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RESEARCH

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

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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.[1] An estimated 14.5 million deaths in 2008 were in the Southeast Asia region,[1] with more than 34% of NCD-related deaths occurring in individuals younger than 60 years in the Arab world.[2] 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.[3]

It is estimated that, globally, 17.3 million people died from cardiovascular diseases (CVD) alone in 2008, with more than 80% of the global burden of CVD occurring in underdeveloped and developing countries.[4] It is estimated that this figure may reach 23.6 million by the year 2030.[5] Diabetes is a major NCD currently expected to affect more than 439 million adults globally by 2030.[6]

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.[7] 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.[8] Stroke accounted for 318 083 (147 986 males and 170 097 females) deaths,[8] 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.[9]

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.[3,10] 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.[11] 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.[12]

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.[13,14]

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[15] Fruits and vegetables are linked to better health, when consumption is adequate.[13] The global recommended (adequate) consumption is five servings (400 g) of both fruits and vegetables per day.[16–18] 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).[19] 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.[20]

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.[21] 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.[22] To the reseachers' 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.[23]

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 groups ($n_1 = 149$, consuming less than two servings of vegetables and less than two servings of fruits per day; $n_2 = 15$, 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 (54%, $n = 40$) was three times more likely to consume two or more servings of fruits 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.

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)
> R 2000	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)

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.

Table 2: Multivariate analysis of factors associated with vegetable intake in ADLM, 2018 ($n = 164$)

	< 2 servings		2–3 servings			Unadjusted			Adjusted		
Variable	***n***	**%**	***n***	**%**	**Total**	**OR**	**95% CI**	***p*-value**	**OR**	**95% CI**	***p*-value**
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		0.5
35–62	25	33.8	49	66.2	74	1.61	0.78–3.8	0.3	Out		0.9
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		0.7
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	0.9–4.5	0.11
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	0.9–4.6	0.053
Income category:									Excluded, correlated with employment		
< 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			
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	0.9–4.1	0.054
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	1.5–7.2	0.002
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	1.5–7.7	0.004
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			
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		0.32

Adjusted and unadjusted odds ratios (OR).

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% ($n = 60$)

Table 3: Multivariate analysis of factors associated with fruit intake in ADLM, 2018 ($n = 164$)

	< 1 serving		2 servings			Unadjusted			Adjusted		
Variable	***n***	**%**	***n***	**%**	**Total**	**OR**	**95% CI**	***p*-value**	**OR**	**95% CI**	***p*-value**
Age (years):											
< 25	22	71.0	9	29.0	31	1					
25–34	35	59.3	24	40.7	59	1.68	0.7–4.3	0.28	Out		0.2
35–62	34	45.9	40	54.1	74	2.88	1.2–7.1	0.02	Out		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			Out		0.23
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			Out		0.22
> 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

were eating vegetables on between one and three days. The average daily consumption was two servings of both fruits and vegetables combined. Most participants had taken fruits and vegetables in the past 24 hours, but the daily consumption was not sustained.

Constraints for not taking fruits and vegetables

Tables 4 and 5 describe the four main constraints reported by the participants preventing them from consuming fruits and vegetables on a daily basis.

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

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.[24,25] The researcher could not find local studies presenting similar results. A qualitative

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.[30] 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.[31] 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 vouchers on children from low-income families in France. The study revealed that issuing fruit and vegetable vouchers to disadvantaged households significantly decreased low consumption of fruits and vegetables in these households.[32] Another study by Betty investigated the use of financial incentives to increase fruit and vegetable consumption in the UK. The study found a 23% increase in the sales of fruits and vegetables following the redemption of fruit and vegetable vouchers issued to participating households that previously had challenges buying these.[33]

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.

This study found that households with vegetable gardens and those who bought their vegetables from local shops were significantly more likely to consume 2–3 servings of vegetables. This is consistent with the results of the study by Ekesa and co-authors, which found that poor availability of fruits and vegetables in the local shops was linked to poor consumption[21] (in this case local availability was linked to better consumption). This is also consistent with the findings from a study by Gardiner and co-authors, which reported that fruits and vegetables retail initiatives in rural community stores have a role in supporting and promoting fruit and vegetable consumption.[34] 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.

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.

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.[35,36] 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.

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 under- or overestimated 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[37] (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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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?

Apples	Daily	4–6 days/week	1–3 days /week	< 1 day/week	Never
Avocado	Daily	4–6 days/week	1–3 days/week	< 1 day/week	Never
Banana	Daily	4–6 days/week	1–3 days/week	< 1 day/week	Never
Granadilla	Daily	4–6 days/week	1–3 days/week	< 1 day/week	Never
Grapes	Daily	4–6 days/week	1–3 days/week	< 1 day/week	Never
Mango	Daily	4–6 days/week	1–3 days/week	< 1 day/week	Never
Naartjies	Daily	4–6 days/week	1–3 days/week	< 1 day/week	Never
Nectarines	Daily	4–6 days/week	1–3 days/week	< 1 day/week	Never
Oranges	Daily	4–6 days/week	1–3 days/week	< 1 day/week	Never
Paw paw	Daily	4–6 days/week	1–3 days/week	< 1 day/week	Never
Peaches	Daily	4–6 days/week	1–3 days/week	< 1 day/week	Never
Pears	Daily	4–6 days/week	1–3 days/week	< 1 day/week	Never
Pineapple	Daily	4–6 days/week	1–3 days/week	< 1 day/week	Never
Plums	Daily	4–6 days/week	1–3 days/week	< 1 day/week	Never

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

2 or more
1
None

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

Cost
Availability
Accessibility
Personal preference

4. Is there a fruit tree in this household?

Yes
No

5. If yes, which fruit tree is available?

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?

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?

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?

3 or more
2
1
None

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

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
Imifino
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.