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Assessment of nutritional status of the population in Senegal

Master´s thesis

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Food and Nutrition

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Declaration

I hereby declare that I have authored this master's thesis carrying the name „Assessment of nutritional status of the population in Senegal "independently under the guidance of my supervisor. Furthermore, I confirm that I have used only professional literature and other information sources that have been indicated in the thesis and listed in the bibliography at the end of the thesis. As the author of the master's thesis, I further state that I have not infringed the copyrights of third parties in connection with its creation.

In Prague on 11.04.2022 _____

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Assessment of nutritional status of the population in Senegal

Summary

Despite experiencing economic growth from 1995 to 2005 and being the second-largest economy in French-speaking West Africa behind the Ivory Coast, Senegal is still facing several nutrition-related issues commonly found in developing countries, as well as a noticeable disparity among parts of the country, especially between urban and rural areas.

This master's thesis aims to make a comparison between the nutritional status of the population of urban and rural areas of Senegal and to compare it to the one of the Czech population, but also to several recommendations such as DACH, EFSA, and food pyramids.

The data was collected using a food frequency questionnaire, which was distributed in Dakar, the capital city of the country, and in Velingara, a rural area located in the Kolda region in the south of the country. Additional health-related questions were also asked.

The study findings were that dietary recommendations from DACH and EFSA were met at almost all levels by rural respondents except for vitamin C, while respondents from Dakar were below recommendations for several nutrients, including magnesium, calcium, vitamin A, vitamin D, vitamin E, fibers and overall calorie consumption. Consumption of vegetable sources of protein was higher among rural respondents than urban. The comparison with food pyramids showed that sweets and animal products were overconsumed overall compared to plant products in both areas. Comparison with data from the Czech Republic showed an overall lower consumption of most food groups among the Dakar population except for legumes and nuts, sweets, and juices; and an overall higher consumption of food groups from respondents from Velingara except juices, grains, tubers, and fruits.

In conclusion, most nutritional recommendations were met by both localities, but some micronutrients were found in deficit, especially in Dakar. The nutritional status of the urban population of Senegal was rated as worse than the one of the Czech Republic, while the one of the rural population was better compared to the one of the Czech Republic.

Keywords: food consumption, nutrition, health, malnutrition, West Africa, nutritional recommendations

Contents

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1 Introduction

Nutrition is the cornerstone for sustainable development, both at the individual and national levels. It is therefore everyone's business. Malnutrition in all its forms (undernutrition, micronutrient deficiencies and overnutrition) is widely recognized as one of the most widespread and pernicious causes of human suffering worldwide. It is a burden especially in developing countries where it remains a serious obstacle to economic growth and social progress with consequences for both individual and community well-being.

Senegal, like other Sahelian countries, faces the double burden of malnutrition. Data from the latest Demographic and Health Survey estimates that 9 percent of children under five years of age suffer from acute malnutrition. Chronic malnutrition affects 17 percent of children, or nearly one child in five (ANSD 2017).

In addition to climatic variations and the low level of knowledge in nutrition, behavioral problems are among the factors that aggravate malnutrition in Senegal. In order to address these issues, it is necessary to inform and educate the population on practices that promote good nutrition using appropriate materials.

In order to feed themselves adequately, families must have sufficient resources to produce and purchase enough food. They must also have the knowledge and motivation to make good decisions about food and care practices. Whether the food supply is adequate or not, it is essential that households know how to make the best use of their resources to obtain a variety of good quality, healthy foods. Nutrition education is therefore an important means of improving nutrition in populations. It is particularly important in developing countries such as Senegal, where traditional knowledge alone is often no longer sufficient to meet the new challenges of rapid and profound social and economic change.

This thesis aims to understand and assess the nutritional status of the Senegalese population, to compare the nutritional differences between urban and rural areas in the country and to rate the nutritional status according to European standards.

2 Scientific Hypothesis and Aims of the Thesis

The hypothesis of this thesis is that the dietary intake of the population in Senegal did not correspond to the dietary recommendations. The body mass index of the population in Senegal was higher than recommended.

The aim of the theoretical part of the thesis was to summarize the current knowledge about eating habits and the nutritional status of the population in Senegal. In the practical part, the comparison of real dietary intake and selected anthropometrical parameters with recommended values was evaluated. Based on the results, recommendations were suggested to improve the nutritional habits of the Senegalese population.

