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PREFERENCE RANKING OF SELECTED CARBOHYDRATE ENERGY STAPLES BY VERY ACTIVE MANUAL WORKERS IN NAIROBI, KENYA

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ABSTRACT

In Kenya, "*Ugali*", made from milled whole sifted dry maize (corn) flour, is the popular staple food consumed by nearly 80% of the population. The overreliance on "*Ugali*" has posed a major problem socially, economically and politically. *Ugali* is generally perceived to have higher energy and satiety compared to other carbohydrate staple foods. A descriptive cross-sectional study was conducted using 322 purposefully selected respondents. The objective was to determine the preference ranking of selected commonly consumed carbohydrate energy staple foods by Very Active Manual Workers (VAMW). The VAMW require high energy in order to sustain their very active lifestyle. Three group categories were targeted: VAMW, moderately active Civil servants (CS) and University students (US). Structured questionnaires were administered to respondents to indicate their top ranking and preferred staple foods among six commonly consumed carbohydrate energy foods - *Ugali*, rice, chapati, Irish potatoes, bananas (Matoke), and "others" category (foods such as Githeri (mixed maize and beans), cassava, spaghetti, noodles, Sweet potatoes, and bread among many alternatives). The foods were ranked according to the most preferred to the least preferred on a scale of 1 to 6. Results indicated a higher preference for *Ugali* by all respondent groups. The mean rank for *Ugali* by VAMW was 1.134±0.492, followed by chapati 2.588±0.976, third was rice 3.27±1.242, fourth was Irish Potatoes 4.299±0.970, fifth bananas (matoke) 4.588±1.068, and sixth was "others" 5.165±1.296. US preference ranking for *Ugali was* 1.628±1.067, rice 2.5±1.085, chapati 2.564±1.083, Irish potatoes 4.053±0.943, bananas 4.394±0.918, and others 5.872±0.421; CS ranking for *Ugali* was 1.471±0.930, rice 2.608±1.101, chapati 3.09±1.264, bananas 4.029±1.173, Irish potatoes 4.51±0.972, and others 5.284±1.396. Combined groups mean was 1.410±0.064 and food preference ranking was very significantly different, $P < 0.0001$. Pairwise comparison of mean ranks indicated a significant difference between rank means of all groups, but there was no significant difference between the ranking for rice versus chapati, and Irish potatoes versus bananas. The VAMW had a higher preference for *Ugali* compared to the moderately active groups.

Key words: *"Ugali,"* Preference ranking, Carbohydrate energy staple, Satiety, Very active manual workers

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INTRODUCTION

Human food preferences and diet have evolved over time and vary within and between ethnicities [1]. Communities around the world have established preferences for specific foods as their main source of energy mainly influenced by taste, availability, cost and convenience[2]. Staple foods are those that constitute the major part of a routine diet and generally supply most or all of the total energy and nutrient intake of an individual's need [3]. Some staple foods around the world were adopted during the period of transition in human history [4], from small hunter-gatherer nomadic bands to larger agricultural settlements between 10,000 to 3,500 years ago [5] . According to the United Nations Food and Agricultural Organization (FAO), cereal grains- maize (corn), wheat and rice are the top ranking energy staples providing about 80 percent of global population food calories. Maize alone contributes nearly 20% of calories in human diet [6, 7].

Kenya is a land of great diversity of its people and cultures [8]. Each of the 44 ethnic tribes has a preference and attachment to a particular staple diet or cuisine, which in many ways is also a reflection and source of cultural identity and diversity[9, 10]. The main staples in Kenya are based on maize, wheat, rice, Irish potatoes, bananas (matoke) and beans; including millet, cassava and sorghum**.** However, maize is one of the key crops with stable and guaranteed demand, and continues to attract high government attention in the form of budget, subsidies, research and extension. Issues pertaining to maize production, supply and demand attract high political, social and economic interest in the country. Consequently, maize has a lower national supply deficit (20-30 percent) compared to other carbohydrate staples, 70-90 percent [11]**.**

Maize meal, locally referred to as" Ugali*"*, has been widely adopted as the popular staple food consumed by over 80% of the population. *'Ugali'* was originally associated with the Bantu ethnic group, but has been accepted countrywide by all ethnic groups as a reliable source of energy, regardless of social economic status. *Ugali* is a soft paste made from stirring a mixture of milled dry maize (corn) flour, locally referred to as *Unga*, with boiling water over heat and allowed to bake for about 10 to 15 minutes. It is served hot, but basically has no additive(s), seasoning, nor sweetener. Some ethnic groups prefer the traditional "brown *Ugali* made from a milled flour mixture of millet, sorghum and cassava.

There is a common slang that "when there is no *Ugali,* there is no food"[12]. Acute shortages or major price hikes of *'Unga'* have been a source of protests and street demonstrations in agitation for government interventions [13]. Attempts to introduce or draw attention to other staples have been met with resistance, grumbles and nationwide demonstrations [14]**.** Some staple foods are considered inferior by some individuals and ethnic communities. Consequently, there is a developed stereotype that physical stature, choice of work, or performance of individuals can be attributed to the type of staple diet they subsist on. Work output is driven by energy supply from the food we eat. High energy foods define routine diets of most very active individuals. Very active manual labourers are among the hardest working individuals in society, and high energy foods are important factors of their diet, for productivity and nutritional health.

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The ability to balance energy consumption with expenditure has not been explored adequately in many epidemiological studies. Also, claims regarding the correlation between carbohydrate energy source with activity level or work productivity have not been elucidated. The Kenya National Bureau of statistics quinquennial studies on Well-being of Kenyans, only captures data on the source of food and household budget allocated to food. This study investigated the top ranking carbohydrate energy staple and preference ranking by Very Active Manual Workers (VAMW) in Nairobi, Kenya. High activity level requires adequate energy intake.

METHODOLOGY

A purposeful sampling method was used to identify and recruit respondents. Very active manual workers (VAMW) were drawn from four companies in Industrial Area of Nairobi, Kenya: Assi Engineering, Designtech Limited, Elwin Limited, Toyota Kenya and Sarjudas Limited. Civil servants (CS) working in the Ministry of Agriculture, Livestock, Fisheries and Cooperatives; and Ministry of Health offices and University students (US) from Kenyatta University, considered moderately active, working/studying in Nairobi were included for comparison. The criterion for inclusion was healthy individuals aged between 18-60 years old.

Respondents were informed of the purpose of the study, assured that data collected would remain confidential, and their consent sought before administering questionnaires. A priori sample size was determined using G*power version 3.1.9.4 [15] with small effect size 0.23, $\alpha = 0.05$ [16]. The required sample size was 297, but a total of 322 questionnaires were administered. There was no discrimination between genders, as long as they were observed to be of similar activity level. However, female subjects were not found among the VAMW groups interviewed. Interviews were conducted at site, work or study environment to minimize significant interruption of their work or study schedules. Approval to administer questionnaires was obtained from management, and arrangements made to be at the site on time. Interviews for the VAMW were conducted during lunch break period, but some resistant respondents were motivated to be interviewed by promising to pay for their lunch after the interview. Each interview took an average of 15-20 minutes.

