Factors associated with consumption of fruits and vegetables amongst adults in the Alfred Duma Local Municipality, Ladysmith

Thandi Xaba* and Siyabonga Dlamini

Discipline of Public Health Medicine, University of KwaZulu-Natal, Durban, South Africa
*Correspondence: thandi.madlala@kznhealth.gov.za

Introduction: Non-communicable diseases (NCDs) account for more than 63% of all deaths globally. Intake of fruits and vegetables is linked to a lower risk of NCDs.

Objectives: (a) to describe the socio-demographic, psychosocial, environmental and socio-economic profile of adults aged 18–64 years (study participants) in Alfred Duma Local Municipality (ADLM), (b) to assess the level of consumption of fruits and vegetables, and (c) to investigate association between socio-demographic, psychosocial, socio-economic factors and consumption of fruits and vegetables.

Methodology: An observational, analytical, cross-sectional study involving 164 households from six selected municipal wards in ADLM was conducted. A structured questionnaire using a combination of 24-hour recall method and food frequency was used to collect data (Appendix). Multivariate analysis was used to identify factors associated with consumption of 2–3 or more servings of vegetables daily and 2 or more servings of fruit daily. Binary logistic regression was used to measure the strength of the associations between daily consumption and other variables.

Results: Only 0.6% (n = 1) participants were found to be consuming an adequate amount of fruits and vegetables daily. Employment was associated with consumption of 2–3 daily servings of vegetables and two of fruits (OR 2.37; p-value 0.01 and OR 5.22; p-value < 0.001 for vegetables and fruits respectively). Local availability of vegetables was associated with consumption of vegetables (OR 2.35; p-value 0.014) but not fruits.

Conclusion: Improving local availability of vegetables and employment may improve consumption in this municipality and help prevent NCDs.

Summary: This study was conducted to assess consumption of fruits and vegetables in ADLM, and to identify factors associated with consumption. The study found that consumption of fruits and vegetables in ADLM is extremely poor. Local availability and employment were the main factors associated with consumption of fruits and vegetables. Supporting households in having vegetable gardens, and advocating for local vendors to sell fruits and vegetables on commute routes are key recommendations of this study.

Keywords: barriers, enablers of fruits and vegetables intake, factors associated with adequate consumption, fruits and vegetables

Introduction
Non-communicable diseases (NCDs) account for more than 63% of all deaths globally, making them the leading cause of mortality. An estimated 145 million deaths in 2008 were in the Southeast Asia region, with more than 34% of NCD-related deaths occurring in individuals younger than 60 years in the Arab world. It is projected that the cost to public health systems and world economies will exceed $30 trillion over the next 20 years due to the burden of NCDs.

It is estimated that, globally, 17.3 million people die from cardiovascular diseases (CVD) alone in 2008, with more than 80% of the global burden of CVD occurring in underdeveloped and developing countries. It is estimated that this figure may reach 23.6 million by the year 2030. Diabetes is a major NCD currently expected to affect more than 439 million adults globally by 2030.

Deaths due to NCDs increased by 68% in sub-Saharan Africa (SSA) between 1990 and 2013, where in Ethiopia the proportion of deaths due to NCDs increased by 73.7% during the same period. Mortality due to NCDs is approximately 5% greater in SSA than in the Southeast Asia region. The initial burden of diseases report for South Africa (SA) listed diabetes in the top 20 specific causes of premature deaths in 2000; these deaths accounted for 59 267 and 86 154 in males and females respectively. Stroke accounted for 318 083 (147 986 males and 170 097 females) deaths, which was approximately 46% greater than diabetes. A 38% prevalence of hypertension was reported in 2016 in the Dikgale rural area, which is situated in the Limpopo province of SA.

Consumption of fruits and vegetables is linked to lowering the risk of NCDs such as CVD, diabetes and some cancers, and has further been shown as one of the critical health behaviours that can help prevent mortality related to NCDs. An increased consumption of fruits and vegetables has been linked to reduced risk of coronary artery diseases (CAD), stroke and hypertension, and has a beneficial effect on blood lipid metabolism. Low or no consumption of fruits and vegetables results in avoidable expenses to the health system. Del Pozo and co-authors reported an increase in annual utilisation of health services by those who did not consume fruits and vegetables.

Fruits and vegetables contain micronutrients, antioxidants, phytochemical compounds and fibre, which enable them to play a protective role against major diseases including protection of lungs from oxidative damage caused by tobacco smoke.
Factors associated with consumption of fruits and vegetables

Daily intake of five servings of fruits and vegetables has been linked to psychosocial well-being, and reduced risk of diseases was demonstrated by Boehm and co-authors. Fruits and vegetables are linked to better health, when consumption is adequate. The global recommended (adequate) consumption is five servings (400 g) of both fruits and vegetables per day. In KwaZulu-Natal (KZN), one serving is described as one fruit or half a cup of cooked vegetables or one cup for uncooked vegetables such as salads. The benefits of high consumption of fruits and vegetables are widely documented, but levels of consumption are low across the globe. An average consumption of three servings per day was reported in a group of young adults from the United Kingdom (UK). The results of the South African National Health And Nutrition Examination Surveys (SANHANES) revealed an average consumption of two or fewer servings of fruits and vegetables per day in SA.

Factors that have been documented to have an influence on consumption of fruits and vegetables include age, gender, level of education, socio-economic status, cost, availability of and access to fruits and vegetables, knowledge of fruits and vegetables consumption, and taste. Current research indicates that consumption of fruits and vegetables remains low globally and, in SA, KZN is not immune to the global and national situation. The results of a study done in Marrianhill revealed that approximately 74% of the households did not consume fruits and approximately 45% did not consume vegetables everyday.

To the researchers’ knowledge this is the only study done in KZN. Certainly, no study has been done in the Alfred Duma Local Municipality (ADLM). Consumption levels and factors associated with consumption of fruits and vegetables in this area are not known.