3 Literature Review

3.1 Senegal

3.1.1 General information

Senegal is located in the westernmost part of Africa and is bordered by Mauritania, Mali, Guinea and Guinea-Bissau. It itself surrounds Gambia, an English-speaking country with one of the smallest surface on the African continent. The location of the country is shown in the Figure 1. Senegal land area is approximatively 197,000 square kilometers. Senegal has 15.7 million inhabitants in 2018 including 7.896 million women (50.2%) and 7.829 men (49.8%). Nearly a quarter of the Senegalese population live in the capital region, Dakar, on 0.3% of the territory (ANSD 2019).

Figure 1 Map of the Senegal (Source: Encyclopedia Britannica 2022)

Senegal is located in the intertropical zone, experiencing a hot and sunny climate. The dry season is from October to June, and the rainy season from July to September (Roudier et al. 2014). From north to south, the climate changes from Sahelian (up to 35 cm of rainfall per year) to Sudanese (more than 1 m of rainfall per year) (FAO, 2021)

According to Encyclopedia Britannica (2022), the Sahelian climate is located between the Senegal River in the North and a horizontal line going from Thiès to the border of Mali. The weather is generally in January, especially in the mornings before sunrise, with an approximate temperature of 14 °C. Afternoon temperatures are significantly higher, reaching up to 35 °C. However, in May the temperature reach a minimum of 22 °C and maximums can often top 40 °C. The dry season is quite distinct and lasts from November to May. Northern parts close to the border of Mauritania such as Podor and Matam, are particularly dry with high temperatures. The rainfall between July and October is on average around 360 mm, moderating the temperature. The maximum temperature is 35 °C.

The Sudanic zone in the southern half of the country has an overall hot and humid climate. Annual precipitation is much higher than in the North of the country. Indeed, rainfall averages between 740 mm and 990 mm in the Kaolack-Tambacounda area, mainly occurring on about 60 days, between June and October, allowing cultivation without irrigation. Annual rainfall in the Gambian area can go up to 1,270 mm, which can induce the growth of a continuous belt of light forest and groups of herbaceous undergrowth. In the southern part of Casamance, it exceeds 1,270 mm, for up to 90 days of the year. The forest there is dense, green, and continuous, without undergrowth, and oil palms, mangroves, and rice fields are characteristic (Encyclopedia Britannica 2022).

Some 39 languages are spoken in Senegal including French, the official language of the country. African languages spoken in the country can be divided into two main families: Atlantic, generally found in the western half of the country, and Mande usually found in the eastern half of the country. Atlantic languages contain the languages most widely spoken in Senegal: Wolof, Serer, Fula, and Diola. Mande languages include Bambara, Malinke, and Soninke (Bonvini & Houis 2022).

3.1.2 Political situation

Since its independence in 1960, Senegal has had stable internal geopolitics compared to that of most other African countries (Dumont & Kanté 2019). Thus, in more than half a century of independence, Senegal has never known either a military regime, domination of political life by the military, or a dictatorship. Its political and geopolitical situation is marked by a civil harmony that contrasts with many African countries. Senegal is one of the most stable countries in Africa because there has never been a coup, and the "Senegalese model" was often put forward in the past, even if political arrests can still occur in the country (Brossier 2019).

Senegal has experienced since 1960 three major political alternations, which all happened in peaceful terms. The current president of the country is president Macky Sall who has been in power since 2012 and won a second term in February 2019, a second term that is supposed to last until 2024 due to the fact that the presidential mandate has been reduced from seven to five years since the referendum of March 2016 (World Bank 2021)

3.1.3 Economic situation

Senegal's economy has experienced growth from 1995 until 2005, before slowing down. After a devaluation of its currency in 1994, and thanks to a series of structural reforms and better management of public finances which stimulated exports of the main products such as peanuts and phosphate, Senegal's Gross Domestic Product (GDP) grew by an average of 4.4 % per year between 1995 and 2005. This increase is greater than the annual population growth over the same period, which translated into an average annual growth of GDP per capita of 1.8 % (World Bank 2015). Senegal is the second largest economy in French-speaking West Africa behind the Ivory Coast. However, problems of employment, cost of living, quality of public services, supply and cost of electricity, and water supply remain the primary concerns of Senegalese. Since 2005, various shocks including the food, oil, and financial crises of 2008, and a series of droughts experienced in 2006, 2007, and 2011 (WFP 2014; World Bank 2015) have, among other factors, led to erratic economic performance marked by annual GDP growth of 3.2 %, barely enough to keep pace with population growth, and stagnation in per capita GDP growth which even recorded negative values in 2006, 2009, and 2011.

