

EVALUATION OF PREFERENCE AND POSTPRANDIAL EFFECT OF SELECTED CARBOHYDRATE STAPLES BY VERY ACTIVE MANUAL WORKERS IN NAIROBI, KENYA

Mwale MM^{1*}



Mwale Mabel Mary

*Corresponding author email: marymwale23@gmail.com

¹Ministry of Agriculture, Livestock, Fisheries and Cooperatives, Kilimo House, Cathedral Road, P.O Box 30028, 00100, Nairobi, Kenya



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ABSTRACT

In Kenya, the overwhelming reliance on “Ugali” continues to pose a major problem socially, economically, and politically. There is a general perception that Ugali has higher satiety and energy compared to other staple foods, making it a common choice by very active individuals. The objective of this study was to evaluate the preference and postprandial effect of selected carbohydrate staples by very active manual workers (VAMW) compared to less active groups in Nairobi, Kenya. A total of 322 questionnaires were administered to respondents categorized into three groups: very active manual workers (VAMW); and for comparison, two moderately active groups: civil servants (CS) and university students (US). Respondents were asked to indicate their main carbohydrate staple from a choice of six commonly consumed carbohydrate foods: Ugali, rice, chapati, Irish potatoes, bananas, and “others” [foods such as Githeri (mixed maize and beans), cassava, spaghetti, noodles, Sweet potatoes, and bread among many alternatives], explain reasons for preferences, describe how they felt when they did not eat enough food or when hungry, and indicate their meal frequency per day. The minimum sample size was determined using G*Power version 3.1.9.4. Data was analyzed using Excel Data Analysis Tools for Descriptive Statistics and Analysis of Variance, Scheffé’s test and G*power for Post hoc tests. Results indicated that Ugali was the main carbohydrate for 90% of the VAMW, compared to 79 percent of all respondents combined. The average number of meals consumed was 3, reported by 80% of VAMW compared to 59% of CS and 48% of US. Analysis of variance indicated a significant difference in the number of meals consumed by VAMW compared to that of Civil servants and University students; $F (0.05, 2,330) = 13.089, P < 0.0001$; and final Power (1- err prob) of 0.97. Pairwise comparison of the mean ranks indicated significant differences between the mean ranks of all foods, except for rice versus chapati, and Irish potatoes versus bananas where there was no significant difference. Results also indicated that the choice of main staple by VAMW depends on energy value, occupation, and satiety index. Satiety of the foods depends on carbohydrate type, carbohydrate factor, glycemic load, quantity, and the combination with other nutrients.

Key words: Carbohydrate, Staple, “Ugali, Energy, Postprandial, Satiety, Very active manual workers



INTRODUCTION

All parts of the human body (including muscles, brain, heart, and liver) need energy to function normally and to facilitate physical activity. The energy needed by the human body comes from food and should basically support relative energy needs of individuals [1]. The level of energy supply affects concentration span, endurance and duration of intensive strenuous work or activities [2]. Carbohydrate, fat and protein supply basic energy needs for our activity level. Sedentary and moderately active people will require less energy daily compared to very active people [3]. Isocaloric foods from the same food group can be interchanged to deliver equivalent amounts of energy for physiological and physical activities [4], but the postprandial effect produced may be different due to type of energy source [5].

A staple food is a food that is eaten routinely in such quantities that it constitutes a dominant portion of a standard diet for a given people [6, 7]. A staple food should generally supply a significant proportion of energy needs and nutrients. It may supply one or more of the three organic macronutrients, carbohydrate, protein, or fat, needed for survival and health. Typically, most people live on diets based on just two staples, which in most instances are usually inexpensive, readily available and eaten as often as every day, or at every meal [8]. Different ethnic communities have established preferences for specific foods as their staples, depending on how comfortable they feel, or the lasting effect after consumption.

Ethnic foods are defined as foods originating from a heritage and culture of an ethnic group who use their knowledge of local ingredients of plants and/or animal sources for nutrition [9]. The members of the community consider ethnic foods 'their own' and others attribute the foods to the ethnic community. Broadly, ethnic foods can also be defined as an ethnic group's or a country's cuisine that is culturally and socially accepted by other consumers outside the particular region. Examples are Greek food, Indian food, Italian food, Cambodian food, Ethiopian food, Thai food, Korean food, and Chinese food, among many [7]. Further, foods consumed by people of different religions are also considered ethnic foods, for example, Traditional Buddhist cuisine, Christian cuisine and Muslim cuisine. The United Nations Food and Agriculture Organization postulates that cereal grains: corn (maize), wheat and rice, are the top global energy staples and provide about 80 percent of global population caloric intake [10]. Globally, maize (corn) alone contributes nearly 20% of calories in human diet [11, 12]. Maize is widely adopted in many parts of the world, consumed in different forms, and is an important staple in most Sub-Saharan Africa ethnic communities. Manual labourers such as loaders

and construction workers, are considered a very active category of people. They require foods that can sustain adequate energy supply for their work output to improve productivity, remain alert and maintain their health.

Starchy staple foods in Kenya are based on maize, wheat, rice, Irish potatoes, green bananas and beans including millet, cassava and sorghum. However, maize meal locally referred to as "Ugali," has been adopted as the popular staple food consumed by nearly 80% of the population in Kenya [13]. Ugali is a specially prepared soft mixture of milled maize (corn) flour prepared by mixing it in boiling water over dry heat and baked for about 10 to 15 minutes. It basically has no additive(s), seasoning, nor sweetener, making it the perfect combination with a wide range of protein and vegetable foods. Ugali was originally associated with the Bantus, but it has been accepted and adopted countrywide by all ethnic groups. It is commonly eaten with beef, chicken or fish, either fried, boiled, roasted or barbecued, and/or fried cabbage, kale (locally known as "Sukuma wiki") or any of the indigenous vegetables, usually associated with specific ethnic groups in different regions. Some ethnic groups prefer the traditional "brown Ugali made from a milled flour mixture of millet, sorghum and cassava. Brown flour from millet and sorghum may also be used to prepare brown porridge.