The aim of the study was thus to determine the factors associated with consumption of fruits and vegetables amongst adults aged 18–64 years in ADLM, KZN. The specific objectives were, (a) to describe the socio-demographic, psychosocial, environmental and socio-economic profile of adults aged 18–64 years (study participants) in ADLM, (b) to assess the level of consumption of fruits and vegetables and, (c) to investigate association between socio-demographic, psychosocial, socio-economic factors and consumption of fruits and vegetables.

Methods

Study design and population

An observational, analytical, cross-sectional study was done in ADLM, which is mainly rural with some peri-urban and urban areas within Uthukela Magisterial District in KZN. The ADLM has 36 municipal wards, 22 health facilities (private and public), a population of 340 554 and 76 076 households.

Adult males and females aged 18–64 years of age, fluent in either English or IsiZulu, living within the geographical boundaries of ADLM between November 1, 2017 and May 30, 2018 were included. Males and females younger than 18 years or older than 64 years, visitors to the ADLM and those not able to converse in English or IsiZulu were excluded.

Sample size and selection

The numbers of all 36 municipal wards in ADLM were put into a container and six wards were randomly selected. A total of 164 households (with approximately 30 households from each selected ward) were systematically selected and visited. This was the sample size required to provide statistically significant results. The clinic was chosen as a starting point, the first household on the right-hand side of the clinic was selected, and thereafter every third household was selected until the boundary of the local municipality was reached. This was to detect a 30% difference in the consumption of fruits and vegetables between those consuming 2–3 or more servings of vegetables daily and those consuming less than two servings per day, and two or more servings of fruits and those consuming less than two servings. This was assuming a 10:1 ratio in the numbers of households (n1 = 149, consuming less than two servings of vegetables and less than two servings of fruits per day; n2 = 15, consuming 2–3 servings of vegetables and two or more servings of fruits), a power of 80% and probability of 95% (p-value < 0.05). One resident of the household between the ages of 18 and 64 years was selected to answer questions on behalf of the household. The data presented in this study are those of the household.

Data collection and tools

Data were collected using a structured questionnaire. A combination of a food frequency questionnaire (FFQ) and a 24-hour recall method was used to interview participants. This was deemed an appropriate combination for this study, and is widely used to assess food consumption at both individual and household level. The questionnaire contained food items (fruits and vegetables) that are locally available, acceptable, accessible and widely consumed in ADLM. One serving of fruit was described as one fruit; the actual mass (in grams) of the fruit was not considered since households often do not keep food scales. One serving of vegetables was described as half a cup of cooked vegetables or one cup of uncooked vegetables such as salads; again the actual mass (in grams) was not considered because of the absence of food scales and a household measure (cup) was used. Information on demographic and socio-economic characteristics of the participants was collected. Data were captured on Epi Info 7 (CDC, Atlanta, GA, USA), with each household allocated a unique household ID number. Data were exported to the Statistical Package for Social Sciences (SPSS) for analysis.

Data analysis

Data were analysed using SPSS version 25 (IBM Corp, Armonk, NY, USA). Descriptive statistics (means, standard deviations, frequencies) were used to summarise demographic and socio-economic data. Multivariate analysis was used to identify factors associated with the consumption of 2–3 servings of vegetables and two or more servings of fruit daily. Binary logistic regression was used to measure the strength of the associations between daily consumption and other variables (age, gender, employment, level of education, local availability of fruits and vegetables, and knowledge of fruits and vegetables). The results were adjusted to eliminate confounding. The level of significance was accepted as p-value < 0.05. This study was approved by the Biomedical Research Ethics Committee at the University of KwaZulu-Natal (BE468/17), KwaZulu-Natal Department of Health Research and Knowledge Management (HRKM369/17) and the Municipal Manager of ADLM. The completed questionnaires were stored in a lockable cupboard. Electronic data were kept in the primary researcher’s password-protected personal laptop.

Results

A total of 164 households participated in the study with a response rate of 100%. The mean age of the participants was 34 with the majority (45%) ranging between 35 and 62 years. More females (80%) participated in the study than males (20%). More than half (59%) of the participants were unemployed, with more than half (57%) having a household income less than R2000 per month. Only 0.6% (n = 1) participants were
found to be consuming adequate (five servings) fruits and vegetables daily.

The following three tables present the data relating to the characteristics of the study participants (Table 1), the results of the multivariate analysis of factors associated with vegetables consumption (Table 2) and fruits consumption (Table 3).

Demographic factors

**Age**

Participants aged 35–62 years (66%; n = 49) were found to be twice as likely to consume 2–3 servings of vegetables (OR 1.61; p-value 0.9) compared with those aged 25–34 years (54%; n = 32) (OR 0.98; p-value 0.5). This finding was, however, not statistically significant. The finding was similar for fruits: the same age group of 35–62 years who were twice as likely to consume two or more servings daily (OR 2.88; p-value 0.02), compared with those aged 25–34 years who were twice as likely to consume two or more servings of fruits daily (41%, n = 24) (OR 1.68; p-value 0.28).

**Gender**

Females were twice as likely to consume 2–3 servings of vegetables daily (66%; n = 81) (OR 1.52; p-value 0.7), compared with males who were less likely to consume 2–3 servings of vegetables daily (41%; n = 17). The female likelihood of taking 2–3 servings was, however, statistically insignificant. The finding was sustained for fruits: females were found to be six times more likely to consume two or more servings of fruits daily (49.6%; n = 65) (OR 5.99; p-value 0.002) than males, who again had no likelihood of taking fruits, and this remained statistically significant even after adjusting for confounding variables. The disparities between proportions of females and males should be noted, as it was only 20% of males versus 80% of females who participated in the study.

**Socio-economic factors**

**Employment**

The majority of the households fell within the lowest income category. It was found that 57% (n = 93) were in the category R0–R2 000, whereas 19% (n = 31) were in R2 001–R5 000 category, 11% (n = 18) were in the R5 001–R7 000 category, 9% (n = 14) were in the R7 001–R10 000 category, lastly 5% (n = 8) had a household income of > R10 000. Employed participants (72%; n = 48) were twice as likely to consume 2–3 servings of vegetables daily as the unemployed (unadjusted OR 2.37, p-value 0.01); after adjustment the OR dropped to 2.12 and p-value to 0.053. Participants with household income of more than R2 000 were likely to consume 2–3 servings of vegetables daily (OR1.45; p-value 0.25). The association between being employed and consuming 2–3 servings of vegetables was, however, not statistically significant.