Senegal's population grew at an accelerated rate between 2002 and 2013, an increase supported mainly by population growth in urban areas and in the western and central regions. Between the two main censuses of 2002 and 2013, the population increased by almost 50%, or an average annual growth of 2.5% (ANSD 2014). The estimated average annual population growth of 3.5% in urban areas over the same period is twice as high as that estimated for rural areas, which partly reflects the well-documented massive rural exodus that the country has known (Gueye et al. 2015). In addition, the population is very unevenly distributed among the regions of the country.

Thanks to the trends in the country's economic performance over the period 2000 to 2011, the number of people affected by poverty fell considerably between 2001 and 2005, before stagnating between 2005 and 2011. The number of people affected by poverty, compared to at the national poverty line, fell from 55.2 % in 2001 to 48.3% in 2006, then to

46.7% in 2011 (ANSD 2013). Poverty reduction during the 2000s was mainly an urban phenomenon, especially during the first half of the decade, with the Dakar Region recording the largest decline ranging from 38% in 2001 to 28% in 2006. In 2011, as a consequence of the smaller reduction in the number of poor people in rural areas over the same period, going from 65% in 2001 to 59% in 2006, and a general stagnation of poverty everywhere during the second half of the decade, the poverty prevalence in Dakar was almost half of the prevalence recorded in rural areas (ANSD 2014).

Between 2014 and 2018, Senegal recorded one of the strongest economic growths in Africa, always exceeding 6% per year. GDP growth stood at 5.3% in 2019, against 6.3% in 2017. That growth is mainly driven by the tertiary sector of the economy, while, on the demand side, the main drivers of growth are investments with + 12.5% and exports with + 7.2%. The coronavirus pandemic has however significantly impacted that growth, creating an economic drop of 1.3% in 2020 (World Bank 2021).

3.1.4 Differences between urban and rural areas

As indicated in the following Figure 2, Senegal has an important disparity of population regarding its regions.

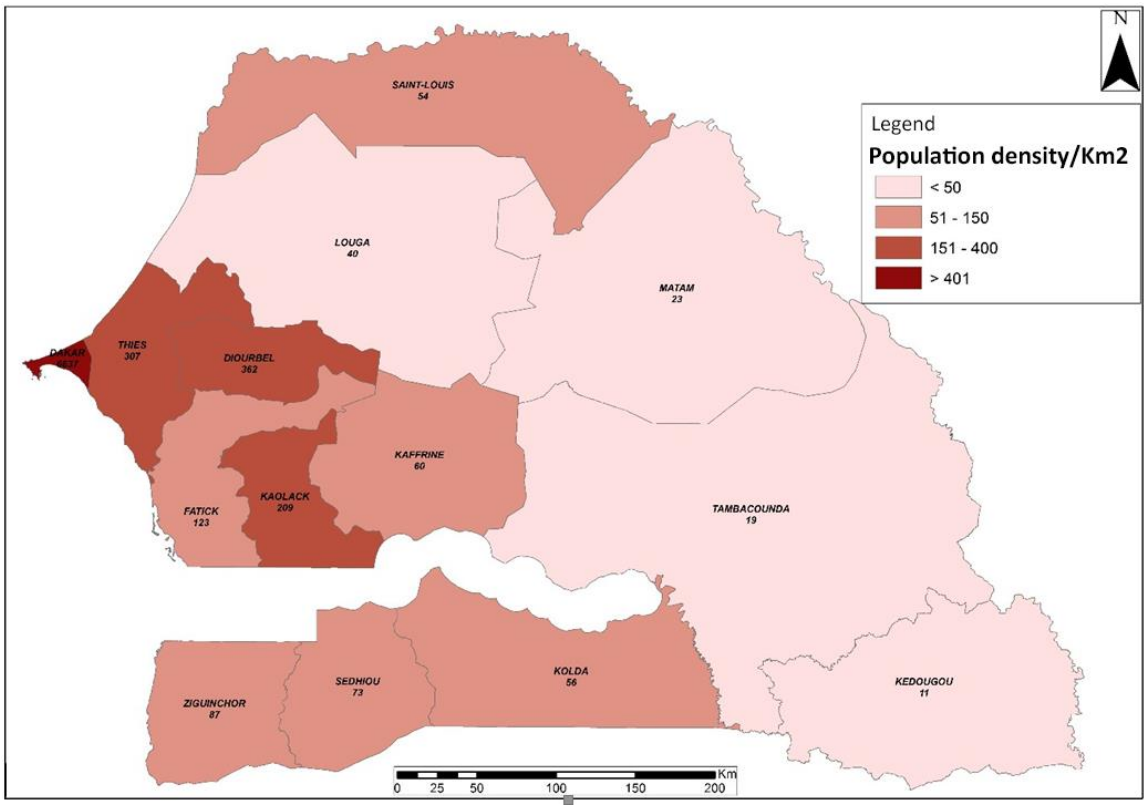


Figure 2 Density of population per km^2 in 2018 (Source: ANSD, Population du Sénégal, February 2019)