Ugali is a reliable source of energy of most households or ethnic communities regardless of social or economic status. The wide acceptance and reliance on maize meal is propelled by the general perception and stereotypes that it is convenient, easy to prepare, has high energy value, tastier, nutritious and has a higher satiety index compared to other common staples [14]. Other attributes are widespread availability, affordability, stability, easy handling, and preservation [15].

Regionally, maize is readily marketed and is one of the most traded and monitored commodities across the East African Community borders, with highest flow towards Kenya [16]. Maize has also become a political staple, as issues pertaining to its production, supply and demand attract a high political interest in Kenya and the region. Shortfalls in supply and price hikes have been a source of protest, outcries and street demonstrations, especially of low income and very active individuals, which at times cripples economic activities [17,18]. There is a common belief in Kenya that "when there is no 'Unga' (maize flour), there is no food" [19]. Urban interaction and integration of different ethnic communities in settlement schemes and cosmopolitan urban communities have influenced and brought about dietary changes among all ethnic communities in Kenya. The interaction and integration of cosmopolitan communities has also seen further amplification and adoption of certain exotic diets, further influencing production patterns, dietary and

lifestyle changes. However, still each ethnic community has strong convictions about the dominant staple food they subsist on, whether it is ugali, banana, Irish potatoes, Githeri, rice, chapatti, or any other.

This study investigated the preference and postprandial effect of selected carbohydrate staples (Rice, Chapati, Irish Potatoes, Bananas and others) consumed by very active manual workers in Nairobi. Literature review revealed limited similar studies that have investigated the source of the claims of more energy and satiety, cultural perceptions and stereotypes regarding the correlation between the staple consumed and occupation. The Null Hypothesis was that there is no significant difference between the choice of carbohydrate staple by very active manual workers and less active workers in Nairobi, Kenya.

METHODOLOGY

This study was a descriptive cross-sectional study conducted in Nairobi, Kenya. Approval for the study was provided by the Ministry of Agriculture, Livestock, Fisheries and Cooperatives. Three categories of the respondents were selected: Very active manual workers working in industrial area of Nairobi, University students (Kenyatta University), and Civil servants working in the Ministry of Agriculture, Livestock, Fisheries and Cooperatives and in the Ministry of Health offices. The interviewers explained the purpose of the study and sought the consent of the respondents before administering the questionnaire. Respondents agreed to participate in the study by confirming their consent to the interviewer before administration of the questionnaire.

Respondents were asked to indicate the main carbohydrate staple food from a list of familiar commonly consumed carbohydrate staples in Kenya; then state the reasons for the most and least preferred choices, and describe how they felt when they had not eaten enough food or when hungry. The selected staples were: ugali, chapati, rice, Irish potatoes, bananas and 'others'. The 'others' group included responses such as githeri (mixed maize and beans), cassava, spaghetti, noodles, sweet Potatoes, and bread among many alternatives. Respondents were also asked to describe what happens when they do not eat enough food (low quantity/no food), their meal frequency per day and stating the reasons for their meal frequency. The study sought to determine whether the main staple selected fulfills their energy needs based on their occupation. The minimum sample size for administration of the questionnaires was determined using G*Power version 3.1.9.4 [20], effect size of 0.23 and $\alpha = 0.05$. A total of 322 questionnaires were administered.



RESULTS AND DISCUSSION

Preferred carbohydrate staple

The average age of the manual workers was 33 years, 23 years for university students and 38 years for civil servants. The combined groups' mean age was 32 years. Results indicated that Ugali was not only a preferred staple for the VAMW, but was the most preferred staple by all groups combined.

Overall, 79% of all the respondents selected "Ugali" as their most preferred staple, followed by chapati 11%, rice at 6%, bananas 2%, and Irish potatoes and the "others" showing 1% each (Figure 1). However, 90% of the VAMW preferred Ugali, 6% preferred Chapati, and 4% preferred rice (Figure 2). There was a significant difference in the choice of staple by very active manual workers compared to the less active groups, CS and US. The Null hypothesis that there is no significant difference between the choice of staples by VAMW and less active individuals in Nairobi was rejected. Results indicated that Ugali was the most preferred staple for VAMW in Nairobi. Overall, analysis of the combined mean ranks suggested a significant difference in ranking of the carbohydrate staples by all the three groups, $p < .0001$. The results show $F (0.05, 5, 12)$ is 64.590 compared to the F critical value of 3.106 (Table 1). The outcome supports the evidence in the Kenya Food Composition Tables where Ugali and Chapatti, the main staples for the VAMW, have higher calories than rice, bananas, Irish potatoes and the "others" [21, 22].