Being employed was associated with consuming two or more fruits daily and this association was statistically significant (OR 5.22, p-value 0.001). In the category with a household income of more than R2 000 per month, 55% (n = 39) of participants reported consuming two or more fruits per day compared with 37% (n = 34) of those with household income of R2 000 or less who reported consuming two or more fruits per day.

**Level of education**

Participants with more than 10 years of schooling (66%; n = 82) were twice as likely to consume 2–3 servings of vegetables daily (unadjusted OR 2.74; p-value 0.007, adjusted OR 1.97; p-value 0.11). This association was statistically insignificant after adjusting for possible confounding variables. Similarly, participants with more than 10 years of education were three times more likely to consume two or more servings of fruits daily compared with those with less than 10 years of schooling (OR 2.51; p-value 0.021); this association was statistically significant. This may suggest that people with more than 10 years of schooling possibly prefer fruits to vegetables.

**Environmental factors**

**Local availability of fruits and vegetables**

Households with vegetable gardens were more than three times likely to consume 2–3 servings of vegetables daily (OR 3.38; p-value 0.002) compared with those with no vegetable garden. The association between having a vegetable garden and consuming 2–3 servings of vegetables was statistically significant. Participants who bought vegetables locally were twice as likely to consume 2–3 servings of vegetables per day (OR 2.35; p-value 0.014) compared with those who bought from town. This association was also statistically significant. This was confirmed by the fact that 78% (n = 40) of participants who got their vegetables within walking distance were three times more likely to consume 2–3 servings of vegetables per day (OR 3.34; p-value 0.004), compared with 51% (n = 58) of those who had to travel by bus or car to get their vegetables.

Participants with household fruit trees were five times more likely to consume two or more servings of fruits daily (OR 4.69; p-value 0.001) compared with those with no fruit trees. This association was statistically significant. However, 49% (n = 48) of participants who bought their fruits from town consumed two or more servings of fruits daily, compared with 38% (n = 25) of those who bought their fruits locally. Fewer households (52%; n = 86) had fruit trees, compared with those (67%; n = 109) with vegetable gardens.

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**Table 1:** Characteristics of study participants residing in ADLM, 2018 (n = 164)

| Characteristics | n (%) |
|-----------------|-------|
| Mean age (standard deviation) | 34 (10.6) |
| Age | |
| < 25 | 31 (19) |
| 25–34 | 59 (36) |
| 35–62 | 74 (45) |
| Gender | |
| Male | 33 (20) |
| Female | 131 (80) |
| Employment status | |
| Employed | 67 (41) |
| Unemployed | 97 (59) |
| Income category | |
| < R2 000 | 93 (57) |
| > R2 000 | 71 (43) |
| Level of education | |
| 0–Grade 10 | 39 (24) |
| Beyond grade 10 | 125 (76) |
| Vegetable garden | |
| Yes | 109 (66.5) |
| No | 55 (33.5) |
| Fruit tree | |
| Yes | 86 (52.4) |
| No | 78 (47.6) |
Participants who spent R206 or more (per month) on vegetables (57%; \( n = 33 \)) consumed 2–3 servings daily. However, those who spent less than R206 (61%; \( n = 65 \)) consumed 2–3 servings. Similarly, 67% (\( n = 75 \)) who had a household vegetable garden consumed 2–3 servings per day. This suggests that households with a vegetable garden (local availability) spend less money purchasing but they can consume close to the recommended amount of three servings of vegetables. The picture is, however, slightly different for fruits, as 78% (\( n = 38 \)) of those who spent > R80 (per month) on fruits had two or more servings per day, whereas 30% (\( n = 35 \)) of those who spent < R80 on fruits had two or more servings daily. Those who consumed close to the recommended servings of fruits spent more, as fruits are not always available locally. Likewise, those who bought their fruits from town consumed two or more servings of fruits daily.

Knowledge of fruits and vegetables

More participants (70%; \( n = 57 \)) with poor knowledge of vegetables (size of a single serving and number of recommended servings per day) consumed 2–3 servings of vegetables daily, compared with 49% (\( n = 41 \)) of those with good knowledge who took 2–3 servings. This suggested that having good knowledge of vegetables does not necessarily translate into improved consumption. The findings were similar for fruits, as 57% (\( n = 46 \)) of participants with poor knowledge of fruits took two or more servings daily, compared with 33% (\( n = 27 \)) of those with good knowledge who consumed two or more servings.

Level of fruits and vegetables consumption in the ADLM

It was found that only 0.6% (\( n = 1 \)) consumed adequate fruits and vegetables. Most participants (83%; \( n = 136 \)) had consumed fruits the day before they were interviewed, and 92% (\( n = 151 \)) had consumed vegetables the day before the interview. The consumption was, however, not maintained on a daily basis as 30% (\( n = 49 \)) of the participants reported consuming fruits daily and 35% (\( n = 58 \)) reported consuming vegetables daily. Most (43%; \( n = 71 \)) were consuming fruits on between one and three days per week, and 37% (\( n = 60 \))