According to ANSD (2019), almost a quarter of the Senegalese population lived in Dakar in 2015 (23%), despite the fact that the region has the smallest area in the whole country: 547 km^2, in other words, 0,3% of the country´s total surface. More than one in five Senegalese resided in Dakar in 2015.

The Senegalese population tends to migrate from rural to more urbanized areas. According to ASND (2019), 25% of the Senegalese population was living in the urban areas in 1960 against 46% in 2015. Urbanization in Senegal hides significant interregional disparities. Indeed, it is a phenomenon much more present in the regions located in the west of the country, which is the regions where the density of population is the highest (Figure 2). The following Table 1 shows the urbanization rate in percentage in Senegal regions.

Table 1 Distribution of the population according to place of residence in 2015 (ANSD 2018)

Regions	Urban Population	Rural Population	**Total Population**	Urbanization Rate (%)
Dakar	3 210 787	119 905	3 330 692	96,4
Diourbel	256 246	1 335 346	1 591 592	16,1
Fatick	125 682	636 028	761 710	16,5
Kaffrine	101 200	508 438	609 638	16,6
Kaolack	370 861	650 795	1 021 656	36,3
Kédougou	42 322	119 211	161 533	26,2
Kolda	190 019	513 755	703 774	27,0
Louga	208 836	715 215	924 051	22,6
Matam	143 306	463 922	607 228	23,6
Saint-Louis	449 116	508 486	957 602	46,9
Sédhiou	101 591	382 177	483 768	21,0
Tambacounda	178 235	552 238	730 473	24,4
Thiès	946 550	942 771	1 889 321	50,1
Ziguinchor	273 674	309 853	583 527	46,9
SENEGAL	6 598 425	7 758 140	14 356 565	46,0

It shows that almost all the population of Dakar is urbanized. Indeed, 96% of the population living in the region of Dakar is in an urban area. The urbanization rate is also non neglectable in regions like Thiès, Ziguinchor or Saint-Louis. However, the biggest part of the population of other regions such as Diourbel, Fatick, or Kolda is living in rural areas

(Table 1).

The differences in terms of poverty rate between Senegalese regions are shown in the following Figure 3.

