*South African Journal of Clinical Nutrition* 2026; 39(1):49–57
https://doi.org/10.1080/16070658.2025.2594290



SAJCN
ISSN 1607-0658 EISSN 2221-1268

RESEARCH ARTICLE

# Smartphone-based dietary assessment of food away from home and the risk of non-communicable diseases among young working adults in Johannesburg, South Africa

**Swapnil Godbharle[a*], Hema Kesa[a] and Angeline Jeyakumar[a,b]**

[a]*Food Evolution Research Laboratory (FERL), School of Tourism and Hospitality, University of Johannesburg, Johannesburg, South Africa*
[b]*Department of Nutrition, University of Nevada, Reno, USA*
**Correspondence: swapnilg660@gmail.com*

**Background** The rising consumption of food away from home (FAFH) among young working adults is a growing public health concern, particularly due to its association with non-communicable diseases (NCDs).
**Objective** This study employed 'FoodLog', a validated smartphone-based dietary tracking application, to investigate the determinants of FAFH consumption and its relationship with NCD risk among young adults.
**Design** Case-control study.
**Setting** Johannesburg, South Africa.
**Subjects** The analysis included 442 employed adults aged 25–45 years. Cases (146) were defined as individuals with self-reported NCDs, while controls (296) had no NCDs.
**Outcome measures** The primary outcome measures were the identification of determinants of FAFH consumption and the assessment of its association with NCD risk, using multivariate logistic regression models.
**Results** Multivariate analysis revealed that 33% of participants consumed FAFH in the week before the survey. Significant associations were found between FAFH consumption and female gender (AOR = 1.52, CI: 1.01–2.30), higher education (AOR = 2.05, CI: 1.16–3.61), physical inactivity (AOR = 2.44, CI: 1.56–3.79), and low vegetable intake (AOR = 1.33, CI: 1.09–1.57). Additionally, NCDs were more prevalent among individuals reporting alcohol use, non-vegetarian diets, and frequent FAFH consumption. FAFH consumers were 1.12 times more likely to report NCDs than non-consumers (AOR = 1.12, 95% CI: 1.01–1.61).
**Conclusion** These findings underscore the utility of mobile dietary assessment tools in capturing nuanced eating behaviours and highlight the need for targeted interventions addressing both individual choices and the urban food environment to reduce NCD risk.

**Keywords** dietary habits, food away from home, mHealth, non-communicable diseases, South Africa, young adults

## Introduction

Globalisation, economic progress, and technological advancements have significantly altered dietary habits worldwide. Many individuals are moving away from traditional diets emphasising staple grains, legumes, vegetables, and fruits, opting instead for increased consumption of processed foods, food away from home (FAFH), and sugar-sweetened beverages.[1,2] These modern diets often contain high levels of unhealthy ingredients, which are associated with a greater risk of non-communicable diseases (NCDs).[3] Furthermore, urban consumption patterns reflect characteristics such as a tech-savvy younger population, shifts in work dynamics, heightened competition in food promotion, and evolving family and gender roles.[4]

South Africa has experienced a sharp rise in FAFH consumption; between 1995 and 2012, household reliance on externally prepared food increased from 22% to 35% nationally, driven by Johannesburg and other metropolitan areas.[5] The city's expanding array of fast food outlets and food service businesses mirrors transformations in the broader African food environment, where annual FAFH growth rates exceed 20%.[6]

Young working adults in Johannesburg are central to this transition. Pressed for time by demanding jobs and complex commutes, and often living apart from extended families, they regularly choose the speed and convenience of commercially prepared meals. Influences such as limited cooking skills, food budgets, and digitally facilitated food delivery add to this shift.[7,8] Yet, while the public health implications for this group are considerable, particularly as NCD risk rises, research capturing the true scope and complexity of their diets remains limited in South Africa.

Notably, most previous studies in African urban settings have depended on traditional dietary tools such as 24-hour recalls or food frequency questionnaires (FFQ), which are vulnerable to recall and reporting biases and may miss irregular or spontaneous eating behaviours common in city life.[9] To address these methodological gaps, the present study investigated the factors influencing the consumption of FAFH and the associated NCD risk among young professionals in Johannesburg, leveraging FoodLog, an innovative smartphone-based dietary assessment application.[10] By employing real-time, app-based recording, this research provides a nuanced, accurate picture of dietary practices in a dynamic urban context, contributing valuable local evidence to support healthier food systems in South Africa's rapidly changing cities.

## Methodology

### Study design

A case-control study design was employed for its efficiency in examining associations between exposures like FAFH and NCDs within a practical timeframe. Cases consisted of young adults who self-reported having been diagnosed by a physician with NCDs such as diabetes, hypertension, chronic obstructive pulmonary disease, cancer, or cardiovascular diseases (e.g. myocardial infarction, stroke). The controls did not report having any of the conditions mentioned.

### Inclusion and exclusion criteria

The study applied specific inclusion and exclusion criteria to ensure a well-defined sample of young working adults aged 25–45 years. Eligible participants were employed across diverse sectors such as IT (information technology), finance, insurance, professional services, customer service, and healthcare, fluent in English, possessed an Android smartphone necessary for using the FoodLog app, and had spent at least one year in their current organisation. Exclusion criteria included pregnancy, eating disorders, temporary residence, cognitive impairments, and concurrent participation in other dietary or health interventions.

### Study setting/locale

Participants in the study were recruited from Johannesburg, South Africa, one of the foremost urban centres on the African continent.

### Study sample

The study employed a purposive sampling approach to select a diverse group of young professionals aged 25–45 years from various industries in Johannesburg. While purposive sampling may introduce selection bias and limit generalizability, efforts were made to enhance sample diversity by including participants from multiple sectors, ensuring representation across genders, educational backgrounds, and varying work experiences. This approach aimed to capture a broad spectrum of the target population's characteristics, thereby improving the relevance and applicability of the findings within the urban professional community.

### Sampling frame and sample selection

The research employed a comprehensive strategy to actively recruit participants for the study. This strategy used various communication channels, including WhatsApp and email, to maximise outreach and engagement. The researcher contacted the Human Resources (HR) departments of various companies and organisations across multiple industries to identify potential participants. The team requested that these HR departments distribute the study invitation to their employees via WhatsApp and email as the company policies prevented direct contact with employees. By partnering with HR departments, the research team effectively accessed a wide pool of potential participants within specific professional sectors.

