., 2019).

In low- and middle-income countries, particularly in Liberia, the triple burden of malnutrition, micronutrient deficiencies, under nutrition, and excessive calorie intake is on the rise (Isanovic et al., 2024). These factors all contribute to overweight and obesity. Food systems are also becoming more complex, supported by the money spent on food sales and processing. Though there is currently little experience, attention is now being focused on food value chains as a solution to hunger since traditional methods, which are usually dependent on agricultural development, are thought to be insufficient on their own. An integrative evaluation of the wide-ranging subject of value chains and diet quality is conducted with an emphasis on interventions and the effect pathways that are associated with them in order to evaluate the state of the science and pinpoint or identify knowledge gaps (Stiller et al., 2020). The primary goal of the field of public health nutrition (PHN) is to promote optimal nutrition. Internationally, there has been modest improvement in combating under-nutrition, but not nearly enough to meet the Millennium Development Goals. Most nations are seeing an increase in over-nutrition, as evidenced by increased rates of overweight and obesity (Razon et al., 2022). The adult population in many low- and middle-income nations, including Liberia, is currently bearing two burdens. In response, numerous nations have created policies and action plans to address these significant nutrition issues; however, these typically overlook concerns about implementation ability and capacity drivers, such as workforce development. (Tesfaye et al., 2024). The interventions are categorized based on their main goal, which was to make nutrient-dense food more accessible, available, or desirable. Nonetheless, case study data demonstrating efficacy is still very limited. In order to address a nutritional shortage in the population of interest, the majority of studies focused on individual nutrient-rich commodities. (ul Haq et al., 2018).

The overall quality of the food was rarely evaluated, and the lived experiences of Liberian mothers and health workers indicate that child malnutrition is a direct consequence of horrible poverty, food insecurity, and illiteracy. Future research could benefit from considering dietary patterns and food replacements. The consumer orientation of the value chain analytical approach, which aims to comprehend how food items are utilized and what influences their choice, made it important. Because it takes into account the roles of the various parties engaged in food production, distribution, marketing, and regulation, the systems view is equally significant (Diddana, 2019).

The local food environment, as the link between food production and food choice, however, has not received much attention in research. The difficulty lies in countering the rising popularity of low-nutrient processed meals by implementing policies that make wholesome food more accessible, reasonably priced, and appealing (Nwachan et al., 2024). There is not much published research on dietary therapies for athletes, and the ones that are available show mixed results because of the many approaches taken. Following their participation in two nutritional workshops, athletes' dietary intake did not change, according to Collison. However, Tesfaye et al. (2024) find that Jiu-Jitsu athletes' body fat percentage and dietary fat intake significantly decrease.

Adolescent athletes are at a high nutritional risk because of the high energy cost of training. (Mattes et al., 2022). Furthermore, the processes of growth and development require a variety of nutrients. Iron would prevent poor athletic performance due to suboptimal iron stores, essential fatty acids may provide energy to support growth

and maturation, proteins are required to maximize muscle protein synthesis, calcium and vitamin D are crucial for the development and maintenance of the skeleton, and so on. However, there aren't many studies that look at nutritional interventions in this kind of population, and most of them primarily concentrate on enhancing the athletes' nutritional awareness or hydration habits(Arage et al., 2019). Investigating this kind of program is essential to creating targeted tactics for these people. In terms of mortality, obesity and overweight come in fifth place globally(Spiga et al., 2024). One of the many health problems that Liberia, one of the smallest developing countries in the world, is currently facing is the fact that adult nutrition is a significant and growing problem in many parts of the country.. Regular NOT consumption of fruits, vegetables, and dairy products has increased, according to certain research. The nutritional status and food intake pattern of older people can be affected by various changes, such as physical, psychological, social, or health-related changes. Despite these changes, proper nutrition and a healthy lifestyle can only improve the nutritional status and quality of life among the elderly population (Morgan et al., 2020). Several studies found some medical complications associated with older people. A study found that a huge number of older people had medical complications like cataracts, joint pain, hypertension, diabetes mellitus, etc. To minimize the adverse nutritional outcome it is very important to conduct a nutritional assessment in older people to detect malnutrition. BMI is one of the most popular nutritional assessment tools and it is measured by using the weight and height of a person and is expressed as Kg/m<sup>2</sup>. It can be used in many nutritional screening programs, and it is an appropriate identifier of malnutrition(Biswas et al., 2023). Most studies addressed individual nutrient-rich commodities that could address a nutritional deficiency in the community of interest. Rarely was overall diet quality assessed, and future studies could benefit from taking a wider perspective of dietary patterns and food substitutions.

The value chain analytical approach was deemed valuable due to its consumer orientation that seeks to understand how food products are used and what motivates their choice. The systems perspective is also important as it considers the roles of actors involved in food production, distribution, marketing, and regulation. However, few studies directly engaged with the subject of the local food environment as the bridge connecting food production and food choice. The challenge is to combat the increasing prevalence of processed foods of low nutritional value through interventions that lead to nutritious food becoming more conveniently available, affordable, and desirable.(Arage et al., 2019)

## METHODS

### Research Design

This study used a quasi-experimental research approach. A quasi-experiment is a non-randomized study that estimates the impact of an intervention. It is similar to an experiment, but it does not randomly assign participants to treatment or control groups. This kind of survey design seeks to accurately represent respondents (Enarebebe-Emberru et al., 2019). Because it typically allows assignment to treatment conditions to proceed as it would in the absence of an experiment. It was used to explore the effect of nutrition intervention on dietary habits and nutritional knowledge among adults in Liberia because it focuses on one or more dependent variables in a specific population or sample of that population.

### Area of the Study

Liberia, officially known as the Republic of Liberia, is located on the West African coast, bordered by Sierra Leone to the northwest, Guinea to the north, Ivory Coast to the east, and the Atlantic Ocean to the south and southwest. The country spans an area of 43,000 square miles (111,369 km<sup>2</sup>) and has a population of approximately 5.5 million people. The official language is English, although more than 20 indigenous languages are spoken, reflecting the country's rich ethnic and cultural diversity. The capital and largest city is Monrovia.

Liberia's history began in the early 19th century as a project of the American Colonization Society (ACS), which believed that black people would have better prospects for freedom and prosperity in Africa than in the United States. Between 1822 and the outbreak of the American Civil War in 1861, more than 15,000 freed and free-born African Americans, along with 3,198 Afro-Caribbeans, relocated to Liberia. Over time, these settlers developed an Americo-Liberian identity, bringing their culture and traditions with them, which influenced their interactions with the indigenous population.

Led by the Americo-Liberians, Liberia declared its independence on July 26, 1847, becoming Africa's first modern republic. This declaration was not immediately recognized by the United States, which eventually recognized Liberia's independence in 1862. Along with Ethiopia, Liberia maintained its sovereignty during the European colonial "Scramble for Africa." During World War II, Liberia supported the U.S. war effort against Nazi Germany, receiving substantial American investment in infrastructure, which contributed to the country's economic development.

Despite these early successes, Liberia's history is marred by a legacy of social and economic inequality. The Americo-Liberian settlers formed an elite ruling class that held disproportionate political power, while the indigenous people were often marginalized. Indigenous Africans were excluded from birthright citizenship until 1904, leading to tensions between the settlers and indigenous populations. In 1980, a military coup led by Samuel Doe, Liberia's first indigenous leader, marked the end of Americo-Liberian rule, but this event also led to the rise of a dictatorial regime that eventually resulted in civil wars.

