**Fruits and Vegetables Consumer Access and Consumption Behaviour in Kenya: The role of Retail Markets**

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**Abstract**

**Background**: Food systems in developing countries are currently undergoing rapid transformation towards provision of sustainable healthy diets due to the rising burden of non-communicable diseases (NCDs). Adequate consumption of F&Vs is associated with a lower risk of NCDs. Retail markets play a crucial role in promoting access to and consumption of fresh F&Vs, however, the association between dimensions of access and consumption is not fully understood. The objective of this study was to assess the role of formal and informal urban retail markets in consumers` access to and consumption of F&Vs in Kenya as guided by the food environment framework.

**Methods:** The cross-sectional study adopted a mixed-methods approach with quantitative data collected from adult consumers (n=206) and qualitative data from F&Vs vendors, county government staff and market leaders. A stratified random sampling technique was used to select the formal and informal markets. Multivariate logistic regression model was used to analyse the predictors of F&V consumption.

**Results:** There was a significant (P<0.05) gender difference in consumer purchasing behaviours for F&Vs. Most women consumers preferred to purchase F&Vs from informal markets (82.2%) compared to men (17.8%). The study demonstrated a low consumption of fruits (2.03 ±1.27 servings) and vegetables (2.17±1.35 servings) by adult male and female consumers despite ease of access to retail markets. Overall, only 3.1% and 4.5% of the adults consumed recommended number of servings (≥ 5) of F&Vs respectively per day. The significant (P<0.05) predictors for daily consumption of fruits were consumer age (P=0.018), education level (P=0.032), occupation (P=0.032) and perception on the safety of the retail market (P=0.046). Age (P=0.028), distance to the market (P=0.001) and perceptions on safety of the market (P=0.040) were the key determinants for the number of fruits servings consumed in a week. Further, only monthly income (P=0.043) influenced daily consumption of adequate amounts of vegetables while consumer gender, occupation, monthly income, time taken to the market, and ease of market accessibility predicted (P<0.05) weekly vegetable consumption.

**Conclusion & Recommendations:** There is a need for gendered nutrition education and social behaviour change communication intervention programmes to promote purchase and consumption of adequate amounts of F&Vs among adult consumers in urban areas. Context specific retail market policies, regulations and initiatives targeted at improving infrastructure, food safety and safety of consumers are needed to increase access to F&Vs in urban settings.

**Keywords:** Access to retail markets; Consumer purchasing behaviours; Fruits and vegetables consumption; Retail Market Food Environment; Urban Retail Markets

1. **Introduction**

Non communicable diseases (NCDs) including cardiovascular diseases, cancers, diabetes and chronic respiratory diseases are becoming the leading cause of mortality in Africa (Müller et al, 2024). These NCDs can be prevented by reducing common risk factors such as tobacco use, harmful alcohol use, physical inactivity and eating unhealthy diets (Budreviciute, et al, 2020). However, in newly developing urban areas, dietary habits are shifting towards unhealthy diets due to a variety of factors such as changes in consumer socio-economic and lifestyle behaviours (Casari et al, 2022). This dietary transition poses threats such as nutrient inadequacy, stunting, overweight, obesity and related NCDs (Popkin and Ng, 2022) that have societal and disease epidemiological consequences. For example, in African countries including Kenya, dietary transition from traditional to highly processed foods are highly attributed to globalization and urbanization (Stadlmayr et al. 2023) and fast rise in obesity (Reardon et al, 2021). Therefore, it is imperative to accelerate efforts towards transforming food systems to promote the consumption of environmentally sustainable, safe and healthy diets (Burgaz, et al, 2024, IFPRI, 2024,). A long-term change in dietary structure can be achieved by involving governments, retailers, food producers, and consumers to address cultural barriers and social norms (Wu et al, 2024). A recent study (Kiplagat et al, 2023) reported that many of the adolescents in Uasin Gishu County, Kenya had low level of knowledge regarding NCDs and their risk factors. Thus, nutrition interventions that promote consumption of health diets consisting of fruits and vegetables (F&Vs), whole grains, legumes, seeds, and nuts, low sugar, salt and fat may help reduce NCD risks (Cena and Calder, 2020). Context-specific policy interventions are also needed to ensure that sustainable, healthy, and diverse diets are more affordable, accessible, and desirable to consumers while considering environmental impacts (Herrero, et al, 2023, Kalmpourtzidou, et al, 2022).

Although increased F&Vs intake is promoted across all dietary guidelines, national surveys confirm that dietary intakes are suboptimal and are not increasing over time (Woodside et al, 2023). Inadequate F&Vs intake is more pronounced in resource-poor countries (Msambichaka et al. 2018). The benefits of consuming a F&V rich diet cannot be over emphasized. As indicated by Liu (2013) and World Health Organization (WHO) (2023), F&Vs have vitamins, minerals and fiber which either singly or synergistically protects against NCDs. However, despite the positive benefits, global consumption is far below the WHO recommendation of 400 grams or more F& V (equivalent to 5 servings of 80 g each) per day (Stadlmayr et al. 2023). This has severe negative implications on the health outlook and well-being of consumers and can even lead to death. The WHO 2023 report indicates that an estimated 3.9 million deaths worldwide were attributable to inadequate F&Vs consumption in 2017. This illustrates the importance of promoting considerable dietary shifts including ensuring adequate F&V consumption across all populations.

Apart from being a public health priority to promote healthy lifestyles amongst consumers, changes in nutrition are critical to achieving several of the Sustainable Development Goals (SDGs) (FAO, 2017). The development of SDGs aims at assisting households to transition to healthy diets and end various forms of malnutrition by 2030 (Chen, Chaudhary & Mathys, 2022). Low intake of F&Vs is reported in most African countries, including Kenya, and particularly in socio-economically challenged households (Okop, 2019). Furthermore, majority of households make incorrect food choices and habits, perpetuating the cycle of malnutrition. Nutritious and health diets promote healthy development and growth especially among young children and contribute to maintaining a productive nation (Neufeld, Hendriks and Hugas, 2023). Availability, produce variety and quality, ease of market accessibility and affordability have been reported to be the key barriers to consumption of F&Vs (Dulin et al, 2024). However, more studies are needed to assess the differences between various types of retail markets and the strategies for improving their impact on access (Hollis-Hansen et al, 2019). Food environments influence the consumer purchasing decisions, dietary habits, consumption of healthy diets and nutrition outcomes (Kennedy et al, 2023, Thomas et al, 2024). For example, consumer concerns such as food safety may reduce consumption of freshly sourced foods such as fruits and vegetables (F&Vs) and increase consumption of processed/packaged food (Liguori et al, 2022). Thus, understanding the food environments and dynamics surrounding the F&Vs environment is a valuable entry point to achieving healthy diets (FAO, 2023). Additionally, having knowledge on the barriers and opportunities to access and consumption of F&Vs will guide development of context specific nutrition interventions. Since most households (especially in urban areas) do not produce enough F&Vs that can sustain consumption, majority of them purchase from retail markets (Elaine, 2022).