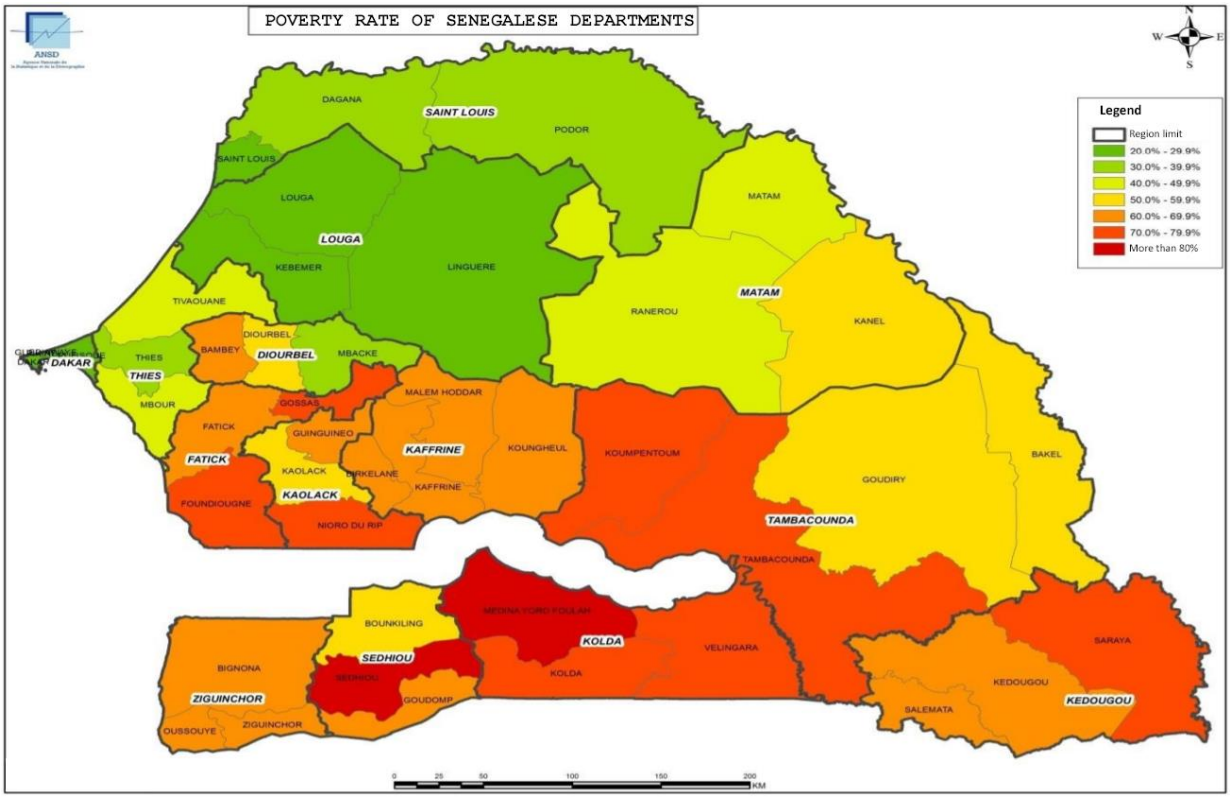


Figure 3 Poverty map of Senegal per percentage at department level (Source: ANSD 2016)

The Figure 3 undeniably shows an unequal disparity between the northern and southern parts of the country. Poverty tends generally to increase from northwest to southwest apart from Dakar. While being the most urbanized region of the country, the capital has the lowest poverty rate with Louga. Kolda however has the highest percentage of poor population in the country.

Figures 2 and 3, and Table 1 confirm that Senegalese people tend to agglomerate in more urbanized, richer areas, mainly in the upper western parts of the country.

3.1.5 Senegalese cuisine

Senegalese cuisine is often described as one of the richest and most varied in West Africa. It has some similarities with those of other West African countries, but it has also undergone other influences: North Africa, France or Portugal (Lynch 2018).

3.1.6 Ingredients used

The proximity of the Atlantic Ocean gives fish a place of choice in local preparations (Destain et al. 2010). The most famous is *Epinephelus Aeneus* or white grouper with firm and fine flesh. But the country's fishery resources are numerous and varied. The fish is sometimes braised, smoked, dried and / or salted and fermented, in particular to make a condiment, the guèdje. Thanks to the mangroves in particular, quality seafood is also often used: mangrove oysters - cooked over a griddle -, crabs, spider crabs, sea cicadas, octopus, lobsters, prawns, shrimps.

Figure 4 Senegalese seafood (Source: Tripadvisor 2022)

Meat is not necessarily part of the main course, especially in the poorest regions. In addition, Fulani herders, for example, hardly eat the animals of their herd, which are primarily intended for milk production. Due to its economic value, chicken often replaces other meats, even though about 70% of animal protein consumed in Senegal is marine fish, with an annual consumption of almost 30 kg per capita (Arnoldus et al. 2020). Sheep, beef and/or goat meat are also consumed depending on the region. On the other hand, due to rare Christian regions, pork consumption is not very common.

Cereals are the staple food in most of the country. Millet (dougoub) is prepared in porridge, in balls, or in the form of couscous. It however takes a long time to cook in large pots.

Fonio is a rustic and undemanding cereal, but endowed with nutritional qualities, found mainly in eastern Senegal. Its preparation is similar to millet.

Figure 5 Millet flour **(**Source: Wikipedia 2020)

Traditionally cultivated in Casamance, rice has been more recently been grown in irrigated areas along the Senegal River. It is however often imported from Asia. Its grains are generally short or broken, which is highly more demanded than long rice (Brüntrup et al. 2006).

As market gardening is generally dependent on irrigation, the vegetables consumed in large cities come mainly from the Grande-Côte (that is to say from the section of the coast between Saint-Louis and Dakar), more precisely of the hills called Niayes. A variety of tropical fruits is also produced in the south of the country: mango, citrus, papaya, guava, banana etc. However, supplies are sometimes limited or of modest quality in the dry season (Gueye et al. 2014). Tomatoes are one of the most common vegetables in Senegal and cans of concentrated tomatoes are often used.