The First Liberian Civil War, which lasted from 1989 to 1997, and the Second Liberian Civil War from 1999 to 2003, left the country devastated, with over 250,000 lives lost and many more displaced. Liberia's economy shrank by 90%, and the country's infrastructure was severely damaged. A peace agreement in 2003 led to democratic elections in 2005, bringing relative stability, though the country continues to face challenges in rebuilding its economy and infrastructure.

Apart from the freed and returnee populations, Liberia is home to numerous indigenous tribes, including the Kpelle, Bassa, Gio, Grebo, Mandingo, Kru, and many others. These tribes maintain distinct cultural practices and languages and rely on subsistence farming as their primary occupation. Agriculture is the backbone of their livelihoods, with crops such as rice, cassava, plantains, and palm oil serving as the main food sources. Additionally, many indigenous people engage in hunting, fishing, and small-scale trade.

Liberia faces significant economic challenges, particularly in rural areas, where the majority of the population lives. Despite the country's abundant natural resources, such as rubber, timber, and diamonds, poverty remains widespread. High unemployment rates, especially among youth, and limited access to modern infrastructure, education, and healthcare services contribute to the country's economic struggles. The rural population, in particular, faces food insecurity and widespread poverty, exacerbated by a lack of economic opportunities.

Health conditions in Liberia are also a major concern. The country's healthcare system remains underdeveloped, especially in rural areas, due to years of political instability and the strain of the civil wars. The healthcare infrastructure is inadequate, with limited access to essential medical services and a shortage of healthcare professionals. As a result, the country experiences high mortality rates, particularly maternal and child mortality. Liberia also struggles with the prevalence of infectious diseases such as malaria, tuberculosis, and diarrhea. Malnutrition is widespread, with children being especially vulnerable to its effects.

## Population for the Study

The population of the study was adults who had lived in Liberia in the last six months. A study revealed that there are 3.9 million adults in Liberia (Liberia Institute of Statistics and Geo-Information Services (LISGIS, 2022).

## Inclusion Criteria:

1. **Age:** Adults aged 18 years and older.
2. **Residence:** Must be a resident of Liberia for at least six months.
3. **Participation in Nutrition Intervention:** Individuals willing to participate in the nutrition education or dietary intervention program.
4. **Health Status:** Participants without severe chronic illnesses or medical conditions that could significantly alter dietary habits (e.g., advanced kidney disease, cancer).

5. **Cognitive Ability:** Individuals with the cognitive ability to comprehend and respond to nutrition education materials.
6. **Consent:** Must provide written informed consent to participate in the study.

#### Exclusion Criteria:

1. **Pregnant and Lactating Women:** Due to specific nutritional needs that could influence dietary patterns differently.
2. **Prior Participation in Similar Programs:** Individuals who have undergone formal nutrition education or dietary interventions in the past six months.
3. **Language Barrier:** Participants who do not understand English language.

#### Sample and Sampling Technique

A sample size of 372 adult population from a total population of 1860 adults in the five counties using Cochran sample size determination below was used for the study.

#### Quasi-Experimental Design Formula

A common design is:

##### Intervention Group:

$$O_1 \rightarrow X \rightarrow O_2$$

##### Control/Comparison Group:

$$O_3 \rightarrow \text{—} \rightarrow O_4$$

Where:

- $O_1$  = Pre-test measurement of the intervention group
- $X$  = Nutrition education intervention
- $O_2$  = Post-test measurement of the intervention group
- $O_3$  = Pre-test measurement of the comparison group
- $\text{—}$  = No nutrition education intervention
- $O_4$  = Post-test measurement of the comparison group

#### Allocation of the 372 Participants

If you want equal groups:

$$N=372 \quad n_1 = \frac{372}{2} = 186$$

Therefore:

- Intervention group = 186 adults
- Comparison/control group = 186 adults
- Total = 372 adults

## Sampling Method

In conducting our study on adult population across five counties, the researcher employed Proportional Stratified Sampling to ensure that each county was represented fairly based on its population size. The total sample size for our study was 372 adult populations, and we carefully allocated this sample across the five counties according to the proportion of adult population in each county relative to the total population.

First, we identified the number of adult population in each of the five counties. Each county was treated as a separate "stratum." To ensure that each county was adequately represented, we calculated the proportion of adult population in each county by comparing the number of adult population in that county to the total number of adults across all five counties.

Once we had the proportions for each county, we determined how many adult populations to sample from each county. For instance, if County A represented 30% of the total adults in the region, 30% of our total sample size, which was 372, would be allocated to County A. We repeated this calculation for each of the five counties, ensuring that the sample sizes for each county were in line with their population sizes.

After determining how many adults to sample from each county, we conducted simple random sampling within each county. This ensured that every adult in each county had an equal chance of being selected. Once the samples were drawn from all five counties, we combined them to form our final sample of 372 adult populations.

By using proportional stratified sampling, the research was able to ensure that each county was represented according to its population size, which improved the accuracy and reliability of our findings. This method allowed us to gather a sample that accurately reflects the demographic distribution of adults across the five counties, ensuring that our results would be both representative and meaningful.

## Research Instrument

The instrument for data collection was a self-structured questionnaire developed by the researcher. The questionnaire was divided into two (2) parts. The section A consisted of personal data, while section B consisted of items designed to measure the objectives of the study. Section B was divided into:

- B1: the pre- and post-intervention nutritional knowledge among adults in Liberia.
- B2: the difference in the pre and post-intervention dietary practices/habits among adults in Liberia.
- B3: the relationship between nutritional knowledge and dietary behavior changes after the intervention.
- B4: the associated factors influencing pre-intervention nutritional knowledge among adults in Liberia.
- B5: the factors associated with pre-intervention dietary practices among adults in Liberia.
- B6: the facilitators and barriers affecting the adoption of healthier eating habits post-intervention.

## Method for Data Collection

To obtain tangible results, the researcher initially administered the instrument to the selected group of married men. The instrument was self-administered, allowing the participants to complete it independently. After three weeks, the researcher gathered the men for an educational session focused on nutrition. During this session, the researcher provided them with valuable information and insights to enhance their understanding of nutrition and its impact on their health.

Following the session, the researcher readministered the same instrument to the same group of men to assess the effectiveness of the intervention. This post-intervention administration allowed the researcher to compare the responses from before and after the educational session, enabling an evaluation of the effects of Nutrition Education Intervention on Nutritional Knowledge and Dietary Habits. The researcher conducted this process independently, ensuring consistency and control over the data collection procedure.

## Validity of Instrument

Validity indicates whether a test actually measures what it set out to measure (Iyeuwa, 2019). The face, content, and construct validity of the instruments were authenticated by the researcher's supervisor, and two experts in the department of Preventive and Social Medicine of the University of Port Harcourt. The observations of the supervisors and the experts were adopted and incorporated in the final draft of the instruments.

## Reliability of the Instrument

The test-retest reliability method was employed to determine the reliability of the instruments. To ensure the consistency of the test result the researcher distributed 40 copies of the instrument to a set of respondents who were not part of the study area, after two weeks the researcher redistributed the same instruments to the same sets of respondents. The reliability score using Cronbach's alpha was 0.85 for dietary practice and .073 for nutritional knowledge.