Retail markets have a major influence on the consumption and availability of F&Vs in many African households (Stadlmayr et al., 2023). Understanding the larger food systems and retail market transitions to support sustainable diets demands an awareness of market dynamics and the role that they play in improving households' access to and consumption. In Kenya, the F&Vs value chain is one of the most important value chains, receiving attention from the government and community development partners. These commodities are sold mainly in wholesale and retail formal and informal marketplaces (Kuboka et al, 2024, Downs et al, 2022), which are the main sectors in the country's economic pillar of Vision 2030. Analyzing the operationalization of these marketplaces is crucial because they affect access and consumption of F&Vs. It is possible that variations in F&Vs intake is related to the type and locations of markets where consumers acquire these nutritious foods. Lack of availability of fresh F&Vs is associated with less intake among lower-income individuals (Hansen et al., 2019). Since F&Vs are highly perishable, the retail market environment greatly influences their availability and accessibility by consumers. Importantly, the performance of retail markets is influenced by a number of factors including prices, quality and safety, infrastructure, and cooperation between the actors, among others (Kaur, 2022). Food policies should consider multi-dimensional interventions to promote access to F&Vs in the retail food environment across all domains (Turner et al, 2021).

Therefore, this paper uncovers the issues related to access to and acquisition of F&Vs from both formal and informal retail market context in large cities within a developing county. It also examines gender dynamics with relation to consumer access and consumption. Specifically, the study seeks to better understand how consumer access and consumption behaviors for F&Vs are influenced by retail market access dimensions such as distance to the market, time, daily mobility and mode of transport. It aims to i) understand consumer purchasing behaviours for F&Vs, ii) evaluate factors influencing consumer access to F&Vs in formal and informal markets, and iii) identify factors influencing consumption of F&Vs. Addressing these influencing factors, informs design of context-specific interventions that can effectively increase access to and consumption of F&Vs especially among low-income urban consumers. Moreover, the study can potentially provide pathways in which retail markets can be improved to provide better services to consumers to enable them adequately meet F&Vs daily requirements.

1. **Methods**
   1. ***Study design and location***

The cross-sectional study was conducted in Eldoret city, the headquarters of Uasin Gishu County, Kenya (CIDP 2023-2027) and the Kenya’s fifth city. The county is one of the fastest growing counties and a dynamic urban centre located in the fertile highlands of the Rift valley and plays a vital role in the supply chain of agricultural products. Eldoret city was purposively selected because it serves as a regional commercial center where fresh F&Vs are sold to consumers.

* 1. ***Study participants and sampling***

Data were collected from formal and informal retail markets in urban areas of the city. There are two types of retail markets in the city: formal, which are well established, organized and regulated by the municipality and the informal which are less structured. The informal retail markets include open‐air markets, kiosks, roadside vendors and stalls (*mama mboga*). The city is covered in six sub-counties. Two sub-counties (Soy, Kesses) were excluded from the study because they do not have formal retail markets in the city. Stratified random sampling technique was used to select the urban retail markets from four sub-counties (Ainabkoi, Moiben, Turbo, Kapseret) and Wards (Kapsoya, Kimumu, Huruma, Langas) respectively that form part of the city*.* The selected markets are predominantly for fresh F&Vs and have been in existence for more than a year. Furthermore, these markets are close to densely populated areas and are frequented by households. The formal markets in these four wards include Kenya Service, Kimumu Bahati, Huruma Kahoya, and Langas market. The data collection tools were pretested at Kenya Service formal market in Kapsoya Ward. The informal markets included roadside stalls in Action, Jerusalem, Hawaii, Peris, Kimumu, Junction, Sogomo, Beta Farm and Rock Centre in Kimumu Ward. The informal markets selected from Huruma Ward included roadside stalls in Maili Nne, West, Kidiwa, Mwanzo, Huruma Jua kali and Turbo. Kisumu Ndogo and Langas roadside malls were selected from Langas Ward. The markets are served by several neighbouring counties including Elgeyo Marakwet, Nandi, Tranzoia. Fruits and vegetables such as bananas, watermelon, pineapples and onions are also supplied by traders from Uganda and Tanzania. The total population of the consumers is unknown hence Cochran’s (1977) formular was used to calculate the sample size of 206. Convenience sampling procedure was used to select the male and female consumers who were purchasing F&Vs in these markets at the time of interviews. To capture the context and nuances on the market and gender dynamics on access and consumption of F&Vs, focus group discussions were conducted in the three formal markets. The male and female participants (8-10) included F&Vs vendors (retailers, wholesalers) and market committee members. The discussions were adequately moderated by nutrition and gender experts. Key informant interviews with county government staff (market masters, trade officers) who had in-depth knowledge on the subject matter were also conducted.

* 1. ***Data collection tools***

Data were gathered in May 2024 through a survey of F&Vs consumers in both formal and informal markets. A structured questionnaire was used to interview respondents, and well-structured open-ended questions guided the discussions. Audio recordings and meticulous note-taking were employed to document the discussions. A pre-test was conducted at Kenya Service Market, Kapsoya because of its similarities to the targeted markets for the main study. Thirty respondents were interviewed, representing at least 10% of the study's minimum sample size. The pilot research data were utilized to correct and adapt the final questionnaires administered to the participants.

* + 1. ***Structured Consumer Questionnaire***

A consumer structured questionnaire was used to collect information on household demographics and livelihoods, consumer access to, acquisition and consumption of F&Vs, and gender and socio-cultural factors influencing access and consumption. Socio-demographic measures included sex, age, education attained, marital status, occupation, religion, household size, source of income and the amount of income spent on food. The dimensions of personal and external domains (Turner et al, 2018) that shape consumer acquisition and consumption of F & Vs were selected. In terms of F&V acquisition, respondents were asked questions about where they obtain F&Vs, modes of transportation and distance to the market, as well as the problems they face when accessing the markets. To estimate the number of servings of F&Vs consumed in a typical day of a week, the consumer was shown the size of a serving using actual fruits portions and a cup for the vegetables. Questions about gender and socio-cultural issues emphasized on food choice and planning decisions, as well as the norms that influence F&V consumption behaviour.

* + 1. ***Focus Group Discussion and Key Informant Interview Guides***

Focus group discussion (FGD) and Key informant interview (KII) guides with key stakeholders were used to analyze perspectives on access and consumption of F&Vs among consumers. The FGD guide captured information on market dynamics (availability of F&Vs, accessibility to the market (physical distance, location, daily mobility, transport, infrastructure), product quality and safety, consumption, and gender dynamics such as market participation and institutional barriers, roles and decision making, gendered norms and expectations, attitudes and perceptions, gendered access to and control over resources. The key informants included county staff from the Ministry of Agriculture, Trade and industry. Interviews lasted for approximately 30 minutes, digitally recorded, transcribed verbatim and verified by the interviewer. The collected data were transcribed and checked for relevance, consistency and accuracy before analysis.