Main carbohydrate staple by all by groups

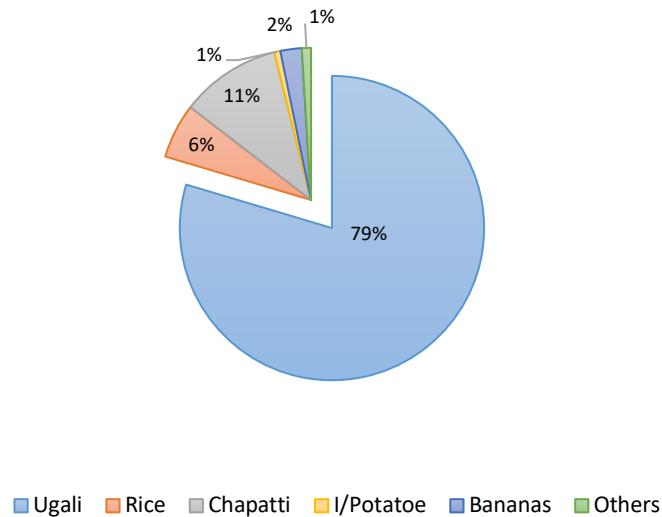


Figure 1: Main carbohydrate energy staple - all respondents

Main carbohydrate staple by VAMW

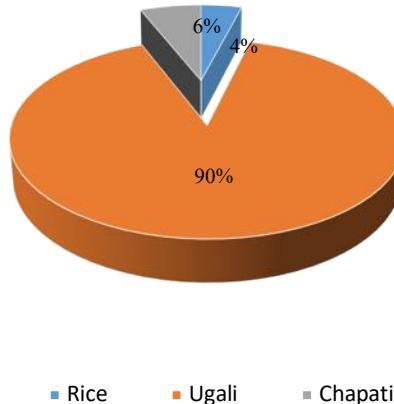


Figure 2: Main carbohydrate energy staple – VAMW

Post hoc analysis of the results was conducted using Scheffé's test, to determine which of the carbohydrate mean ranks were significantly different. The pairwise comparison of the mean ranks indicated significant differences between the mean

ranks of all foods except for the mean ranks for rice versus chapati, and Irish potatoes versus bananas, where the results indicate that there was no significant difference (Table 2).

Number of meals consumed per day

Data on number of meals per day was collected as a reflection of sufficiency of energy intake and postprandial effect (satiety index) of the selected carbohydrate staples by the respondents. The average number of meals consumed by each group was 3 meals per day. This study established that 91% of VAMW consumed three meals or more per day, compared to 67% of CS and 55% of US (Figure 3). The results indicated that the range for the number of meals per day for VAMW was 2 to 4 meals, compared to 1 to 4 meals per day for CS and US. Specifically, 80% of VAMW consumed three meals a day compared to 59% and 48% of CS and US, respectively. Only 9% of VAMW consumed two meals a day compared to 33% of CS and 45% of US that reported taking two meals or less per day. The results also indicated that 11% of the VAMW consumed more than three meals per day, compared to 8% of CS and 7% of US. None of the VAMW reported skipping a meal or consuming one meal per day, unlike CS and US groups where 3% and 1% respectively, reported consuming one meal per day (Figure 3).

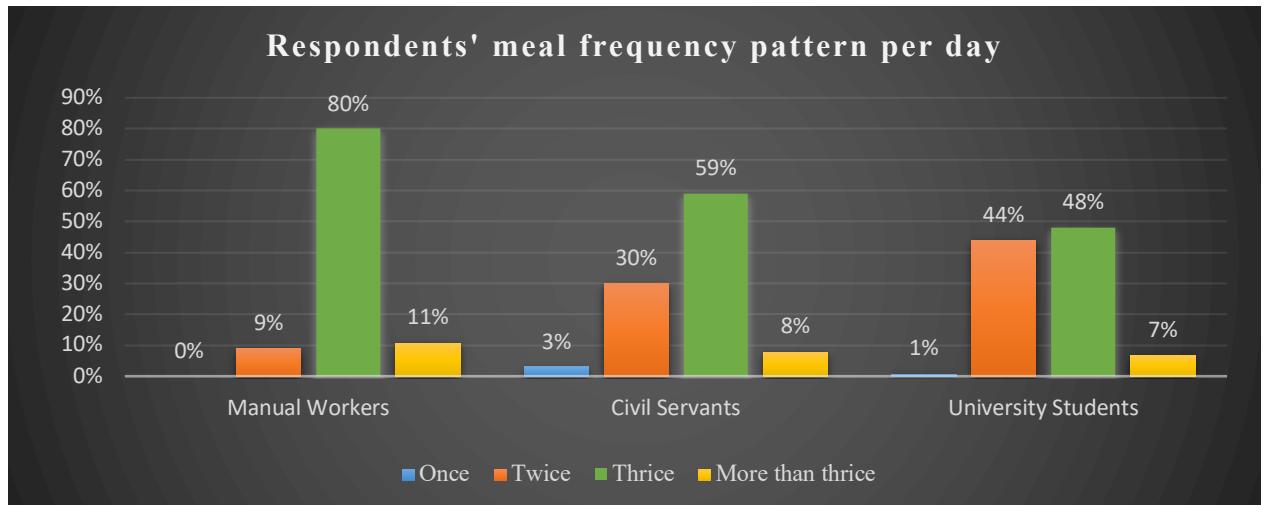


Figure 3: Summary of the meal frequency per day by group category

Further analysis using ANOVA indicated a significant difference between the numbers of meals taken per day by VAMW compared to moderately active groups, US and CS; $F (0.05, 2,330) = 13.089$, $p < 0.0001$, (Table 4). A pairwise comparison of meal frequency means was done using Scheffé's test to determine which group means were significantly different. The Post hoc test indicated that there was no significant difference in the number of meals consumed between CS

and the US groups, but there was a significant difference in number of meals consumed between VAMW and CS, and between the VAMW and US (Table 5). Further, Post hoc analysis revealed an effect size of 0.23, $F (0.05, 2,329)$; the test statistic was 3.023 with a non-centrality parameter of 17.563, and a final Power (1- α err prob) of 0.97. Figure 4 shows the distribution curve for the results.