| Variable                  | < 2 servings | 2–3 servings | Unadjusted  | Adjusted     |
|---------------------------|--------------|--------------|-------------|--------------|
| Age (years):              |              |              |             |              |
| < 25                      | 14           | 45.2         | 17          | 54.8         | 31           | 1            |              |
| 25–34                     | 27           | 45.8         | 32          | 54.2         | 59           | 0.98         | 0.4–2.3      | 0.9 Out      |
| 35–62                     | 25           | 33.8         | 49          | 66.2         | 74           | 1.61         | 0.78–3.8     | 0.3 Out      |
| Gender:                   |              |              |             |              |
| Male                      | 16           | 48.5         | 17          | 41.0         | 33           | 1            |              |
| Female                    | 50           | 38.2         | 81          | 65.6         | 131          | 1.52         | 0.7–3.3      | 0.3 Out      |
| Education:                |              |              |             |              |
| 0–grade10                 | 23           | 59.0         | 16          | 41           | 39           | 1            |              |
| Beyond grade 10           | 43           | 34.4         | 82          | 65.6         | 125          | 2.74         | 1.3–5.7      | 0.007 1.97   |
| Employment:               |              |              |             |              |
| Unemployed                | 47           | 48.5         | 50          | 51.5         | 97           | 1            |              |
| Employed                  | 19           | 28.4         | 48          | 71.6         | 67           | 2.37         | 1.2–4.6      | 0.01 2.12    |
| Income category:          |              |              |             |              |
| < R2 000                  | 41           | 44.1         | 52          | 55.9         | 93           | 1            |              |
| > R2 000                  | 25           | 35.2         | 46          | 64.8         | 71           | 1.45         | 0.8–2.7      | 0.25 2.12    |
| Frequency:                |              |              |             |              |
| 1–3 days/week             | 41           | 50           | 41          | 50           | 82           | 1            |              |
| 4–7 days/week             | 25           | 30.5         | 57          | 69.5         | 82           | 2.28         | 1.2–4.3      | 0.01 2.02    |
| Vegetable garden:         |              |              |             |              |
| No                        | 32           | 58.2         | 23          | 41.8         | 55           | 1            |              |
| Yes                       | 34           | 31.2         | 75          | 68.8         | 109          | 3.07         | 0.16–6.0     | 0.001 3.38   |
| Purchased in:             |              |              |             |              |
| Town                      | 49           | 47.6         | 54          | 52.4         | 103          | 1            |              |
| Locally                   | 17           | 27.9         | 44          | 72.1         | 61           | 2.35         | 1.2–4.6      | 0.014 Out    |
| Distance:                 |              |              |             |              |
| > 7 km (car)              | 55           | 48.7         | 58          | 51.3         | 113          | 1            |              |
| < 7 km (walk)             | 11           | 21.6         | 40          | 78.4         | 51           | 3.45         | 1.6–7.4      | 0.001 3.34   |
| Spent on vegetables:      |              |              |             |              |
| < R206                    | 41           | 38.7         | 65          | 61.3         | 106          | 1            |              |
| > R206                    | 25           | 43.1         | 33          | 56.9         | 58           | 0.83         | 0.4–1.6      | 0.581 0.83   |
| Knowledge:                |              |              |             |              |
| Poor (0–2)                | 24           | 29.6         | 57          | 70.4         | 81           | 1            |              |
| Good (3–5)                | 42           | 50.6         | 41          | 49.4         | 83           | 0.41         | 0.2–0.8      | 0.007 Out    |

Adjusted and unadjusted odds ratios (OR).
Table 3: Multivariate analysis of factors associated with fruit intake in ADLM, 2018 (n = 164)

| Variable                  | < 1 serving | 2 servings | Unadjusted | Adjusted |
|---------------------------|-------------|------------|------------|----------|
|                           | n    | %  | n    | %  | Total | OR  | 95% CI | p-value | OR  | 95% CI | p-value |
| Age (years):              |     |    |     |    |       |     |        |         |     |        |         |
| < 25                      | 22   | 71.0 | 9   | 29.0 | 31 | 1.68 | 0.7–4.3 | 0.28  | 0.2 |          |         |
| 25–34                     | 35   | 59.3 | 24  | 40.7 | 59 | 1.68 | 0.7–4.3 | 0.28  | 0.2 |          |         |
| 35–62                     | 34   | 45.9 | 40  | 54.1 | 74 | 2.88 | 1.2–7.1 | 0.02  | 0.2 |          |         |
| Gender:                   |     |    |     |    |       |     |        |         |     |        |         |
| Male                      | 25   | 75.8 | 8   | 24.2 | 33 | 1 |         |         |     |        |         |
| Female                    | 66   | 50.4 | 65  | 49.6 | 131 | 3.08 | 1.3–7.3 | 0.01  | 5.99 | 1.9–19 | 0.002  |
| Education:                |     |    |     |    |       |     |        |         |     |        |         |
| 0–grade10                 | 28   | 71.8 | 11  | 28.2 | 39 | 1 |         |         |     |        |         |
| Beyond grade 10           | 63   | 50.4 | 62  | 49.6 | 125 | 2.51 | 1.1–5.5 | 0.021 |     |        |         |
| Employment:               |     |    |     |    |       |     |        |         |     |        |         |
| Unemployed                | 65   | 67.0 | 32  | 33   | 97 | 1 |         |         |     |        |         |
| Employed                  | 26   | 38.8 | 41  | 61.2 | 67 | 3.20 | 1.7–6.1 | < 0.001 | 5.22 | 2.1–12.8 | < 0.001 |
| Income category:          |     |    |     |    |       |     |        |         |     |        |         |
| < R2 000                  | 59   | 63.4 | 34  | 36.6 | 93 | 1 |         |         |     |        |         |
| > R2 000                  | 32   | 45.1 | 39  | 54.9 | 71 | 2.11 | 1.1–4.0 | 0.02  |     |        |         |
| Frequency:                |     |    |     |    |       |     |        |         |     |        |         |
| 1–3 days/week             | 78   | 75.7 | 25  | 24.3 | 103 | 1 |         |         |     |        |         |
| 4–7 days/week             | 13   | 21.3 | 48  | 78.7 | 61 | 11.52 | 5.4–24.6 | < 0.001 |     |        |         |
| Fruit tree:               |     |    |     |    |       |     |        |         |     |        |         |
| No                        | 50   | 64.1 | 28  | 35.9 | 78 | 1 |         |         |     |        |         |
| Yes                       | 41   | 47.7 | 45  | 52.3 | 86 | 1.96 | 1.0–3.7 | 0.035 | 4.69 | 1.9–11.4 | 0.001  |
| Purchased in:             |     |    |     |    |       |     |        |         |     |        |         |
| Town                      | 50   | 51.0 | 48  | 49.0 | 98 | 1 |         |         |     |        |         |
| Locally                   | 41   | 62.1 | 25  | 37.9 | 66 | 0.64 | 0.3–1.2 | 0.16  |     |        |         |
| Distance:                 |     |    |     |    |       |     |        |         |     |        |         |
| > 7 km (car)              | 59   | 52.7 | 53  | 47.3 | 112 | 1 |         |         |     |        |         |
| < 7 km (walk)             | 32   | 61.5 | 20  | 38.5 | 52 | 0.7 | 0.4–1.4 | 0.29  |     |        |         |
| Spent on fruits:          |     |    |     |    |       |     |        |         |     |        |         |
| < R80                     | 80   | 69.6 | 35  | 30.4 | 115 | 1 |         |         |     |        |         |
| > R80                     | 11   | 22.4 | 38  | 77.6 | 49 | 7.90 | 3.6–17.2 | < 0.001 | 13.27 | 4.8–36.7 | < 0.001 |
| Knowledge:                |     |    |     |    |       |     |        |         |     |        |         |
| Poor (0–2)                | 35   | 43.2 | 46  | 56.8 | 81 | 1 |         |         |     |        |         |
| Good (3–5)                | 56   | 67.5 | 27  | 32.5 | 83 | 0.37 | 0.2–0.7 | 0.002 | 0.3 | 0.1–0.7 | 0.004  |