* 1. ***Data analysis***

The quantitative data was analyzed using Stata version 16. To further understand the socio-demographic characteristics of consumer responses for F&Vs, descriptive statistics such as frequency, percentage, means, and standard deviation were used. Paired-sample t-tests were utilized to examine significant variations in the mean amount of consumer access to F &Vs in formal and informal markets as well as consumer acquisition and consumption behaviours among male and female respondents. Multivariate logistic regression model was used to analyse the predictors of adequate Fruits &Vegetables consumption against one outcome variable. The fourteen independent variables that influenced daily and weekly F&Vs consumption among low-income households were theoretically chosen. In this study, two dependent variables were used; fruits and vegetable servings per day (FruitServeDay, VegServeDay model) and fruits and vegetable servings per week (NumberFruitWeek, VegEatWeek model). The multivariate logistic statistical model was used to assess the effects of numerous factors on adequate F&Vs consumption. The model is as presented below;

(1)

Where are predictor variables fitted in the multivariable model.

and in case the independent variable is binary

* 1. ***Ethical approval***

Ethical approval was obtained from Laikipia University Ethics and clearance Board (LU/APP/73/2024) and permission to conduct the study was obtained from National Commission for Science, Technology and Innovation (NACOSTI) reference NACOSTI/P/24/35294. Informed verbal and written consent were obtained from all participants before commencement of interviews. The objectives of the study were clearly explained to the participants and were assured of utmost confidentiality and anonymity.

1. **Results**
   1. ***Socio-demographic characterises of the study participants***

Table 1 shows the socio-demographic characteristics of the study participants. As shown, a total of 206 consumers (mean age, 34.3±9.2 years) were interviewed with majority being female (76.2%) as compared to males (23.8%). The households are mainly male headed (52.4%) with majority of the respondents interviewed being from monogamous marriages (53.9%). Most of the respondents had attained tertiary level of education (33.5%). Majority of the women owned their businesses/traders (54.8 %) while most of the men were farmers/livestock rearing (30.8%). Average monthly income varied by gender (χ2= 15.8314, P=0.07) with more women (35.7%) earning less than KES 5000 than men (10.2?). There was no gender difference (P=0.005) in the number of household members, children under five years old, consumer marital status, education level, occupation, religion, area of residence, main source of income and estimate income spent on food.

**Table 1-Socio-demographic characteristics of the study participants**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | **Total**  **(n= 206)** | **Female**  **(n=157)** | **Male**  **(n=49)** | **χ2 value**  **P value\*** |
|  | **% (n)** | **% (n)** | **% (n)** |  |
| **Gender (HH)a** |  |  |  |  |
| Male | 52.4 (108) | 40.1 (63) | 91.8 (45) | 40.0360 |
| Female | 47.6 (98) | 59.9 (94) | 8.2 (4) | 0.001\*\* |
| **Marital status** |  |  |  |  |
| Married monogamous | 53.9 (111) | 49.0 (77) | 69.4 (34) | 7.3232 |
| Married polygamous | 7.7 (16) | 8.9 (14) | 4.1 (2) | 0.120 |
| Separated | 7.3 (15) | 8.9 (14) | 2.1 (1) |  |
| Single | 26.2 (54) | 28.0 (44) | 20.3 (10) |  |
| Widowed | 12.2 (10) | 5.2 (8) | 4.1 (2) |  |
| **Education level** |  |  |  |  |
| None | 5.8 (12) | 6.4 (10) | 4.1 (2) | 6.3768 |
| Primary | 28.6 (59) | 34.7 (51) | 16.3 (8) | 0.095 |
| Secondary | 32.1 (66) | 31.2 (49) | 34.7 (17) |  |
| Tertiary | 33.5 (69) | 27.7 (22) | 44.9 (47) |  |
| **Occupation** |  |  |  |  |
| Farming | 14.1 (29) | 13.4 (21) | 16.3 (8) | 2.5404 |
| Own business/trade | 52.4 (108) | 55.4 (87) | 42.9 (21) | 0.468 |
| Salaried employment | 14.6 (30) | 14.0 (22) | 16.3 (8) |  |
| Others | 18.9 (39) | 17.2 (27) | 24.5 (12) |  |
| **Religion** |  |  |  |  |
| Christian | 95.6 (197) | 96.8 (152) | 91.8 (45) | 2.2154 |
| Muslim | 4.4 (9) | 3.2 (5) | 8.2 (4) | 0.137 |
| **Area of Residence** |  |  |  |  |
| Urban | 99.0(204) | 98.7 (155) | 100.0 (49) | 0.6303 |
| Peri-Urban | 1.0 (2) | 1.3 (2) | 0.0 (0) | 0.427 |
| **Main source of income** |  |  |  |  |
| Own business/trade | 53.9 (111) | 54.8 (86) | 22.5 (11) | 4.5230 |
| Salaried work with regular income | 16.0 (33) | 15.3 (24) | 27.3 (14) | 0.718 |
| Farming/livestock rearing | 12.6 (26) | 11.5 (18) | 30.8 (15) |  |
| Othersd | 17.5 (36) | 18.4 (29) | 19.4 (9) |  |
| **HH average monthly income** |  |  |  |  |
| Less than 5000 | 29.6 (61) | 35.7 (56) | 10.2 (5) | 15.8314 |
| 5001-10000 | 27.7 (57) | 28.0 (44) | 26.5 (13) | 0.007 |
| 10001-20000 | 20.4 (42) | 17.2 (27) | 30.6 (15) |  |
| 20001- 50000 | 13.1 (27) | 10.8 (17) | 20.5 (10) |  |
| Above 50000 | 9.2 (19) | 8.3 (13) | 12.2 (6) |  |
|  | **Means±SD** | **Means±SD** | **Means±SD** | **P value#** |
| **Estimate income spent on Food** | 1680.8±1194.4 | 1658.3±1255.5 | 1753.1±981.7 | 0.6289 |
| **Age in years (HH)c** | 39.6±9.5 | 40.2±9.4 | 38.0±9.9 | 0.1595 |
| **Age in years (consumer)c** | 34.3±9.2 | 33.8±8.9 | 35.8±9.9 | 0.2046 |
| **Number of HH members** | 3.9±2.4 | 3.9±2.6 | 3.7±1.8 | 0.4891 |
| **Number of adultsc** | 2.1±1.4 | 2.0±1.3 | 2.2±1.7 | 0.4613 |
| **Children <5 years oldc** | 0.5±0.7 | 0.5±0.7 | 0.5±0.7 | 0.9601 |

aHousehold Head characteristics; bcharacteristics of the consumer; \*P<0.05 significant by χ2 test; cdata are mean ± standard deviations; #p < 0.05 significant using independent samples t-test. dcasual labour, petty trade, food vending, support from families

