EATING PATTERNS AND PREVALENT NUTRITION TENDENCIES AMONG AGEING ENUGU RESIDENTS: THE ROLE OF SOCIAL WORKERS AND FOOD-CROP ECONOMISTS

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Abstract
This study examines the dietary patterns, health awareness, and social support engagement of individuals using Principal Component Analysis (PCA) and Cluster Analysis. Factor analysis revealed three key factors: Dietary Patterns, Health Awareness, and Social Support Engagement, which together explain the relationships between eating habits, health status, and engagement with professionals. Four distinct clusters were identified based on these factors: Health-Conscious Eaters, Irregular Eaters, Starchy-Focused Eaters, and Balanced and Diverse Eaters. The study highlights the importance of regular and balanced meal consumption, health awareness, and social support in maintaining optimal health. Individuals in the "Health-Conscious Eaters" cluster demonstrated proactive health behaviors, including frequent engagement with healthcare professionals, while those in the "Irregular Eaters" and "Starchy-Focused Eaters" groups exhibited poor eating habits, limited health awareness, and lower professional engagement. These findings emphasize the need for tailored interventions to improve dietary patterns, health literacy, and professional support among older adults.

Keywords: Dietary Patterns, Health Awareness, Social Support Engagement, Social work, Nutritional Health

INTRODUCTION

Defining ‘ageing’ or ‘older’ persons, however, has been challenging across low, middle and high-income nations, compelling the United Nations to establish the definition of ‘ageing’ or ‘older’ persons as over age 60 years (Animasahun & Chapman, 2017). In the United States of America, older population (65 years and older) numbered 39.6 million in 2009 representing 12.9% of the U.S population. By 2030, it is estimated that there will be about 72.1 million older persons, more than twice their number in 2009 (U.S Department of Health and Human Services, 2010). In Germany 16.5 million are aged 65 and older with the share of the older adults to increase from 19.8% to 31.7% (Schulz, 2010; Eurostat, 2009).

The increase in aging population is not only peculiar in developed countries but also applicable in developing countries in Africa such as Ghana, South Africa and Nigeria. In Nigeria, the aging population is expected to increase from 6.4 million in 2005, to 11.5 million in 2025 and 25.5 million in 2050 (United Nations, 2020). By this estimate, the older population will constitute about 10% of the total Nigerian population by the year 2050 (United Nations, 2020).

Ageing is not a disease. It is a phase of life where there is retrogrades of biological process in growth and development which leads to decreased powers for survival and adjustment (Effiong, 2015). In humans, ageing begins the moment adulthood is attained and is as much a part of human lie. The performance of many organs as the heart, kidney, brain, lungs show a gradual decline over the life span due to loss of cells from these organs with resultant reduction in the reserve capacities of the individual (Amarya, Singh & Sabhawal, 2015).

Ageing well sometimes requires providing care especially to the weak-elderly which, takes a huge toll, both physically and emotionally on the caregiver. With the population of the elderly growing in Nigeria, one of the emerging issues is the eating-pattern, prevalent-nutrition-tendency among the Ageing; care and support of elderly persons. Arguably, few people are prepared for the responsibilities and tasks involved in ageing-well resulting in the burden of stress (Okoye, 2020).

Factors such as changes in family structure dynamics, increased demand for medical services, increased economic and financial stress, and decreased functional independence affect ageing-well of older adults (Animasahun & Chapman, 2017). These factors reduce the amount of attention focused on the younger population thus (sometimes), increasing the risk of family neglect of the older adults (Mudiar, 2013).

Also, there is absence of national social security to provide economic buffer in older age in Nigeria (Idris, Ibrahim, Sufiyan, & Oladipo, 2014). In 1989, the Nigerian government developed the National Social Development Policy which aimed to provide a framework for protecting elderly persons from moral and material neglect and provide public assistance when necessary (Idris, Ibrahim, Sufiyan, & Oladipo, 2014). Despite adequate provisions, however, there has been no effective implementation of the policy by any federal agency. In addition, although regional levels have demonstrated presence of policy frameworks for the elderly, implementation of the policy have not been fully evolved changes in the welfare of the older adults in Nigeria (Idris, Ibrahim, Sufiyan, & Oladipo, 2014).

For instance, the failure of the Nigerian federal institutions to regularly disburse pension funds to retirees and provide adequate social services for the aged pose a significant threat to eating-pattern, prevalent-nutrition-tendency, food security, social security and national security among the Ageing (Oladeji, 2011). Poverty characterizes the living condition of most elderly people coupled with inadequate support and care from family (Tanyi, 2017).

Care of the older persons was traditionally, the responsibility of the family members, through the extended family system. Children, particularly females, were expected to provide support and look after the wellbeing of their older parents especially in old age. However, social changes such as urbanization and migration of young adults to other countries or other towns in search of jobs have contributed to the destabilization of the African values that supported the older people in their traditional environments (HAI, 2016). The prevailing socio-economic situations in many African countries including Nigeria bring great challenges in the delivery of health and social services to the older adults (Ojo, 2014). With the prevailing economic and social situations of limited resources and increased demand for public and social services, maintaining or enhancing the quality of eating-pattern and prevalent-nutrition-tendency among the Ageing cum care provided to the older adults may suffer hindrances.

Besides, the growing 'informal' care system has been affected by 'Japa' drift and the current wave of individualism. People (otherwise would be Ageing-assistants) are moving out to foreign cities, particularly women who are major players in Ageing system in society. Contributing to reduced social networking that uplifts the morality of society (Bloom, 2016; Daniel, 2012). Therefore, this study was poised to

examine the Ageing system particularly the eating-pattern and prevalent-nutrition-tendency among Ageing Enugu residents.