Some vegetables seem quite familiar internationally, such as cabbage, carrots or eggplant. Others are less so like okra, oblong and fibrous green vegetables that are eaten in a sauce with rice or sometimes used as vegetables, cowpeas, small black-eyed beans, very rich in protein, cassava roots. Cassava leaves are however consumed less than in other West African countries.

Figure 6 Okra (Source: Labone Express 2020)

Figure 7 (Source: Healthline 2020)

Raw, boiled, roasted, salted or sweet peanuts are often sold on the street, as well as are cashew nuts.

3.1.7 Senegalese dishes

We can locate different recipes according to the geographical areas of Senegal. Each region therefore has its specialties, but most dishes are eaten indiscriminately throughout the country. Here is a non-exhaustive list of some of the most popular dishes:

Thiep bou dien: invented by Penda Mbaye, a 19th century cook in Saint-Louis, it is the national dish of the country (Belhabib et al. 2014). In Wolof, thiep bou dien literally means "rice with fish". It is indeed a preparation based on fresh fish, dried fish, yeet (fermented and dried pheasant mollusk flesh with a pronounced taste) and rice, cooked with vegetables (cassava, pumpkin, cabbage, carrot, turnip, eggplant…), parsley, tomato paste, peppers, garlic and onions. There are two variants: the red thiep bou dien (the most famous) called thiep bou xonq (red rice) cooked with tomato and sometimes accompanied by a sauce called “souwer” and composed of small fried fish balls simmered in a tomato sauce with onions and macedonia, and white thiep bou dien called thiep bou weex (white rice) where there will be almost no tomato. Tieb bou wekh will often be accompanied by a kind of whipped sauce made from guinea sorrel leaves called “beugueudj” and a preparation with a rather characteristic taste made from nététou (fermented fruits of the néré) called “soule”.

Figure 8 Thiep bou dieun (Source: wanacorp.fr 2016)

Chicken yassa (yassa guinar). From the southern region of Senegal, chicken yassa is one of the most well-known meals of the country and one of the most common (Duteurtre et al. 2005) . The chicken, cut into pieces, is first marinated (traditionally overnight) with onions, the juice of several limes supplemented with as much vinegar and peanut oil, then grilled over a wood fire and finally gently cooked in its marinade. It is served with white rice, if possible diola rice. Yassa can also be prepared with sheep or fish.

3.2 Dietary guidelines

The dietary guidelines aim to lay the foundations for the development of public policies in food, nutrition, health and agriculture and nutritional education programs, which promote healthy eating habits and lifestyles. Using short, positive, science-based messages showcasing healthy food and lifestyle choices, the dietary guidelines educate the general public about foods and eating habits that provide everyone with the nutrients they need for their health. promote good health and prevent chronic disease.

Globalization and the increasing urbanization of the planet have increased the importance of dietary guidelines (Mendez & Popkin 2004). Changing food systems and lifestyles have resulted in a change in eating habits and the loss of traditional food cultures in favor of quick meals and food products with low nutritional value. Diet is essential for health, which is why these guidelines are an important tool in forging healthy eating habits and preventing diet-related noncommunicable diseases (including type II diabetes, cardiovascular disease and certain types of cancer) (Shikany & White 2000).

3.2.1 Dietary standards

They are called Dietary Reference Values (DRVs). The values indicate how much nutrients should be consumed daily to ensure the health of the individual or the entire population. They are made by specialists based on scientific studies. These standards include:

- Population Reference Intakes (PRI): the amount of nutrients whose daily consumption leads to the provision of needs of virtually all people in a population group.
- Average Requirement (AR): The amount of nutrients needed to ensure the health of half of the individuals in a certain age group.

- Lower Threshold Intake (LTI): The amount of nutrients below which, intake is not sufficient for almost the entire population to ensure proper metabolic function.
- Adequate Intake (AI): If the PRI cannot be determined because an average requirement cannot be found, the AI is instead determined. It is the average daily intake of nutrients sufficient to ensure health in healthy individuals in the population characterized as adequate.
- Reference Intake ranges for macronutrients (RI): Macronutrient intake expressed as percentage of energy intake. The values are sufficient to ensure health and a low risk of chronic diseases.

3.2.2 General dietary guidelines

General dietary guidelines generate nutritional standards in a way that is understandable to the general public. Each country usually issues its own recommendations based on an assessment of the nutritional deficiencies of the population. They deal with the determination of individual nutrient and energy requirements, as well as recommendations for BMI or maximum and minimum amounts of various nutrients. They tend to be understandable to the general public, but some may be difficult to understand, which is why Food Based Dietary Guidelines (FBDGs) are then developed to make understanding easier (Herforth et al., 2015)

3.2.3 Food Based Dietary Guidelines (FBDG)

They are based on the division of food into different groups, such as fruit and vegetables. It is important to determine how often and what portion is appropriate to consume. This method of dietary information should be easily understandable by the general public. Therefore, visual representations are often used to describe it (EUFIC 2009).