### Sample size

The sample size for this study was determined using the two-population proportion formula in Epi-Info software version 7.2.2.2 (https://www.cdc.gov/epiinfo/support/downloads.html). The following assumptions were made to estimate the required sample size: the expected proportion of exposure among cases was 50%, while it was 35% among controls due to a lack of prior studies on the determinants of NCDs in this population. With a 95% confidence level, 85% power, a case-to-control ratio of 1:2, and an odds ratio of 1.85, the sample size was adjusted for a 10% non-response rate and a design effect of 2. This adjustment resulted in a required sample size of 155 cases and 309 controls, summing up to 464 participants from Johannesburg, South Africa. A final sample of 442 young adults (146 cases and 296 controls) was included in the analysis.

### Data collection

Data collection for both cases and controls occurred from April to September 2024 using a semi-structured questionnaire of 52 questions, administered via Google Forms and the FoodLog app. Two distinct data collection approaches were employed with different recall periods. Questionnaire data (presented in Tables 1–3) utilised a 7-day recall period, asking participants about their dietary behaviours and FAFH consumption in the week prior to the survey. FoodLog application data (presented in Table 4) involved real-time recording over five consecutive days, where participants logged their food consumption as it occurred to minimise recall bias.

The questionnaire was developed through a rigorous process, starting with a review of literature on FAFH consumption and NCD risk factors among urban adults in India. Relevant items were adapted from validated instruments like the World Health Organization (WHO) STEPS survey and the South Africa Demographic and Health Survey (SADHS).[11,12] Context-specific questions were added to meet the study's unique focus. The draft was pilot-tested for clarity and relevance, with feedback used to finalise the instrument, ensuring cultural appropriateness and comprehensiveness.

The questionnaire collected detailed information on participants' sociodemographic characteristics, including age, gender, education, marital status, and occupation (categorised by professional sector such as IT, banking, customer service, etc.). Anthropometric data, specifically self-reported height and weight, were gathered to calculate BMI. Lifestyle variables included personal habits (e.g. smoking and alcohol consumption), hours spent in sedentary work, and physical activity levels. Dietary assessment encompassed specific food consumption patterns such as frequency of fruit, vegetable, and non-vegetarian food intake. Additionally, economic variables included self-reported weekly expenditure on food and groceries, as well as money spent specifically on FAFH. The participants' health status captured self-reported NCDs.

A customised smartphone application called 'FoodLog' was utilised to gather comprehensive dietary intake data. Participants were asked to use the app diligently for five consecutive days, including weekends, to record all food and beverages consumed during this period. This duration balances reducing recall bias, accounting for day-to-day variability, and maintaining participant compliance. Prior usability studies demonstrated that sustained use over multiple days is feasible and yields accurate dietary data.[13]

Participants were asked to provide detailed information on the types, quantities (in grams/millilitres), costs, and sources of consumed items, ensuring thorough documentation of dietary patterns. To reduce recall bias, participants were also instructed to enter information as soon as possible after consumption. Additionally, they were encouraged to specify whether the food was prepared at home or away from home to accurately capture FAFH consumption. The FoodLog app was pilot

**Table 1:** Distribution of sociodemographic characteristics of study participants ($N = 442$)

| Variables | *n* (%) |
|---|---|
| Age (in years): | |
| 25–35 | 182 (41.2) |
| 36–45 | 260 (58.8) |
| Gender: | |
| Male | 212 (48) |
| Female | 230 (52) |
| Level of education: | |
| Graduate | 376 (85.1) |
| Postgraduate | 60 (13.6) |
| PhD and above | 6 (1.4) |
| Occupation: | |
| Accountant | 34 (7.7) |
| Banking | 59 (13.3) |
| Consultant | 44 (10) |
| Customer service | 83 (18.8) |
| Insurance | 44 (10) |
| Research | 9 (2) |
| IT | 169 (38.2) |
| Marital status: | |
| Single/Never married | 143 (32.4) |
| Married/Domestic partnership | 259 (58.6) |
| Divorced/Separated/Widowed | 40 (9) |
| Religion | |
| Christian | 360 (81.4) |
| Muslim | 56 (12.7) |
| Hindu | 17 (3.8) |
| Did not mention | 9 (2) |
| Ethnicity | |
| African/Black | 291 (65.8) |
| White | 45 (10.2) |
| Coloured | 79 (17.9) |
| Indian/Asian | 27 (6.1) |
| Living condition | |
| Live alone | 144 (32.6) |
| Live with immediate family | 274 (62) |
| Live with extended family | 24 (5.4) |

*n* = frequency; % = percentage.

**Table 2:** Behavioural characteristics of the study participants ($N = 442$)

| Variables | *n* (%) or mean ± SD |
|---|---|
| Perform physical activity: | |
| Yes | 177 (40) |
| No | 265 (60) |
| Ever drank alcohol: | |
| Yes | 127 (28.7) |
| No | 315 (71.3) |
| Ever smoke cigarettes: | |
| Yes | 150 (33.9) |
| No | 292 (66.1) |
| Body mass index: | |
| Normal weight (18.5–24.9 kg/m$^2$) | 249 (56.3) |
| Overweight (25–29.9 kg/m$^2$) | 190 (43) |
| Obese (≥ 30 kg/m$^2$) | 3 (0.7) |
| No. of meals consumed in a day: | |
| ≤ 2 times a day | 212 (48) |
| ≥ 3 times a day | 230 (52) |
| Consumed fruits: | |
| ≤ 2 times a week | 250 (56.6) |
| ≥ 3 times a week | 192 (43.4) |
| Consumed vegetables: | |
| ≤ 3 times a week | 329 (74.4) |
| ≥ 4 times a week | 113 (25.6) |
| Consume non-vegetarian food: | |
| Yes | 436 (98.6) |
| No | 6 (1.4) |
| Add salt: | |
| Yes | 256 (57.9) |
| No | 186 (42.1) |
| Duration of physical activity (in minutes) | 53.98 ± 11.66 |
| No. of hours each day spent in leisure activity (in hours) | 1.09 ± 0.28 |
| No. of hours each day spent in sedentary work (in hours) | 8.45 ± 0.63 |
| Total amount of money spent on food and groceries in the past seven days (in ZAR) | 1 212.90 ± 499.56 |