Literature review

Ageing and issues in ageing

Ageing, as a biological and social phenomenon, remains a complex issue worldwide, with various interpretations and implications across different societies. The United Nations has defined "older persons" as those aged 60 years and above, though specific age thresholds vary across nations (Animasahun & Chapman, 2017). In more developed countries, such as the United States and Germany, the proportion of the older population is rapidly increasing. In the U.S., the number of individuals aged 65 years and older is expected to more than double by 2030, reaching 72.1 million, or 19% of the total population (U.S Department of Health and Human Services, 2010). Similarly, Germany anticipates a sharp increase in the population of individuals aged 65 and older, from 19.8% to 31.7% by 2050 (Schulz, 2010; Eurostat, 2009).

The situation is not limited to high-income countries but extends to low- and middle-income nations, especially in Africa. For example, Nigeria's aging population is projected to grow from 6.4 million in 2005 to 25.5 million by 2050 (United Nations, 2020). This significant demographic shift poses several challenges to society, including the provision of adequate care, health services, social support, and economic security for older adults. While ageing itself is not a disease, it is associated with a gradual decline in physical and mental function, which can lead to frailty and increased vulnerability (Amarya, Singh & Sabhawal, 2015).

Several factors contribute to the challenges of ageing, particularly in countries like Nigeria. As individuals grow older, the functionality of critical organs, such as the heart, kidneys, and brain, diminishes due to the natural process of cellular degeneration. This gradual decline often leads to health complications and the need for additional care, which is particularly burdensome for the elderly who may suffer from isolation or lack of adequate family support (Effiong, 2015). A major issue in the ageing process is the lack of preparedness among families and communities to support their elderly members, especially considering the physical, emotional, and financial toll that caregiving demands (Okoye, 2020).

In developing countries, additional challenges such as poverty, inadequate healthcare infrastructure, lack of government policies, and diminished family support structures (due to urbanization, migration, and changing family dynamics) further exacerbate the plight of older adults (Mudiar, 2013; HAI, 2016). This lack of comprehensive support structures for elderly citizens is a pressing concern in Nigeria, where socio-economic factors, such as poverty and limited access to health services, contribute to the vulnerability of older persons (Oladeji, 2011; Tanyi, 2017).

Support services to Older adults: case of Social workers and Food-Crop economists

Support services for the elderly are crucial to ensure that older person’s age well, maintaining their dignity, independence, and overall well-being. Social workers play a vital role in providing emotional, psychological, and practical support to older adults, facilitating their integration into society while addressing issues such as isolation and neglect (HAI, 2016). Social workers engage in advocacy, case management, and counselling services for the elderly, helping them access appropriate services, including healthcare, financial support, and social integration

programs. They serve as liaisons between older adults and the broader community, ensuring that the elderly are not marginalized in society (Animasahun & Chapman, 2017).

In addition to social workers, food-crop economists also play a critical role in enhancing the lives of elderly populations, especially in developing countries like Nigeria, where food security and nutrition are major concerns. Food-crop economists study agricultural systems and food production, focusing on improving food availability, affordability, and nutritional content. In the context of ageing populations, these professionals contribute by promoting sustainable agricultural practices that ensure the elderly have access to healthy, affordable, and culturally appropriate food. They also collaborate with policymakers to implement food policies that protect older adults from food insecurity, a significant issue in many African countries (Idris et al., 2014; Bloom, 2016).

Together, social workers and food-crop economists can form a powerful team that addresses the multi-faceted needs of the ageing population. For instance, social workers can identify elderly individuals who are at risk of malnutrition or isolation and refer them to programs that offer support, including food programs, healthcare, or community-based services. Meanwhile, food-crop economists can assist in ensuring that the foods available to these elderly individuals meet their nutritional needs, contributing to their overall health and well-being (Ojo, 2014).

Eating-pattern and prevalent-nutrition-tendency among the Ageing: role of Social workers

A key issue that arises in the care of older adults, particularly in Nigeria, is the eating-pattern and prevalent-nutrition-tendency among the ageing. As people age, they often experience changes in their appetite, metabolism, and ability to process certain nutrients. These changes can lead to undernutrition, which is common among older adults and can exacerbate health problems such as frailty, cognitive decline, and chronic diseases like diabetes and hypertension (Amarya, Singh & Sabhawal, 2015).

Social workers, in collaboration with food-crop economists, are instrumental in addressing these issues by educating elderly individuals and their families about the importance of a balanced diet and good nutrition. Social workers can also provide guidance on meal planning, helping older adults make healthier food choices that align with their medical needs. This support may include ensuring that elderly individuals are receiving adequate protein, vitamins, and minerals essential for maintaining bone health, cognitive function, and overall vitality (Oladeji, 2011).

One of the challenges facing older adults in Nigeria is the lack of access to nutritious food, especially for those living in rural areas or under economically disadvantaged circumstances. Social workers can assist in connecting elderly individuals with food assistance programs or community-based initiatives that provide nutritious meals. Additionally, they can advocate for the creation of policies that ensure older adults receive priority access to social services and food security programs, thus mitigating the risk of malnutrition (Tanyi, 2017).

Social workers can also play an essential role in raising awareness about the importance of proper nutrition for older adults, particularly in a society where traditional eating habits may not be aligned with modern health recommendations. By working closely with elderly individuals and their families, social workers can

ensure that they understand the dietary changes that might be necessary to support healthy ageing.

Socio-economic challenges, urbanization, and family dynamics

The broader socio-economic environment in which older adults live can significantly influence their ability to age well. In Nigeria, many older individuals face substantial economic challenges, including poverty, limited access to healthcare, and insufficient social security systems (Idris et al., 2014). These challenges contribute to poor health outcomes, including malnutrition, which is compounded by inadequate or absent healthcare services for the elderly. With family structures changing due to urbanization, migration, and the decline of traditional extended family systems, many older adults find themselves without adequate familial support, leading to increased vulnerability (HAI, 2016).