According to the theory of food exchanges, food energy is obtained from carbohydrates, proteins or oils/fats in the diet. This study focused on carbohydrate energy staples to differentiate from other energy giving food groups. Some ethnic communities consume milk, meat or pulses as staples. Five foods commonly consumed by different ethnic groups in Kenya were selected to limit the category of responses: *Ugali*, rice, chapati, Irish potatoes, bananas, and the "other" category. The "other" category option represented any other alternative carbohydrate foods other than the 5 listed foods such as Githeri (mixed maize and beans), cassava, spaghetti, noodles, Sweet potatoes, and bread. To determine the most preferred carbohydrate energy staple, the respondents were asked to indicate the energy staple food they consume most regularly, then rank the foods on a scale of 1 to 6, from the most to the least preferred. The rank of numeric value 1 indicated the most preferred and numeric value 6 indicated the least preferred. There was no rank tying allowed. The assumptions were that all the

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responses were independent, unbiased, and all respondents were familiar with or understood the foods listed in the study questionnaire.

The interview questionnaire was designed with cross checking questions using the 7-day food frequency recall and the 24-hours recall of foods consumed to confirm the preference rankings by the respondents. However, the quantities consumed were not determined, since the objective was only to validate which carbohydrate staples featured in their meals the preceding 7-days and cross checked with 24-hours recall. The respondents first indicated whether the previous day was a normal day and if so, proceeded to describe the foods they consumed. A normal day meant they were at work/University and there was no ceremony. Data obtained was analyzed using Excel data analysis tools and G*power version 3.1.9.4.

RESULTS AND DISCUSSION

The ages for VAMW ranged from 35 to 53 years, with a median age of 31 years and mode of 30 years; University students (US) ages ranged from 19 years to 66 years, with a median age of 23 years and a mode of 24 years. Civil servants (CS) age range was 20 to 60 years with a mode of 26 years and a median age of 35 years. The respondents who had completed secondary education, high school, or had a Certificate/Diploma were 43%; and 57% were either enrolled or had a first degree or Postgraduate degree; and 81% of the respondents were males, while 19 % were females.

Preference ranking results

The descriptive analysis of the data by VAMW (Table 1) indicated that *Ugali* was ranked first with a mean rank of 1.134±0.492. The second preference was chapati with a mean rank of 2.588±0.976; followed by rice with a mean rank of 3.247±1.242. Irish potato with a mean rank of 4.299±0.970 was fourth, and bananas was fifth with a mean rank of 4.588±1.068 followed by the "others" as least preferred with a mean rank of 5.165±1.297. The ranking for *Ugali* ranged from 1 to 3, 95% confidence interval. The range for rice and chapati was 1 to 5, while that of Irish potatoes bananas and others ranged from 2 to 4. The results suggested that Ugali was the most preferred carbohydrate energy staple among VAMW (Figure 1). Results for Analysis of Variance indicated a significant difference in preference ranking for different carbohydrate energy staples by the VAMW, F (0.05, 5,576); $P < .0001$ (Table 2). The null hypothesis that there was no significant difference in the preference ranking of the carbohydrate energy staples by the VAMW was, therefore, rejected.

The Descriptive analysis for US data showed that the mean rank for *Ugali* was 1.629±1.067. The second preference was chapati with a mean rank of 2.564±1.083, very close to the ranking of rice with a mean rank of 2.500±1.085. The fourth was Irish potatoes with a mean rank of 4.053±0.943, followed by bananas, ranked fifth with a mean rank value of 4.394±0.918. The sixth was the "others" group with a mean rank of 5.872±0.421, (Table 3). Results suggested that *Ugali* was the most preferred carbohydrate energy staple among US, (Figure 2). The preference rankings for *Ugali,* rice and chapati ranged from 1 to 5, 95% confidence interval, indicating wider variation in ranking by this group. Ranking for Irish potatoes and bananas ranged from 2 to 4,

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and ranking for "others" category was from 4 to 6. Results of the Analysis of Variance results also suggested a very significant difference in preference ranking of different carbohydrate energy staples, F (0.05, 5, 558); P < .0001 (Table 4).

The Descriptive analysis of CS data indicated the mean rank for *Ugali* was 1.471±0.930. Rice was ranked second, mean rank 2.608±1.101; followed by chapati with a mean rank of 3.078±1.264. Bananas were ranked fourth with a mean rank of 4.029±1.173, whereas an Irish potato was ranked fifth with a mean rank of 4.510±0.972. The least preferred was the "others" group with a mean rank of 5.284±1.396 (Table 5). *Ugali* was the most preferred staple, similar to VAMW (Figure 3). Results also indicated the ranking for *Ugali* ranged from 1 to 5, but 1 to 6, for all other carbohydrates at the 5% level of significance. Analysis of Variance for ranking indicated a significant difference in mean ranks, F (0.05, 5,606); P < .0001 (Table 6).

Analysis of variance of the rank means of the combined data for the three groups was done. The rank mean for *Ugali* was 1.411 with a variance of 0.064. The combined rank mean for chapati was 2.743 and a variance of 0.084 almost tying with the rank mean for rice 2.785 with a variance of 0.163, the third most preferred carbohydrate staple. The fourth was Irish potatoes with a mean rank of 4.287 and a variance of 0.052; followed by bananas mean rank 4.337 with a variance of 0.080 coming fifth. The "others" group was the least preferred with a combined mean rank of 5.441 and a variance of 0.143 (Table 7). *Ugali* was ranked first by all the groups, but the results suggested a significant difference in preference ranking of the staple foods by all the three groups, F (0.05, 5, 12); P < .0001, (Figure 4).

Post hoc analysis was done to determine which of the rank means were significantly different from others. A pairwise comparison of mean ranks conducted using Scheffe' test suggested a significant difference in the mean ranking of all carbohydrate energy staples except for rice versus chapati, and of Irish potatoes versus bananas, where there was no significant difference (Table 8), Further analysis revealed that the effect size for the sample groups was 0.23, and final Power of 0.949 (Figure 5).

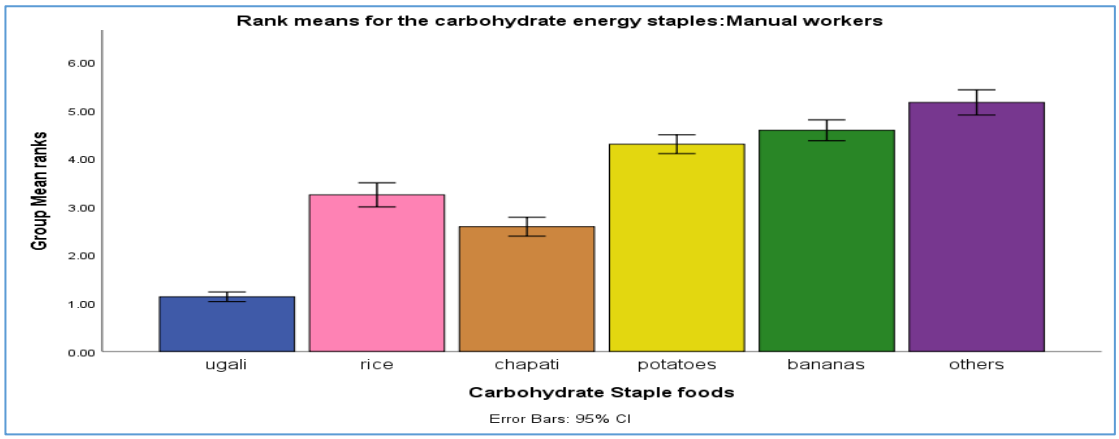

Figure 1: Carbohydrate energy staple preference ranking by Very Active Manual Workers VAMW