*n* = frequency; % = percentage; SD = standard deviation; ZAR = South African Rand.

tested before the study using the Mobile Application Usability Questionnaire (MAUQ) to assess user-friendliness, acceptability, and compliance. Pilot results demonstrated high usability and participant adherence, supporting its suitability for real-time dietary data collection.[10]

## Data analysis

The statistical analyses were conducted using IBM SPSS Statistics 21.0 for Windows (IBM Corp, Armonk, NY, USA). First, univariate descriptive statistics were computed for each variable in the dataset. This included measures of central tendency (means), variability (standard deviations), and frequencies. Next, chi-square tests of independence were used to examine the associations between sociodemographic and behavioural variables and their relationship with the consumption of FAFH and the risk of NCDs. Additionally, both crude and adjusted odds ratios were calculated to assess the strength of the relationships between sociodemographic and behavioural variables and the likelihood of FAFH consumption and NCD risk. A significance level of $p \leq 0.05$ was applied to determine statistically significant associations. For the regression models, adjustments were made for key confounding variables, including age, gender, marital status, educational attainment, occupation sector, living arrangements, physical activity, smoking status, and alcohol consumption.

## Ethical considerations

All participants were required to provide informed consent by actively selecting a checkbox option in Google Forms. This consent process included detailed information on the study, such as its purpose, potential risks, measures to ensure confidentiality, and participants' rights to withdraw at any time. The study was part of the author's doctoral research and received approval from the Research Ethics Committee (REC) of the Faculty of Health Sciences at the University of Johannesburg. The committee thoroughly reviewed the study's protocol, including the informed consent process, and granted the

**Table 3:** Patterns of FAFH consumption and associated dietary behaviours in the study participants

| Variables | *n* (%) or mean ± SD |
|---|---|
| Consumed food away from home (FAFH) in the 7-day recall (*n* = 442): | |
| Yes | 147 (33.3) |
| No | 295 (66.7) |
| Place of FAFH consumption (*n* = 147): | |
| Food shop/Takeaway | 59 (40.1) |
| Restaurant | 58 (39.5) |
| Street vendor | 20 (13.6) |
| Others' house | 10 (6.8) |
| Paid for FAFH (*n* = 147): | |
| Yes | 121 (82.3) |
| No | 26 (17.7) |
| If not, who paid? (*n* = 26): | |
| Household member | 10 (38.5) |
| Non-household member | 16 (61.5) |
| No. of days consumed FAFH in the 7-day recall (*n* = 147): | |
| ≤ 2 times a week | 48 (32.6) |
| ≥ 3 times a week | 99 (67.4) |
| Amount of money spent on FAFH in the 7-day recall (in ZAR) | 556.78 ± 393.08 |

n = frequency; % = percentage; SD = standard deviation; SAR = South African Rand.

clearance (Reference number: REC-01-06-2021). No incentives or compensation were provided to participants for using the FoodLog app or for study involvement.

## Results

The data presented in Tables 1–3 were gathered through the administration of a questionnaire, whereas the data in Table 4 were obtained using the FoodLog application. Table 1 shows the sociodemographic characteristics of the study participants. Of the 155 cases and 309 controls invited, 146 cases and 296 controls participated, resulting in 94.1% and 95.7% response rates, respectively. Therefore, the analysis involved a total sample size of 442 participants. The mean age of the participants was 36.73 years, with a standard deviation of 4.97 years. The demographic composition of the study participants indicated that over half of the participants were female (52%). The majority were married or were in a domestic partnership (58.6%), resided with their immediate family (62%), identified with the Christian religion (81.4%), and were affiliated with the African/Black ethnicity group (65.8%). About 38% of the participants were employed in the IT sector. The mean number of family members living in a household was 3.56 ± 1.04. The mean number of earning members living in a household was 1.72 ± 0.52.

**Table 4:** Data on FAFH consumption derived from the 'FoodLog' application

| Variables | *n* (%) or mean ± SD |
|---|---|
| Number of participants who recorded meals in the 'FoodLog' app (*n* = 442): | |
| Yes | 308 (69.7) |
| No | 134 (30.3) |
| Number of meals recorded as FAFH (*n* = 4 852): | |
| Yes | 1 058 (21.8) |
| No | 3 794 (78.2) |
| Place of FAFH consumption (*n* = 1 058): | |
| Food shop/Takeaway | 206 (19.5) |
| Restaurant | 368 (34.7) |
| Street vendor | 159 (15.1) |
| Workplace cafeteria | 192 (18.2) |
| Others house/function/event | 133 (12.5) |
| Meal occasion for FAFH consumption (*n* = 1 058): | |
| Breakfast | 241 (22.8) |
| Lunch | 269 (25.4) |
| Dinner | 382 (36.1) |
| Snack | 166 (15.7) |
| Average amount of money spent per FAFH meal in the five days (in ZAR) | 61.43 ± 28.03 |

*n* = frequency; % = percentage; SD = standard deviation; ZAR = South African. Rand.

Table 2 displays the behavioural characteristics of the study participants. Some 40% of the participants engaged in some form of physical activity. The mean duration of the physical activity was 53.98 minutes (SD 11.66 minutes). The mean duration participants spent on leisure activities daily was 1.09 hours (SD 0.28 hours), while the mean time spent on sedentary work was 8.45 hours (SD 0.63 hours). About 28.7% of the participants consumed alcohol and 33.9% smoked cigarettes. The table also demonstrates that 43% of the participants were overweight, while 0.7% were obese. The participants had a mean height of 170.8 cm (SD 5.9 cm) and a mean weight of 72.5 kg (SD 8.5 kg). About 43.4% of the participants ate fruits at least three times a week, and 25.6% ate vegetables at least four times each week. The majority (98.6%) of the participants consumed non-vegetarian food (such as meat, poultry, fish, or other animal-derived products). Over half of the participants (57.9%) added salt to their meals during or before consumption. The weekly average expenditure on food and groceries prior to the day of the survey was ZAR1 212.90 Rands (SD ZAR499.56).