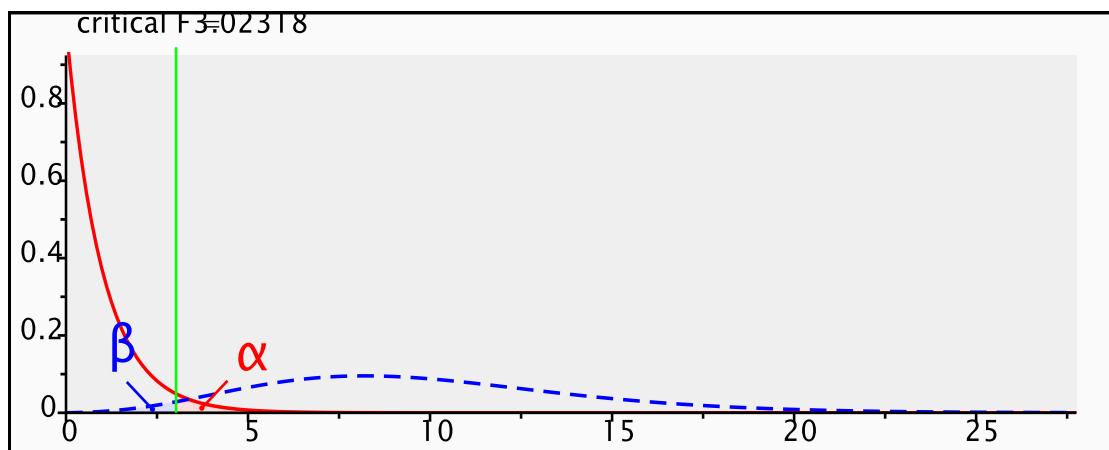


Figure 4: Distribution curve for the number of meals taken per day

Reasons for the most preferred carbohydrate staple by respondents

Respondents were asked to state the reasons for the most preferred and least preferred staples. The aim was to determine satiety effect and factors that influence the choice of carbohydrate staples. The postprandial effect explained by respondents was necessary as an indication of the effect of the carbohydrate staple on satiety. The reasons given for the preferred staple by VAMW were related more to the need for adequate energy due to nature of work, satiety, affordability, and convenience (preparation time/methods), but reasons given by CS and US were more varied and included the nutritional and energy value, availability, affordability, taste, health, convenience/time, satiety, work/learning schedule, culture, ethnicity, and gender (Table 6). The energy value, satiety, convenience, and affordability were explained by all groups, but these factors were most important for VAMW than among CS and US (Table 7). The reasons for the least preferred staple by VAMW were related more to low energy, lower satiety, high cost, health (gluten sensitive) and inconvenience in preparation time and methods, but reasons for least preferred by CS and US were mainly related to taste, cost/affordability, low energy, availability, and convenience (Table 8).

Responses on what happens if they do not eat enough food or when hungry

Respondents were asked to explain the hunger sensation and how they felt when they had not eaten enough or when hungry. This question was the most

challenging part of the questionnaire, since answers were very subjective. Expression of hunger was understood to indicate inadequate food intake. In the responses, most manual workers expressed great fear of hunger while working because of the bad feeling they get when it happens. The combined summary of the responses were: body weakness, lack or low energy, exhausted, dizzy, uncomfortable, thirsty, cannot function properly, can't concentrate, weak joints, fatigued, headache, heartburn, stomach acidity, empty stomach, stomach upset, hunger pangs, unproductive, shivering, anger, don't like talking, worrisome, unwell, hopeless and tend to give up easily, or just "feel like they have not eaten". In such a state work productivity is minimal.

Food energy and activity level

Human survival and ability to sustain work productivity is highly dependent on the ability to balance energy intake, expenditure, and replenishment. The body's energy need is determined by energy expenditure rate, which in turn is related to activity level [23]. Energy changes in the body determine the need and timing for replenishment, which influences the quantity and number of meals consumed per day. Most cells in the body can produce energy, adenosine triphosphate (ATP), from metabolism of dietary carbohydrates, fats, and proteins, but with a mix of these nutrients in the diet, the body cells preferentially use carbohydrates as the primary source of energy [24, 25].

Manual work is characterized by high intensity work involving long durations of regular muscle contractions and energy use. Muscle cells are crucial for body motility during high-intensity physical activities. The VAMW cannot miss a meal due to higher need of energy for their nature of work and for replenishment after strenuous work. The nature of work of VAMW demands adequate provision of food energy. Most manual workers work on temporary basis, earning income based on their productivity or man-days. Inadequate food intake implies less energy and productivity, hence less or no income.

During endurance activities, the body first draws on its muscle glycogen, then once depleted liver glycogen is used [26]. Exercise and diet changes can deplete energy stores, and if not replenished an individual experiences decreased strength to work or continue with any physical activity. The brain uses glucose for energy, beside muscle contraction, hence consuming inadequate carbohydrates in diet may affect concentration, attention span or mental sharpness [27]. Energy can also be derived from proteins, fat, and fibre in the diet, including alcohol. However, most cells preferentially use carbohydrate glucose as the primary source of energy. The results of this study agree with the findings of the studies on nutrition, energy

expenditure and physical activity level by Popkin [2]. The study portrayed a strong correlation between nutrition, labour time and intensity of work. Labour intensive work requires high energy, which may dictate the number of meals taken per day. The importance of consuming some carbohydrates in diet, was emphasized by Kanter [28], indicating that carbohydrates are easier to digest and absorb, and simple carbohydrates are ideal for explosive bursts of energy.

Food glycemic index (GI) and glycemic load (GL)

Glycemic index (GI) indicates how quickly blood glucose level is raised, but glycemic load (GL) refers to both the amount of carbohydrate in the food and how quickly glucose is released and absorbed into the bloodstream, thereby becoming available for cell uptake and energy release [29]. Some foods have high GI with low GL resulting in lower effect on blood glucose level. Processed carbohydrates with low fibre and germ have a high glycemic index (GI) [30], and are digested quickly, but complex carbohydrates take longer to be digested and are slowly absorbed into the bloodstream. The combination of low GL and high GI foods causes very rapid release of insulin into the bloodstream, which is taken up by the cells and once glucose is exhausted, hunger sets in [25]. A low GI and high GL prolongs the release of glucose into the blood stream and insulin response, hence prolonging the satiety feeling.