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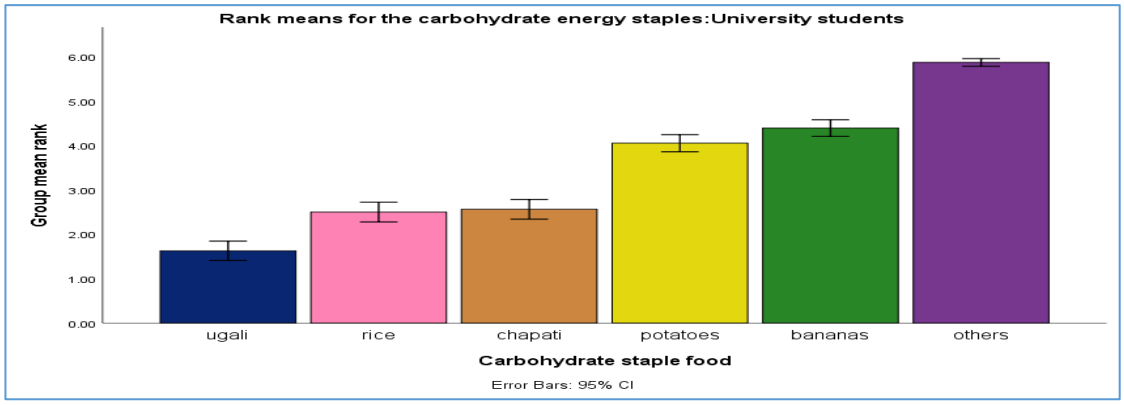

Figure 2: Carbohydrate energy staple preference ranking by University Students

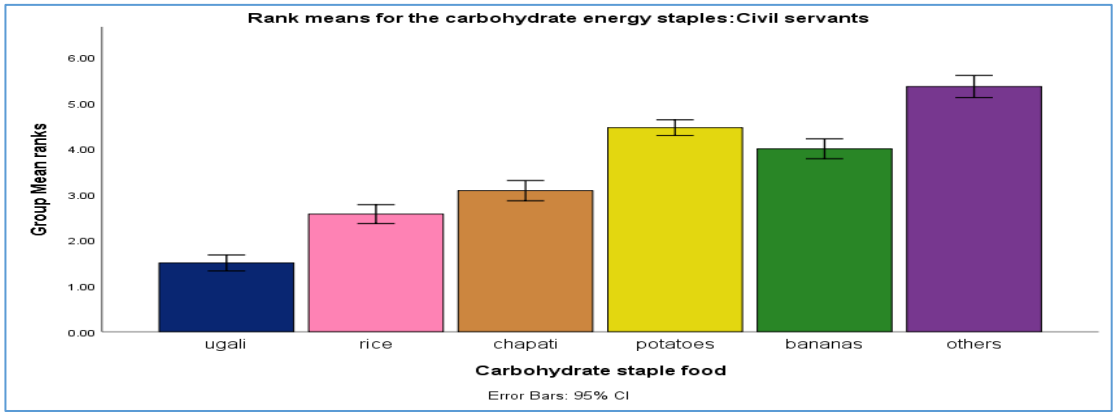

Figure 3: Carbohydrate energy staple preference ranking by Civil Servants

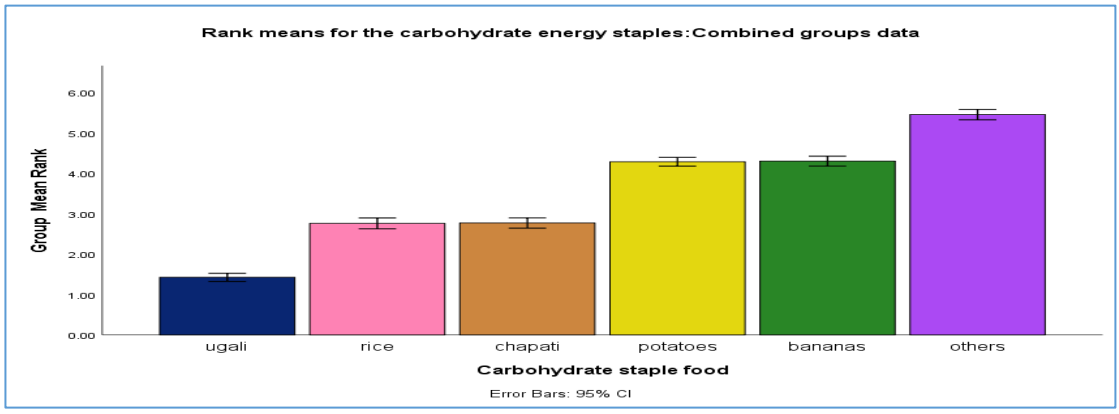

Figure 4: Carbohydrate energy staple preference ranking for the Combined groups (VAMW, US and CS)

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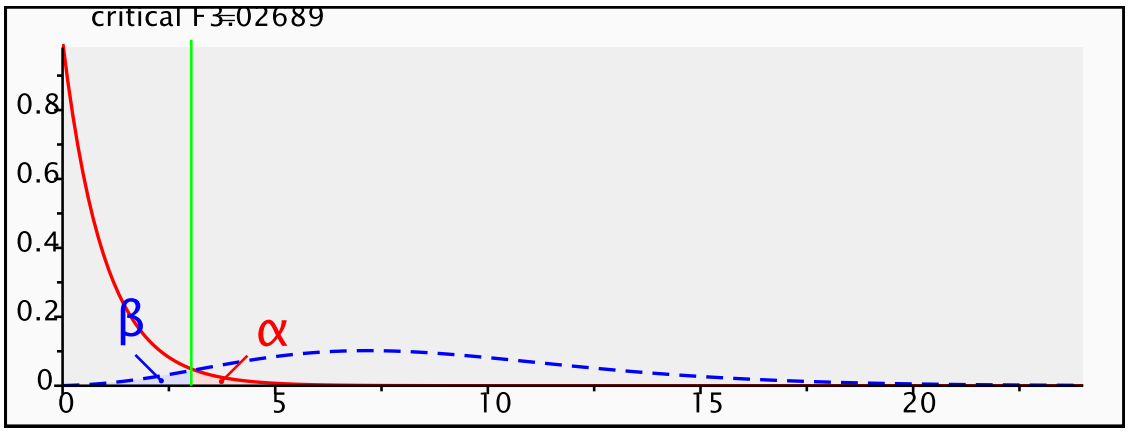

Figure 5: Distribution graph for the combined mean ranks

Food frequency consumption using the 7-day recall method

The respondents were asked to provide a recall of the number of times each carbohydrate staple was consumed over the past seven-day period. Results indicated that the average consumption of *Ugali* by VAMW was 6 days compared to 5 days by US and 4 days by CS groups. The average consumption of chapati by VAMW was 3 days, but 4 days by US and 2 days by CS. Average consumption of rice by VAMW was 1 day compared to 3 by the US and 2 days by CS. Average frequency of consumption of Irish potatoes, bananas and 'other' group of carbohydrate staples was only once by each of the respondent group, indicating lowest frequency of consumption, (Figure 6).