Discussion

This discussion will compare and contrast the results of the ADLM study with studies of the same nature conducted elsewhere in SA and in other countries.

This study found that older people had better intake levels of both fruits and vegetables; this is consistent with two other studies done in Portugal and Canada. The researcher could not find local studies presenting similar results. A qualitative approach to understanding the reasons behind the daily consumption of fruits and vegetables can help in identifying potential barriers and facilitating strategies to improve intake.

Table 4: Constraints on not taking fruits daily in ADLM study participants, 2018 (n = 164). The remaining 29.8% were participants whose response was not applicable since they had reported eating fruits daily, constraints were not applicable.

| Constraint                  | Number | Percentage |
|-----------------------------|--------|------------|
| Cost                        | 69     | 42.1       |
| Availability                | 32     | 19.5       |
| Accessibility               | 8      | 4.9        |
| Personal preference (taste)  | 6      | 3.7        |

Table 5: Constraints on not taking vegetables daily in ADLM study participants, 2018 (n = 164). The remaining 34.9% were participants whose response was not applicable since they had reported eating vegetables daily, constraints were not applicable.

| Constraint                  | Number | Percentage |
|-----------------------------|--------|------------|
| Cost                        | 56     | 34.1       |
| Availability                | 25     | 15.2       |
| Accessibility               | 11     | 6.7        |
| Personal preference (taste)  | 15     | 9.1        |
study done on 31 adolescent girls and boys in Iran reported that vegetables were perceived by this group as ‘tasteless’, which affected consumption.26 This may suggest that younger people consume fewer fruits and vegetables, and they may be missing the protective effect against various NCDs that they could develop when they age.

The results of the current study revealed that females consume more fruits and vegetables than males, which is consistent with the results of five other studies done in Canada, Sweden, France, the USA and Finland. They all revealed that women had better consumption levels of fruits and vegetables than men.25,27–29 Women are generally responsible for meal planning and preparation rather than men, which could give them an advantage of consuming more fruits and vegetables than men.

This study revealed that being employed was associated with consumption of 2–3 servings of vegetables, but this association was not statistically significant. Association between being employed and consumption of two or more servings of fruits was, however, found to be statistically significant. Households with income of more than R2 000 per month were more likely to consume 2–3 servings of vegetables, and two or more servings of fruits daily than those with income of less than R2 000. This is consistent with the results of the study by Lallukka and co-authors, which investigated the association of income with fruit and vegetable consumption at different levels of education. The study reported that higher income resulted in higher consumption of fruits and vegetables.28 Another study by Herman and co-authors studied the effect of targeted subsidy on intake of fruits and vegetables among low income women. The study showed correlation between low income and low intake of fruits and vegetables.29 Jones and Charlton analysed cost and availability of achieving recommended intakes of fruits and vegetables in Vanuatu: the study reported that poor households were unable to consume the recommended amount of fruits and vegetables.30 This is consistent with the finding that households with a monthly income of less than R2 000 were not able to consume 2–3 servings of vegetables and 2 or more servings of fruit daily. The study by Buscail and co-authors investigated the impact of fruit and vegetable consumption in rural community stores. They found that poor availability of fruits and vegetables is not associated with intake of either 2 or more servings of fruit or vegetables.31 This suggests that local availability of vegetables may promote intake of the recommended servings of vegetables. Households may also need to be supported to initiate sustainable household and local vegetable production.

This study found that having good knowledge of fruits and vegetables is not associated with intake of either 2–3 servings of vegetables or 2 or more servings of fruit. This is in contrast with the results of the two studies done in Iran and Romania, which found that knowledge of fruits and vegetables was a significant factor influencing intake of fruits and vegetables and that knowledge was positively associated with intake of fruits and vegetables.32,33 This finding suggests that community members in ADLM have basic knowledge concerning fruits and vegetables, yet they do not consume them. The contributing constraints are discussed in the section on levels of fruit and vegetable consumption.

This study revealed that people with more than 10 years of education were more likely to consume 2–3 servings of vegetables than those with less than 10 years of education. This finding was, however, not statistically significant, but the association between having more than 10 years of education and consuming two or more servings of fruits was statistically significant. There have not been many studies directly and independently correlating level of education and intake of fruits and vegetables. However, the study by Oliveira and co-authors reported that people with more than 12 years of education have a 50% lower probability of poor intake of fruits and vegetables compared with those who have less than five years of education.24 The results of this study suggest that those with more than 10 years of education prefer to eat fruits over vegetables. The study did not explore the possible reasons for this, but the study — conducted in adolescent boys and girls from Iran — reported that they preferred fruits over vegetables because of their sweet taste compared with vegetables, which were perceived as ‘tasteless’.26 In the current study, only 4% (n = 6) reported that they did not consume fruits daily because of personal preference, referring to the taste. Slightly more participants (9%; n = 15) reported that they did not eat vegetables daily because of their taste. This suggests that more people dislike the taste of vegetables.