* 1. ***Consumer access to fruits and vegetables in formal and informal markets***

Most consumers acquire fruits and vegetables from informal and formal retail markets. As shown, there was a significant (p<0.05) difference in the shopping patterns for male and female consumers. Male consumers prefer shopping from the formal markets (31.8%) as compared to the informal markets (17.8%) while female consumers prefer informal (82.2%) than formal markets (68.2%). Overall, the markets were perceived to easily accessible, with only a few consumers (7.3%) finding it difficult to access the markets. More than half (52.9%) of the consumers walked to the market, 23.3% used a public service vehicle (*matatu*), motorcycle (17.9%), a few drove (5.3%) to the market while others used bicycles or *tuktuk* (a simple vehicle with an engine and three wheels). However, a significant difference (P<0.05) was observed in the retail market food environments access dimensions. The informal markets were more accessible (P=0.009) to consumers as compared to the formal markets. These roadside informal markets are significantly (P<0.05) nearer (2.6±3.3 km) to the households as compared to the formal markets (3.7±3.1 km) which are usually located in designated areas by the city council. Majority of the consumers (63.6%) walk to these informal markets as compared to formal markets where consumers must use public service vehicles (*matatu*) (30.7%), motorcycles or bicycles. More than a third of the consumers find it safe (secure) to access informal (35.6%) and formal market (30.7%) with half (49.9%) finding the markets somewhat safe. The informal markets were relatively (P<0.05) unsafe (22%) as compared to the formal markets (10.2%). Overall, most consumers (85.9%) find it easy to access fruits and vegetables (90.8%) although a few indicated that they face difficulties accessing the markets (7.3%).

**Table 2-Consumer access to fruits and vegetables in formal and informal markets**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | **Total (n=206)** | **Informal markets (n=118)** | **Formal markets (n=88)** | **χ2 value**  **P value\*** |
|  | **% (n)** | **% (n)** | **% (n)** |  |
| **Gender** |  |  |  |  |
| Male | 23.8 (49) | 17.8 (21) | 31.8 (28) | 5.4668 |
| Female | 76.2 (157) | 82.2 (97) | 68.2 (60) | 0.019 |
| **Means of transport to the market** |  |  |  |  |
| Walking | 52.9 (109) | 63.6 (75) | 38.6 (34) | 13.8637 |
| *Matatu* | 23.3 (48) | 17.8 (21) | 30.7 (27) | 0.008 |
| Motorcycle | 17.9 (37) | 13.6 (16) | 23.9 (21) |  |
| Driving | 5.3 (11) | 4.2 (5) | 6.8 (6) |  |
| Othersb | 0.85 (1) | 0 (0) | 0.49 (1) |  |
| **Accessibility to the market** |  |  |  |  |
| Very easy | 42.2 (87) | 50.0 (59) | 31.8 (28) | 17.1890 |
| Somewhat easy | 28.2 (58) | 20.3 (24) | 38.6 (34) | 0.009 |
| Somewhat difficult | 20.8 (43) | 17.8 (21) | 25.0 (22) |  |
| Very difficult | 7.3 (15) | 10.2 (12) | 3.4 (3) |  |
| Othersc | 1.5 (3) | 1.7 (2) | 1.2 (1) |  |
| **How safe (secure) is it to access the market** |  |  |  |  |
| Very safe | 33.5 (69) | 35.6 (42) | 30.7 (27) | 7.3441 |
| Somewhat safe | 49.5 (102) | 42.4 (50) | 59.1 (52) | 0.025 |
| Unsafe | 17.0 (35) | 22.0 (26) | 10.2 (9) |  |
| **Easy to access fruits** |  |  |  |  |
| Yes | 85.9 (177) | 84.8 (100) | 87.5 (77) | 0.3161 |
| No | 14.1 (29) | 15.3 (18) | 12.5 (11) | 0.574 |
| **Reasons for difficulty in accessing fruits** |  |  |  |  |
| Too expensive | 40.0(6) | 40.0(4) | 40.0(2) | 5.1000 |
| Market is too far | 46.7(7) | 50.0(5) | 40.0(2) | 0.531 |
| Not available throughout the year | 13.3(2) | 10.0(1) | 20.0(1) |  |
| Othersd |  |  |  |  |
| **Easy to access vegetables** |  |  |  |  |
| Yes | 90.8 (187) | 91.5 (5) | 89.8 (79) | 0.1849 |
| No | 9.2 (19) | 8.5 (10) | 10.2 (9) | 0.667 |
| **Reasons for difficulty in accessing vegetables** |  |  |  |  |
| Too expensive | 50.0(100) | 60.0(71) | 33.33(30) | 1.9556 |
| Market is too far | 37.5(77) | 40.0(29) | 33.33(29) | 0.376 |
| Not available throughout the year | 12.5(29) | 0.00(0) | 33.33(29) |  |
|  | **Means±SD** | **Means±SD** | **Means±SD** | **P value#** |
| **Distance to the market from home (km)** | 3.0±3.3 | 2.6±3.3 | 3.7±3.1 | 0.0198 |
| **Time taken to the market (minutes)** | 18.5±15.2 | 17.0±15.0 | 20.6±15.3 | 0.0914 |

\*P<0.05 significant by χ2; test;a street vendors, gifts from a farmer, food assistance, exchange for other items; bbicycle, *tuktuk*; cnot very easy or very difficult #p < 0.05 significant using independent samples t-test; d cultural beliefs and practices, unavailability of quality fruits or vegetable, limited varieties in the market, inflexible opening hours, social favours

***3.3. Consumer acquisition and consumption behaviours for fruits and vegetables***

As shown in Table 3, there was no gender difference (P>0.05) in the consumer acquisition and consumption behaviours for fruits and vegetables. Overall, fruits (95.1%) and vegetables (99.5%) were consumed daily and consumers reported that the markets supply all the fruits (92.2%) they need. Fresh fruits are mainly purchased twice a week (37.9%) with prices (37.4%), quality (19.4%) and distance (8.7%) guiding the decisions to buy at the market. Fresh vegetables are purchased daily (52.9%) with prices (37.9%), quality (24.3%) and distance (10.7%) influencing purchasing decisions.