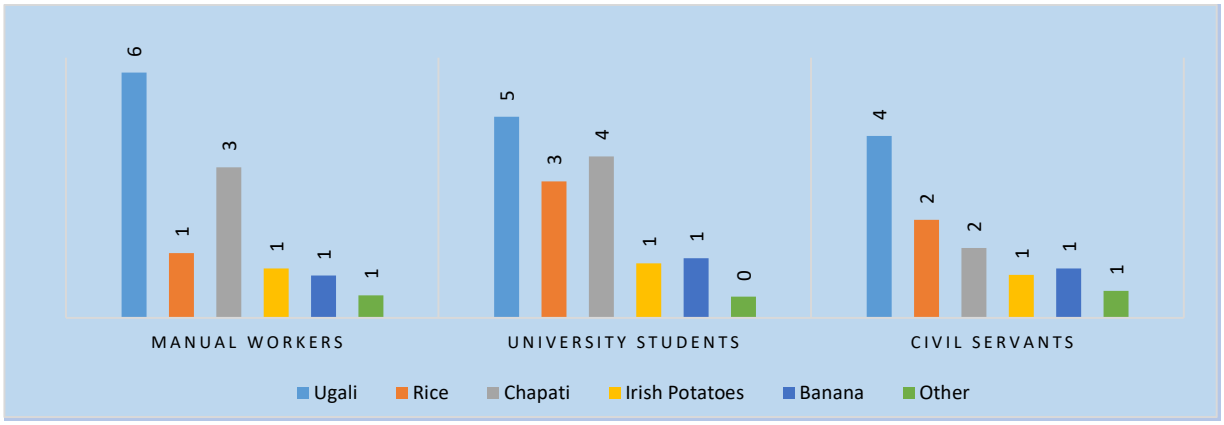

Figure 6: Consumption frequency of different carbohydrate staples by group category

The results were consistent with the preference ranking indicating that VAMW consume *Ugali* more often than less active respondent groups, indicating activity level affects choice of carbohydrate energy staple. Results also suggest that the US group, relatively more active than CS group, consumed *Ugali,* chapati and rice more often consisted with preference ranking results (Figure 5). The column graphs in Figures 7, 8, and 9, depict the consumption frequency of different carbohydrate energy staples.

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Food Consumption Frequency results

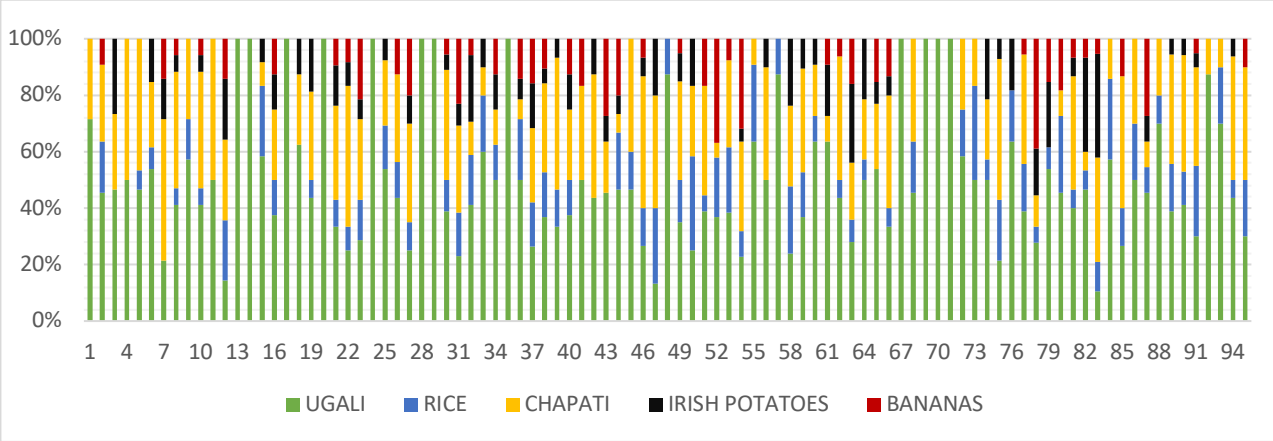

Figure 7: Manual Workers Staple Food Consumption Frequency - 7 Day Recall

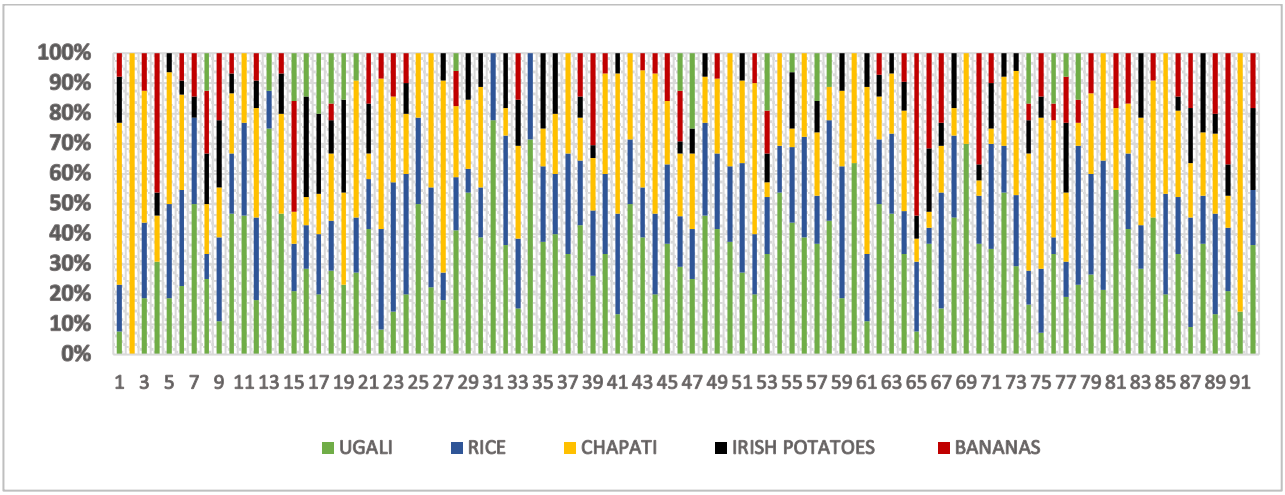

Figure 8: University Students Staple Food Consumption Frequency - 7 Day Recall

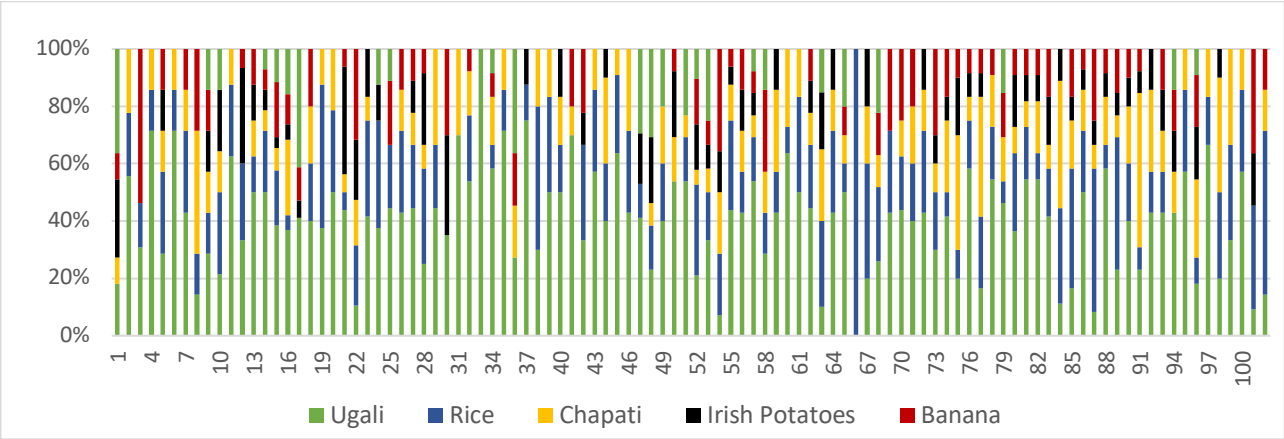

Figure 9: Civil Servants Staple Food Consumption Frequency - 7 Day Recall

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24-hour dietary recall of foods consumed