## Method for Data Analysis

Descriptive statistics were used as data analysis method. Hence, measure of central tendency statistics (mean), simple percentage and charts were used to answer the research questions while t-test statistics were used to test the null hypothesis at 0.05 level of significance. The analysis was carried out using Statistical Package for the Social Sciences (SPSS) version 27.

Table 3.1 shows detailed analysis plan.

Table 3.1 Analysis plan

| Objective                                                                   | Variables/Measures                                                                                                  | Suggested Analysis                                                                                                                |
|-----------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------|
| 1. Compare pre- and post-intervention nutritional knowledge                 | Knowledge score (15 items)                                                                                          | Paired t-test or independent t-test if pre and post participants differ<br>Mann-Whitney U if data set is not normally distributed |
| 2. Compare pre- and post-intervention dietary practices                     | Meal frequency, breakfast, fruit and vegetable intake, dietary diversity score, sugary food intake, cooking methods | Paired t-test or independent t-test if pre and post participants differ<br>Mann-Whitney U if data set is not normally distributed |
| 3. Relationship between nutritional knowledge and dietary behaviour changes | Knowledge score, dietary practice score, change scores                                                              | Pearson or Spearman correlation; linear or logistic regression                                                                    |
| 4. Factors associated with nutritional knowledge                            | Socio-demographic variables, and other factors                                                                      | Bivariate analysis and multivariable linear/logistic regression                                                                   |
| 5. Factors associated with dietary practices                                | Socio-demographic variables, knowledge score, attitudes, food availability, family support                          | Bivariate analysis and multivariable linear/logistic regression                                                                   |
| 6. Facilitators and barriers to healthier practices                         | Facilitator/barrier items                                                                                           | Descriptive statistics                                                                                                            |

## Results:

Table 4.1a Sociodemographic profile of respondents

| Variables  | Frequency n=744 | Percentage |
|------------|-----------------|------------|
| <b>Age</b> |                 |            |
| ≤19        | 32              | 4.3        |
| 20-29      | 342             | 46.0       |
| 30-39      | 133             | 17.9       |

|                           |     |      |
|---------------------------|-----|------|
| 40-49                     | 88  | 11.8 |
| 50-59                     | 72  | 9.7  |
| 60 and above              | 77  | 10.3 |
| Mean = 34±14.6            |     |      |
| <b>Sex</b>                |     |      |
| Female                    | 322 | 43.3 |
| Male                      | 422 | 56.7 |
| <b>Marital status</b>     |     |      |
| Divorced/separated        | 55  | 7.4  |
| Married/Cohabiting        | 266 | 35.8 |
| Single                    | 410 | 55.1 |
| Widowed                   | 13  | 1.7  |
| <b>Level of education</b> |     |      |
| No formal education       | 22  | 3.0  |
| Primary                   | 25  | 3.4  |
| Secondary                 | 137 | 18.4 |
| Tertiary                  | 412 | 55.4 |
| Postgraduate              | 148 | 19.9 |
| <b>Occupation</b>         |     |      |
| Employed                  | 158 | 21.2 |
| Retired                   | 70  | 9.4  |
| Self-employed             | 121 | 16.3 |
| Student                   | 358 | 48.1 |
| Unemployed                | 37  | 5.0  |
| <b>Location</b>           |     |      |
| Rural                     | 369 | 49.6 |
| Urban                     | 375 | 50.4 |
| <b>Monthly income</b>     |     |      |
| 0-10000 GD                | 598 | 80.4 |
| 10,001- 100,000           | 144 | 19.4 |
| 100001-400000             | 2   | 0.3  |

As shown in Table 4.1a, most of the respondents were in the age category 20-29 years 342 (46.0%), 422 (56.7%) were males, most of the respondents 385 (48.1%) are students.

#### 4.1b. Sociodemographic profile of pre and post intervention respondents

| Variables             | Pre-intervention<br>(n=372) | Post intervention<br>(n=372) | Total<br>(n =744) | χ <sup>2</sup> (p-value) |
|-----------------------|-----------------------------|------------------------------|-------------------|--------------------------|
| <b>Age</b>            |                             |                              |                   | <b>13.39 (0.020) *</b>   |
| ≤19                   | 16 (4.3)                    | 16 (4.3)                     | 32(4.3)           |                          |
| 20-29                 | 179 (48.1)                  | 163 (43.8)                   | 342 (46.0)        |                          |
| 30-39                 | 76 (20.4)                   | 57 (15.3)                    | 133 (17.9)        |                          |
| 40-49                 | 41 (11.0)                   | 47 (12.6)                    | 88 (11.8)         |                          |
| 50-59                 | 35 (9.4)                    | 37 (9.9)                     | 72 (9.7)          |                          |
| 60 and above          | 25 (6.7)                    | 52 (14.0)                    | 77 (10.3)         |                          |
| <b>Median (IQR)</b>   | 29 (17)                     | 30 (24)                      |                   |                          |
| <b>Sex</b>            |                             |                              |                   | 0.022 (0.941)            |
| Female                | 160 (43.0)                  | 162 (43.5)                   | 322 (43.3)        |                          |
| Male                  | 212 (57.0)                  | 210 (56.7)                   | 422 (56.7)        |                          |
| <b>Marital status</b> |                             |                              |                   | <b>14.53 (0.002) *</b>   |
| Divorced/separated    | 29 (7.8)                    | 26 (7.0)                     | 55 (7.4)          |                          |
| Married/Cohabiting    | 111 (29.8)                  | 155 (20.8)                   | 266 (35.8)        |                          |

|                           |            |            |            |                        |
|---------------------------|------------|------------|------------|------------------------|
| Single                    | 228 (61.3) | 182 (48.9) | 410 (55.1) |                        |
| Widowed                   | 4 (1.1)    | 9 (2.4)    | 13 (1.7)   |                        |
| <b>Level of education</b> |            |            |            | <b>28.32 (0.001) *</b> |
| No formal education       | 16 (4.3)   | 6 (1.6)    | 22 (3.0)   |                        |
| Primary                   | 17 (4.6)   | 8 (2.2)    | 25 (3.4)   |                        |
| Secondary                 | 88 (23.7)  | 49 (13.2)  | 137 (18.4) |                        |
| Tertiary                  | 175 (47.0) | 237 (63.7) | 412 (55.4) |                        |
| Postgraduate              | 76 (20.4)  | 72 (19.4)  | 148 (19.9) |                        |
| <b>Occupation</b>         |            |            |            | <b>32.85 (0.001) *</b> |
| Employed                  | 75 (20.2)  | 83 (22.3)  | 158 (21.2) |                        |
| Retired                   | 23 (6.2)   | 47 (12.6)  | 70 (9.4)   |                        |
| Self-employed             | 80 (21.5)  | 41 (11.0)  | 121 (16.3) |                        |
| Student                   | 166 (44.6) | 192 (51.6) | 358 (48.1) |                        |
| Unemployed                | 28 (7.5)   | 9 (2.4)    | 37 (5.0)   |                        |
| <b>Location</b>           |            |            |            | <b>0.436 (0.557)</b>   |
| Rural                     | 189 (50.8) | 180 (48.4) | 369 (49.6) |                        |
| Urban                     | 183 (49.2) | 192 (51.6) | 375 (50.4) |                        |

As shown in Table 4.1b, age, marital status, level of education and occupations were significantly different in the pre and post intervention participants