The fact that households which consumed two or more servings of fruits and vegetables bought them from town indicates poor local availability of fruits; as indicated in the results section, fewer households had fruit trees. Improving local availability could therefore help improve consumption.

The results of the study further revealed that households were consuming vegetables slightly more than fruits on a daily basis, which may be linked to the finding that more households had vegetable gardens than fruit trees. These findings are consistent with those of the Marrianhill study by Faber and co-authors, which revealed that 55% (n = 222) of the households were consuming vegetables daily, whereas only 26% (n = 103) were consuming fruits daily. This indicated that households in this area were consuming more vegetables than fruits daily.22 Vegetables are often consumed in these households. However, the recommended amount of three servings daily is often not met, and cost and availability were the two main constraints cited by the households as their hindrance to either consuming vegetables daily or consuming the recommended number of servings. Seasonal availability of both fruits and vegetables was not mentioned by the households as a barrier to consuming them. The study was conducted between October and May when summer and autumn fruits and vegetables are available.

The participants of this study had good knowledge of fruits and vegetables. However, they were not consuming the
recommended servings despite knowing the benefits. The two constraints (cost and availability) need to be addressed at a population level to enable communities to put the knowledge of fruits and vegetables into practice.

**Limitations**

The study used a combination of 24-hour recall and FFQ method as a basis for data collection because it was deemed appropriate for this study. However, participants’ intake may have been limited to just one day. To avoid this, participants were asked how often they consumed fruits and vegetables ranging from daily, to 1–3 days per week, 4–7 days per week or less than 1 day per week. Using the 24-hour recall may also distort data on intake as participants may have consumed fruits and vegetables the previous day but not have been able to sustain this. Participants may have underestimated the quantities of vegetables they consumed since they were not asked to measure prior to the interview. They may also have under- or over-reported their quantities for their responses to be socially acceptable to the interviewer social desirability bias). The study results cannot be generalised for the KZN province due to small sample size.

**Conclusion**

This study uncovered that consumption of fruits and vegetables in ADLM is extremely inadequate, with only 0.6% (1 out of 164) participants taking the recommended five daily servings of fruits and vegetables. This may suggest that majority of the ADLM population could possibly be missing out on the protective effects of fruits and vegetables and may not be immune to the risks of the currently prevailing NCDs. Various factors were identified as associated with intake of at least 2–3 servings of vegetables daily and two or more servings of fruits daily. These factors included age, gender, employment, household income of more than R2 000, having more than 10 years of education and local availability of fruits and vegetables. Knowledge of fruits and vegetables was found not to be associated with intake of fruits and vegetables. Fruits and vegetables may be in and out of season; in this study seasonal availability of both fruits and vegetables was not reported as a factor preventing their consumption.

This study concludes that the extreme lack of adequate intake of fruits and vegetables in ADLM requires attention, addressing the constraints identified (cost and availability), and enhancing the identified enablers is recommended. Fruits and vegetables need to be made available locally; advocating for and supporting local fruits and vegetables retailers needs to be explored. The results of this study suggest that fruits and vegetables may need to be made affordable for poor households with household income of less than R2 000. Policy-makers (government, the Department of Agriculture leading the process) may make redeemable vouchers available (only redeemable for fruits and vegetables), which these households can redeem at their local supermarkets and/or farm stalls. These commodities may also be subsidised by the government so that residents purchase them at reduced retail/supermarket prices. This study provides further support for public health recommendations and interventions to increase fruit and vegetable intake.

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**References**

1. Mishra S, Neupane D, Shaky A, et al. Modifiable risk factors for major non-communicable diseases among medical students in Nepal. J Community Health. 2015;40(5):863–8.
2. Rahim HFA, Sibai A, Khader Y, et al. Non-communicable diseases in the Arab world. Lancet. 2014;383(9914):356–67.
3. Reininger BM, Jing W, Fisher-Hoch SP, et al. Non-communicable diseases and preventive health behaviors: a comparison of Hispanics nationally and those living along the US-Mexico border. BMC Public Health. 2015;15(1):1–7.
4. Nikolić M, Nikić D, Petrovic B. Fruit and vegetable intake and the risk for developing coronary heart disease. Cent Eur J Public Health. 2008;16(1):17–20.
5. Ghazali SM, Seman Z, Kee Chee C, et al. Sociodemographic factors associated with multiple cardiovascular risk factors among Malaysian adults. BMC Public Health. 2015;15(1):1105–23.
6. Cooper AJ, Sharp SJ, Lentjes MAH, et al. A prospective study of the association between quantity and variety of fruit and vegetable intake and incident type 2 diabetes. Diabetes Care. 2012;35(6):1293.
7. Melaku YA, Temesgen AM, Deribew A, et al. The impact of dietary risk factors on the burden of non-communicable diseases in Ethiopia: findings from the global burden of disease study 2013. Int J Behav Nutr Phys Act. 2016;13:1–13.
8. Bradshaw D, Groenewald P, Laubscher R, et al. Initial burden of disease estimates for South Africa, 2000. S Afr Med J. 2003;93(9):682–8.
9. Maimela E, Alberts M, Modjadji SEP, et al. The prevalence and determinants of chronic non-communicable disease risk factors amongst adults in the Dikgale health demographic and surveillance system (HDSS) Site, Limpopo Province of South Africa. PLoS One. 2016;11(2):1–18.
10. Todea DA, Rosca LE, Coman AC, et al. Benefits of the Mediterranean diet in the prevention of non-communicable diseases as the epidermic of the 21st century. Not Bot Horti Agrobot Cluj-Napoca. 2013;41(1):21–5.
11. Izumi A, Hiroko I, Yukiko S, et al. Compared with the intake of commercial vegetable juice, the intake of fresh fruit and komatsuna (Brassica rapa L. var. perviridis) juice mixture reduces serum cholesterol in middle-aged men: a randomized controlled pilot study. Lipids Health Dis. 2014;13(1):1–15.
12. Del Pozo Rubio R, Moya-Martinez P, Escobado-Sotos F, et al. [Costs of health services associated with fruit and vegetable consumption habits]. Nutr Hosp. 2018;35(4):520–7.
13. Guillaumie L, Godin G, Vézina-Im L-A. Psychosocial determinants of fruit and vegetable intake in adult population: a systematic review. Int J Behav Nutr Phys Act. 2010;7:1–12.
14. Kaluza J, Harris HR, Linden A, et al. Long-term consumption of fruits and vegetables and risk of chronic obstructive pulmonary disease: a prospective cohort study of women. Int J Epidemiol. 2018.
15. Boehm JK, Soo J, Zevon ES, et al. Longitudinal associations between psychological well-being and the consumption of fruits and vegetables. Health Psychol. 2018;37(10):959–67.
16. Carter P, Gray LJ, Talbot D, et al. Fruit and vegetable intake and the association with glucose parameters: a cross-sectional analysis of the Let’s Prevent Diabetes Study. Eur J Clin Nutr. 2013;67(1):12–7.
17. Mohammadifard N, Omidvar N, Houshiarrad A, et al. Validity and reproducibility of a food frequency questionnaire for assessment of fruit and vegetable intake in Iranian adults*. J Res Med Sci. 2011;16(10):1286–97.
18. Luszczynska A, Cieslak R. Mediated effects of social support for healthy nutrition: fruit and vegetable intake across 8 Months after myocardial infarction. Behav Med. 2009;35(1):30–8.
19. Evans R, Kawabata M, Nikić D, Petrović B. Fruit and vegetable intake and the risk of developing type 2 diabetes. Br J Health Psychol. 2015;20(3):534–48.
20. Ronquest-Ross L-C, Vink N, Sigge GO. Food consumption changes in South Africa since 1994. S Afr J Sci. 2015;111(9–10):1–12.
21. Ekesa BN, Walingo MK, Abukutsa-Onyango MO. Accessibility to and consumption of indigenous vegetables and fruits by rural households in Matungu division, Western Kenya. Afr J Food Agric Nutr Dev. 2009;9(8):1725–38.
22. Faber M, Laubscher R, Laurie S. Availability of, access to and consumption of fruits and vegetables in a peri-urban area in KwaZulu-Natal, South Africa. Matern Child Nutr. 2013;9(3):409–24.