Carbohydrates are found in a wide array of foods with sugars, starches and fibers being the most common and abundant forms. They occur in smaller quantities in fruits, vegetables and proteins; including nuts grains legumes and seeds. According to the food exchange list theory, foods of the same group can be interchanged to deliver an equivalent amount of energy in the body [17]**.** It is, therefore, expected that Isocaloric foods from the same food group can be interchanged to deliver equivalent amount of energy to support an individual's activity level.

The 24-hour recall of foods consumed was done to further validate the preferred carbohydrate energy staple. This question was designed to capture information about the carbohydrate staples that featured in the meals of the respondents over the preceding 24-hours period before the interview, starting from their breakfast meal the previous day until they woke up on the morning of the interview. However, the quantities taken were not determined, because the objective was only to validate which carbohydrate staples featured in their diets. The respondents first indicated whether the previous day was a normal day and if so, proceeded. to describe the foods consumed. A normal day meant they were at work, there was no feast, or were not working far away from home.

Results for breakfast indicated that chapati or alternative wheat-based products (mandazi, bread, pan-cake, or cake) were commonly consumed. In order to avoid judgmental errors, all the wheat products consumed during breakfast were considered under one type of carbohydrate energy source (Figure 10). Wheat-based carbohydrate during breakfast were: 66% for VAMW, 53% for CS and 67% for US. Results also indicated that 3% of the VAMW consumed *Ugali* in their breakfast meal compared to 6% of CS and 2% of US. The frequency of consumption of rice was 5% for VAMW, 3% for CS and 2% for US. Consumption of Irish potatoes was 4%, and 5% for Bananas and "Others" for VAMW, (5%); but 3%, 4% and 18% among CS; and 1%, 5% and 2% among US, respectively.

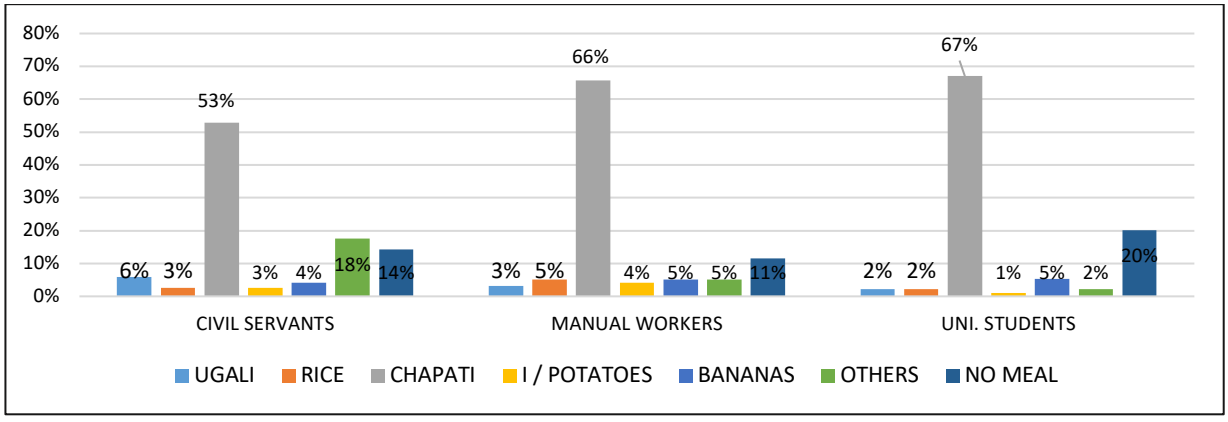

Figure 10: Comparison of 24-hours recall of carbohydrate energy staples consumed during breakfast by category

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Generally, the responses on lunch and dinner foods provided a better picture of the main carbohydrate staples included in the meals during and after work. *Ugali* featured most, and chapati emerged as the second most consumed carbohydrate energy source featuring in both lunch and dinner meals of all the groups. Lunch recall results indicated that 53% of VAMW ate *Ugali* compared to 29% of CS and 17% of US (Figure 11). Chapati also featured in 40% of the VAMW lunch compare to 23% of US and 8% of CS. A very small number of VAMW (1%) reported consuming rice, bananas, Irish potatoes and other carbohydrates during lunch compared to CS and US groups. The consumption of Irish potatoes was 1% among VAMW, compared to 4% of CS and 3% of US. Also, 2% of the VAMW did not take lunch compared to 20% of CS and 23% of the US. Results for dinner meal recall indicated that 77% of the VAMW consumed *Ugali* compared to 61% of CS and 64% of US (Figure 12). The second highest frequency of intake for the VAMW was rice at 8%, Chapati 5% and less than 5% for respondents reported consuming 'other' carbohydrate staples. Results indicate that 2% of the VAMW did not take dinner, compared to 5% of CS and 1% of the US. Overall, results also agree with the preference ranking by the respondent groups, except for rice which appeared to have higher frequency than chapatti. However, *Ugali* remained the most preferred carbohydrate energy staple.

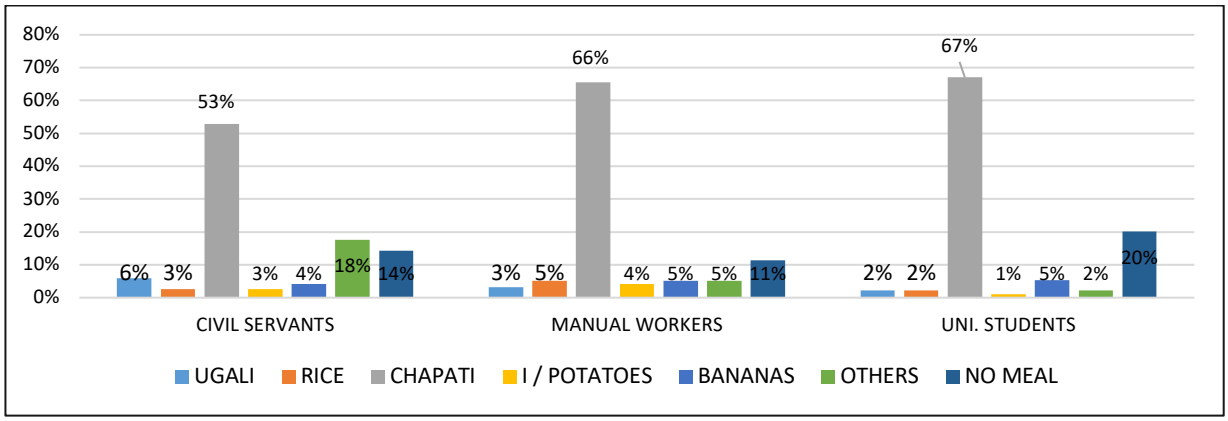

Figure 10: Comparison of 24-hours dietary recall of carbohydrate energy staples consumed during breakfast