Table 3 presents the patterns of FAFH consumption and associated dietary behaviours in the study population. Over one-third (33.3%) responded affirmatively to having consumed FAFH in the past seven days. Of these, 39.5% consumed FAFH in restaurants, 40.1% in food shops or takeaways, and 13.6% from street vendors. Most of the participants paid for the FAFH they consumed in the seven-day recall period. More than two-thirds (67.4%) of the participants consumed FAFH three or more times during the week. The average expenditure on FAFH during this period was ZAR556.78 ± 393.08.

Table 4 presents the description of FAFH as recorded through the 'FoodLog' application. The table provides details concerning meals recorded by participants in the app over five consecutive days. Among the 442 participants, 308 (69.7%) used the FoodLog app to document their dietary intake. These 308 participants collectively recorded a total of 4 852 meals within the application. In total, 22% of these meals were reportedly consumed outside the home environment (FAFH). The primary venues for FAFH consumption were restaurants (34.7%), followed by food outlets or takeaways (19.5%), and workplace cafeterias (18.2%). Regarding the meal timing, FAFH consumption was most prevalent during dinner (36.1%), followed by lunch (25.4%). The average expenditure per FAFH meal over the five days was recorded at ZAR61.43 ± 28.03 Rands.

Table 5 presents the logistic regression results for unadjusted and adjusted determinants of FAFH consumption. The logistic

**Table 5:** Regression results of adjusted and unadjusted determinants of FAFH consumption

| Variables | FAFH consumption Yes (*n* = 147) *n* (%) | No (*n* = 295) *n* (%) | COR (95% CI) | AOR (95% CI) |
|---|---|---|---|---|
| Gender: | | | | |
| Male[a] | 59 (40.1) | 153 (51.9) | | |
| Female | 88 (59.9) | 142 (48.1) | 1.60 (1.07,2.40)* | 1.52 (1.01,2.30)* |
| Level of education: | | | | |
| Graduate[a] | 118 (80.3) | 258 (87.5) | | |
| Postgraduate and above | 29 (19.7) | 37 (12.5) | 1.71 (1.06,2.91)* | 2.05 (1.16,3.61)* |
| Living conditions: | | | | |
| Live alone | 61 (41.5) | 83 (28.1) | 0.97 (0.40,2.33) | 0.84 (0.33,2.10) |
| Live with immediate family | 76 (51.7) | 198 (67.1) | 1.86 (0.79,4.36) | 1.84 (0.76,4.45) |
| Live with extended family[a] | 10 (6.8) | 14 (4.8) | | |
| Perform physical activity: | | | | |
| Yes[a] | 38 (25.9) | 139 (47.1) | | |
| No | 109 (74.1) | 156 (52.9) | 2.55 (1.65,3.94)*** | 2.44 (1.56,3.79)*** |
| Consumed vegetables: | | | | |
| ≤ 3 times a week | 128 (87.1) | 201 (68.1) | 3.15 (1.83,5.40)*** | 1.33 (1.09,1.57)*** |
| ≥ 4 times a week[a] | 19 (12.9) | 94 (31.9) | | |

*n* = frequency; % = percentage; COR = crude odds ration; AOR = adjusted odds ratio; CI = confidence interval; [a] = reference category; FAFH = food away from home; level of significance: ***$p < 0.001$, **$p < 0.01$, *$p < 0.05$.

regression model incorporated only the factors found to be statistically significant in the chi-square analysis. The unadjusted (bivariable) analysis revealed a correlation between FAFH consumption and being female, having a postgraduate or higher level of education, physical inactivity, and reduced vegetable intake. These findings remained consistent in the adjusted (multivariable) analysis. The likelihood of consuming FAFH was 1.52 times higher among female participants than among their counterparts (AOR = 1.52, 95% CI: 1.01–2.30). Similarly, participants with postgraduate or higher levels of education were 2.05 times more likely to consume FAFH than graduates (AOR = 2.05, 95% CI: 1.16–3.61). The odds of FAFH consumption were 2.44 times higher among participants who did not engage in physical activity than among those who did (AOR = 2.44, 95% CI: 1.56–3.79). Participants with reduced vegetable intake were 1.33 times more likely to consume FAFH than those with higher vegetable intake (AOR = 1.33, 95% CI: 1.09–1.57).

Figure 1 illustrates the distribution of self-reported NCDs among cases in the study sample. The most prevalent self-reported NCD among cases was hypertension (39.7%), followed by diabetes (24%), chronic respiratory disorders (12.3%), hypercholesterolemia (8.2%), and lastly heart disease (6.2%). Cancer (4.1%) was the least reported NCD.

Table 6 presents the logistic regression results for both unadjusted and adjusted factors associated with NCDs. The unadjusted analysis showed a significant association between NCDs and several factors, including early midlife (36–45 years old), being physically inactive, consuming alcohol, eating non-vegetarian food, and consuming FAFH. However, after adjustment, factors such as being an adult in early midlife, having a sedentary lifestyle, non-vegetarian dietary habits, and FAFH consumption remained significant.

Accordingly, participants between the ages of 36 and 45 years were 1.07 times more likely to have NCDs than those aged 25–35 (AOR = 1.07, 95% CI: 1.03–1.66). The odds of NCDs were 1.19 times higher among participants who did not engage in physical activity than those who did (AOR = 1.19, 95% CI: 1.07–1.85). Participants who consumed non-vegetarian food were 1.78 times more likely to have NCDs than their counterparts (AOR = 1.78, 95% CI: 1.21–4.85). In addition, the consumption of FAFH was associated with a 1.12 times higher likelihood of NCDs than for non-consumers (AOR = 1.12, 95% CI: 1.01–1.61).