**Table 3- Consumer acquisition and consumption behaviours for fruits and vegetables**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | **Total n=206** | **Female n=157** | **Male n=49** | **χ2 value**  **P value\*** |
|  | **% (n)** | **% (n)** | **% (n)** |  |
| **Fruits** | | | | |
| **Consume fruits (yes)** | 95.1 (196) | 94.3 (148) | 98.0 (48) | 1.1019  0.294 |
| **Frequency of consumption** |  |  |  |  |
| Daily | 36.2 (71) | 33.8 (50) | 43.8 (21) | 3.4378 |
| Twice a week | 24.5 (48) | 25.0 (37) | 22.9 (11) | 0.815 |
| 3-4 times a week | 21.4 (42) | 21.0 (31) | 22.9 (11) |  |
| Once a week | 12.2 (24) | 13.5 (20) | 8.3 (4) |  |
| Monthly | 5.7 (11) | 6.7 (10) | 2.1 (1) |  |
| **Frequency of purchase in a week** |  |  |  |  |
| Once | 27.7 (57) | 29.3 (46) | 22.5 (11) | 10.9961 |
| Twice | 37.9 (78) | 39.5 (62) | 32.7 (16) | 0.088 |
| Three times | 19.9 (41) | 15.9 (25) | 32.7 (16) |  |
| More than three times | 24.5 (20) | 15.3 (15) | 12.1 (5) |  |
| **Form of fruits sold in the markets (fresh)** | 100 (206) | 100 (157) | 100 (49) | - |
| **Form of fruit mainly accessed by households** |  |  |  |  |
| Fresh | 99.5 (205) | 99.4 (156) | 100 (49) | 0.3136 |
| Fruit Juices | 0.5 (1) | 0.6 (1) | 0 (0) | 0.575 |
| **Factors influencing decision to buy fruits at the market** |  |  |  |  |
| Prices | 37.4 (77) | 38.2 (60) | 34.7 (17) | 20.2472 |
| Product quality | 19.4 (40) | 19.1 (30) | 20.4 (10) | 0.380 |
| Distance to the market | 8.7 (18) | 10.8 (17) | 2.0 (1) |  |
| Prices and product quality | 8.7 (18) | 8.9 (14) | 8.2 (4) |  |
| Prices and distance | 7.8 (16) | 8.3 (13) | 6.1 (3) |  |
| Others (packaging, quality service, partner preference) | 18.0 (37) | 14.7 (23) | 28.6 (14) |  |
| **Do you think the market has all the fruits you need (Yes)** | 92.2 (190) | 93.0 (146) | 89.8 (44) | 0.5331  0.465 |
| **Vegetables acquisition and consumption** | | | | |
| **Consume vegetables (yes)** | 99.5 (205) | 99.4 (156) | 100 (49) | 0.3136  0.575 |
| **Frequency of consumption** |  |  |  |  |
| Daily | 70.2 (144) | 71.1 (111) | 67.4 (33) | 8.6759 |
| 5-6 times a week | 9.9 (20) | 10.9 (17) | 6.1 (3) | 0.070 |
| 3-4 times a week | 11.7 (24) | 8.3 (13) | 22.5 (11) |  |
| Once or twice a week | 8.2 (18) | 9.7 (16) | 4.0 (2) |  |
| **Frequency of purchasing** |  |  |  |  |
| Daily | 52.9 (109) | 51.6 (81) | 57.1 (28) | 2.4402 |
| Weekly | 32.0 (66) | 33.8 (53) | 26.5 (13) | 0.932 |
| Monthly | 15.1 (31) | 14.6 (23) | 16.4 (8) |  |
| **Form of vegetables sold and acquired (fresh** | 100 (206) | 100 (157) | 100 (49) | **-** |
| **Factors influencing decision to buy vegetables at the market** |  |  |  |  |
| Prices | 37.9 (78) | 39.5 (62) | 32.7 (16) | 20.7641 |
| Product quality | 24.3 (50) | 22.3 (35) | 30.6 (15) | 0.188 |
| Distance | 10.7 (22) | 12.1 (19) | 6.1 (3) |  |
| Price and product quality | 7.8 (16) | 7.0 (11) | 10.2 (5) |  |
| Prices and distance | 5.3 (11) | 6.4 (10) | 2.0 (1) |  |
| Others (packaging, quality service, partner preference) | 14 (29) | 12.7 (20) | 18.4 (9) |  |

\*P<0.05 significant by χ2 test

**3.4.** **Consumption of fruits and vegetables**

The World Health Organization (WHO) and Food and Agriculture of the United Nation (FAO) reports recommend adults to consume at least five servings (400g) of F&Vs per day excluding starchy vegetables. Although F&Vs were consumed daily by women and men, the quantities taken were lower (Fig. 1) than the recommendations to improve overall health and reduce the risk of certain NCDs. On average, women (2.09±1.33) and men (1.98±1.22) consumed 2 servings of fruits per day (Fig. 1 A) which is way below the recommended number of servings. Overall, only 3.4% of adults consumed fruits with no significant difference (X2=1.8457, P=0.397) between the proportion of women (3.1%) and men (4.1%) who did not meet the WHO/FAO recommendations (Fig. 1 B). Majority of the women (75.2%) and men (65.3%) consumed less than three servings of fruits in a day while less than a third consumed 3-4 servings. Similarly, vegetable consumption was lower than the recommended 5 servings per day. On average, women (2.28±1.49) and men (2.08±1.85) consumed 2 servings of vegetables per day (Fig. 1 A). Overall, only 3.4% adults consumed five servings of vegetables with 73.8% and 22.8% consuming less than 3 and between 3-4 servings per day respectively. Like fruits, there was no gender difference (P>0.05) in quantity of vegetables consumed per day, with only 4.5% of women consuming five servings while none of the men (0%) met the recommendations. Further, when the number servings of F&Vs consumed in a day were combined, more than a third (32.3%) of both women and men consumed 5 servings of F & V with majority (49%) consuming 3-4 servings per day. There was no difference (P=0.3821) between the numbers of servings of F&Vs consumed by women (4.14 ±2.07) with men (4.43±1.90).

|  |
| --- |
|  |
| **Figure 1- (A) Number of servings of fruits and vegetables (F&Vs) consumed by adults per day. Data are mean ±standard deviations. P< 0.05 significant using independent samples t-test; (B) Proportion of consumers consuming recommended amounts of F&Vs per day; \*P<0.05 significant by χ2 test** |

**3.5. Determinants of consumer access to and consumption of fruits and vegetables**

The multivariable logistic regression analysis reveals important insights into how various factors influence the number of fruit servings per day (FruitServeDay) and the number of fruits consumed per week (NumberFruitWeek) (Table 4). The model fit for FruitServeDay indicates an R-squared value of 0.1282, meaning that approximately 12.82% of the variability in daily fruit consumption is explained by the predictors. The model is statistically significant (P<0.05), with an F-statistic of 2.0176 and a p-value of 0.0183, indicating that the predictors have a significant effect (P<0.05) on daily fruit servings. Similarly, the model for NumberFruitWeek has a higher R-squared value of 0.2572, explaining 25.72% of the variability in weekly fruit consumption. This model is also highly significant (P<0.05), with an F-statistic of 4.7480 and a p-value of 0.0000.