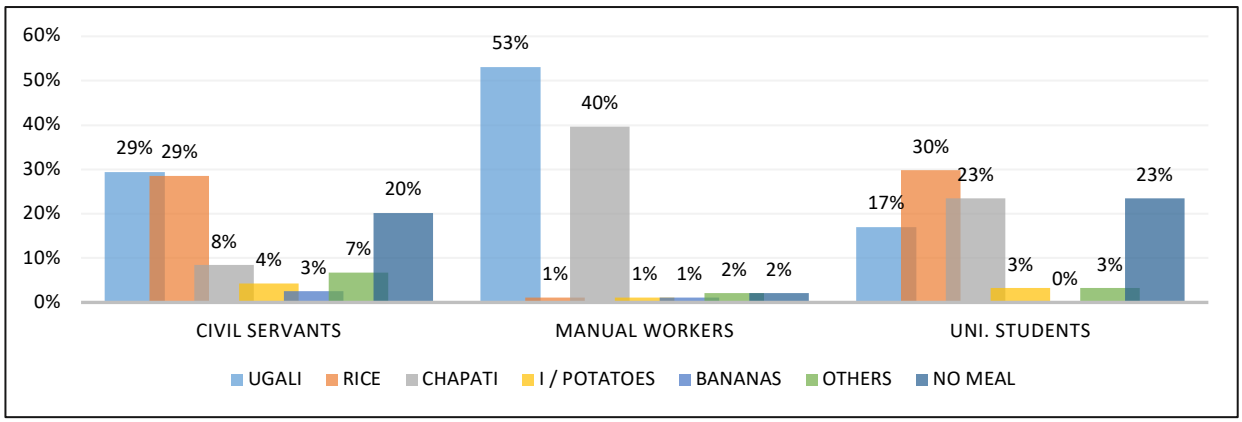

Figure 11: Comparison of 24-hours dietary recall of carbohydrate energy staples consumed during lunch

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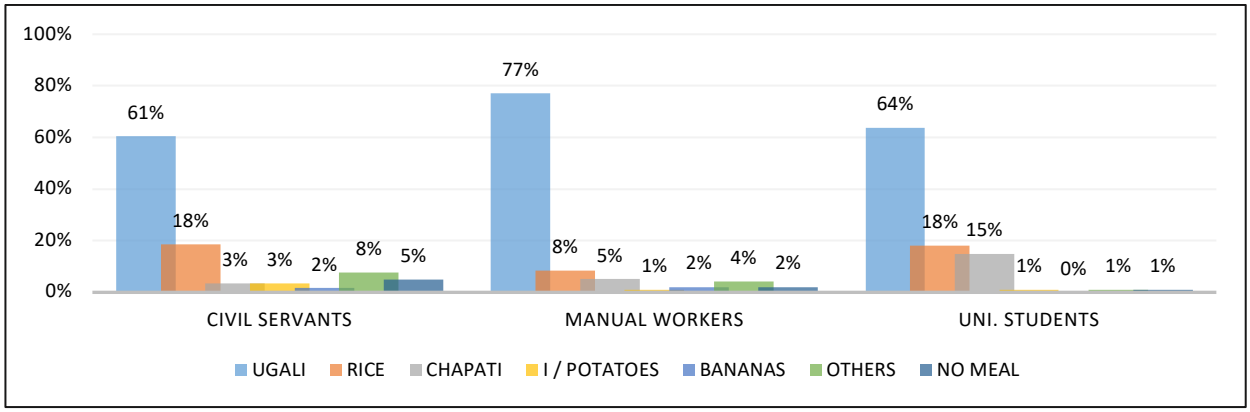

Figure 12: Comparison of 24-hour dietary recall of carbohydrate energy staples consumed during dinner

Results of this study bring in the aspect of the carbohydrate factor of foods, commonly referred to as the "carb factor", which estimates the actual quantity of carbohydrate per unit measure of a food type, and the postprandial glycemic load [18]. Energy needs are determined by energy expenditure rate, which is related to individual activity level. Further, our survival and ability to sustain work productivity is highly dependent on the ability to balance energy intake, expenditure and replenishment.

The choice of energy staples is important as high energy is needed prior to labour intensive work. The postprandial effect of different foods affect energy supply, concentration span, endurance and duration of intensive work differently [19]. However, a combination of factors such as carbohydrate type, load, quantity, preparation method and combination with other nutrients affect digestion, absorption and postprandial effect differently. These attributes affect choice depending on activity level. Manual work is characterized by high intensity activity involving long durations of muscle contractions and energy expenditure. In this study VAMW preferred to eat *Ugali* or chapatti as their main source of energy compared to the moderately active groups, because of the duration of strenuous work requiring adequate provision of energy. Further, most VAMW work on temporary basis and income is based on their productivity. *Ugali* stands out as the undisputed preferred carbohydrate energy staple food for VAMW. These results agree with the study by Wanjala *et al.* [20] as all respondents overwhelmingly selected *Ugali* as the top energy staple food based on their activity level. Results of this study also agree with the findings of the Nutrition and labor productivity study by Popkin [21], which corroborates many of the theories on nutrition and activity level. Popkin found a strong correlation between nutrition, labour time and intensity of work. The choice of the carbohydrate energy staple is determined mainly by postprandial effect of the food, the feeling of not just fullness, but also feeling less energetic during or after a physical activity. Ideally, both physiological conditions are important in determining what and how much is consumed.

Studies by Adamska-Patruno *et al.* [22], Benelam [23] and Holt *et al*. [19], indicated that satiety and satiation influence hunger and our ability to consume adequate energy for our activity level. Satiety is the period between the perceived levels of fullness after

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you stop eating to the time you feel hungry again. Satiety is one of the factors that influence appetite and decline in hunger in the postprandial period. Karalus [24], define satiation as the feeling of inhibition of eating suppressing further consumption, mainly influenced by quantity, texture, water content, protein and fiber content of the food.

In the studies by Benelam [23], apart from the sensory quality, the macronutrient composition and physical structure, quantity/volume, and energy density of the food components contribute to the modulation of satiety [25]. The same study also indicated that the overall, energy density of a food or drink appears to have more impact on satiety than the macronutrient composition. Hence, high-fat foods with a higher energy density than high-protein and high-carbohydrate foods should convey higher satiety. However, carbohydrates are ranked according to how fast they raise the blood sugar level to a maximum potential (glycemic index). A study by Alfenas and Paiva [25] demonstrated that ingestion of low glycemic index foods results in greater satiety and lower energy intake than high glycemic index foods. The fibre content of isocaloric foods affects digestion, absorption and metabolism, positively impacting satiety. The water binding ability of starch and soluble fibers increase the bulk of the diet and have a specific effect on satiety. The effect of dietary fibre on the attenuation of postprandial glycemic response has also been demonstrated in the studies by Kendall *et al*. [26], and Sadakiyo *et al.* [27], mechanisms that increase satiety of food after ingestion. Hence, foods with a high glycemic index are not necessarily satisfying, therefore not preferred by VAMW. The 'carb factor' for *ugali* and chapatti are higher than that of boiled rice, Irish potatoes and Boiled/mashed bananas [28]. When protein and fat are present in a meal, they not only add to the energy value of the food, but also increase the satiety of the meal. This explains why maize and wheat based meals with higher protein, fat and fibre content portray higher satiety levels.