## Discussion

To our knowledge, this study is the first to thoroughly examine the factors related to self-reported FAFH consumption and its association with self-reported NCD risk among young working adults in Johannesburg, South Africa. The sociodemographic profile of the study population was assessed across key variables, including age, gender, educational attainment, marital status, ethnicity, and religious affiliation. These variables were included because they are established potential confounders in studies of dietary behaviours and health outcomes. Including these variables in the regression models improves the accuracy and validity of the analysis by controlling for underlying differences in dietary behaviours that are shaped by sociocultural context. This follows best practices for multivariable analyses in public health research to address confounding factors and ensure robust, generalisable findings.[14,15]

In addition, the study investigated specific behavioural factors such as physical activity, alcohol and tobacco use, body mass index (BMI), fruit and vegetable intake, non-vegetarian consumption, and household food expenses. The study also delved into FAFH behaviour, place of FAFH consumption, frequency, and expenses. Furthermore, the researcher examined the relationship between FAFH consumption and its association with the risk of NCDs.

Importantly, unlike many previous studies that relied on traditional dietary assessment methods such as 24-hour recalls or Food Frequency Questionnaires, which are prone to recall

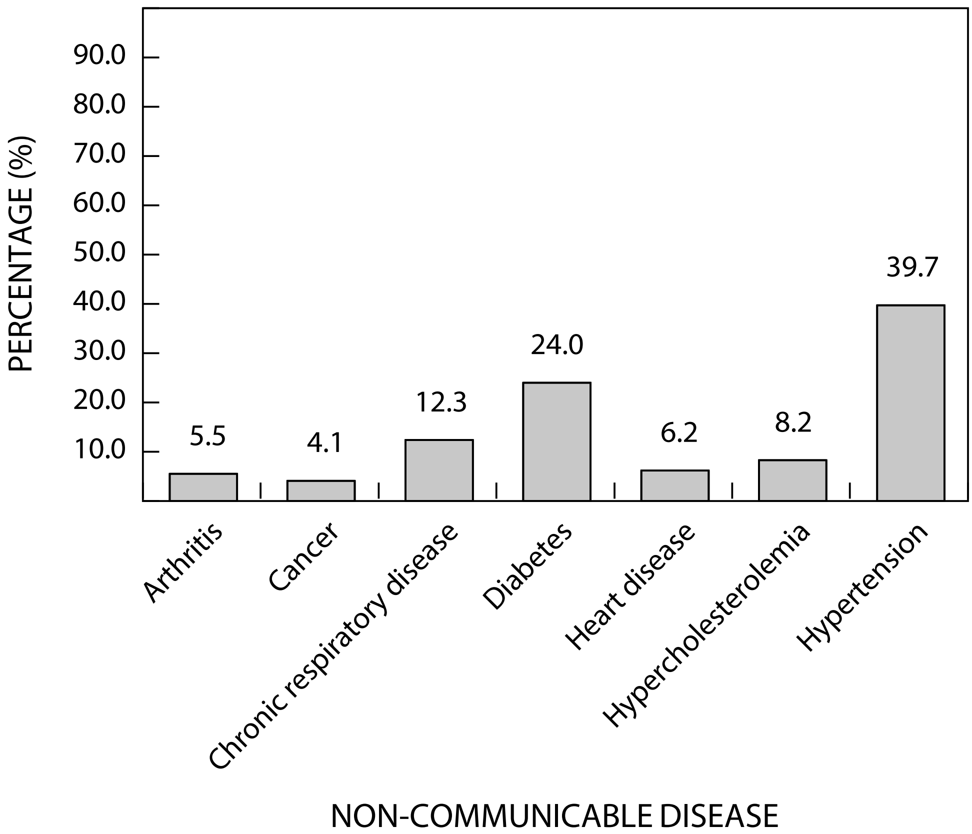


**Figure 1:** Distribution of self-reported NCDs among cases ($n = 330$) in the study sample.

and reporting biases, this study utilised the FoodLog smartphone application for real-time dietary intake recording. Digital tools like FoodLog prompt users to record foods immediately after consumption, thus reducing recall bias and enhancing accuracy.[16,17] These technology-assisted approaches offer advantages such as improved portion size estimation, standardised food entry, and participant preference for convenience compared with paper-based tools. Recent research

**Table 6:** Regression results of factors associated with NCDs among participants

| Variables | Presence of NCDs: Yes (cases) ($n = 146$) $n$ (%) | Presence of NCDs: No (controls) ($n = 296$) $n$ (%) | COR (95% CI) | AOR (95% CI) |
|---|---|---|---|---|
| Age (in years): | | | | |
| 25–35[a] | 55 (37.7) | 127 (42.9) | | |
| 36–45 | 91 (62.3) | 169 (57.1) | 1.24 (0.82,1.86)* | 1.07 (1.03,1.66)* |
| Living conditions: | | | | |
| Live alone | 41 (28.1) | 103 (34.8) | 1.79 (0.73,4.36) | 1.53 (0.59,3.97) |
| Live with immediate family | 95 (65.1) | 179 (60.5) | 1.34 (0.57,3.14) | 1.12 (0.46,2.75) |
| Live with extended family[a] | 10 (6.8) | 14 (4.7) | | |
| Perform physical activity: | | | | |
| Yes[a] | 52 (35.6) | 125 (42.2) | | |
| No | 94 (64.4) | 171 (57.8) | 1.32 (0.87,1.99)* | 1.19 (1.07,1.85)* |
| Ever drank alcohol: | | | | |
| Yes | 48 (32.9) | 76 (26.7) | 1.34 (0.87,2.07)* | 0.76 (0.49,1.20) |
| No[a] | 98 (67.1) | 217 (73.3) | | |
| Consume non-vegetarian food: | | | | |
| Yes | 141 (96.6) | 295 (99.7) | 1.46 (1.21,3.82)* | 1.78 (1.21,4.85)* |
| No[a] | 5 (3.4) | 1 (0.3) | | |
| Consumed food away from home (FAFH): | | | | |
| Yes | 53 (36.3) | 94 (31.8) | 0.81 (0.53,1.23)* | 1.12 (1.01,1.61)* |
| No[a] | 93 (63.7) | 202 (68.3) | | |

$n$ = frequency; % = percentage; COR = crude odds ration; AOR = adjusted odds ratio; CI = confidence interval; [a] = reference category; NCD = non-communicable disease; lLevel of significance: ***$p < 0.001$, **$p < 0.01$, *$p < 0.05$.

supports that digital dietary assessment methods not only improve compliance and user engagement but also address some of the systematic errors present in traditional methods, particularly for populations comfortable with digital technology.[18,19] Therefore, the use of a validated mHealth app in this study strengthens the reliability of dietary data and represents a novel strategy to better capture dynamic eating behaviours, such as food away from home, in urban populations.