Food type, satiety and satiation

Satiation and satiety are part of the body's biological control mechanisms triggered by hormones that define our appetite and hunger sensations [31]. Food intake is determined not just by the feeling of fullness or inhibition of eating, suppressing further consumption, but also feeling less energetic for a physical activity. Both factors are important in determining selection of carbohydrate staples and the number of meals taken per day by VAMW. Studies by Benelam [31], Holt *et al.* [32] and Snell [33], indicate that satiety and satiation influence hunger and our ability to consume adequate energy.

Satiety is governed by hormones and stretch receptors in the stomach, while satiation is influenced mainly by the quantity, texture, protein, water and fibre content of the food. Satiety is also defined as the period between the perceived level of fullness after you stop eating to the time when you feel hungry again [34]. Benelam [31] and Karalus [34] explain that the sensation of hunger is triggered by Ghrelin hormone, also regarded as the hunger hormone, which triggers the brain to elevate the motivation to eat (appetite) [32]. Leptin on the other hand, sometimes referred to as the satiety hormone, regulates energy balance and food intake by diminishing the appetite stimulation, and inhibiting the hunger sensation when food



is not needed [31, 34]. Studies by Benelam indicate that the overall energy density of a food or drink appears to have more impact on satiety than the macronutrient composition of foods. In other studies, by Holt *et al.* [32], the comparison of satiety index of different isocaloric foods indicated that foods differ greatly in their satiating capacities, due to water, protein, fibre and fat content. The water-binding ability of starch and soluble fibres could have a specific effect on satiety. Generally, high liquid foods are less satiating than solid food as they tend to have lower energy density. The results of this study are consistent with one of Benelam [31] with regard to satiation and satiety of foods. Some respondents referred to foods with higher water contents as being too light in energy and have lower satiety. Further studies indicated that foods that scored highly on satiety index did not necessarily have to have high energy, and high fibre foods cause greater fullness than low fibre foods [32, 33]. High-fat foods tend to have a higher energy density than high-protein and high-carbohydrate foods, but in terms of bulk carbohydrates are more satiating followed by proteins. Although the study by Holt *et al.* [32] listed low calories as a factor in satiation and satiety index of foods, the subjective responses in this study have confirmed that low calorie food may be satiating, but not hunger combating.

Boiled Irish potatoes, bananas and many roots and tubers are highly satiating foods, but negate the independent effect of glycemic load with regard to satiety. Hence, other components in the staple food- protein and fibre contribute more to satiety index than carbohydrates alone [35]. Findings of this study also agree with the findings of studies by Holt *et al.* [32] and Snell [33] regarding postprandial effect of Irish potatoes and bananas (matoke), which were satiating, but not preferred by VAMW. Irish potatoes were described by VAMW as being too light (low in energy), and not ideal to be consumed prior to labour intensive work (Table 4). In the study by Alfenas and Paiva [36], satiety does not always imply adequate energy consumed and foods with a high Glycemic Index (GI) are not necessarily satisfying. Ingestion of low glycemic index foods resulted in greater satiety and lower energy intake than high glycemic index foods.

Food type and postprandial glucose

Cereals, legumes, roots and tubers, milk, fruits and vegetables contain some amount of carbohydrate and food composition tables are quite useful in determining the carbohydrate content of foods [21]. The study by Kawamura *et al.* [37] argues that the quantity rather than carbohydrate type is associated with postprandial blood glucose level, and perception of foods can also affect intake and satiation [37]. The American Dietetic Association and American Diabetes Association recommend the use of a digital gram scale, as a more accurate

measurement of the amount of carbohydrate in foods [38]. They recommended use of the 'carb factor' as the most precise methods for counting calories. The "carb factor" represents the exact amount of carbohydrate found in 1 gram of food by weight, and corresponds to the amount of carbohydrate that is available to raise the blood glucose level, excluding fibre [4].

CONCLUSION

According to the food exchange theory, foods from the same group can be interchanged to deliver equivalent amount of energy in the body. However, factors such as carbohydrate type, carb factor, load, preparation method, and combination with other nutrients affect the postprandial satiety index. This study explains some stereotypes and claims regarding ethnic staple foods and energy value. It provides empirical evidence regarding the preference and postprandial effect of Ugali compared to other carbohydrate energy staples. The postprandial satiety effect has been shown to be an important factor in the preference of staples by VAMW. Carbohydrates are important, needed before and after intense activity to maintain energy levels and health. Muscles, crucial for body motility during physical activities, require adequate steady energy provision. The type of staple food selected will determine glucose supply rate, satiety index, endurance and alertness during work or physical activity. This study indicates that Ugali is more energy dense. Further, whole grain based foods and/or a combined with protein, fat and fibre can be recommended to support very active manual work. The effect of the low-calorie foods on satiety can be assessed through further blood glucose response studies, which this study did not elucidate.



Table 1: Comparison of rank means of the carbohydrate staples by all groups

ANOVA: Single Factor				
Summary				
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
Between Groups	31.603	5	6.321	64.590
Within Groups	1.174	12	0.0979	
Total	32.778	17		

Table 2: Pairwise comparison of rank means of the staples using Scheffé's test

Pairwise comparison of rank means using Scheffé's 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 3: Results of the mean number of meals consumed per day by each groups

Statistic	Civil servants	University students	Manual Workers
Mean	2.706	2.617	3.009
Range	3	3	2
Minimum	1	1	2
Maximum	4	4	4
Count	119	107	107

Table 4: Analysis of Variance: Significance of differences in number of meals taken per day by the three groups

SUMMARY: ANOVA: Single Factor

Groups	Count	Sum	Average	Variance
Civil servants	119	322	2.706	0.430
University students	107	280	2.617	0.408
Manual Workers	107	322	3.009	0.198

ANOVA						
Source of Variation	SS	df	MS	F	P-value	F crit
Between Groups	9.122	2	4.561	13.089	0.000	3.023
Within Groups	114.986	330	0.348			
Total	124.108	332				