Preference ranking results of VAMW concurs with findings of the studies on satiation and satiety of low calorie foods. Although boiled Irish potatoes and bananas are more satiating compared to *Ugali*, chapatti and rice; the levels of energy and satiety potentials are lower, due to higher water and lower fibre contents. Boiled rice has more water, but less fibre, protein and fat compared to *Ugali* and chapatti. The slight difference in the preference ranking of bananas and Irish potatoes may be attributed to the proportion of protein and fibre in the foods. The Kenya Food Composition tables indicate that Irish potatoes have higher protein and energy, but bananas have higher fibre. The fibre content of potatoes can be improved if cooked with the skin.

CONCLUSION

This study provides empirical evidence regarding individual preferences and satiety claims of the five main carbohydrate staple foods in Kenya, and the potential to support individual activity level. Different ethnic communities have strong convictions on the energy and nutrient value of their dominant staple food. This study demystifies some perceptions held by certain communities regarding the staple foods. In most studies, glycemic load and satiety have mainly been studied with regard to obesity, diabetes control and weight management. This finding will facilitate greater understanding of ethnic staple foods, and influence carbohydrate staple food choices and combinations

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by individuals for desired post-prandial effect. The results of this study will provide insight and decision support to Policy makers to ensure availability of the specific staple foods, as manual workers play a big role in driving the economy of Kenya. This study also will deepen the understanding of the food exchanges theory, the "carb factor", glycemic index and post prandial effect of different ethnic carbohydrate staple foods. Further studies could provide more clarity on postprandial effect of the carbohydrate staples on blood sugar changes over time, satiety effect and work productivity, which this study did not elucidate.

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Table 1: Preference ranking results of the carbohydrate energy staple foods by VAMW in Nairobi

Statistic	*Ugali*	Rice	Chapati	Irish Potatoes	Bananas	Others
Mean	1.134	3.247	2.588	4.299	4.588	5.165
Standard Error	0.050	0.126	0.099	0.099	0.108	0.132
Median	1	3	2	4	5	6
Mode	1	2	2	5	5	6
Standard Deviation	0.492	1.242	0.976	0.970	1.068	1.297
Sample Variance	0.242	1.542	0.953	0.941	1.141	1.681
Range	3	5	5	4	4	4
Minimum	1	1	1	2	2	2
Maximum	4	6	6	6	6	6
Sum	110	315	251	417	445	501
Count	97	97	97	97	97	97

Table 2: Results of Preference ranking of carbohydrate energy staple foods by VAMW in Nairobi

Summary statistics

Groups	*Count*	*Sum*	*Average*	*Variance*
Ugali	97	110	1.134	0.242
Rice	97	315	3.247	1.542
Chapati	97	251	2.588	0.953
Irish Potatoes	97	417	4.299	0.941
Bananas	97	445	4.588	1.141
Others	97	501	5.165	1.681

ANOVA

Source of Variation	*SS*	*df*	*MS*	*F*	*P-value*	*F crit*
Between Groups	1075.473	5	215.095	198.542	0.000	2.230
Within Groups	624.021	576	1.083			
Total	**1699.493**	**581**				

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Table 3: Preference ranking results of the carbohydrate energy staple foods by University students

Statistic	*Ugali*	Rice	Chapati	Irish Potatoes	Bananas	Others
Mean	1.628	2.500	2.564	4.053	4.394	5.872
Standard Error	0.110	0.112	0.112	0.097	0.095	0.043
Median	1	2.5	2	4	5	6
Mode	1	3	2	4	5	6
Standard Deviation	1.067	1.085	1.083	0.943	0.918	0.421
Sample Variance	1.139	1.177	1.173	0.890	0.843	0.177
Range	4	4	4	4	4	2
Minimum	1	1	1	2	2	4
Maximum	5	5	5	6	6	6
Sum	153	235	241	381	413	552
Count	94	94	94	94	94	94

Table 4: Variance in preference ranking of energy staples by University students

Summary statistics

Groups	*Count*	*Sum*	*Average*	*Variance*
Ugali	94	153	1.628	1.139
Rice	94	235	2.500	1.177
Chapati	94	241	2.564	1.173
Irish potatoes	94	381	4.053	0.890
Bananas	94	413	4.394	0.843
Others	94	552	5.872	0.177

ANOVA

Source of Variation	*SS*	*df*	*MS*	*F*	*P-value*	*F crit*
Between Groups	1138.775	5	227.755	253.049	0.000	2.230
Within Groups	502.223	558	0.900			
Total	**1640.998**	**563**				

Table 5: Preference ranking results of the carbohydrate energy staple foods by Civil Servants

	Ugali	Rice	Chapati	Irish Potatoes	Banana	Others
Mean	1.471	2.608	3.078	4.510	4.029	5.284
Standard Error	0.092	0.109	0.125	0.096	0.116	0.138
Median	1	2	3	5	4	6
Mode	1	2	3	5	4	6
Standard Deviation	0.930	1.101	1.264	0.972	1.173	1.396
Sample Variance	0.866	1.211	1.598	0.945	1.375	1.948
Range	4	5	5	4	5	5
Minimum	1	1	1	2	1	1
Maximum	5	6	6	6	6	6
Sum	150	266	314	460	411	539
Count	102	102	102	102	102	102

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Table 6: Variance in Preference ranking of energy staples by Civil Servants

Summary statistics

Groups	*Count*	*Sum*	*Average*	*Variance*
Ugali	102	150	1.471	0.866
Rice	102	266	2.608	1.211
Chapati	102	314	3.078	1.598
Irish Potatoes	102	460	4.510	0.945
Banana	102	411	4.029	1.375
Others	102	539	5.284	1.948

ANOVA

Source of Variation	*SS*	*df*	*MS*	*F*	*P-value*	*F crit*
Between Groups	976.739	5	195.348	147.560	0.000	2.229
Within Groups	802.255	606	1.324			
Total	**1778.994**	**611**				

Table 7: Comparison of rank means for all the three group categories

Summary Statistics

Groups	**Count**	**Sum**	**Average**	**Variance**
Ugali	3	4.232	1.411	0.064
Rice	3	8.355	2.785	0.163
Chapati	3	8.230	2.743	0.084
Irish Potatoes	3	12.862	4.287	0.052
Bananas	3	13.011	4.337	0.080
Others	3	16.322	5.441	0.143

ANOVA

Source of Variation	*SS*	*df*	*MS*	*F*	*P-value*	*F crit*
Between Groups	31.603	5	6.321	64.590	0.000	3.106
Within Groups	1.174	12	0.0979			
Total	**32.778**	**17**				

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Table 8: Pairwise comparison of means using Scheffe' test Fs crit = 15.53