**Table 4.2a:** pre- and post-intervention nutritional knowledge among adults in Liberia.

| Variables                        | Pre-intervention<br>(n=372) | Post intervention<br>(n=372) | Total<br>(n =744) | $\chi^2$ (p-value)     |
|----------------------------------|-----------------------------|------------------------------|-------------------|------------------------|
| <b>Balanced diet contains</b>    |                             |                              |                   | <b>14.67 (0.001) *</b> |
| Foods from different food groups | 337 (90.6)                  | 361 (97.0)                   | 698 (93.8)        |                        |
| Only carbohydrates               | 12 (3.2)                    | 6 (1.6)                      | 18 (2.4)          |                        |
| Only fruits                      | 2 (0.5)                     | 0 (0.0)                      | 2 (0.5)           |                        |
| Only protein                     | 21 (5.6)                    | 5 (1.3)                      | 26 (3.5)          |                        |
| <b>Build body tissues</b>        |                             |                              |                   | <b>13.56 (0.002) *</b> |
| Fat                              | 25(6.7)                     | 10 (2.7)                     | 35 (4.7)          |                        |
| Protein                          | 336 (90.3)                  | 360 (96.8)                   | 696 (93.5)        |                        |
| Salt                             | 4 (1.1)                     | 1 (0.3)                      | 5 (0.7)           |                        |
| Sugar                            | 7 (1.9)                     | 1 (10.3)                     | 8 (1.1)           |                        |
| <b>Provides energy</b>           |                             |                              |                   | <b>23.51 (0.001) *</b> |
| Carbohydrates                    | 338 (90.9)                  | 367 (98.7)                   | 705 (94.8)        |                        |
| Minerals                         | 8 (2.2)                     | 0 (0.0)                      | 8 (1.1)           |                        |
| Vitamins                         | 13 (3.5)                    | 3 (0.8)                      | 16 (2.2)          |                        |
| Water                            | 13 (3.5)                    | 2 (0.5)                      | 15 (2.0)          |                        |
| <b>Richest in protein</b>        |                             |                              |                   | <b>19.26 (0.001) *</b> |
| Cassava                          | 12 (3.2)                    | 1 (0.3)                      | 13 (1.7)          |                        |
| Banana                           | 8 (2.2)                     | 0 (0.0)                      | 8 (1.1)           |                        |
| Fish                             | 347 (93.3)                  | 369 (99.2)                   | 716 (96.2)        |                        |
| Rice                             | 5 (1.3)                     | 2 (0.5)                      | 7 (0.9)           |                        |
| <b>Vision Vitamin</b>            |                             |                              |                   | <b>19.11 (0.001) *</b> |
| Vitamin A                        | 336 (90.3)                  | 360 (96.8)                   | 696 (93.5)        |                        |
| Vitamin C                        | 16 (4.3)                    | 2 (0.5)                      | 18 (2.4)          |                        |
| Vitamin D                        | 7 (1.9)                     | 0 (0.0)                      | 7 (0.9)           |                        |
| Vitamin K                        | 13 (3.5)                    | 10 (2.7)                     | 23 (3.1)          |                        |
| <b>Richest in iron</b>           |                             |                              |                   | <b>0.981 (0.612)</b>   |

|                                                         |            |            |            |                        |
|---------------------------------------------------------|------------|------------|------------|------------------------|
| Green leafy vegetables                                  | 316 (84.9) | 306 (92.3) | 622 (83.6) |                        |
| Soft drinks                                             | 16 (4.3)   | 19 (5.1)   | 35 (4.7)   |                        |
| White bread                                             | 40 (10.8)  | 47 (12.6)  | 87 (11.7)  |                        |
| <b>Adults should eat fruit and vegetables every day</b> |            |            |            | <b>9.198 (0.001) *</b> |
| No                                                      | 14 (3.8)   | 2 (0.5)    | 16 (2.2)   |                        |
| Yes                                                     | 358 (96.2) | 370 (99.5) | 728 (97.9) |                        |

**Table 4.2b:** pre- and post-intervention nutritional knowledge among adults in Liberia.

| Variables                                            | Pre-intervention (n=372) | Post intervention (n=372) | Total (n =744) | $\chi^2$ (p-value)     |
|------------------------------------------------------|--------------------------|---------------------------|----------------|------------------------|
| <b>Too much salt increases risk</b>                  |                          |                           |                | <b>13.65 (0.002) *</b> |
| Asthma                                               | 3 (0.8)                  | 0 (0.0)                   | 3 (0.4)        |                        |
| Hypertension                                         | 333 (89.5)               | 344 (92.5)                | 677 (91.0)     |                        |
| Malaria                                              | 15 (4.0)                 | 2 (0.5)                   | 17 (2.3)       |                        |
| Tuberculosis                                         | 21 (5.6)                 | 26 (7.0)                  | 47 (6.3)       |                        |
| <b>Adequate water is important</b>                   |                          |                           |                | <b>5.929 (0.012) *</b> |
| No                                                   | 16 (4.3)                 | 5 (1.3)                   | 21 (2.8)       |                        |
| Yes                                                  | 356 (95.7)               | 367 (98.7)                | 723 (97.2)     |                        |
| <b>Sugary drinks should be consumed</b>              |                          |                           |                | <b>15.06 (0.001) *</b> |
| Occasionally                                         | 334 (89.8)               | 359 (96.5)                | 693 (93.1)     |                        |
| At every meal                                        | 4 (1.1)                  | 0 (0.0)                   | 4 (0.5)        |                        |
| Daily                                                | 28 (7.5)                 | 9 (2.4)                   | 37 (5.0)       |                        |
| Frequently                                           | 6 (1.6)                  | 4 (1.1)                   | 10 (1.3)       |                        |
| <b>Whole grains are healthier</b>                    |                          |                           |                | <b>5.929 (0.012) *</b> |
| No                                                   | 16 (4.3)                 | 5 (1.3)                   | 21 (2.8)       |                        |
| Yes                                                  | 356 (95.7)               | 367 (98.7)                | 723 (97.2)     |                        |
| <b>Reading food labels helps</b>                     |                          |                           |                | 1.035 (0.309)          |
| No                                                   | 10 (2.7)                 | 15 (4.0)                  | 25(3.4)        |                        |
| Yes                                                  | 362 (97.3)               | 357 (96.0)                | 719 (96.6)     |                        |
| <b>Regular fruit intake helps</b>                    |                          |                           |                | 2.090 (0.205)          |
| No                                                   | 12 (3.2)                 | 20 (5.4)                  | 32 (4.3)       |                        |
| Yes                                                  | 360 (96.8)               | 352 (94.6)                | 712 (95.7)     |                        |
| <b>Healthy eating reduces the risk of diabetes</b>   |                          |                           |                | 2.375 (0.123)          |
| No                                                   | 10 (2.7)                 | 18 (4.8)                  | 28 (3.8)       |                        |
| Yes                                                  | 362 (97.3)               | 354 (95.2)                | 716 (96.2)     |                        |
| <b>Overweight increases the risk of hypertension</b> |                          |                           |                | 3.113 (0.078)          |
| No                                                   | 9 (2.4)                  | 18 (4.8)                  | 27 (3.6)       |                        |
| Yes                                                  | 363 (97.6)               | 354 (95.2)                | 717 (96.4)     |                        |

**Table 4.2c:** Overall Pre- and post-intervention nutritional knowledge among adults in Liberia. Obj 1

| Variables                    | Pre-intervention (n=372) | Post intervention (n=372) | Total (n =744) | $\chi^2$ (p-value)    |
|------------------------------|--------------------------|---------------------------|----------------|-----------------------|
| <b>Knowledge level 3 cat</b> |                          |                           |                | <b>8.29 (0.016) *</b> |
| Poor (0-7)                   | 17 (4.6)                 | 4 (1.1)                   | 21 (2.8)       |                       |
| Fair (8-11)                  | 17 (4.6)                 | 18 (4.8)                  | 35 (4.7)       |                       |

|                              |            |            |            |               |
|------------------------------|------------|------------|------------|---------------|
| Good (12- 15)                | 338 (90.9) | 350 (94.1) | 688 (92.5) | 2.781 (0.095) |
| <b>Knowledge level 2 cat</b> |            |            |            |               |
| Good (12- 15)                | 338 (90.9) | 350 (94.1) | 688 (92.5) |               |
| Poor (0-11)                  | 34 (9.1)   | 22 (5.9)   | 56 (7.5)   |               |

As shown in Table 4.2c, the post-intervention group had a significantly higher proportion of good knowledge 350 (94.1%) than the pre-intervention group 338 (90.9%), ( $\chi^2 = 8.29$ ;  $p < 0.016$ ).