Table 5: Pairwise comparison of mean number of meals taken by each group

Scheffé's critical value = 6.046186

Category	Group mean	Pair comparison	Difference between means	Scheffé's calculated value	Decision
Manual Workers	3.009	Manual workers Vs University students	0.393	23.660	Significant
Civil servants	2.706	Manual workers Vs Civil servants	0.303	14.892	Significant
University students	2.617	Civil servants Vs University students	0.089	1.283	Not significant



MEAL FREQUENCY AND POSTPRANDIAL EFFECT

Table 6:	Reasons for meal frequency by respondents	What happens when you do not eat enough food?
Manual worker	<ul style="list-style-type: none"> It is a routine, timing, Need for energy to work, Due to financial constraints, Activities of the day, nature of work, my energy expenditure suggest so- three meals a day, To stay healthy, enable me to stay strong for long 	<p>I feel fatigue, headache, low energy, heartburn, feel hungry, dizziness, weak, stomach upset, body weakness due to lack of energy, hunger pangs, unproductive, acidity, exhausted, feels normal, feels angry, don't like talking, worries, thirsty, weak, hopeless and tend to give up easily, you just feel like you have not eaten</p>
Civil servants	<ul style="list-style-type: none"> It is just normal routine, I am used to 3 meals, and time, Not a fan of breakfast, There is plenty of food, eat when money is available, Need to get enough energy to work throughout the day, It is because of cash budget, affordability, disposable income, mostly to save money, Being away from home, I prefer lunch, time factor 	<p>Exhaustion, lack of concentration, malnutrition, weakness, dizziness, headache, hunger, loss of energy, I feel like taking more meals within a day than usual, low morale to work, less productivity, slows down interest in energy demanding activity, tired, easily irritable, emaciated, angry, nauseated, moody, sleepy, yawns a lot, lack concentration, am normal, I feel sad, dehydrated, stomach aches, high appetite, stomach feels empty, I feel irritable, weak, lazy and less effective</p>
University Students	<ul style="list-style-type: none"> Three meals a day is normal, just a habit, because most people eat three meals, to maintain energy I believe it is also better eating thrice a day; I am more comfortable having three meals, 3 meals per day is satisfying, Just a preference, I prefer to have three meals per day, I can afford 3 meals a day, food is available, I am under food therapy, eat when I am free. 	<p>I feel dizzy, sleepy, weak, take the next meal as planned, tired, thirsty, low energy, no energy, I can't concentrate, always lose concentration in my daily activities, I worry, weight reduces, uncomfortable and thirsty, lack energy and dizzy, cannot function properly, stomach ulcers, irritable, become angry, irritated, hunger accompanied with discomfort, hunger pangs, growling stomach,</p>

	<ul style="list-style-type: none"> Busy schedule and not having enough time to cook, being too busy with my study in school/I get enough time to study and do other chores limited time, school schedule is quite hectic that I rarely have enough time to sit and have a meal, I got time and I am hungry by then, mostly I don't have time, Laziness or waking up late at times. three meals per day reduces the risk for stomach ulcers, lack of time, I am on weight adding journey, to regain energy, I take three meals because whenever I miss a meal I feel hungry; when I fail to eat, I feel weak and dizzy; Being idle, eating becomes an option (>3 times) <p>1-2 meals: One to two meals because of financial problems; I have to save on what I eat to avoid hunger and depression; I cannot afford two meals a day due to financial reasons body weakness; I find it fit for my day to day activities for instance; I cannot afford three meals a day so I end up having 2; I eat one meal because I do not have enough money, two meals due to workload; not enough time to eat three meals, was taught that way (family norm); too busy most of the time; I don't have enough time to eat every time; being a student to save/economize spending to get energy to run my day and body building</p>	<p>general body weakness, feel weak and bored, weak and not motivated to carry out daily activities, weak and sorrowful, desperation and anxiety, I am less productive, I feel uncomfortable and restless, weak joints, risk of ulcers, I become lazy, feel lazy, inactive and dizzy, headache, loss of energy is faster, I may faint, I feel not satisfied, feel hungry more often and ends up eating a lot of snacks, unwell, my day is dull, tiresome, lack concentration in class, no psyche to do anything, get emotional, cranky, feel somehow sick, I get the urge to eat again, loss of weight, hopeless and tend to give up, I don't like talking</p>
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Table 7: Reasons for ranking most preferred carbohydrate energy staple

	Manual Workers	University Students	Civil Servants
Ugali	Ugali has more energy, energy giving, strong, heavy work, strength, healthy food, , it is filling(satiation), readily available, lasts longer before feeling hungry, (Satiety) feels hungry after 3 hours (satiety index), less time consuming in preparation and easy to cook, occupation requires a lot of energy, sustainability, culture (men eat Ugali), man's culture, makes me strong, it is a routine practice, stable food, I am an African "Jua kali man" (meaning casual labourer working in informal sector), easy to cook, easy to prepare (cooks faster saving time and energy), cheaper and mostly cooked well in many hotels, can	Ugali-Easily available, cheaper, routine, weight of work, maize is not grown in my home county, cost friendly, Ugali is cheaper in my home area making it the preferred food, Ugali is readily available since Bungoma is a maize producing county, maize is readily available and cheap. Ugali provides more energy and easily available, Ugali provides a lot of energy to the body, it is delicious, makes me full, because family invests in this food, quite affordable and accessible, easily available at your disposal, Ugali is energy giving, I love eating Ugali since it is mainly cheap, easy to make, cooks fast and less time consuming, not boring food, can be eaten every day, goes well with or can eat with a variety of accompaniments, it is convenient, Good complementarity with other foods	Ugali is bulky, it is satisfying, my staple food, nutritious, cheap, heavy meal, readily available, tasty, my preference, due to culture, work load, it is palatable, prefers "kienyeji food" (traditional food), easy to make and can go with a variety of combinations, Ugali is cheap to make and has many accompaniments