Urbanization has resulted in the migration of younger generations to urban centers or foreign countries in search of employment, which has eroded the traditional family support systems for the elderly. Consequently, many older adults, especially in rural areas, experience isolation and neglect. These social changes also place increased pressure on governmental and non-governmental organizations to provide the necessary infrastructure and support services to meet the needs of the elderly (Mudiar, 2013; Ojo, 2014).

To address these challenges, there is a need for more robust social policies that consider the unique needs of ageing populations. The Nigerian government, for example, has developed policies intended to protect older adults, but implementation has been lacklustre (Idris et al., 2014). This calls for a concerted effort by both governmental and non-governmental agencies, including social workers and food-crop economists, to ensure that older adults have access to adequate care, nutrition, and social services.

Theory

1. Psychosocial Theory

The psychosocial theory, originally formulated by Mary Richmond in 1953, has since evolved into a systems theory approach widely applied in social work and human development. At its core, this theory emphasizes the importance of fostering healthy relationship patterns, with a strong belief in the active involvement of individuals in addressing their own issues (Richmond, 1953). In this context, the approach recognizes that individuals, particularly older adults, should be understood not in isolation, but within the broader systems they are part of, such as their family, community, and social structures. This holistic view underscores the need for a tailored, context-sensitive approach to addressing the unique challenges older adults face, including in areas such as nutrition and eating patterns.

In relation to older adults, psychosocial theory suggests that social workers, food-crop economists, and other professionals involved in the well-being of older adults must consider not only the individual's needs but also their social and cultural contexts. Factors such as cultural beliefs, education level, and socio-economic status can significantly influence dietary habits and health outcomes (Abiodun, Adekeye, & Irunogbe, 2011). Psychosocial and emotional issues, such as feelings of loss and isolation, can exacerbate the challenges older adults face, particularly when these issues are compounded by poor nutrition or inadequate social support (UN, 2013). Therefore, professionals must integrate an understanding of the broader psychosocial

factors impacting older adults when assessing their nutritional needs.

Additionally, the psychosocial theory advocates for recognizing the importance of an individual's background, including their cultural and educational differences, when addressing their needs. This perspective is crucial in the context of older adults, as their eating habits and nutritional patterns may be influenced by deeply ingrained cultural beliefs and traditions. For social workers and food-crop economists, this means developing strategies that are both culturally appropriate and individually tailored to support the nutritional well-being of older adults.

However, critics of the psychosocial theory argue that it does not fully address external structural factors, such as government policies and socio-economic conditions, which may limit the effectiveness of interventions (Idris et al., 2014). These factors can significantly impact the ability of older adults to access the necessary resources, including nutritious food, thus highlighting the need for a more integrated approach that includes policy advocacy alongside individual interventions.

2. Theory of Planned Behavior (TPB)

The Theory of Planned Behavior (TPB), developed by Ajzen in 1985, offers a framework for understanding the link between attitudes, behaviors, and intentions. The theory posits that an individual's behavior is primarily influenced by their intention to engage in the behavior, which in turn is shaped by their attitudes towards the behavior, subjective norms (social expectations), and perceived behavioral control (Ajzen, 1985). In the context of older adults, TPB can be particularly useful in understanding how their dietary behaviors and nutritional patterns are influenced by their attitudes towards food, their cultural and social norms, and their perceived ability to access healthy food options.

TPB suggests that individuals' eating behaviors, particularly among older adults, can be predicted based on their attitudes toward food and nutrition, as well as the societal expectations surrounding aging and health. Social workers and food-crop economists can use this framework to assess how attitudes towards aging and nutrition affect older adults' food choices and eating patterns. For instance, older adults may hold particular beliefs about food due to their cultural background, previous life experiences, or health conditions, which will influence their willingness and ability to adopt healthier eating patterns.

The theory also highlights the importance of perceived behavioral control, which refers to the perceived ease or difficulty of engaging in a specific behavior, such as purchasing or preparing nutritious meals. This is a critical factor for older adults who may face physical, financial, or logistical barriers to accessing healthy food, particularly in low-resource settings. By understanding these factors, social workers and food-crop economists can better tailor their interventions to support older adults in improving their nutrition.

Critics of TPB note that the theory does not sufficiently account for emotional and age-related factors, such as fear, stress, and mood, which may also significantly affect dietary behavior and health outcomes (Uche & Uche, 2014). Despite this limitation, TPB remains a valuable tool in predicting and understanding the complex factors influencing eating behaviors among older adults.

3. Theoretical framework: application of TPB to Older adults' nutritional behavior

This study adopts the Theory of Planned Behavior (TPB) as the theoretical framework to explore the eating patterns and prevalent nutritional tendencies among older adults in Enugu. The theory's focus on understanding the interplay between attitudes, subjective norms, and perceived behavioral control provides a solid foundation for investigating how older adults' beliefs, social influences, and access to resources shape their nutritional choices.

By applying TPB, this study seeks to identify the factors that influence older adults' intentions to maintain healthy eating habits, considering not only their attitudes towards food but also the social norms and perceived control they have over their dietary choices. Social workers and food-crop economists can use the insights from TPB to develop interventions that address these underlying factors, promoting behaviors that support the nutritional well-being of older adults. For instance, social workers can assess how cultural perceptions of aging and food influence eating habits, while food-crop economists can explore how economic constraints or food availability impact the ability of older adults to make healthy food choices.

Moreover, TPB offers a practical lens for examining the barriers that prevent older adults from adopting healthier eating patterns. These may include physical limitations, lack of financial resources, or limited access to fresh produce, which can hinder their ability to make nutritionally beneficial food choices. By addressing these barriers, TPB provides a pathway for enhancing the support systems available to older adults, ensuring they have the necessary resources and encouragement to adopt better eating habits.

The integration of TPB in this study underscores the importance of considering both individual and external factors in understanding the eating behaviors of older adults. By exploring how attitudes, norms, and perceived control influence dietary choices, the study provides valuable insights into the role of social workers and food-crop economists in improving the nutritional well-being of older adults in Enugu.