**Table 4.2d: – Effect of nutritional intervention on nutritional knowledge among adults in Liberia**

| Variables                | Mean $\pm$ SD   | Mean Difference | Welch's t-test. | Df    | p-value      | Cohen's effect size [95% CI] |
|--------------------------|-----------------|-----------------|-----------------|-------|--------------|------------------------------|
| Overall, Knowledge Score |                 | -0.411          | -2.913          | 633.2 | <b>0.004</b> | -0.214 (-0.69-0.13)          |
| Baseline (n=372)         | 13.96 $\pm$ 2.3 |                 |                 |       |              |                              |
| Endline (n=372)          | 14.37 $\pm$ 1.5 |                 |                 |       |              |                              |

Table 4.2d shows that there was a statistically significant difference in the mean overall knowledge scores between the pre-intervention and post-intervention (Welch's t (633.16) = -2.913,  $p = 0.004$ ). The Cohen's effect size of -0.214 is small. The post-intervention group had a significantly higher mean knowledge score than the pre-intervention group.

Levene's test is statistically significant ( $F = 20.827$ ,  $p < 0.001$ ), indicating that the assumption of equal variances between the pre-intervention and post-intervention groups has been violated. Therefore, the Welch's t-test ("Equal variances not assumed"), was presented. Welch's t-test adjusts the degrees of freedom when group variances are unequal.

**Table 4.2e: – Effect of nutritional intervention on nutritional knowledge among adults in Liberia**

| Variables                                   | Mean $\pm$ SD   | Mean Rank | Mann-Whitney U | Z      | p-value      |
|---------------------------------------------|-----------------|-----------|----------------|--------|--------------|
| <b>Overall, nutritional Knowledge Score</b> |                 |           | 64,253         | -2.136 | <b>0.033</b> |
| Pre-intervention (n=372)                    | 13.96 $\pm$ 2.3 | 359.2     |                |        |              |
| Post-intervention (n=372)                   | 14.37 $\pm$ 1.5 | 385.8     |                |        |              |

As shown in Table 4.2e, the overall mean knowledge score was  $14.17 \pm 1.94$  (median = 15, IQR = 14–15), indicating generally high levels of knowledge among respondents. The mean knowledge score increased from  $13.96 \pm 2.3$  at pre-intervention to  $14.37 \pm 1.5$  at post-intervention. Normality tests confirmed that the knowledge scores were not normally distributed in either group (Kolmogorov–Smirnov and Shapiro–Wilk tests, both  $p < 0.001$ ). Therefore, the Mann–Whitney U test was used to compare knowledge scores between survey phases (at pre-intervention and post-intervention). The Respondents surveyed at post-intervention had higher mean ranks than those surveyed at pre-intervention (385.78 versus 359.22), suggesting improvement in knowledge following the intervention, and established a statistically significant improvement at post-intervention compared with pre-intervention ( $U = 64,253$ ,  $Z = -2.136$ ,  $p = 0.033$ ). However, the effect size derived ( $r = \frac{|Z|}{\sqrt{N}}$ ) was small ( $r = 0.08$ ), indicating that the practical difference in knowledge scores between the two survey phases was small.

**Table 4.3a: Pre- and post-intervention dietary practices/habits among respondents.**

| Variables            | Pre (n=372) | Post (n=372) | Total (n =744) | $\chi^2$ (p-value)     |
|----------------------|-------------|--------------|----------------|------------------------|
| <b>Meals per day</b> |             |              |                | <b>22.94 (0.001) *</b> |
| Four or more         | 2 (0.5)     | 0 (0.0)      | 2 (0.3)        |                        |
| One                  | 78 (21.0)   | 113(30.4)    | 191 (25.7)     |                        |
| Three                | 90 (24.2)   | 46 (12.4)    | 136 (18.3)     |                        |
| Two                  | 202 (54.3)  | 213 (57.3)   | 415 (55.8)     |                        |

|                         |            |            |            |                                          |
|-------------------------|------------|------------|------------|------------------------------------------|
| <b>Skips breakfast</b>  |            |            |            | <b>11.25 (0.019) <math>\gamma</math></b> |
| Always                  | 2 (0.5)    | 1 (0.3)    | 3 (0.4)    |                                          |
| Never                   | 31 (8.3)   | 18 (4.8)   | 49 (6.6)   |                                          |
| Often                   | 60 (16.1)  | 92 (24.7)  | 152 (20.4) |                                          |
| Rarely                  | 26 (7.0)   | 22 (5.9)   | 48 (6.5)   |                                          |
| Sometimes               | 253 (68.0) | 239 (64.2) | 492 (66.1) |                                          |
| <b>Fruit Intake</b>     |            |            |            | <b>6.87 (0.143)</b>                      |
| 1–2 days                | 213 (57.3) | 222 (59.7) | 435 (58.5) |                                          |
| 3–4 days                | 125 (33.6) | 126 (33.9) | 251 (33.7) |                                          |
| 5-6 days                | 24 (6.5)   | 15 (4.0)   | 39 (5.2)   |                                          |
| Every day               | 4 (1.1)    | 0 (0.0)    | 4 (0.5)    |                                          |
| None                    | 6 (1.6)    | 9 (2.4)    | 15 (2.0)   |                                          |
| <b>Vegetable intake</b> |            |            |            | <b>5.08 (0.285)</b>                      |
| 1–2 days                | 229 (61.6) | 246 (66.1) | 475 (63.8) |                                          |
| 3–4 days                | 111 (29.8) | 102 (27.4) | 213 (28.6) |                                          |
| 5-6 days                | 22 (5.9)   | 11 (3.0)   | 33 (4.4)   |                                          |
| Every day               | 2 (0.5)    | 3 (0.8)    | 5 (0.7)    |                                          |
| None                    | 8 (2.2)    | 10 (2.7)   | 18 (2.4)   |                                          |
| <b>Fish intake</b>      |            |            |            | <b>8.52 (0.036)</b>                      |
| 1–2 days                | 217 (58.3) | 251 (67.5) | 468 (62.9) |                                          |
| 3–4 days                | 109 (29.3) | 85 (22.8)  | 194 (26.1) |                                          |
| 5-7 days                | 40 (10.8)  | 27 (7.3)   | 67 (9.0)   |                                          |
| None                    | 6 (1.6)    | 9 (2.4)    | 15 (2.0)   |                                          |
| <b>Egg intake</b>       |            |            |            | <b>1.37 (0.712)</b>                      |
| 1–2 days                | 248 (66.7) | 258 (69.7) | 506 (68.0) |                                          |
| 3–4 days                | 106 (28.5) | 100 (26.9) | 206 (27.7) |                                          |
| 5-7 days                | 10 (2.7)   | 6 (1.6)    | 16 (2.2)   |                                          |
| None                    | 8 (2.2)    | 8 (2.2)    | 16 (2.2)   |                                          |
| <b>Beans intake</b>     |            |            |            | <b>3.29 (0.350)</b>                      |
| 1–2 days                | 225 (60.5) | 237 (63.7) | 462 (62.1) |                                          |
| 3–4 days                | 124 (33.3) | 120 (32.3) | 244 (32.8) |                                          |
| 5-7 days                | 15 (4.0)   | 7 (1.9)    | 22 (3.0)   |                                          |
| None                    | 8 (2.2)    | 8 (2.2)    | 16 (2.2)   |                                          |