A well-known illustration of the recommendations is the food pyramid, where the groups are ranked in descending order according to the frequency of their suitability for consumption. The base of the pyramid is made up of foods that should be consumed most frequently, followed by foods with a lower frequency of consumption, up to the exceptional foods at the very top of the pyramid (EFSA 2010). Pyramids are often used at the national level. More recently, recommendations for physical activity and drinking are also included in the food pyramid.

Another graphic alternative is the food plate, which shows the recommended amounts of each food group. The plate is divided into several sections: fruit, vegetables, whole grains and

proteins from plant (legumes and nuts) and animal sources. Recommended drinking intake and consumption of dairy products are also usually included.

In order to enable the consumer to correctly estimate the portion size in practice, additional auxiliary rules have been introduced. A serving size is matched, for example, to the size of a fist or palm (Gibson et al. 2016).

3.2.3.1 Recommendations for the Senegal

The FAO gave some nutritional recommendations for the Senegalese population (Kwadjode et al. 2020). Among the mentioned recommendations are included:

- Eat several fruits, vegetables or leaves a day to help prevent disease
- Moderate the consumption of oils and fats, sweets, and sugary drinks
- Drink enough water, especially in period of heat
- Having a varied and diversified diet to have a better coverage of the nutritional needs
- Emphasize the consumption of locally available foraged products.
- Consume legumes (cowpeas, lentils, chickpeas, etc.) as alternative foods
- Eat foods fortified with micronutrients (oil fortified with vitamin A, iodized salt and flour fortified with iron)
- Cook red meats thoroughly to kill microbes or parasites and facilitate their digestion
- Reduce cooking time as much as possible, especially for vegetables and certain tubers (orange-fleshed sweet potatoes). It is preferable to steam them or to introduce them towards the end of the cooking time
- Not to add baking soda during the cooking of leaves and green beans because it destroys some nutrients

Fernandes et al. (2021) also proposed a graphic representation of the food pyramid for Sub-Saharan Africa, with serving sizes and examples given. (Figure 9).