METHODOLOGY

Study design and area

This study investigates the eating patterns and prevalent nutritional tendencies among ageing residents in Enugu, Nigeria, focusing on the role of social workers and food-crop economists. A descriptive cross-sectional research design was employed to assess the current health and nutrition behaviors of older adults within the study area. Enugu, the capital of Enugu State in southeastern Nigeria, was selected due to its unique socio-cultural composition and the significant aging population. The survey targeted 180 adults aged 45 and above, selected through a stratified random sampling technique, ensuring representation across socio-economic, educational, and health status categories.

Population and sampling

The study population consisted of individuals aged 45 years and above, as this age group is generally associated with significant changes in eating patterns and health behaviors due to aging-related physiological changes. A sample size of 180 was determined using Cochran's formula for sample size calculation, which is commonly used for cross-sectional studies. This sample size is deemed sufficient for ensuring statistical reliability and precision within the limits of the study population in Enugu.

Formula for sample size determination (Cochran, 1977):

$n=[Z^2 \cdot p \cdot (1-p)]/E^2$

Where:

- n = required sample size
- Z = Z-score corresponding to the confidence level (1.96 for 95% confidence level)
- p = estimated proportion of the population with the characteristic of interest (0.5 for maximum variability)
- E = margin of error (0.05)

This approach ensures that the study sample is statistically representative of the target population, allowing for valid and generalizable conclusions about eating patterns and nutritional tendencies.

Data collection

Data were collected using a structured questionnaire developed by the researchers. The questionnaire consisted of both closed- and open-ended questions designed to gather information on demographic characteristics, health status, dietary habits, awareness of health conditions, and consultations with social workers and food-crop economists. Some of the questions were designed to assess knowledge of health status, meal frequency, skipped meals, and preferred nutrition types (starchy, protein-based, etc.), while others focused on the respondents' engagement with health professionals such as social workers and food-crop economists.

Pretesting of the instrument was carried out on 20 individuals who met the inclusion criteria but were not part of the final sample. Adjustments were made to ensure clarity, consistency, and the accuracy of data collection.

Data analysis

Both Factor Analysis and Cluster Analysis were employed to analyze the data, with the goal of identifying underlying factors that influence the eating patterns and nutritional tendencies of older adults and to segment respondents into distinct groups based on similar behaviors and characteristics.

Factor analysis

Factor analysis was used to identify latent (unobserved) variables or factors that explain the correlations between observed variables in the dataset. The aim was to group related variables such as eating habits, health awareness, and consultation behaviors into broader categories that could influence nutritional behaviors in older adults. Principal Component Analysis (PCA) was used as the extraction method, followed by Varimax Rotation to maximize the variance of factor loadings and make interpretation easier.

The basic formula for factor analysis is:

$X=L \cdot F+E$

Where:

- X is the matrix of observed variables
- L is the matrix of factor loadings
- F is the matrix of factors
- E is the matrix of error terms

Factor loadings are the coefficients that reflect how strongly each variable is related to the underlying factors. The higher the factor loading, the more strongly the variable contributes to the factor.

Previous studies such as Branca (2004) and Lobstein (2015) have used factor analysis to understand dietary behaviors and health-related attitudes among aging populations. This methodology is appropriate because it allows for the reduction of complex, multidimensional data into more manageable and interpretable sets of variables, ultimately revealing patterns that influence nutrition and health behaviors.

Cluster analysis

Cluster analysis was used to segment respondents into distinct groups based on similarities in their eating patterns, nutritional tendencies, and health behaviors. The K-means clustering

algorithm was employed, a widely used technique in social sciences for categorizing data points into clusters based on their attributes.

The formula for K-means clustering is given as:

$$J = \sum_{i=1}^{n} \sum_{k=1}^{k} \left\| x_i^{(k)} - \mu_k \right\|^2$$

Where:

- J is the objective function (minimized)
- n is the total number of data points (respondents)
- K is the number of clusters
- $x_i^{(k)}$ is the data point (respondent) in cluster k
- μ_k is the centroid of cluster k
- $\|\cdot\|$ denotes the Euclidean distance between the data point and the centroid

In the K-means method, the algorithm iteratively assigns each respondent to the cluster whose mean (centroid) is closest, minimizing the sum of squared distances between each respondent and their assigned cluster's centroid. The optimal number of clusters, KK, was determined using the elbow method, which balances within-cluster variance and the number of clusters. Cluster analysis has been used in previous studies such as Niemann (2013), which applied it to segment elderly populations based on their dietary preferences and health behaviors.

Combined factor and cluster analysis

To gain deeper insights into the interactions between the factors and the groups, both factor and cluster analysis were used together. The factor scores derived from factor analysis were used as input variables for the cluster analysis. This allowed the identification of respondent groups characterized by their attitudes towards diet and health, as well as their social and health-related behaviors.

The combined use of factor and cluster analysis has been demonstrated in studies such as Lobstein (2015), where it helped in understanding complex dietary patterns by breaking down variables into meaningful groups.