In the outcomes of the multivariable logistic regression analysis, it was established that, except for gender and level of education, no significant correlation existed between sociodemographic characteristics and FAFH consumption. The analysis revealed that a higher likelihood of FAFH consumption was linked with female participants in the study, indicating that gender may play a significant role in influencing FAFH consumption habits within the cohort. This could be attributed to factors such as women's increased participation in the workforce, resulting in less time for home-cooked meals.[5] However, multiple studies have indicated that male gender is generally correlated with an increased consumption of FAFH.[4,20,21] Our cohort of young urban professionals includes substantial female workforce participation in office-based roles with constrained meal-prep time and dense exposure to quick-service outlets around workplaces. In such settings, women may equal or exceed men in workday FAFH frequency, especially lunch purchases, even if evening FAFH remains higher among men in other populations. Thus, gender patterns are contingent on employment type, commuting time, caregiving responsibilities, and the retail food outlets around workplaces.

The study also found that people with higher levels of education are more likely to eat FAFH, indicating that education may influence FAFH intake. This could be because individuals with higher education have greater exposure to diverse dining options and increased financial capacity to afford FAFH.[5] However, there are conflicting findings in the literature regarding the relationship between education and FAFH consumption.[20,22–24] In Johannesburg, higher education often aligns with formal employment in central business districts, long commutes, and limited time for food preparation, increasing FAFH during workdays and commutes.[25] The local food environment offers abundant, convenient but largely energy-dense, heavily promoted options. Spatial mismatch between residential and work areas, limited access to cooking facilities, and workplace proximity to fresh produce constrain healthy choices. Rising prices for minimally processed foods versus ultra-processed ones may weaken education's protective effect on diet quality. Unlike Europe, where workplace canteens are more regulated and healthier options more prevalent,[26] Johannesburg's food landscape drives higher FAFH frequency among educated adults without better nutritional quality.

The findings also indicated that higher odds of FAFH consumption were associated with physical inactivity and reduced vegetable intake. This finding aligns with previous studies, which also found FAFH consumption and an overall lifestyle that is inclusive of other NCD risk factors, such as physical inactivity and reduced vegetable intake.[27,28]

The multivariable logistic regression analysis indicated that NCDs were associated with factors such as age, physical activity, consumption of non-vegetarian food, and FAFH consumption. The study established a significant association between advancing age and the emergence of NCDs. This could be attributed to the accumulation of unhealthy behaviours and exposures over time, which increases the risk of NCDs later in life.[29] This observed pattern is consistent with the findings of several studies conducted across several nations, indicating a uniform propensity for age-related susceptibility to NCDs.[30–32]

The analysis also revealed a statistically significant correlation between NCDs and physical inactivity. Numerous studies have shown a strong link between physical inactivity and an increased risk of developing NCDs.[33,34] Notably, a sedentary lifestyle, frequently linked to increased reliance on FAFH, can contribute to weight gain, obesity, and the subsequent onset of NCDs. This study also observed a noteworthy correlation between the consumption of non-vegetarian food and the onset of NCDs. These findings align with several other studies, emphasising the association between non-vegetarian food consumption and the emergence of chronic health conditions.[35–37] This relationship can be attributed to the high content of saturated fat, cholesterol, food additives and processing techniques, which have been linked to increased risk of heart disease, cancer, and other NCDs.[38]

The results of the multivariable logistic regression also indicate a significant positive association between FAFH consumption and the development of NCDs among the study cohort. Several studies have consistently established a correlation between FAFH consumption and elevated risks of multiple chronic conditions, such as obesity, type 2 diabetes, hypertension, and cardiovascular disease.[39–41] This association stems from the generally higher calorie, fat, sugar, and sodium content found in FAFH food items.[42] These findings emphasise the significant role of consumption of FAFH as a potential risk factor that contributes to the increasing global prevalence of non-communicable diseases.

## Conclusion

In summary, this study is among the first to provide detailed insights into the drivers of FAFH consumption and its association with NCD risk among young working adults in Johannesburg, South Africa. By leveraging a novel, app-based dietary assessment (FoodLog) and comprehensive sociodemographic, behavioural, and dietary data, the research highlights the growing intersection between urban modernisation and health risks.

Importantly, the results emphasise the urgent need for targeted health promotion and policy efforts aimed at educating young urban professionals on the risks associated with frequent FAFH consumption and sedentary lifestyles. Interventions that support healthier eating environments, encourage physical activity, and promote balanced dietary habits are vital to mitigating the rising NCD burden in South African cities like Johannesburg. Future research, ideally utilising longitudinal designs and broader population samples, is warranted to further elucidate causal pathways and to assess the effectiveness of mHealth tools in supporting sustainable dietary improvements at scale.

## Strengths and limitations

This study presents several significant strengths. First, it thoroughly investigates the complex interplay between socioeconomic factors, lifestyle choices, and dietary habits within a rapidly urbanising region of South Africa. Second, the case-control study design offers a solid foundation for examining the relationship between the consumption of FAFH and various risk markers for NCDs. Moreover, the innovative implementation of a smartphone-based application, called FoodLog, in the collection of dietary data has significantly enhanced the quality and depth of the information gathered. Furthermore, the rigorous statistical analyses employed contribute to the reliability of the study's findings.

However, it is also imperative to acknowledge the presence of several limitations in the study. First, given the study sample's specific demographic and regional characteristics, the findings may not be readily generalisable to diverse populations or different geographical locations. Furthermore, the study design does not lend itself to establishing direct causal relationships between FAFH consumption and the risk of NCDs. The dependence on self-reported data on anthropometry, dietary intake, and NCD status introduces the potential for bias. Furthermore, other unmeasured or residual confounding factors (e.g. individual preferences and the food environment) could influence the observed relationships despite controlling for several potential confounding variables.

### Public health implications and recommendations

This study highlights critical opportunities for South Africa's urban health policy. Interventions should focus on transforming workplace and urban food environments through robust nutrition standards, portion controls, and clear calorie labelling in public institutions and workplaces. Fiscal policies such as extending levies on high-sodium and sugary foods, combined with portion size standardisation, can reduce harmful dietary exposures. Urban planning must prioritise creating healthy food options near transit hubs and workplaces, using incentives to encourage vendors to provide affordable fresh produce and reformulated meals.