	get it anywhere at very cheap price.		
Chapati	It is delicious, sweet, heavy work, does give energy, satisfied for long, feel satisfying	Chapati is readily available and at cheaper cost, chapati goes well with various foods, I prefer chapati because it is cheap, easy to get, efficient, tasty, sweet and easy to prepare, just preference, chapati is alternative to Ugali since it is energy giving, does not affect my health	Best preference of my dishes, affordability, doesn't have a lot of sugar,
Rice	It is light, It is delicious	Rice is commonly available and cheap, easy to digest, I like rice because it is easy to cook, it is not hard, it can't bring tooth problem, rice is light and does not cause bloating, it is easily available and light, I just love rice, I prefer it because it is the best for me, rice is ready to cook and yummy!	Delicious, easy to cook, preferred by most of my family members, goes along with many stews, price is pocket friendly
Irish potatoes		Irish potatoes are tasty, sweet, it is delicious,	
Bananas		Bananas enhance digestion,	Readily available, staple food, acts as a fruit and staple food too, banana is healthy,
Others			Githeri- easy to prepare, readily available, cultural preference, its balanced, easy to store when cooked

Table 8: Reasons for ranking least preferred carbohydrate energy staple

	Manual Workers	University Students	Civil Servants
Ugali		Ugali takes more time to prepare, Ugali is least preferred because it is more expensive compared to chapatti, sometimes Ugali is poorly cooked, I don't love Ugali	
Chapati	Wheat is not favourable to my health, too much wheat adds a lot of weight, takes time to prepare, not energetic, chapatti involves a lot of work, Chapatti least preferred because of nature of preparation and also expensive	Chapatti is mostly carbohydrate and fat which is not very healthy when consumed regularly,	I dislike wheat flour (chapatti), hard to prepare, requires a lot of time
Rice	I believe that it is not food, but just appetizer, ulcers, men do not like it, easily digested, needs spice to spice it, rice is too light for my type of work. rice is expensive and cannot hold stomach for long, rice is like water	Rice is too expensive and cannot make you feel full for long, I hate rice, it does not make me full, rice is too weak, I consider it as low nutritive value food	Rice- does not taste good, not satisfying, too light to maintain any occupation



Irish potatoes	Dislike, light food/ too light, not common in our area, gives less energy, not satisfying, it cannot be taken alone, expensive, not palatable, it is a vegetable	Irish potatoes- Used to feed on I/Potatoes a lot when I was young hence, I got bored feeding on them, least in energy, light food which does not give enough energy, not satisfying, not filling, least available, costly, I got bad childhood experiences, not satisfying, potatoes are very expensive, I am from central community therefore I have consumed enough of potatoes, because of ulcers, feels food dehydrates the body, not a comfortable food, causes flatulence, Irish potatoes rarely come (found, sold) where I stay so I am not used to it, Irish potatoes not readily available or obtained, least preferred because it lacks consistency in pricing- sometimes expensive, sometimes cheap, moreover I/Potatoes cannot fulfill daily diet that I usually observe, Only indulge in occasionally, like when I am treating myself, Irish potatoes affects concentration, Irish	Irish Potatoes- It is cooked in a lot of oil (chips), provides less energy, dislike potatoes, not filling, not readily available, gives heart burn, culture preference, its baby food, feels like it dehydrates the body, it is not a comfortable meal, because of gas (flatulence)
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		<p>potatoes are for breakfast, I don't quite like Irish potatoes because of its taste and it is not my favorite, rarely consume Irish potatoes, Light in energy, Irish potatoes do not satisfy the standard expected and not readily available, do not like Irish potatoes and bananas,</p>	
Bananas	<p>It is a fruit, hard to acquire, simply dislike, cost, causes heartburn, I overate when young, not very nutritious compared to the rest of the foods, banana and I/potatoes are not that much available, I/potatoes and bananas are very expensive, not easily available, rarely consume bananas</p>	<p>Bananas not easily available, not convenient, not satisfying, bananas not yummy, feel hungry too fast, no energy, I am not that much interested in bananas, I hate bananas, simply don't like bananas, bananas are more for commercial purposes, banana is expensive, low quantity, bananas are expensive for nothing, bananas are not affordable in the market because they are mostly found in rural areas and when transported to urban areas they tend to be quite expensive. In addition, they cannot feed a family with many people because much quantity is needed, banana is fruit you can</p>	<p>It is expensive, not delicious, has less energy, not in my culture, not used to it, food intolerance, because children cannot eat it, need to eat a lot and cannot afford</p>

		live without it, lack of enough money, lack of knowhow to cook, light food as it won't last long. Banana not tasty, expensive, sick, more time to cook,	
Others			Githeri- has less energy, does not last long