23. District UH. District Health Plan. 2015.

24. Oliveira A, Maia B, Lopes C. Determinants of inadequate fruit and vegetable consumption amongst Portuguese adults. J Hum Nutr Diet. 2014;19:1–10.

25. Dehghan M, Akhtar-Danesh N, Merchant AT. Factors associated with fruit and vegetable consumption among adults. J Hum Nutr Diet. 2011;24(2):128–34.

26. Rahkshanderou S, Rameanzhani A, Mehrabi Y, et al. Determinants of fruit and vegetable consumption among Tehranian adolescents: a qualitative research. J Res Med Sci. 2014;19(6):482–9.

27. Tameka SL, Agurs-Collins T, Dodd KW, et al. US and France adult fruit and vegetable consumption patterns: an international comparison. Eur J Clin Nutr. 2009;63(1):11–7.

28. Laukka T, Pihlaniemi J, Rahkonen O, et al. The association of income with fresh fruit and vegetable consumption at different levels of education. Eur J Clin Nutr. 2010;64(3):324–7.

29. Simunaniemi A-M, Andersson A, Nydahl M. Fruit and vegetable consumption close to recommendations. A partly web-based nationwide dietary survey in Swedish adults. Food Nutr Res. 2009;53:1–9.

30. Herman DR, Harrison GG, Affi AA, et al. Effect of a targeted subsidy on intake of fruits and vegetables among low-income women in the special supplemental nutrition program for women, infants, and children. Am J Public Health. 2008;98(1):98–105.

31. Jones HA, Charlton KE. A cross-sectional analysis of the cost and affordability of achieving recommended intakes of non-starchy fruits and vegetables in the capital of Vanuatu. BMC Public Health. 2015;15(1):1–10.

32. Buscail C, Margat A, Petit S, et al. Fruits and vegetables at home (FLAM): a randomized controlled trial of the impact of fruits and vegetables vouchers in children from low-income families in an urban district of France. BMC Public Health. 2018;18(1):1065.

33. Betty AL. Using financial incentives to increase fruit and vegetable consumption in the UK. Nutr Bull. 2013;38(4):414–20.

34. Gardiner B, Blake M, Harris R, et al. Can small stores have a big impact? A qualitative evaluation of a store fruit and vegetable initiative. Health Promot J Austr. 2013;24(3):192–8.

35. Salehi L, Eftekhar H, Mohammad K, et al. Consumption of fruit and vegetables among elderly people: a cross sectional study from Iran. Nutr J. 2010;9:1–9.

36. Lotrean LM, Tutui I. Individual and familial factors associated with fruit and vegetable intake among 11- to 14-year-old Romanian school children. Health Soc Care Community. 2015;23(5):541–9.

37. Krumpal I. Determinants of social desirability bias in sensitive surveys: a literature review. Qual Quant. 2013;47(4):2025–47.

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Appendix A. Extraction tool for data collection
University of KwaZulu-Natal

Master of Public Health programme

Food Frequency Questionnaire to measure consumption of fruits and vegetables in adult residents of Alfred Duma local municipality in KZN.

You are kindly requested to take 60 minutes of your time to answer the following questions; please answer to the best of your knowledge.