***3.5.1. Determinants of daily and weekly consumption of fruits***

Age significantly (P<0.05) predicted daily and weekly fruit consumption. For FruitServeDay, the coefficient for age is -0.0106 with a P-value of 0.018, suggesting that as individual’s age increase, their daily fruit servings decrease. Conversely, in the model for NumberFruitWeek, the coefficient for age is 0.0139 with a p-value of 0.028, indicating that older individuals tend to consume more fruits over the course of a week. Education level influences (P<0.05) daily fruit consumption but not weekly consumption. In the FruitServeDay model, the coefficient for education level is -0.0990 with a P-value of 0.032, indicating that individuals with higher education levels tend to consume fewer fruit servings per day. Occupation also predicted daily fruit consumption. In the FruitServeDay model, the coefficient for occupation is -0.1249 with a P-value of 0.003, suggesting that certain occupations are associated with lower fruit intake.

The consumer perception about the safety (security) of the market is a significant predictor in both models, positively influencing fruit consumption. For FruitServeDay, the coefficient for market safety is 0.1181 with a p-value of 0.046, and for NumberFruitWeek, the coefficient is 0.1723 with a p-value of 0.040. Distance to the market is particularly significant for weekly fruit consumption. In the NumberFruitWeek model, the coefficient for distance to the market is 0.0892 with a p-value of 0.000, indicating that greater distance from the market is associated with higher weekly fruit consumption. Finally, the Breusch-Pagan test of independence revealed a significant correlation between the residuals of the two models (Chi-square = 4.488, P = 0.0341), suggesting that the outcomes of daily and weekly fruit consumption are not entirely independent.

**Table 4-Multivariate Regression Analysis on Predictors of Adequate Fruit Consumption**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Predictors** | **Fruit servings/day Coef.** | **Fruit servings/day Standard error** | **Fruit servings/day P>/t/** | **Number Fruits/Week Coef.** | **Number Fruits/Week Standard error** | **Number Fruits/Week P>/t/** |
| Age | -0.0106 | 0.0044 | 0.018\* | 0.0139 | 0.0063 | 0.028\* |
| Gender | -0.0275 | 0.0822 | 0.7390 | -0.1662 | 0.1161 | 0.1540 |
| Education level | -0.0990 | 0.0459 | 0.032\* | 0.0305 | 0.0648 | 0.6380 |
| Occupation | -0.1249 | 0.0418 | 0.003\* | 0.0164 | 0.0591 | 0.7820 |
| Household size | -0.0158 | 0.0301 | 0.5990 | 0.0273 | 0.0425 | 0.5210 |
| Children under 5 | -0.0440 | 0.0516 | 0.3950 | -0.0530 | 0.0729 | 0.4680 |
| Monthly income | 0.0233 | 0.0216 | 0.2810 | 0.0316 | 0.0305 | 0.3010 |
| Income on Food | 0.0000 | 0.0000 | 0.5980 | 0.0001 | 0.0000 | 0.2180 |
| Distance to market | 0.0103 | 0.0164 | 0.5320 | 0.0892 | 0.0231 | 0.001\*\* |
| Time to market | -0.0006 | 0.0036 | 0.8710 | 0.0001 | 0.0051 | 0.9920 |
| Easy Access Fruit | -0.0725 | 0.1145 | 0.5270 | -0.0237 | 0.1618 | 0.8840 |
| Ease of access to market | -0.1045 | 0.0615 | 0.0910 | -0.0503 | 0.0869 | 0.5640 |
| Perception on safety of the market | 0.1181 | 0.0589 | 0.046\* | 0.1723 | 0.0831 | 0.040\* |
| Market type | 0.1409 | 0.0750 | 0.0620 | 0.1938 | 0.1059 | 0.0690 |
| Cons | 1.9690 | 0.2688 | 0.0000 | 0.2481 | 0.3797 | 0.5140 |
| **Equation** | **Obs** | **Parms** | **RMSE** | **R-sq** | **F** | **P** |
| FruitServeDay | 206 | 15 | 0.514 | 0.128 | 2.018 | 0.018 |
| NumberFruitWeek | 206 | 15 | 0.726 | 0.257 | 4.748 | 0.000 |
|  | **Fruit servings/day** | **Number Fruits/Week** | | |  |  |
| Fruit servings/day | 1.000 |  |  |  |  |  |
| Number Fruits/Week | 0.147 | 1.000 |  |  |  |  |

\*P<0.05 significant by multivariate logistic regression; Breusch-Pagan test of independence: Chi2(1) = 4.488, Pr = 0.0341

***3.5.2. Determinants of daily and weekly consumption of vegetables***

The multinomial logistic regression analysis explored the factors influencing the number of vegetable servings per day (VegServingsDay) and the number of vegetables consumed per week (VegsEatWeek) (Table 5). The analysis revealed significant socio-economic, lifestyle, and accessibility factors shaping these dietary behaviors. The model for daily vegetable servings (VegServingsDay) had an R-squared value of 0.1120, indicating that 11.20% of the variability in daily vegetable servings is explained by the predictors. The model's fit was borderline significant with an F-statistic of 1.7117 and a p-value of 0.0560. In contrast, the model for weekly vegetable consumption (VegsEatWeek) had a higher R-squared value of 0.3908, explaining 39.08% of the variability, with a statistically significant F-statistic of 8.7065 and a p-value of 0.0000. The Breusch-Pagan test of independence (Chi-square = 1.417, p = 0.2339) suggested no significant correlation between the residuals of these models, indicating that daily and weekly vegetable consumption patterns are influenced by different factors.

Age was not a predictor (P>0.05) of either daily or weekly vegetable consumption, as indicated by p-values of 0.306 for VegServingsDay and 0.826 for VegsEatWeek. However, gender showed a significant (P<0.05) influence on weekly vegetable consumption but not on daily intake. Women were found to consume fewer servings of vegetables weekly compared to men, as indicated by the negative coefficient of -0.2699 with a p-value of 0.020 for VegsEatWeek. This could reflect gender-based dietary preferences or cultural factors influencing women's overall vegetable consumption. However, gender did not affect (P>0.05) daily servings of vegetables (p = 0.442) consumed, suggesting that both men and women incorporate vegetables into their daily diets. Education level had a near-significant negative effect on daily vegetable servings (coefficient = -0.0903, p = 0.071) and a marginally positive effect on weekly consumption (coefficient = 0.1195, p = 0.081).

Occupation was another variable with mixed effects. It had a marginally significant negative impact on daily vegetable servings (coefficient = -0.0825, p = 0.052) and a positive and significant influence on weekly consumption (coefficient = 0.1209, p = 0.036). Monthly income had a significant positive effect on daily vegetable servings (coefficient = 0.0444, p = 0.043) but a significant negative impact on weekly vegetable consumption (coefficient = -0.0973, p = 0.001).

Perceptions on accessibility and time taken to the market were significant predictors of weekly vegetable consumption but not daily intake. Better market access was associated with lower weekly vegetable consumption (coefficient = -0.1782, p = 0.005), possibly because individuals with easy access to markets might have more varied food choices. On the other hand, longer travel times to markets were associated with higher weekly consumption (coefficient = 0.0108, p = 0.024).