Tailored education campaigns for young professionals should focus on practical healthy swaps, budgeting, and menu literacy, supported by workplace influencers. Culinary literacy apps and retail collaborations can enhance skills for preparing quick, healthy meals. Monitoring frameworks requiring sodium, sugar, and portion size reporting by food vendors, supplemented by sentinel surveillance and mobile health dietary tracking, will support adaptive policy-making. Collectively, these strategies offer a focused, context-relevant roadmap to curb NCD risks linked to FAFH consumption in South Africa's urban settings.

### Author contributions

The authors' responsibilities were as follows: SG, HK, and AJ: conceptualised the study and established the methodology; SG: collected the data, conducted the formal analysis, performed validation and visualisation, managed the software, and wrote the first draft; HK and AJ: supervised the project, obtained resources, and reviewed and edited the manuscript.

### Consent for publication

All authors consent to the publication of this study.

*Disclosure statement* – No potential conflict of interest was reported by the authors.

*Funding* – This work was supported by the Fourth Industrial Revolution (4IR)/Global Excellence and Stature Scholarships (GES) 4.0 doctoral fellowship award [grant number 202004683].

*Data availability statement* – The data used to support the findings of this study are available from the corresponding author upon request.

### ORCID

*Swapnil Godbharle* http://orcid.org/0000-0001-5793-1285
*Hema Kesa* http://orcid.org/0000-0002-1258-9145
*Angeline Jeyakumar* http://orcid.org/0000-0001-7973-0388

### References

1. Turner C, Aggarwal A, Walls H, et al. Concepts and critical perspectives for food environment research: a global framework with implications for action in low- and middle-income countries. Glob Food Secur. 2018;18:93–101. https://doi.org/10.1016/j.gfs.2018.08.003
2. Branca F, Lartey A, Oenema S, et al. Transforming the food system to fight non-communicable diseases. Br Med J. 2019;364:l296. https://doi.org/10.1136/bmj.l296
3. Saxena S, Saini S, Samtiya M, et al. Assessment of Indian cooking practices and cookwares on nutritional security: a review. J Appl Nat Sci. 2021;13:357–372. https://doi.org/10.31018/jans.v13i1.2535
4. Godbharle S, Kesa H, Jeyakumar A, et al. Socio-demographic and economic factors associated with the consumption of processed foods in South Africa – Evidence from demographic and health survey VII. Public Health. 2024;226:190–198. https://doi.org/10.1016/j.puhe.2023.11.018
5. Blick M, Abidoye BO, Kirsten JF. An investigation into food-away-from-home consumption in South Africa. Dev South Afr. 2018;35:39–52. https://doi.org/10.1080/0376835X.2017.1412295
6. Baker P, Machado P, Santos T, et al. Ultra-processed foods and the nutrition transition: global, regional and national trends, food systems transformations and political economy drivers. Obes Rev. 2020;21:e13126. https://doi.org/10.1111/obr.13126
7. Larson N, Neumark-Sztainer D, Laska MN, et al. Young adults and eating away from home: associations with dietary intake patterns and weight status differ by choice of restaurant. J Am Diet Assoc. 2011;111:1696–1703. https://doi.org/10.1016/j.jada.2011.08.007
8. Howse E, Hankey C, Allman-Farinelli M, et al. Buying salad is a lot more expensive than going to McDonalds': young adults' views about what influences their food choices. Nutrients. 2018;10:996. https://doi.org/10.3390/nu10080996
9. Liu B, Young H, Crowe FL, et al. Development and evaluation of the Oxford WebQ, a low-cost, web-based method for assessment of previous 24h dietary intakes in large-scale prospective studies. Public Health Nutr. 2011;14:1998–2005. https://doi.org/10.1017/S1368980011000942
10. Godbharle S, Kesa H, Jeyakumar A. Foodlog: development and evaluation of a smartphone-based application for dietary tracking. Afr J Hosp Tour Leis. 2025;14:664–672. https://doi.org/10.46222/ajhtl.19770720.649
11. World Health Organization. STEPwise approach to NCD risk factor surveillance (STEPS). 2024 . Available from: https://www.who.int/teams/noncommunicable-diseases/surveillance/systems-tools/steps [cited 6 Oct 2025].
12. National Department of Health (NDoH), Statistics South Africa (Stats SA), South African Medical Research Council (SAMRC). South Africa demographic and health survey 2016. Pretoria: National Department of Health; 2019. p. 627. Available from: www.health.gov.za
13. Rangan AM, O'Connor S, Giannelli V, et al. Electronic Dietary Intake Assessment (e-DIA): comparison of a mobile phone digital entry app for dietary data collection With 24-hour dietary recalls. JMIR Mhealth Uhealth. 2015;3(4):e98. https://doi.org/10.2196/mhealth.4613
14. Oviedo-Solís CI, Hernández-Alcaraz C, Sánchez-Ortíz NA, et al. Association of sociodemographic and lifestyle factors with dietary patterns among men and women living in Mexico city: a cross-sectional study. Front Public Health. 2022;10:859132. https://doi.org/10.3389/fpubh.2022.859132
15. Suaárez-González KD, Solis-Manzano AM, Padilla-Samaniego MV, et al. Relationship between diet, sociodemographic factors, and body composition in students from UNEMI and ESPOCH. Front