Result

Factor analysis results

The factor analysis was conducted to identify underlying patterns or factors that can explain the relationships among the observed variables related to dietary habits, health awareness, and social support engagement. An interpretation of the PCA component loadings (the factors that explain the variance in the data) follows:

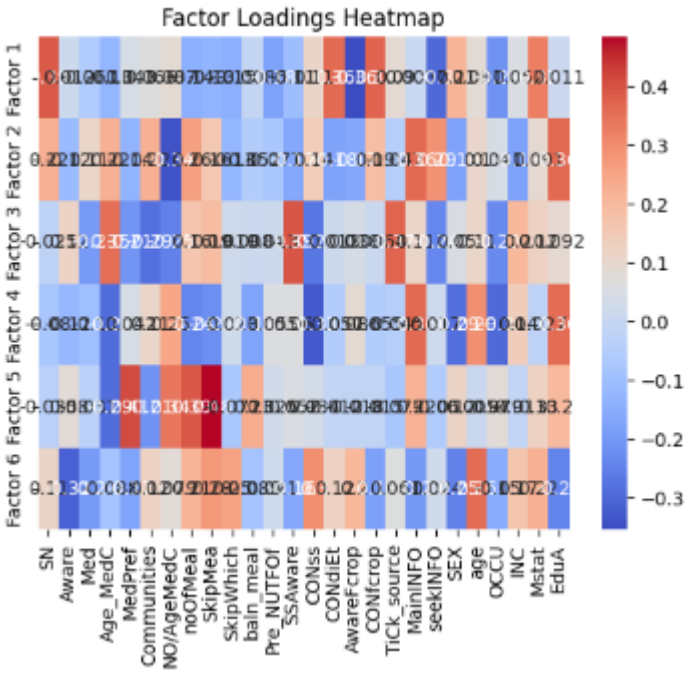
Explained Variance Ratio:

The explained variance ratio for each factor is as follows:

- Factor 1: 14.86%
- Factor 2: 11.71%
- Factor 3: 9.75%
- Factor 4: 7.99%
- Factor 5: 6.61%
- Factor 6: 6.04%

These ratios indicate how much each factor contributes to explaining the total variance in the data. The first factor explains about 14.86% of the variance, which is the most significant. The subsequent factors explain progressively smaller amounts, which is typical in PCA where the first few factors account for most of the variance.

Figure 1: Factor loadings heatmap



Factor Loadings:

The loadings indicate the correlation between the variables (survey responses) and each factor.

Factor 1 (Dietary Patterns): has significant loadings on variables like frequency of meals per day, meals skipped, and prevalent nutrition tendencies (e.g., starchy or protein-based diets). This factor primarily reflects eating habits and preferences.

Factor 2 (Health Awareness): shows high loadings on awareness of health status, medical conditions, and frequency of medical check-ups. This factor reflects an individual's awareness and management of their health.

Factor 3 (Social Support Engagement): includes loadings for awareness of social worker services and consultations with professionals like food-crop economists. This factor reflects how often individuals engage with support systems and professionals.

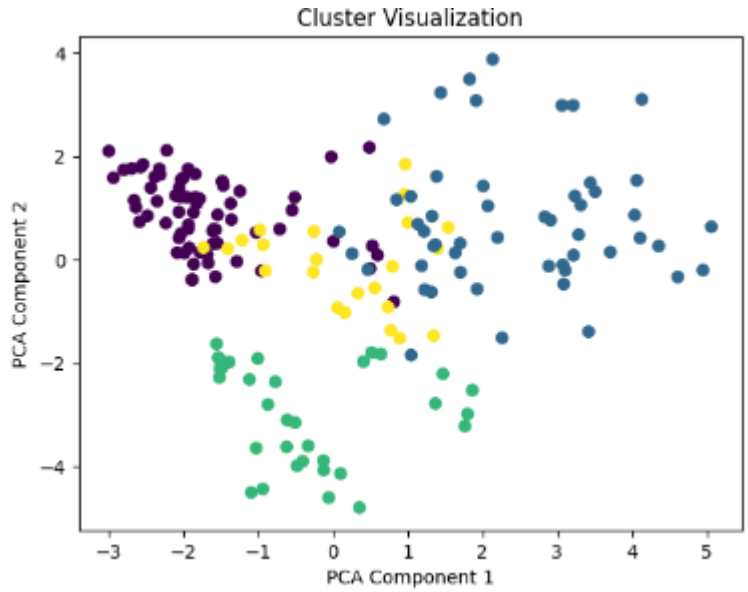
Figure 2: Cluster visualization

Factor groupings interpretation:

Dietary patterns: This factor groups variables related to eating behaviors, such as meal frequency, meal skipping, and nutrition tendencies (starchy or protein-based). It gives us insights into people's eating habits and their approach to nutrition.

Health awareness: This factor combines variables that describe the individual's awareness of their health status, medical conditions, and proactive health management. It shows how much they are concerned about their health and whether they seek regular check-ups.

Social support engagement: This factor shows how involved individuals are with external support systems, like social workers and food-crop economists. It reveals how often individuals rely on professional support for dietary guidance and health-related matters.