Demographic and socio-economic information

| Household ID | Age (years) | Gender | Female | Male |
|--------------|-------------|--------|--------|------|
| Level of education | Never been to school | Grade 1–5 | Grade 6–10 | Grade 11–12 | College/University |
| Employment | Employed | Self-employed | Unemployed |
| Primary source of household income | Salary | Wage | Social grant | Child support grant | Unemployment insurance | None |
| Are you involved in either purchase or preparation of fruits and vegetables or both in this household? | Purchase | Preparation | Both |
The following questions are about your fruit and vegetable consumption in the past 24 hours

**Part A: Fruit consumption**

1. How often did you consume the following fruits in the past week?

| Fruit     | Frequency |
|-----------|-----------|
| Apples    | Daily     |
| Avocado   | Daily     |
| Banana    | Daily     |
| Granadilla| Daily     |
| Grapes    | Daily     |
| Mango     | Daily     |
| Naartjies | Daily     |
| Nectarines| Daily     |
| Oranges   | Daily     |
| Paw paw   | Daily     |
| Peaches   | Daily     |
| Pears     | Daily     |
| Pineapple | Daily     |
| Plums     | Daily     |

2. On the days when you ate fruits, how many did you eat per day?

| Quantity |
|----------|
| 2 or more|
| 1        |
| None     |

3. Are there any constraints that make you unable to eat fruits every day?

| Constraint   |
|--------------|
| Cost         |
| Availability |
| Accessibility|
| Personal preference |

4. Is there a fruit tree in this household?

| Response |
|----------|
| Yes      |
| No       |

5. If yes, which fruit tree is available?

| Fruit     |
|-----------|
| Apples    |
| Avocado   |
| Banana    |
| Granadilla|
| Grapes    |
| Mango     |
| Naartjies |
| Nectarines|
| Oranges   |
| Paw paw   |
| Peaches   |
| Pears     |
| Pineapple |
| Plums     |
Part B: Vegetable consumption

1. How often did you consume the following vegetables in the past 24 hours?

| Vegetable     | Frequency       | 4–6 days/week | 1–3 days/week | < 1 day/week | Never |
|---------------|----------------|---------------|---------------|--------------|-------|
| Beetroot      | Daily          | 4–6 days/week | 1–3 days/week | < 1 day/week | Never |
| Broccoli      | Daily          | 4–6 days/week | 1–3 days/week | < 1 day/week | Never |
| Cabbage       | Daily          | 4–6 days/week | 1–3 days/week | < 1 day/week | Never |
| Carrots       | Daily          | 4–6 days/week | 1–3 days/week | < 1 day/week | Never |
| Cauliflower   | Daily          | 4–6 days/week | 1–3 days/week | < 1 day/week | Never |
| Cucumber      | Daily          | 4–6 days/week | 1–3 days/week | < 1 day/week | Never |
| Green beans   | Daily          | 4–6 days/week | 1–3 days/week | < 1 day/week | Never |
| Imifino       | Daily          | 4–6 days/week | 1–3 days/week | < 1 day/week | Never |
| Imbuya        | Daily          | 4–6 days/week | 1–3 days/week | < 1 day/week | Never |
| Green salad   | Daily          | 4–6 days/week | 1–3 days/week | < 1 day/week | Never |
| Mixed vegetables | Daily     | 4–6 days/week | 1–3 days/week | < 1 day/week | Never |
| Onion         | Daily          | 4–6 days/week | 1–3 days/week | < 1 day/week | Never |
| Peas          | Daily          | 4–6 days/week | 1–3 days/week | < 1 day/week | Never |
| Pepper (Yellow/Green/Red) | Daily | 4–6 days/week | 1–3 days/week | < 1 day/week | Never |
| Spinach       | Daily          | 4–6 days/week | 1–3 days/week | < 1 day/week | Never |
| Tomatoes      | Daily          | 4–6 days/week | 1–3 days/week | < 1 day/week | Never |

2. On the days when you ate vegetables, how much did you eat per day?

| Vegetable     | Quantity Per Day | ½ cup or more | < ½ cup |
|---------------|------------------|---------------|---------|
| Beetroot      |                  | ½ cup or more | < ½ cup |
| Broccoli      |                  | ½ cup or more | < ½ cup |
| Cabbage       |                  | 1 cup         | < 1 cup |
| Carrots       |                  | ½ cup or more | < ½ cup |
| Cauliflower   |                  | ½ cup or more | < ½ cup |
| Cucumber      |                  | ½ cup or more | < ½ cup |
| Green beans   |                  | ½ cup or more | < ½ cup |
| Imifino       |                  | 1 cup or more | < 1 cup |
| Imbuya        |                  | 1 cup or more | < 1 cup |
| Lettuce       |                  | 1 cup or more | < 1 cup |
| Mixed vegetables |                | ½ cup or more | < ½ cup |
| Onion         |                  | ½ cup or more | < ½ cup |
| Peas          |                  | ½ cup or more | < ½ cup |
| Pepper (Yellow/Green/Red) |          | ½ cup or more | < ½ cup |
| Spinach       |                  | 1 cup or more | < 1 cup |
| Tomatoes      |                  | ½ cup or more | < ½ cup |

3. On the days, when you ate vegetables, how many servings did you eat in a day?

| Servings      | |
|---------------|-----|
| 3 or more     |    |
| 2             |    |
| 1             |    |
| None          |    |

4. Are there any constraints that make you unable to eat vegetables every day?

| Constraint   | |
|--------------|-----|
| Cost         |    |
| Availability |    |
| Accessibility|    |
| Personal preference | |
5. Is there a vegetable garden in this household?

| Yes | No |

6. If yes, which vegetables are grown?

| Beetroot | Broccoli | Cabbage | Carrots | Cauliflower | Cucumber | Green beans | Imfino | Imbuya | Lettuce | Mixed vegetables | Onion | Peas | Pepper (Yellow/Green/Red) | Spinach | Tomatoes |
|----------|----------|---------|---------|------------|----------|------------|--------|--------|---------|----------------|--------|------|------------------------|---------|----------|

**Part C: Knowledge of fruit and vegetable consumption**

1. What do you think is the size of a single serving of fruits?

| 1 fruit | 2 fruits | 3 fruits |

2. What do you think is the size of a single serving of vegetables?

| 1 cup | ½ cup | < 1 cup | < ½ cup | Not sure |

3. How many servings of both fruits and vegetables must be eaten on a daily basis?

| 1 serving | 2 servings | 3 servings | 4 servings | 5 servings | 6 servings | 7 servings |

4. Do you think eating fruits and vegetables is beneficial to you?

| Yes | No |
5. If yes, what do you think are the benefits?

| Add colour to the plate |
|-------------------------|
| Add taste to the food   |
| Help prevent diseases   |
| Make food attractive    |

Thank you very much for taking your time to answer my questions.