**Table 5-Multivariate Regression Analysis on Predictors of Adequate Vegetable Consumption**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Predictors** | **Veg Servings/Day Coef.** | **Veg Servings/Day Standard error** | **Veg Servings/Day P>/t/** | **Vegs Eat/Week Coef.** | **Vegs Eat/Week Standard error** | **Vegs Eat/Week P>/t/** |
| Age | -0.0049 | 0.0048 | 0.3060 | 0.0014 | 0.0066 | 0.8260 |
| Gender | 0.0646 | 0.0838 | 0.4420 | -0.2699 | 0.1149 | 0.020\* |
| Education level | -0.0903 | 0.0497 | 0.0710 | 0.1195 | 0.0682 | 0.0810 |
| Occupation | -0.0825 | 0.0422 | 0.0520 | 0.1209 | 0.0578 | 0.036\* |
| Household size | 0.0294 | 0.0304 | 0.3350 | -0.0505 | 0.0417 | 0.2270 |
| Children under 5 | -0.0044 | 0.0513 | 0.9320 | 0.0820 | 0.0704 | 0.2450 |
| Monthly income | 0.0444 | 0.0218 | 0.043\* | -0.0973 | 0.0298 | 0.001\*\* |
| Income on Food | -0.0001 | 0.0000 | 0.0850 | 0.0000 | 0.0000 | 0.4080 |
| Distance to market | 0.0029 | 0.0162 | 0.8590 | -0.0285 | 0.0223 | 0.2020 |
| Time taken to market | -0.0035 | 0.0035 | 0.3210 | 0.0108 | 0.0048 | 0.024\* |
| Easy Access Fruit | -0.1518 | 0.1409 | 0.2830 | -0.0924 | 0.1931 | 0.6330 |
| Ease of access to market | 0.0028 | 0.0461 | 0.9520 | -0.1782 | 0.0631 | 0.005\* |
| Perception on safety of the market | 0.0320 | 0.0597 | 0.5920 | -0.0400 | 0.0818 | 0.6250 |
| Market type | 0.0087 | 0.0760 | 0.9090 | 0.1309 | 0.1042 | 0.2100 |
| Cons | 1.7085 | 0.3362 | 0.0000 | 3.1243 | 0.4610 | 0.0000 |
| **Equation** | **Obs** | **Parms** | **RMSE** | **R-sq** | **F** | **P** |
| VegServingsDay | 206 | 15 | 0.5155 | 0.1120 | 1.7117 | 0.0560 |
| VegsEatWeek | 206 | 15 | 0.7067 | 0.3908 | 8.7065 | 0.0000 |
|  | **VegServingsDay** | **VegsEatWeek** | |  |  |  |
| VegServingsDay | 1.0000 |  |  |  |  |  |
| VegsEatWeek | -0.0831 | 1.0000 |  |  |  |  |

\*P<0.05 significant by multivariate logistic regression; Breusch-Pagan test of independence: Chi2(1) = 1.417, Pr = 0.2339

1. **Discussion**

Consumers play a decisive role in the acquisition and consumption of fruits and vegetables (F&Vs). In the present study, we demonstrated a notable gender difference in the purchasing behaviours of F&V consumers in urban retail markets. Most women consumers preferred to purchase F&Vs from informal markets while most men showed preference for formal markets (Table 2). This is because women are generally price sensitive and bargain far more than males, which is a common practice in informal markets. Other than that, this difference may be attributed to social and cultural factors (Enriquez and Archila-Godinez, 2022) as well as the retail market food environment (Zhao et al, 2020). Cultural norms and gender roles influence decisions on food, food-related roles, shaping who prepares, consumes, and decides on food. For example, in this community setting, women are expected to participate in markets, make decisions on the type of food to be purchased, prepared and consumed by the household members. Shopping for F&V is mainly the responsibility of women as indicated by the higher proportion of women participating in the interviews (Table 1). Notable, in one of the FGDs, a F&V male vendor participant said,

*‘Soko ni ya wamama’. Kununua matunda na mboga ni kazi yao’*. The translation is, ‘Market is for women’. It is the responsibility of women to buy fruits and vegetables.

(A male FGD participant, Huruma Kahoya Market, May 2024)

However, a study in India (Nair et al, 2022) reported that most men and women have similar interests and attitudes or behaviour towards shopping but observed a difference in the expenditure per trip and kind of shopper. Indeed, gender dynamics significantly influence food choice and eating habits (Feraco et al 2024). Therefore, it is necessary to examine and understand these gender-specific characteristics. This helps in devising interventions for enhancing access and promoting consumption of F&Vs. Thus, it is necessary to understand the factors that shape shopping behaviour among women and women in this food environment. In the present study, most fruits were acquired from informal markets as compared to the structured and regulated formal marketsmainly because of the accessibility to households and perceived cheap prices. Most consumers considered these informal markets to be easily accessible because they could just walk or use simple modes of transportation such as bicycles, motorbikes, or *tuktuks*. A key informant observed,

*‘Consumers often think that fruits and vegetables sold by the roadside are cheaper than those sold in the formal market. The retailers are forced to sell outside the market’.*

(A key informant, Huruma Kahoya market, May 2024)

Retail Market food environment dimensions also influence consumer purchasing behaviours (Stadlmay et al, 2020). A notable finding in the study was that the informal markets were easily accessible to consumers as compared to formal markets which are usually located in areas determined by the city council. This suggest that the market location is an important factor that influences access to F&Vs by households. Poorly located markets are barriers to F&Vs consumption. One FGD female participant observed,

*‘Kimumu Bahati market is not strategically located. It is far from the main tarmac road. It is a wholesale market with poor road infrastructure that hinders its accessibility’.* *Pregnant mothers have been reported to fall along the way as they try to access the market especially when it rains. People living with disabilities (PLWDs) cannot fully access the market.*

(A female FGD participant, Kimumu Bahati market, May 2024)

Huruma Kahoya retail market is strategically located along the busy Eldoret-Malaba highway, making it accessible to consumers from within the market and outside the market including travellers; compared to Kimumu Bahati market which is located far from the main tarmac road with poor road infrastructure that makes it inaccessible to consumers. Although the informal markets were more accessible, consumers reported difficulties in accessing the F&Vs because they are expensive despite the availability throughout the year. In Kenya, most food environment in informal settlements are predominantly of informal food vendors/outlets who sell mainly F&Vs (Down et al, 2022). Although these informal markets play a crucial role in providing fresh F&Vs, security and food safety remains a major concern. In the present study, most consumers reported that the informal markets were not safe as compared to the formal markets. Therefore, there is need to consider the location of retail markets, involve all stakeholders to identify strategic locations, improve infrastructure and the safety of informal markets to improve the ability of consumers to access F&Vs and ultimately increase daily consumption. A recent study in informal markets in Kenya (Kuboka et al, 2024) reported that consumers and vendors confounded food quality, especially freshness, with safety, and paid more attention to appearance and physical qualities than food safety. Thus, consumer awareness and behaviour change communication can be utilized to effectively to combat foodborne disease to improve food safety.