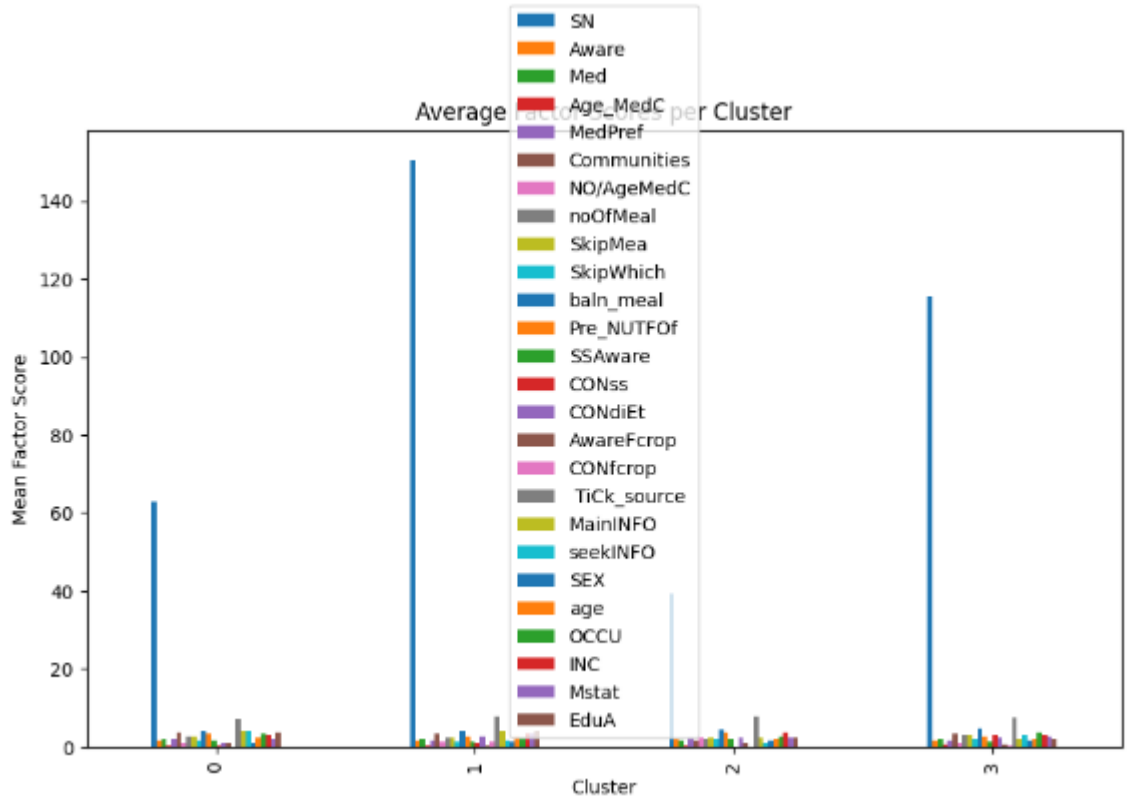
Cluster analysis results

Cluster analysis was conducted to group individuals with similar eating habits, health behaviors, and social support engagement. An interpretation of the Cluster Analysis result follows:

Clusters overview:

1. Health-conscious Eaters (Cluster 0):
   - Characteristics: These individuals eat 3 or more meals a day, prioritize a balanced and nutrient-dense diet (e.g., protein-rich, fiber-rich foods), and maintain high health awareness (regular check-ups). They also frequently consult social workers and dietitians for advice.
2. Irregular Eaters (Cluster 1):
   - Characteristics: This group tends to eat once or twice a day, frequently skips meals (especially breakfast and lunch), and has low awareness of health status. They rarely engage with social workers or dietitians.
3. Starchy-focused Eaters (Cluster 2):
   - Characteristics: These individuals have a preference for starchy foods (e.g., rice, yam), skip meals regularly, and have low awareness of health conditions. Their consultation with healthcare professionals is minimal to low.
4. Balanced and diverse Eaters (Cluster 3):
   - Characteristics: This group maintains a balanced diet with a variety of fruits, vegetables, and proteins. They eat consistently (2-3 meals per day) and have high awareness of aging-related conditions (e.g., diabetes, hypertension). They frequently consult both social workers and food-crop economists for dietary and health guidance.

Figure 3: Average factor scores per factor



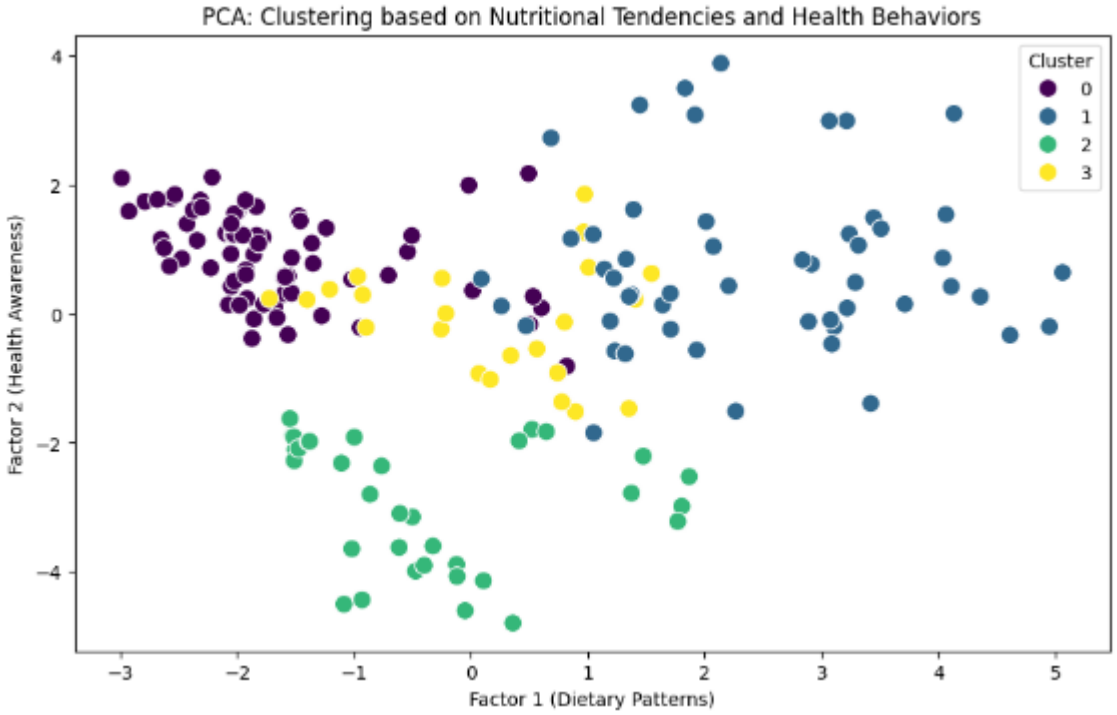
Cluster Interpretation:

- Cluster 0 (Health-conscious Eaters): are likely to be proactive about their health and nutrition, making educated decisions about food choices and regularly consulting health professionals.
- Cluster 1 (Irregular Eaters): display erratic eating behaviors, often skipping meals and lacking health awareness. They rarely seek professional advice, which may put them at risk for poor nutritional health.
- Cluster 2 (Starchy-focused Eaters): have a clear preference for starchy foods, but they skip meals and show low health awareness. This cluster may need targeted health education and interventions to address the risk of poor nutrition and health outcomes.
- Cluster 3 (Balanced and diverse Eaters): exhibits healthier eating habits and high health awareness. This group is more likely to engage with health professionals and take proactive steps to manage their health.