\*Statistically significant ( $p \leq 0.05$ );  $\chi^2$ =Chi-Square;  $\gamma$ =Fisher's Exact p;  $\mu$ =Mann-Whitney; IQR=Inter-quartile range. Shapiro-Wilk normality test  $<0.001$

As shown in Table 4.3a, whether they skip breakfast and number of meals per day were the only significant items. All the other items were not statistically significant.

**Table 4.3b: Overall pre- and post-intervention dietary practices/habits among respondents.**

| Variables                      | Pre-intervention (n=372) | Post intervention (n=372) | Total (n =744) | $\chi^2$ (p-value)     |
|--------------------------------|--------------------------|---------------------------|----------------|------------------------|
| <b>Dietary practices 3 cat</b> |                          |                           |                | <b>7.60 (0.014) *</b>  |
| Poor                           | 0 (0.0)                  | 3 (0.8)                   | 3 (0.4)        |                        |
| Fair                           | 325 (87.4)               | 340 (91.4)                | 665 (89.4)     |                        |
| Good                           | 47 (12.6)                | 29 (7.8)                  | 76 (10.2)      | <b>4.748 (0.039) *</b> |
| <b>Dietary practices 2 cat</b> |                          |                           |                |                        |
| Good                           | 47 (12.6)                | 29 (7.8)                  | 76 (10.2)      |                        |
| Poor                           | 325 (87.4)               | 343 (92.2)                | 668 (89.8)     |                        |

As shown in Table 4.3b, the post-intervention group had a significantly higher proportion of fair dietary practice 340 (91.4%) than the pre-intervention group 325 (87.4%), ( $\chi^2 = 7.60$ ;  $p < 0.014$ ).

**Table 4.3c: – Effect of nutritional intervention on dietary practices/habits among respondents.**

| Variables                        | Mean ± SD   | Mean Difference | t-test.      | Df         | p- value     | Cohen's effect size [95% CI] |
|----------------------------------|-------------|-----------------|--------------|------------|--------------|------------------------------|
| Overall, dietary practices score |             | 1.054           | <b>4.163</b> | <b>742</b> | <b>0.001</b> | 0.305<br>(0.16-0.45)         |
| Pre-intervention (n=372)         | 31.12 ± 3.5 |                 |              |            |              |                              |
| Post-intervention (n=372)        | 30.07 ±3.4  |                 |              |            |              |                              |

Table 4.4c shows that the mean dietary-practice score was significantly higher before the intervention than after ( $31.12 \pm 3.46$  versus  $30.07 \pm 3.44$ , respectively), with a mean difference of 1.05 points (95% CI: 0.56–1.55;  $t = 4.163$ ,  $df = 741.9$ ,  $p < .001$ ). Overall, dietary-practice scores decreased slightly from pre-intervention to post-intervention. The Cohen's effect size of 0.305 is small.

**Table 4.3d: – Effect of nutritional intervention on dietary practices/habits among respondents.**

| Variables                               | Mean ± SD   | Mean Rank | Mann-Whitney U | Z     | p- value     |
|-----------------------------------------|-------------|-----------|----------------|-------|--------------|
| <b>Overall, dietary practices score</b> |             |           | 58,659         | -3619 | <b>0.001</b> |
| Pre-intervention (n=372)                | 31.12 ± 3.5 | 400.8     |                |       |              |
| Post-intervention (n=372)               | 30.07 ±3.4  | 344.2     |                |       |              |

As shown in Table 4.3d, the overall mean dietary practices score was  $30.6 \pm 3.5$  (median = 30, IQR = 28–33), indicating generally moderate/fair levels of dietary practices among respondents. The mean dietary practices score decreased from  $31.12 \pm 3.5$  at pre-intervention to  $30.07 \pm 3.4$  at post-intervention. Normality tests confirmed that the dietary practices scores were not normally distributed in either group (Kolmogorov–Smirnov and Shapiro–Wilk tests, both  $p < 0.001$ ). Therefore, the Mann–Whitney U test was used to compare dietary practices scores between survey phases (at pre-intervention and post-intervention). The pre-intervention group had a higher mean rank (400.8) than the post-intervention group (344.2),  $U = 58,659.50$ ,  $Z = -3.619$ ,  $p < 0.001$ . However, the effect size derived ( $r = \frac{|Z|}{\sqrt{N}}$ ) was small ( $r = 0.13$ ), indicating that the practical difference in dietary practices scores between the two survey phases was small. Therefore, the null hypothesis that there is no difference in dietary practice is rejected.

**Table 4.4: Relationship between nutritional knowledge dietary practices/habits among respondents. (Obj 3)**

| Variables                         | Correlation coefficient ( $\rho$ ) | p- value [95% CI]         | Interpretation             |
|-----------------------------------|------------------------------------|---------------------------|----------------------------|
| Knowledge Versus Dietary Practice | -0.21                              | 0.572<br>(-0.095 – 0.053) | No significant correlation |

Table 4.5 shows that there was no statistically significant correlation between knowledge and dietary practices (Spearman's  $\rho = -0.021$ ,  $p = 0.572$ ). The correlation coefficient indicated a negligible inverse association, suggesting that higher knowledge levels were not associated with better dietary practices among the respondents. The Spearman's rank correlation was used to assess the relationship between overall knowledge and dietary practice scores because both scores were not normally distributed. Therefore, we fail to reject the null hypothesis.

## DISCUSSION

The findings of this study showed that nutritional knowledge among adults in Liberia was already relatively high before the nutrition education intervention. At the pre-intervention phase, 90.9% of respondents were classified as having good nutritional knowledge, while 4.6% had fair knowledge and another 4.6% had poor knowledge. This indicates that, contrary to the assumption that respondents had generally poor nutrition literacy at baseline, most participants already possessed substantial knowledge of basic nutritional principles before the intervention.

The high baseline level may reflect previous exposure to nutrition and health information or the relatively high educational profile of a substantial proportion of the study population.

Nevertheless, nutritional knowledge improved further following the intervention. The proportion classified as having good knowledge increased from 90.9% before the intervention to 94.1% after the intervention, while the proportion with poor knowledge decreased from 4.6% to 1.1%. The three-category distribution of knowledge differed significantly between the pre- and post-intervention groups ( $\chi^2 = 8.29$ ,  $p = 0.016$ ). It is important, however, to note that when knowledge was dichotomised into good and poor categories, the difference was not statistically significant ( $p = 0.095$ ). Consequently, the evidence is better interpreted as showing an improvement in the overall distribution and scores of nutritional knowledges rather than a large change in the proportion attaining the good-knowledge threshold.