A remarkable finding in this study is the significantly low consumption of F&Vs by adult consumers despite availability in the markets all year round, ease of access to retail markets and frequency of acquisition and consumption (Table 3, Fig. 1). Most of the participants interviewed purchased and consumed F&Vs daily however, the intake was not adequate to meet their daily nutrition requirements. In most developing countries, inadequate consumption is ascribed to factors such as affordability, product quality, frequency of purchase, and lack of knowledge on the amount of F&V to be consumed per day (Msambichaka et al, 2018). In the present study, consumers pointed out product prices as the main factor influencing their decisions to purchase F&Vs followed by product quality. The implication is that, consumers who cannot afford F&Vs are less likely to consume adequate amounts. Notably, there was no gender difference in the acquisition and consumption behaviours. This suggests the need for nutrition education and behavioral change approaches to promote daily consumption of F&V by urban consumers. The finding on inadequate consumption is consistent with that of a cross-sectional national population-based survey (2015) which reported being female, lower education and urban residence and tribe as risk factors for the high prevalence of inadequate consumption of F&Vs in Kenya (Pengpid and Peltzer, 2018).

The retail food environment is complex but likely predictor of F&V consumption (Turner et al, 2021). In the current study, the main predictors of daily consumption of adequate amounts of fruits include age, education level, occupation and perceptions on the safety (security) of the market (Table 4). Interestingly, consumer age influenced the daily and weekly consumption of fruits but did not affect vegetable consumption patterns, likely because vegetable intake is a consistent dietary behavior across different age groups. This dual finding may reflect changing dietary habits with age, where older individuals might not eat fruits daily but ensure they meet their weekly fruit consumption. Hoskova and ZentKova (2024) similarly found that adults between 45-54 age group consume low amount of F&Vs per day. In addition, the level of education influenced daily fruit consumption but not weekly consumption. This could be related to lifestyle factors associated with higher education, such as time constraints or dietary preferences that reduce daily fruit intake. It might also be due to the demands or nature of specific jobs that limit access to or provide the opportunity to consume fruits regularly.

Furthermore, the consumer perceptions on the safety of the retail market was positively associated with daily consumption of fruits. These results suggest that safer markets encourage both more frequent daily fruit consumption and a higher overall weekly intake. This supports the findings by Hasan et al., (2021) which expressed concerns about adulterated F&Vs in the markets. This access dimension therefore highlights the consideration of market conditions when promoting healthy dietary habits and consumption of fruits by adult consumers. Likewise, the distance to the market determined weekly fruit consumption whereby, greater distance associated with higher weekly fruit consumption. This counterintuitive finding might suggest that those who live farther from markets make fewer but more substantial trips, buying larger quantities of fruit to last the week. Noteworthy, the outcomes of daily and weekly fruit consumption were not entirely independent as shown by the correlation between the two models. This finding implies that factors affecting daily fruit intake may also influence weekly consumption patterns, warranting further investigation into how these variables interact across different time frames.

Another interesting finding in the study is that gender influenced weekly vegetable consumption but not daily intake (Table 5). Notably, women consumed fewer servings of vegetables weekly compared to men. This could reflect gender-based dietary preferences or cultural factors influencing women's overall vegetable consumption (Enriquez and Archila-Godinez, 2022); Zhao et al, 2020. However, gender did not affect daily number of servings of vegetables consumed, suggesting that both men and women incorporate vegetables into their daily diets similarly. Education level had a near-significant negative effect on daily vegetable servings and a marginally positive effect on weekly consumption. The implication is that individuals with higher education levels might consume fewer vegetables daily due to time constraints or lifestyle choices, but ensure adequate weekly intake, possibly through meal planning or bulk purchases.

Similar studies (Xaba and Dlamini, 2021) have reported association of employment and availability of F&Vs with low consumption by adults. In the present study, occupation positively associated with weekly vegetable consumption suggesting that being in certain occupations may lead to less frequent but more substantial vegetable consumption. This is possibly due to work schedules that allow for meal prepping on specific days of the week suggesting the need for the promotion consumption at the workplace. Importantly, workplace related factors are significant barriers to healthy eating (Leung et al, 2018). In their study among working population in Spain, Ronda-Pérez et al, 2020 reported the lowest consumption of fruits among the military and unskilled workers in the service sector and the lowest consumption of vegetables among skilled construction workers.

Monthly income had a significant positive effect on daily vegetable servings but negatively affected weekly consumption. This concurs with a study by Mustafa et al., (2021) who found out that households with high incomes are less likely to consume low amounts of vegetables per day. This indicates that higher income might facilitate regular access to fresh vegetables, leading to more frequent daily consumption. However, the negative relationship with weekly consumption might indicate that higher-income individuals have more diverse diets, reducing the proportion of vegetables in their overall weekly intake. Moreover, consumer perceptions on accessibility and time taken to the market influenced weekly vegetable consumption but not daily intake. It is possible that individuals with easy access to markets might have more varied food choices. Conversely, longer travel times to markets were associated with higher weekly consumption suggesting that those who live farther away may purchase larger quantities of vegetables to minimize trips, leading to increased weekly intake.

Overall, these findings highlight the complex relationships between age, socio-economic factors, gender and ease to market accessibility in shaping F&Vs consumption patterns. The differences between daily and weekly consumption behaviors underscore the importance of considering multiple consumer and retail market access dimensions when designing nutrition interventions to promote F&Vs consumption. It is important to consider these predictors of adequate consumption while considering gender dynamics about purchasing behaviours in retail markets. A limitation of the study is the cross-sectional nature which may not explain the causal relationship the predictors of low consumption of F&Vs and the daily intake. A longitudinal study is needed to better understand the factors influencing adequate consumption of fruits and vegetables by adults in urban cities. A randomized control trial will also help in identifying the best market and consumer level intervention strategies for increasing access to F&Vs from retail market and improving household consumption.

1. **Conclusion and Recommendations**

The study demonstrated a low consumption of fruits and vegetables by adult consumers despite ease of access to retail markets. The main predictors for daily fruit consumption were age, education level, occupation and consumer perception on the safety/security of the retail market. Age, distance to the market and perceptions on safety of the market were the key determinants for number of fruits consumed in a week. Monthly income influenced daily consumption of adequate amounts of vegetables while consumer gender, occupation, monthly income, time taken to the market and accessibility to the market predicted weekly vegetable consumption. There was a gender difference in purchasing behaviours of women and men in retail markets. Women preferred to shop from informal markets while most men purchased F&Vs from formal markets. Therefore, there is a need to raise public awareness and design gendered nutrition education and social behaviour change communication intervention programmes to promote purchase and consumption of adequate amounts of F&Vs. Context-specific, relevant and enforceable retail market policies, regulations and initiatives targeted at improving infrastructure, food safety and consumer safety are needed to increase access to F&Vs in urban settings.

**Conflicts of interest**

The authors declare no conflict of interest.

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