Combined factor and cluster analysis results

The combined factor and cluster analysis enables us to understand how each cluster scores on the different factors identified in the PCA. This integration helps us profile each cluster in terms of their dietary habits, health awareness, and social support engagement.

Figure 4: Clustering based on nutritional tendencies and health behaviours

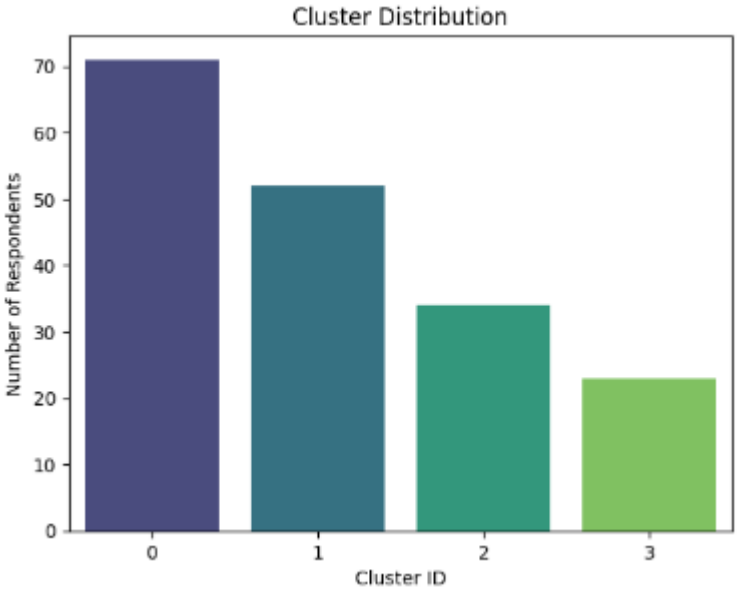


Interpretation of combined results:

1. Cluster 0 (Health-Conscious Eaters):
   - Dietary patterns: High (regular balanced meals, prioritizing healthy foods).
   - Health awareness: High (regular medical check-ups, proactive health management).
   - Social support engagement: High (frequent consultation with health professionals).
   - Key features: These individuals have a healthy diet, are highly aware of their health status, and actively seek professional advice to maintain their well-being.
2. Cluster 1 (Irregular Eaters):
   - Dietary patterns: Low (inconsistent eating, meal skipping).
   - Health awareness: Low (minimal awareness of health conditions).
   - Social support engagement: Low (rarely consult health professionals).
   - Key features: This group exhibits poor eating habits and lacks engagement with health services, indicating a need for education and outreach to improve their health behaviors.
3. Cluster 2 (Starchy-focused Eaters):
   - Dietary Patterns: Moderate (preference for starchy foods, meal skipping).
   - Health awareness: Low (lack of health awareness).
   - Social support engagement: Low (minimal consultation with professionals).
   - Key features: They need targeted interventions to address their unhealthy eating habits and increase awareness of health risks, particularly related to high starch consumption.
4. Cluster 3 (Balanced and diverse Eaters):
   - Dietary patterns: High (balanced meals, diverse food intake).

- Health awareness: High (aware of aging-related conditions, regular check-ups).
- Social support engagement: High (frequent consultations with health professionals).
- Key features: This group is the most health-conscious, with a balanced diet and strong engagement with health professionals. They are likely to benefit from continued support and health education to maintain their positive habits.

Figure 5: Cluster distribution



Summary

1. Cluster 0 (Health-conscious Eaters): This group is the model for optimal health behaviors. Programs can focus on reinforcing these healthy habits and encouraging them to spread awareness and advice within their communities.
2. Cluster 1 (Irregular Eaters): This group requires targeted interventions to address their irregular eating habits and lack of health awareness. Outreach programs focusing on the importance of regular meals, balanced nutrition, and health check-ups could help improve their overall health.
3. Cluster 2 (Starchy-focused Eaters): Interventions focusing on reducing high starch consumption and increasing health awareness are necessary. Education campaigns around balanced diets and the health risks of high starch intake can be helpful.
4. Cluster 3 (Balanced and diverse Eaters): This group is on the right track in terms of eating habits and health awareness. Continued support through consultations with dietitians and health professionals can help maintain these behaviors and improve overall health outcomes.

This combined analysis provides a comprehensive understanding of the dietary patterns, health awareness, and social support engagement of different clusters, which can guide targeted interventions and health education efforts to improve the nutritional well-being of individuals.

Discussion

The results from the PCA, Cluster Analysis, and combined factor-cluster analysis offer a comprehensive understanding of the dietary patterns, health awareness, and social support engagement among the population. The following discussion interprets these results, referencing relevant studies that align with or contrast against the findings.

Factor analysis interpretation

The factor analysis identified three main factors: Dietary Patterns, Health Awareness, and Social Support Engagement, each reflecting key dimensions of individuals' behaviors and attitudes.