Public Health. 2025;13:1621661. https://doi.org/10.3389/fpubh.2025.1621661
16. Shim J-S, Oh K, Kim HC. Dietary assessment methods in epidemiologic studies. Epidemiol Health. 2014;36:e2014009. https://doi.org/10.4178/epih/e2014009
17. Bailey RL. Overview of dietary assessment methods for measuring intakes of foods, beverages, and dietary supplements in research studies. Curr Opin Biotechnol. 2021;70:91–96. https://doi.org/10.1016/j.copbio.2021.02.007
18. Bennett G, Yang S, Bardon LA, et al. Expansion and assessment of a web-based 24-hour dietary recall tool, Foodbook24, for use among diverse populations living in Ireland: comparative analysis. Online J Public Health Inform. 2025;17:e52380. https://doi.org/10.2196/52380
19. Naska A, Lagiou A, Lagiou P. Dietary assessment methods in epidemiological research: current state of the art and future prospects. F1000Res. 2017;6:926. https://doi.org/10.12688/f1000research.10703.1
20. Mills S, Adams J, Wrieden W, et al. Sociodemographic characteristics and frequency of consuming home-cooked meals and meals from out-of-home sources: cross-sectional analysis of a population-based cohort study. Public Health Nutr. 2018;21:2255–2266. https://doi.org/10.1017/S1368980018000812
21. Kristiningrum A, Khusun H, Chandra DN, et al. Food away from home: the characteristics of socio-demographics among office workers in Jakarta during the COVID-19 pandemic. In: Ichsan B, Nursanto D, Sari M, et al. editors. Proceedings of the international conference on health and well-being – ICHWB 2022. Dordrecht: Atlantis Press International BV; 2023. p. 143–152. https://doi.org/10.2991/978-94-6463-184-5_14
22. Nayga RM, Capps O. Impact of socio-economic and demographic factors on food away from home consumption: number of meals and type of facility. J Restaur Foodserv Mark. 1994;1:45–69. https://doi.org/10.1300/J061v01n02_04
23. Haq ZU, Sherif S, Gheblawi M. Impact of socioeconomic and demographic characteristics of households on demand for food away from home in the United Arab Emirates. Int J Hosp Manag. 2014;42:92–99. https://doi.org/10.1016/j.ijhm.2014.06.011
24. Ogundari K, Aladejimokun AO, Arifalo SF. Household demand for food away from home (FAFH) in Nigeria: the role of education. J Dev Areas. 2015;49:247–262. https://doi.org/10.1353/jda.2015.0004
25. Tugendhaft A, Hofman KJ. Empowering healthy food and beverage choices in the workplace. Occup Health South Afr. 2014;20:6–8.
26. Jordan S, Hermann S, Starker A. Utilisation of canteens offering healthy food choices as part of workplace health promotion in Germany. J Health Monit. 2020;5:34–40. https://doi.org/10.25646/6401
27. Leech RM, McNaughton SA, Timperio A. The clustering of diet, physical activity and sedentary behavior in children and adolescents: a review. Int J Behav Nutr Phys Act. 2014;11(1):4. https://doi.org/10.1186/1479-5868-11-4
28. Seguin RA, Aggarwal A, Vermeylen F, et al. Consumption frequency of foods away from home linked with higher body mass index and lower fruit and vegetable intake among adults: a cross-sectional study. J Environ Public Health. 2016;2016:1–12. https://doi.org/10.1155/2016/3074241
29. Atella V, Piano Mortari A, Kopinska J, et al. Trends in age-related disease burden and healthcare utilization. Aging Cell. 2019;18:e12861. https://doi.org/10.1111/acel.12861
30. Wandera SO, Kwagala B, Ntozi J. Prevalence and risk factors for self-reported non-communicable diseases among older Ugandans: a cross-sectional study. Glob Health Action. 2015;8:27923. https://doi.org/10.3402/gha.v8.27923
31. Abebe SM, Andargie G, Shimeka A, et al. The prevalence of non-communicable diseases in Northwest Ethiopia: survey of dabat health and demographic surveillance system. BMJ Open. 2017;7:e015496. https://doi.org/10.1136/bmjopen-2016-015496
32. Demilew YM, Firew BS. Factors associated with noncommunicable disease among adults in Mecha district, Ethiopia: a case control study. PLoS One. 2019;14:e0216446. https://doi.org/10.1371/journal.pone.0216446
33. Booth FW, Roberts CK, Laye MJ. Lack of exercise is a major cause of chronic diseases. Compr physiol. 2011;2:1143–1211. https://doi.org/10.1002/cphy.c110025
34. Lee I-M, Shiroma EJ, Lobelo F, et al. Effect of physical inactivity on major non-communicable diseases worldwide: an analysis of burden of disease and life expectancy. Lancet. 2012;380:219–229. https://doi.org/10.1016/S0140-6736(12)61031-9
35. Fraser GE. Vegetarian diets: what do we know of their effects on common chronic diseases? Am J Clin Nutr. 2009;89:1607S–1612S. https://doi.org/10.3945/ajcn.2009.26736K
36. Alrabadi NI. The effect of lifestyle food on chronic diseases: a comparison between vegetarians and non-vegetarians in Jordan. Glob J Health Sci. 2012;5:65. https://doi.org/10.5539/gjhs.v5n1p65
37. Oussalah A, Levy J, Berthezène C, et al. Health outcomes associated with vegetarian diets: an umbrella review of systematic reviews and meta-analyses. Clin Nutr. 2020;39:3283–3307. https://doi.org/10.1016/j.clnu.2020.02.037
38. Cena H, Calder PC. Defining a healthy diet: evidence for the role of contemporary dietary patterns in health and disease. Nutrients. 2020;12:334. https://doi.org/10.3390/nu12020334
39. Kant AK, Whitley MI, Graubard BI. Away from home meals: associations with biomarkers of chronic disease and dietary intake in American adults, NHANES 2005–2010. Int J Obes. 2015;39:820–827. https://doi.org/10.1038/ijo.2014.183
40. Crespo-Bellido MS, Grutzmacher SK, Takata Y, et al. The association between food-away-from-home frequency and a higher BMI varies by food security status in US adults. J Nutr. 2021;151:387–394. https://doi.org/10.1093/jn/nxaa364
41. Godbharle S, Jeyakumar A, Giri BR, et al. Pooled prevalence of food away from home (FAFH) and associated non-communicable disease (NCD) markers: a systematic review and meta-analysis. J Health Popul Nutr. 2022;41:55. https://doi.org/10.1186/s41043-022-00335-5
42. Todd JE, Mancino L, Lin B-H. The impact of food away from home on adult diet quality. USDA-ERS Economic Research Report No. 90. ; 2010. p. 24. Washington, DC: United States Dept. of Agriculture. https://doi.org/10.2139/ssrn.1557129

**Received: 9-09-2025 Accepted: 19-11-2025**