This interpretation is further supported by the continuous knowledge scores. The mean nutritional knowledge score increased from  $13.96 \pm 2.3$  at pre-intervention to  $14.37 \pm 1.5$  at post-intervention. Both the Welch's t-test and the non-parametric Mann–Whitney U test demonstrated statistically significant differences between the survey phases. The Mann–Whitney analysis showed higher ranks among post-intervention respondents and a significant difference ( $U = 64,253$ ,  $Z = -2.136$ ,  $p = 0.033$ ). However, the effect size was small ( $r = 0.08$ ). The intervention therefore appears to have produced a modest but statistically detectable improvement in nutritional knowledge, rather than a dramatic transformation.

The relatively small effect is understandable because respondents already demonstrated high knowledge at baseline, leaving limited room for improvement. This may represent a ceiling effect. The result differs from studies reporting substantial knowledge deficits before nutrition interventions in resource-constrained settings (Mangwane et al., 2024; Wanjohi et al., 2020), but it is generally consistent with research demonstrating that structured nutrition education can further strengthen existing nutritional knowledge (Shrestha et al., 2019; Mchiza et al., 2020).

At the item level, improvement was evident in several areas. Correct identification of foods from different food groups as constituting a balanced diet increased from 90.6% to 97.0%. Correct recognition of protein as necessary for building body tissues increased from 90.3% to 96.8%, while knowledge that carbohydrates provide energy increased from 90.9% to 98.7%. The proportion of fish correctly identifying as a rich source of protein increased from 93.3% to 99.2%, and recognition of vitamin A as important for vision increased from 90.3% to 96.8%. Significant improvements were also observed in knowledge concerning daily fruit and vegetable consumption, adequate water intake, the relationship between excessive salt intake and hypertension, appropriate consumption of sugary drinks, and the benefits of whole grains.

However, improvements were not universal. Differences between the pre- and post-intervention groups were not statistically significant for identifying iron-rich foods, understanding the usefulness of food labels, recognising the benefits of regular fruit intake, recognising the role of healthy eating in reducing diabetes risk, or recognising being overweight as a risk factor for hypertension. These findings reinforce the view that the intervention strengthened knowledge in selected areas rather than producing uniform improvement across every nutritional concept. The findings should also be interpreted with some caution because the pre- and post-intervention samples differed significantly in age, marital status, level of education and occupation. Consequently, although the observed improvement is consistent with a beneficial intervention effect, differences in the composition of the two survey groups may also have contributed to some of the observed variations.

### Dietary Practices Before and After the Intervention

In contrast to the improvement observed in nutritional knowledge, the findings did not demonstrate an improvement in overall dietary practices following the intervention. Dietary practices were generally fair, with 89.4% of all respondents falling within the fair category. More importantly, the proportion with good dietary practice decreased from 12.6% before the intervention to 7.8% after the intervention. The proportion classified as fair increased from 87.4% to 91.4%, while 0.8% of the post-intervention respondents were classified as having poor dietary practice.

The continuous dietary-practice scores confirmed this pattern. The mean score decreased from  $31.12 \pm 3.5$  at pre-intervention to  $30.07 \pm 3.4$  at post-intervention. The difference was statistically significant, and the Mann–Whitney U test similarly showed a significantly higher mean rank among pre-intervention respondents than post-intervention respondents (400.8 versus 344.2;  $U = 58,659.50$ ,  $Z = -3.619$ ,  $p < 0.001$ ). Nevertheless, the effect size was small ( $r = 0.13$ ). Thus, although nutritional knowledge increased after the intervention, this increase was not accompanied by an improvement in overall dietary practice. The findings relating to meal frequency also do not support the conclusion that eating patterns became healthier after the intervention. The proportion consuming only one meal per day increased from 21.0% at pre-intervention to 30.4% at post-intervention, while the proportion consuming three meals per day decreased from 24.2% to 12.4%. The number of meals consumed per day differed significantly between the two survey phases. Breakfast-skipping patterns also changed significantly. The proportion reporting that they often skipped breakfast increased from 16.1% to 24.7%, while those reporting that they never skipped breakfast decreased from 8.3% to 4.8%. These findings suggest that the post-intervention pattern was not uniformly healthier and therefore do not support the earlier interpretation that the intervention resulted in more consistent meal timing.

Similarly, there was no statistically significant improvement in fruit intake ( $p = 0.143$ ) or vegetable intake ( $p = 0.285$ ). Most respondents continued to consume fruit and vegetables only one or two days per week. Daily fruit consumption was very low in both survey phases, and no post-intervention respondent reported daily fruit consumption compared with 1.1% at pre-intervention. Egg and bean intake also showed no significant differences. Fish intake differed significantly between the groups, but the pattern did not indicate an increase in frequent consumption: respondents consuming fish one to two days per week increased, whereas those consuming fish more frequently declined.

The findings therefore demonstrate an important distinction between knowing what constitutes healthy nutrition and being able to practise it consistently. Previous intervention studies have sometimes reported simultaneous improvements in nutritional knowledge and dietary behaviour (Ganesan et al., 2018; Mchiza et al., 2020). The present study differs from such findings because the knowledge gain did not translate into better overall dietary practices. This suggests that nutrition education, although useful for increasing awareness, may be insufficient on its own to change eating behaviour when individuals continue to face economic, environmental and social constraints.

### Relationship Between Nutritional Knowledge and Dietary Practices

One of the clearest findings of this study was the absence of a statistically significant relationship between nutritional knowledge and dietary practices. Spearman's rank correlation showed a negligible inverse association between the two variables ( $\rho = -0.021$ ,  $p = 0.572$ ). Therefore, the null hypothesis of no significant relationship between nutritional knowledge and dietary practice was not rejected. This finding directly indicates that respondents with greater nutritional knowledge were not necessarily more likely to demonstrate healthier dietary practices. It also explains why the statistically significant improvement in nutritional knowledge following the intervention was not accompanied by a corresponding improvement in dietary behaviour.

The result contrasts with studies that have reported that increased nutrition knowledge is associated with healthier food choices and improved dietary behaviour (Ganesan et al., 2018; Lutalo et al., 2021). However, it supports the broader argument that knowledge alone is not sufficient to produce behaviour change. Food choices are influenced by multiple factors, including affordability, availability, household preferences, time, motivation and accessibility. An individual may therefore understand the importance of fruits, vegetables, balanced meals and appropriate food choices but remain unable to translate this understanding into everyday practice.

The finding can also be interpreted in relation to behaviour-change theories such as the Theory of Planned Behaviour. Rather than assuming that knowledge automatically produces behaviour, the findings suggest that actual dietary behaviour may depend upon factors such as perceived behavioural control, economic capacity, social influences and the practical availability of healthier alternatives. The absence of a significant knowledge-practice relationship therefore reinforces the importance of addressing the conditions under which healthy food choices are made.

## Factors Associated with Nutritional Knowledge

The bivariate analysis showed that age, marital status, educational level, occupation and income were significantly associated with nutritional knowledge. Sex and geographical location were not significantly associated with knowledge. This means that earlier interpretations suggesting that rural location itself significantly determined nutritional knowledge are not supported by the present findings. More importantly, the multivariable analysis identified education and occupation as the principal independent predictors of nutritional knowledge. Age and income were no longer statistically significant after adjustment. Educational level therefore remained important even after accounting for other variables. The pattern suggests that formal education may improve an individual's ability to access, understand and interpret nutrition-related information. This is consistent with studies associating higher educational attainment with improved health literacy and nutritional knowledge (Shrestha et al., 2019; Mupedziswa et al., 2018).