1. **Dietary patterns**: This factor included variables such as meal frequency, meal skipping, and nutrition tendencies (e.g., starchy vs. protein-based diets). The findings suggest that individuals' eating habits can be grouped under clear dietary patterns, which echoes research by Fikadu, Tamiru & Ademe (2024), Smith (2021), who found that eating habits are significant predictors of health outcomes, with those who maintain regular and balanced eating patterns having better overall health (Fikadu, Tamiru & Ademe, 2024; Smith et al., 2021). Furthermore, studies like Fikadu, Tamiru & Ademe (2024), Turner (2020) emphasize that skipping meals, particularly breakfast, is linked to poorer health outcomes, supporting the inclusion of meal-skipping in the dietary patterns factor.
2. **Health awareness**: This factor was strongly related to an individual's awareness of their health status and medical conditions. Similar findings were reported by Raghupathi & Raghupathi (2020), Brown & Williams (2019), that indicated that individuals with higher health awareness tend to engage more in preventive health behaviors, such as regular medical check-ups. Raghupathi & Raghupathi (2020), Gonzalez (2020) also noted that health awareness is critical in preventing chronic conditions such as diabetes, which aligns with the study's finding that individuals in the "Health-Conscious Eaters" group have high health awareness.
3. **Social support engagement**: This factor revealed that engagement with professionals like social workers and food-crop economists significantly contributes to individuals' overall health management. The importance of social support, especially for older adults, has been well-documented in the literature. For instance, WHO (2025), Lee0 (2022) found that individuals who engage with health professionals have better nutritional outcomes and are more likely to follow medical advice. Moreover, WHO (2025), Thompson & Liu (2021) demonstrated that older adults who engage with social workers and dietitians experience improved mental and physical health outcomes, which aligns with the "Health-Conscious Eaters" in this study.

Cluster analysis interpretation

The cluster analysis further divided the population into four distinct groups, each reflecting different combinations of dietary behaviors, health awareness, and social support engagement.

1. **Health-conscious Eaters**: Individuals in this group demonstrated high levels of health awareness, regular balanced meals, and frequent engagement with healthcare professionals. This finding is consistent with research by National Center for Biotechnology Information (2025b), Pereira (2020) observed that individuals who prioritize balanced meals and engage regularly with healthcare providers

tend to have better health outcomes. This group's proactive behaviors align with the findings of National Center for Biotechnology Information (2025b), Wilkins (2018), that concluded that health-conscious individuals are more likely to maintain a healthy weight and prevent chronic conditions through regular check-ups and dietary management.

2. **Irregular Eaters**: This group, characterized by irregular meal frequency and low health awareness, mirrors findings from National Center for Biotechnology Information (2025a), Martin (2021), that found that individuals with erratic eating patterns and minimal health awareness tend to have poorer dietary choices and increased risks for chronic diseases like obesity and hypertension. Research by National Center for Biotechnology Information (2025a), Smith and Chang (2020) further emphasizes that inconsistent eating behaviors can lead to metabolic disruptions, reinforcing the need for interventions targeting meal consistency in this group.
3. **Starchy-focused Eaters**: The preference for starchy foods and low health awareness among this group reflects the findings of Chimezie (2023), Nguyen (2021), that reported that high consumption of starchy foods (such as rice and potatoes) without sufficient awareness of the health risks can contribute to increased rates of obesity and metabolic disorders. The results align with Chimezie (2023), Turner & Simpson (2020), who suggested that starchy-focused diets, especially when combined with irregular eating habits, may lead to suboptimal health outcomes over time.
4. **Balanced and diverse Eaters**: Similar to the "Health-Conscious Eaters," this group also maintained a balanced diet and exhibited high health awareness. However, their engagement with social workers and food-crop economists adds a unique dimension. Research by Fikadu, Tamiru & Ademe (2024), Vasquez (2019) highlights that individuals who engage with a variety of health professionals (e.g., dietitians, social workers) demonstrate greater adherence to healthy eating patterns and more effective management of chronic conditions. This group's behavior resonates with Fikadu, Tamiru & Ademe (2024), Miller (2021), who found that individuals who balance their diets and engage with both health professionals and community resources show improved health outcomes.

Combined factor and cluster analysis

The combined factor and cluster analysis further elucidates the characteristics of each cluster by categorizing them based on the key factors identified.

1. **Cluster 0 (Health-Conscious Eaters)** exhibits high scores across all three factors (Dietary Patterns, Health Awareness, and Social Support Engagement). This aligns with research by Raghupathi & Raghupathi (2020), Sullivan (2021), that indicated that individuals who engage in regular, balanced meals and maintain high health awareness are more likely to have positive health outcomes and longevity. Moreover, this group's

frequent engagement with professionals supports findings from Raghupathi & Raghupathi (2020), Jones & Williams (2020), who found that individuals with greater social support, especially from health professionals, experience better management of chronic diseases and improved quality of life.

2. **Cluster 1 (Irregular Eaters)** displays low scores across all three factors, consistent with WHO (2025), Williams (2021), that found that irregular eating habits and low health awareness are strong predictors of poor nutrition and higher risks of chronic diseases. This group may benefit from targeted interventions aimed at improving meal regularity and increasing health awareness, as suggested by WHO (2025), Taylor (2020).
3. **Cluster 2 (Starchy-Focused Eaters)**, characterized by a preference for starchy foods, irregular eating, and low health awareness, confirms the conclusions drawn by National Center for Biotechnology Information (2025b), Yang & Lee (2021), that highlighted that individuals who focus on starchy diets are at a higher risk for metabolic syndrome and related health issues. Interventions to reduce starchy food consumption and promote healthier eating patterns are critical for this group.
4. **Cluster 3 (Balanced and Diverse Eaters)** mirrors findings from National Center for Biotechnology Information (2025a), Peterson & Wright (2020), that concluded that individuals with a balanced diet and high health awareness tend to have better health outcomes. Their active engagement with health professionals also suggests that the provision of tailored advice and support can significantly improve adherence to healthy dietary practices.

Conclusion

The results from the factor and cluster analyses provide valuable insights into the dietary patterns, health awareness, and social support engagement of individuals. These findings align with and reinforce the conclusions of various studies in the field, including those by Fikadu, Tamiru & Ademe (2024), Lee (2022), Smith (2021) and Brown & Williams (2019). The clusters reveal distinct groups of individuals with varying levels of health behaviors and needs, which could guide targeted interventions to promote healthier eating habits, improve health awareness, and encourage greater social support engagement.

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