Pair	Difference between means	Fs calculated value
Ugali and Rice	1.374	21.057
Ugali and Chapati	1.333	20.416
Ugali and Irish potatoes	2.877	44.073
Ugali and Banana	2.926	44.833
Ugali and Others	4.030	61.742
Rice and chapati	**0.042**	**0.640**
Rice and I/Potato	1.502	23.016
Rice and Bananas	1.552	23.776
Rice and Others	2.655	40.685
Chapati and Irish potato	1.544	23.657
Chapati and Banana	1.594	24.417
Chapati and Others	2.697	41.326
I/Potato and Banana	**0.050**	**0.760**
Irish Potatoes and Banana	1.153	17.669
Irish potatoes and others	1.104	16.909

Table 9: Comparison of frequency of consumption of the staple foods

Staple Food	*Average Frequency of Consumption*		
	Manual Workers	***University Students***	***Civil Servants***
Ugali	5.7	4.6	4.2
Rice	1.5	3.2	2.3
Chapati	3.5	3.7	1.6
Irish Potatoes	1.1	1.3	1.0
Banana	1.0	1.4	1.1
Other	0.5	0.5	0.6

REFERENCES

1. **Breslin PAS** "An evolutionary perspective on Food and Human Taste," *Curr. Biol* 2013;**23.(9)**: 409–418. https://doi.org/10.1016/j.cub.2013.04.010

2. **Amone C** "We are strong because of our millet bread: Staple fods and the growth of ethnic identities in Uganda," *Trames 2014;***18(2)**: 159–172. https://doi.org/10.3176/tr.2014.2.04

3. **Kwon DY** "What is Ethnic Food?," *J. Ethn. Foods* 2015; **2(1)**. https://doi.org/10.1016/j.jef.2015.02.001

4. **Luca F, Perry G and A Di Rienzo** "Evolutionary adaptation to dietary changes," *Annu. Rev. Nutr.* 2010; **30(1)**; 291–314. https://doi.org/10.1146/annurev-nutr-080508-141048

5. **Wrangham R** "Lecture: The Cooking Ape" 2013. https://doi.org/10.1016/j.cub.2013.03.061

6. **O'Leary M** "Maize: From Mexico to the world," 2016. www.commyt.org *(Accessed Jan. 07, 2020).*

7. **O'Leary M** "Preserving native maize and culture in Mexico," *CIMMYT* 2018. https://www.cimmyt.org/news/preserving-native-maize-and-culture-in-mexico/ (*Accessed on 24th March 2020).*

8. **Government of Kenya** "Kenya Peoples and cultures," *MEAC* 2019. http://meac.go.ke/kenya-peoples-and-cultures/ *(Accessed on 20th February 2020).*

9. **Ma G** "Food, eating behavior, and culture in Chinese society," *J. Ethn. Foods*, 2015; **2(4)**, 95–199. https://doi.org/10.1016/j.jef.2015.11.004

10. **Lockwood WG and YR Lockwood** "Ethnic cuisines," *Ethnic cuisines 2020.* Encyclopedia.com

11. **Government of Kenya** *National Food and Nutrition Security Policy Implementation Framework (2017-2022)*. Nairobi: Agricultural Information Center, 2017.

12. **Mbilu S** *Unga Protesters*. Kenya: Citizen TV, 2011. (*Accessed on 20th February 2020*).

13. **IRIN.** *Unga revolution in Kenya*. Kenya: The New Humanitarian, 2011. (*Accessed on 21st April 2020*).

14. **Malimi K, Ladislaus K, Grace M, Elifatio T and C Cypriana** "Acceptability Assessment of Ugali Made from Blends of High Quality Cassava Flour and Cereal Flours in the Lake Zone, Tanzania," *Asian Food Sci. 2018*2, **(1)**; 1–11. https://doi.org/10.9734/afsj/2018/40764

15. **Bluman AG** *Elementary statistics: A Step by Step Approach, sixth edition*. New York: McGraw-Hill Education, 2014.

16. **Cohen L, Manion L and K Morrison** "Research Methods in Education," New York, 2007.

17. **American Diabetes Association.** "Food Exchange Lists for Meal Planning," 2003. https://diabetesed.net/page/_files/THE-DIABETIC-EXCHANGE-LIST.pdf (*Accessed on 20th April 2020).*

18. **Kawamura T, Takamura C, Hashimoto T, Higashide, Kashihara Y, Hashimura K and H Shintaku** "The factors affecting estimation of carbon content of meals in carbohydrtae counting," *Clin. Pediatr. Endocrinol.* 2015; **24(4)**, 153–165. https://doi.org/10.1297/cpe.24.153

19. **Holt S, Brand Miller J, Petocz P and E Farmakalidis** "A satiety index of common foods," *Eur. J. Clin. Nutr.*, 1995; **49(9)** 675–690.

20. **Wanjala W, Onyango, Makayoto M and C Onyango** "Indigenous technical knowledge and formulations of thick (ugali) and thin (uji) porridges consumed in Kenya" 2016; **10(12)**; 385–396. https://doi.org/10.5897/AJFS2016

21. **Popkin BM** "Nutrition and labor productivity," *Soc. Sci. Med. Med. Psychol. Med. Sociol 1978;* 1**2(3-4)**; 117–125. https://doi.org/10.1016/0160-7979(78)90168-6

22. **Adamska-Patruno E, Ostrowska L, Goscik J, Pietraszewska B, Kretowski A and M Gorska.** "The relationship between the leptin/ghrelin ratio and meals with various macronutrient contents in men with different nutritional status: A randomized crossover study," *Nutr. J. 2018;* **17 (1)** https://doi.org/10.1186/s12937-018-0427-x

23. **Benelam B** "Satiation, Satiety and their effects on eating behaviour," in *Nutrition Bulletin* 2009; 126–173. https://doi.org/10.1111/j.1467-3010.2009.01777

24. **Karalus M** "The Creation and Testing of a Scale to Measure the Subjective Experiences of Hunger and Satiety A DISSERTATION SUBMITTED TO THE FACULTY OF THE GRADUATE SCHOOL OF THE UNIVERSITY OF MINNESOTA BY" 2011.

25. **Rita de Cássia GA and E Paiva** "Effect of glycemic index on satiety and body weight," *Revista de Nutricao*, 2007; **20(2)**; Revista de Nutricao, 197–202. https://doi.org/10.1590/s1415-52732007000200009

26. **Kendall C, Esfahani A, Hoffman AJ and A Evans** "Effect of Novel maize-based dietary fibres on postporadial glycemic and insulinemia," *J. Am. Coll Nutr.* 2012; 711–718. https://doi.org10.1080/07315724.2008.10719748

27. **Sadakiyo T, Ishida Y, Inoue S, Taniguchi Y, Sakurai T, Takagaki R, Kurose M, Mori T, Yasuda-Yamashita A, Mitsuzumi H, Kubota M, Watanabe H and S Fukada** "Attenuation of Postprandial blood glucose in Humans Consuming isomaltodextrin: carbohydarte loading studies," *J. Food Nutr. Res.* 2017; (61). https://doi.org/10.1080/16546628.2017.1325306

28. **Food and Agriculture Organization and Government of Kenya**., "Kenya Food Composition Tables" 2018. http://www.fao.org/3/i8897en/I8897EN.pdf *(Accessed Apr. 12, 2020).*