REFERENCES

1. **Bender DA** Introduction to Human Nutrition and metabolism, 5th ed. CRC Press Book, 2014.
2. **Popkin BM** Nutrition and labor productivity, *Soc. Sci. Med. Med. Psychol. Med. Sociol.* 1978; vol. **12(3–4)**: 117–125. [https://doi.org/10.1016/0160-7979\(78\)90168-6](https://doi.org/10.1016/0160-7979(78)90168-6)
3. **Westerterp WD** Exercise, energy expenditure and energy balance as measured with doubly labelled water, in *Proceedings of Nutrition Society* 2018; **77(1)**: 4–10. <https://doi.org/10.1017/S0029665117001148>
4. **National Institute of Diabetes and Digestive and Kidney Diseases.** Carbohydrate counting and diabetes, 2014. <https://www.niddk.nih.gov/> Accessed December 11,, 2020.
5. **Rosset R, Lecoultrre V, Egli L, Cros J, Dokumaci A, Zwygart K, Boesch C, Kreis R, Chneiter P and L Tappy** Postexercise repletion of muscle energy stores with fructose or glucose in mixed meals, *Am. J. Clin. Nutr.* 2017; **105(3)**: 609–617. <https://doi.org/10.3945/ajcn.116.138214>
6. **Leslie CA** The Evolution of Human Nutrition, 2013. <https://doi.org/10.1016/j.cub.2013.03.061>
7. **Kwon DY** What is Ethnic Food?, *J. Ethn. Foods*, 2015; **2(1)**. <https://doi.org/10.1016/j.jef.2015.02.001>
8. **Dorodnykh E** Economic and Social Benefits of Increased Food Self-Reliance. In: Economic and Social Impacts of Food Self-Reliance in the Caribbean. 2017. Palgrave Macmillan, Cham. https://doi.org/10.1007/978-3-319-50188-8_4
9. **Lockwood WG and YR Lockwood** Ethnic cuisines, Ethnic cuisines. Encyclopedia.com, 2020, [Online]. Available: <https://www.encyclopedia.com/food/encyclopedias-almanacs-transcripts-and-maps/ethnic-cuisines> Accessed November 12, 2021.
10. **Pariona A** What are the world's most important staple foods?, 2019.
11. **O'Leary M** Maize: From Mexico to the world, 2016. www.commyt.org Accessed January 07, 2020.

12. **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 February 20, 2020.
13. **Government of Kenya.** Kenya Peoples and cultures, MEAC, 2019. <http://meac.go.ke/kenya-peoples-and-cultures/> Accessed February 20, 2020.
14. **Wanjala WA, Onyango A, Makayoto M and C Onyango** Indigenous technical knowledge and formulations of thick (ugali) and thin (oji) porridges consumed in Kenya, 2016;10(12): 385–396. <https://doi.org/10.5897/AJFS2016>
15. **Jetter K and D Cassidy** The availability and cost of healthiers food alternatives, *Am. J. Prev. Med.* 2006; 38–44. <https://doi.org/10.1016/j.amepre.2005.08.039>
16. **Government of Kenya.** National Food and Nutrition Security Policy Implementation Framework (2017-2022). Nairobi: Agricultural Information Center 2017.
17. **Mbilu S** Unga Protesters. Kenya: Citizen TV, 2011.
18. **Kipsang W** Stern Warning to Millers on Sh 2b Unga Subsidy scheme, Kenya 2017.
19. **n.d** The history of Kenya's staple dish, Ugali dating back to the 19th century, See Africa Today 2019.
20. **Bluman AG** Elementary statistics: A Step by Step Approach, sixth edition. New York: McGraw-Hill Education, 2014.
21. **Food and Agricultural Organization and Government of Kenya.** Kenya Food Composition Tables, 2018. <http://www.fao.org/3/i8897en/I8897EN.pdf> Accessed April 12, 2020.
22. **Sehmi JK** National Food Composition Tables and the Planning of Satisfactory Diets in Kenya. Nairobi: Government Printers, 1993.
23. **Tanhoffer RA, Tanhoffer A, Raymond J, Hills AP and G Davis** Comparison of methods to assess energy expenditure and physical activity in people with spinal cord injury, *J. Spinal Cord Med.* 2012; 35(1): 35–45. <https://doi.org/10.1179/2045772311Y.0000000046>

24. **Kanter M** High-Quality carbohydrates and physical performance, *Nutr. Today* 2018; **53** (1): 35–39. <https://doi.org/10.1097/NT.0000000000000238>
25. **Jensen J, Rustad PI, Kolnes AJ and Y Lai** The Role of Skeletal Muscle Glycogen Breakdown for Regulation of Insulin Sensitivity by Exercise, *Front Physiol.* 2011; 2. <https://doi.org/10.3389/fphys.2011.00112>
26. **Murray B and C Rosenbloom** Fundamentals of Glycogen Metabolism for Coaches and Athletes, *Nutrition Review* 2018; 321–330.
27. **Watts M, Pocock R and C Claudianos** Brain Energy and Oxygen Metabolism: Emerging Role in Normal Function and Disease, *Front. Mol. Neurosci.* 2018; **11**(12). <https://doi.org/10.3389/fnmol.2018.00216>
28. **Kanter M** High Quality Carbohydrate and Physical performance, *Nutr. today* 2018; **53**(1): 35–39. <https://doi.org/10.1097/NT.0000000000000238>
29. American Diabetes Association. Food Exchange Lists for Meal Planning, 2003. https://diabetesed.net/page/_files/THE-DIABETIC-EXCHANGE-LIST.pdf Accessed March 20, 2020.
30. **Putri RK, Saraswati LD and MS Adi** Dietary carbohydrate intake and fasting blood glucose among people visit non-communicable disease risk factor surveillance in Puskesmas Kedungmundu, 2017; **5**(1): 207–211.
31. Benelam B Satiety, Satiety and their effects on eating behaviour, in *Nutrition Bulletin*, 2009; 126–173. <https://doi.org/10.1111/j.1467-3010.2009.01777.x>
32. **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.
33. **Snell H** satisfying foods: 75 most filling foods for weight loss, 2018. https://youtu.be/_npUP11jEXw Accessed April 07, 2020.
34. **Karalus MB** 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. https://conservancy.umn.edu/bitstream/handle/11299/113165/1/Karalus_umn_0130E_12101.pdf Accessed April 07, 2020.

35. **Adamska-Patrunka 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>

36. **Alfenas R and E Paiva** Effect of glycemic index on satiety and body weight, *Revista de Nutricao*, 2007; **20**(2): *Revista de Nutricao*, 97–202. <https://doi.org/10.1590/s1415-52732007000200009>

37. **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>

38. **American Diabetes Association and American Dietetics Association.** Exchange lists for meal planning, 2003. <https://diabetes.org/> Accessed December 11, 2020.