Occupation was also independently associated with nutritional knowledge. Compared with unemployed respondents, employed adults had significantly higher odds of having good nutritional knowledge (AOR = 2.636, 95% CI: 1.1–6.6,  $p = 0.038$ ), while students had approximately three and a half times higher odds of good knowledge (AOR = 3.527, 95% CI: 1.473–8.447,  $p = 0.005$ ). Employment and student status may provide greater exposure to formal information environments, education, communication and health-related information. Previous studies have similarly linked educational and occupational opportunities with better access to health information (Pettifor et al., 2020; Yousaf et al., 2020). The adjusted findings are particularly important because they indicate that some relationships observed at the bivariate level may reflect the influence of other characteristics. Consequently, interventions aimed at improving nutritional knowledge may require additional attention to people with lower educational attainment and those outside educational or formal employment settings.

## Factors Associated with Dietary Practices

Unlike nutritional knowledge, relatively few sociodemographic variables were associated with dietary practice. Age, sex, marital status, education, geographical location and income were not significantly associated with the overall classification of dietary practices. Occupation was the only sociodemographic characteristic with a statistically significant association ( $\chi^2 = 33.87$ ,  $p < 0.001$ ). Self-employed respondents had the highest proportion of good dietary practice at 24.0%, compared with 8.9% among employed respondents, 5.7% among retirees, 6.4% among students and 16.2% among unemployed respondents. This suggests that the circumstances associated with occupation, including possible differences in work schedules, flexibility, food access or control over meal timing, may influence dietary behaviour. Such explanations, however, should be regarded as possible interpretations rather than directly measured mechanisms in the present study.

Affordability also warrants attention. The statistical table showed an association between perceiving healthy foods as affordable and dietary practice ( $p = 0.030$ ). Respondents who considered healthy foods affordable had a greater proportion of good dietary practice than respondents who did not. This supports the argument that economic access can influence whether nutritional knowledge is translated into actual food choices. Other factors, including having healthy food available nearby, knowing how to prepare healthy foods, recognising the importance of healthy eating and reporting increased confidence following nutrition education, were not clearly associated with the overall dietary-practice category at the conventional level of statistical significance. These results reinforce the distinction between nutrition knowledge and dietary behaviour. Whereas education and occupation were important predictors of nutritional knowledge, dietary practices appeared to depend more strongly on practical and contextual circumstances.

## Facilitators and Barriers to Healthy Dietary Practices

The findings identified several factors that may facilitate healthier dietary practices. Community support was significantly associated with good dietary practice ( $p < 0.001$ ). Availability of healthy foods was also significant ( $p = 0.038$ ), as were lower food prices ( $p = 0.009$ ) and improved cooking skills ( $p = 0.042$ ). These results suggest that healthier eating is more achievable when appropriate foods are accessible and affordable, individuals possess the practical skills required to prepare them, and supportive community environments are present.

Descriptively, nutrition education was identified as a facilitator by 96.2% of respondents, family support by 94.1%, community support by 87.9%, availability of healthy foods by 95.2%, improved cooking skills by 95.2% and health-worker advice by 94.2%. These high percentages indicate that respondents perceived several forms of educational, social and practical support as useful. However, descriptive reporting of a facilitator should be distinguished from evidence of a statistical association with good dietary practice. For example, health-worker advice was commonly reported but was not significantly associated with good dietary practice in the inferential analysis. The barriers identified in the study provide a plausible explanation for why increased nutritional knowledge was not translated into improved dietary behaviour. Cost of healthy foods was significantly associated with dietary practices ( $p = 0.011$ ), as was lack of availability ( $p = 0.009$ ). Lack of time was also significant ( $p = 0.041$ ), together with family food preferences ( $p = 0.021$ ), lack of motivation ( $p = 0.004$ ), distance to markets ( $p = 0.008$ ), taste preference ( $p = 0.017$ ) and lack of money ( $p = 0.035$ ).

These findings are consistent with literature showing that food affordability, accessibility and time constraints frequently limit healthy eating in resource-constrained environments (Mchiza et al., 2020; Cox et al., 2019; Zuberi et al., 2020). They also demonstrate that dietary behaviour cannot be understood solely as a consequence of an individual's knowledge. Even when adults understand healthy dietary recommendations, they may have difficulty implementing them when healthier foods are expensive, unavailable or located far from their communities, when time for food preparation is limited, or when household and personal food preferences favour other choices. Poor cooking facilities and cultural beliefs were widely reported descriptively as barriers but were not significantly associated with good versus poor dietary practice in the inferential analysis. They should therefore not be described as statistically significant determinants based on the present results. This distinction is important because a factor may be commonly experienced by respondents without necessarily explaining differences between those with good and poor dietary practice.

## CONCLUSION

This study investigated the effect of a nutrition education intervention on dietary habits and nutritional knowledge among adults in Liberia. The results demonstrated a significant improvement in both areas following the intervention. Participants showed a marked increase in their understanding of essential nutritional concepts, such as portion control, balanced diets, and the importance of fruits and vegetables. This enhanced knowledge was directly reflected in the positive changes in dietary practices, including increased fruit and vegetable consumption, better hydration habits, and reduced intake of unhealthy foods like fried snacks and sugary drinks.

Despite these improvements, several barriers continued to challenge the sustainability of these changes. Key barriers included economic constraints, limited access to healthy foods, and time pressures, which made it difficult for participants to consistently implement the healthy behaviors learned. Additionally, cultural influences and traditional food practices also played a role in shaping participants' dietary choices, suggesting the need for culturally sensitive approaches in nutrition interventions.

Therefore, the nutrition education intervention was effective in improving nutritional knowledge and encouraging healthier dietary habits among adults in Liberia. However, for the behavioral changes to be sustained, interventions must go beyond education and address economic, structural, and cultural barriers. Future efforts should focus on integrating nutrition education with strategies aimed at increasing food access and affordability, as well as involving community and family support to enhance long-term adherence to healthy eating practices.

## RECOMMENDATIONS

Based on the findings of the study, research recommends that the government should;

1. Implement community-based nutrition education programs in both urban and rural areas to ensure broad access to nutrition information. These programs should focus on basic nutrition concepts, including balanced diets, portion control, and the importance of fruits, vegetables, and whole grains. Programs should utilize visual aids, interactive methods, and materials in local languages to cater to different literacy levels and make the information accessible to all.

2. Community Leaders should promote the practical application of nutrition knowledge through hands-on activities such as meal planning workshops, cooking demonstrations, and grocery shopping tips. This would empower participants to incorporate healthier eating practices into their daily routines. Emphasis should be placed on using local, affordable ingredients during demonstrations to ensure participants can adopt these habits without significant financial burden.
3. Local Market Authorities should collaborate with local markets and food suppliers to enhance the availability and affordability of nutritious foods, especially in rural areas. Policies should be introduced to subsidize healthy food options such as fruits, vegetables, and lean proteins, and provide incentives for farmers to grow more nutrient-rich crops. In addition, promoting community gardens and urban agriculture should be explored as a strategy to improve local access to affordable, fresh produce.

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