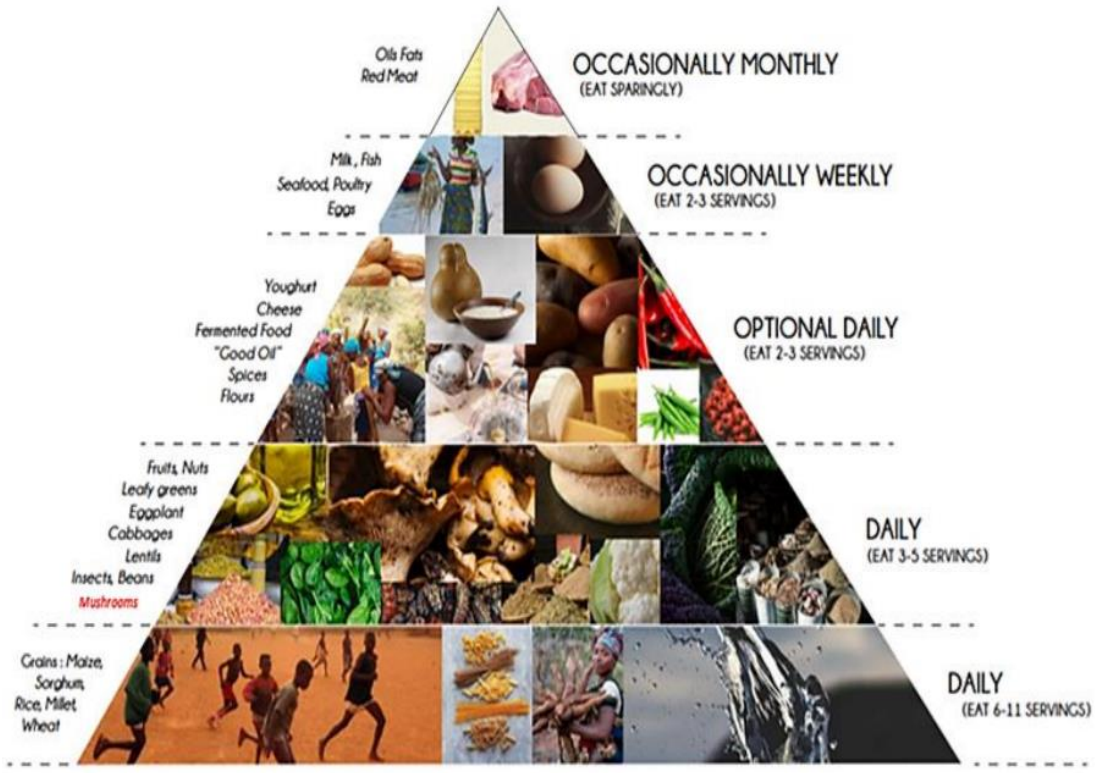


Figure 9 The Sub-Saharan Africa Food Pyramid (Source: Fernandes et al., 2021)

3.2.3.2 Recommendations for the Czech Republic

In the Czech Republic, the first dietary recommendations under the title "Nutritional Guidelines for the Czechoslovak Population" were issued by the Board of the Society for Rational Nutrition (currently operating under the name of the Society for Nutrition) in 1986 and in 1989 in their revised form. In 1994, the Nutrition Council of the Ministry of Health of the Czech Republic developed recommendations on nutrition for a healthy population "Eat Healthy, Live Healthy". In 2004, the Nutrition Society published "Nutritional recommendations for the population of the Czech Republic" and in 2005, the Ministry of Health of the Czech Republic published a leaflet entitled "Nutritional recommendations for the population of the Czech Republic".

The Society for Nutrition is now presenting updated Dietary Guidelines for the Czech population. This is a document in a form intended for workers involved in the prevention of non-communicable diseases (NCDs) of mass incidence through nutrition and the promotion of good dietary habits. In contrast to previous recommendations, these recommendations are also given in relation to childhood, the nutrition of pregnant and breastfeeding women and the nutrition of the elderly.

The most recent revision was in 2012, when the 2005 recommendations were modified by the Nutrition Society. This was necessary to incorporate new scientific evidence on nutrition for children, pregnant and lactating women and the elderly.

It was reported that 80% of vascular disease, diabetes mellitus and 40% of cancers could be prevented by lifestyle changes alone. Risk parameters are: increased salt intake, excessive alcohol consumption, inappropriate fat composition, excess energy intake and insufficient fruit and vegetable consumption.

The basic rules of nutrition are set out in the document Zdravá 13. Among these recommendations are included (Dostálová et al. 2012):

- To move around for at least 30 minutes a day, e.g., by brisk walking or exercise.
- To reduce the intake of animal fats and increase the proportion of vegetable oils in the total fat intake, especially olive and rapeseed oils, preferably without heat treatment to ensure the optimal fatty acid composition of the fat intake. To significantly limit the intake of foods containing coconut fat, palm kernel fat and palm oil
- To reduce sugar intake and limit its replacement by fructose or sorbitol
- Increasing the consumption of vegetables and fruit, including nuts (due to their high fat content, nut intake must be in line with other sources of fat to avoid exceeding total fat intake), with regard to the intake of protective substances important in the prevention of cancer and cardiovascular disease, but also in relation to reducing energy intake and increasing dietary fiber. The daily intake of vegetables and fruit should be 600 g, including cooked vegetables, with a vegetable to fruit ratio of approximately 2:1
- Pregnant women's diets should provide energy for optimum weight gain and fetal development and should be adequate in protein, vitamins (but do not increase vitamin A intake), minerals (especially zinc, iodine, calcium and iron) and fluid

3.3 Nutritional status of the Senegalese population

In absolute terms, the prevalence of stunting in Senegal is among the lowest in Sub-Saharan Africa. With 17.9% of children below 5 who were small for their age in 2019, Senegal has the second least stunting predominance rate in Sub-Saharan Africa, behind Gabon (Figure 10). Even more noteworthy, the prevalence of stunting in Senegal is much lower than what might be anticipated from its income level (Figure 11). Compared

to standards at worldwide level and at the level of Sub-Saharan Africa, Senegal is among the best performing nations when analyzing the indicator of child undernutrition, which is stunting, in connection to the level of national income measured through GDP per capita. The prevalence of child's stunt growth in Senegal is significantly lower than values from other countries with a similar level of income such as Côte d'Ivoire or Cambodia, and equal to the prevalence in nations that have a better income level such as Ghana, a country with two times the GDP per capita of Senegal, and Peru who almost has 5 times the GDP per capita of the country.

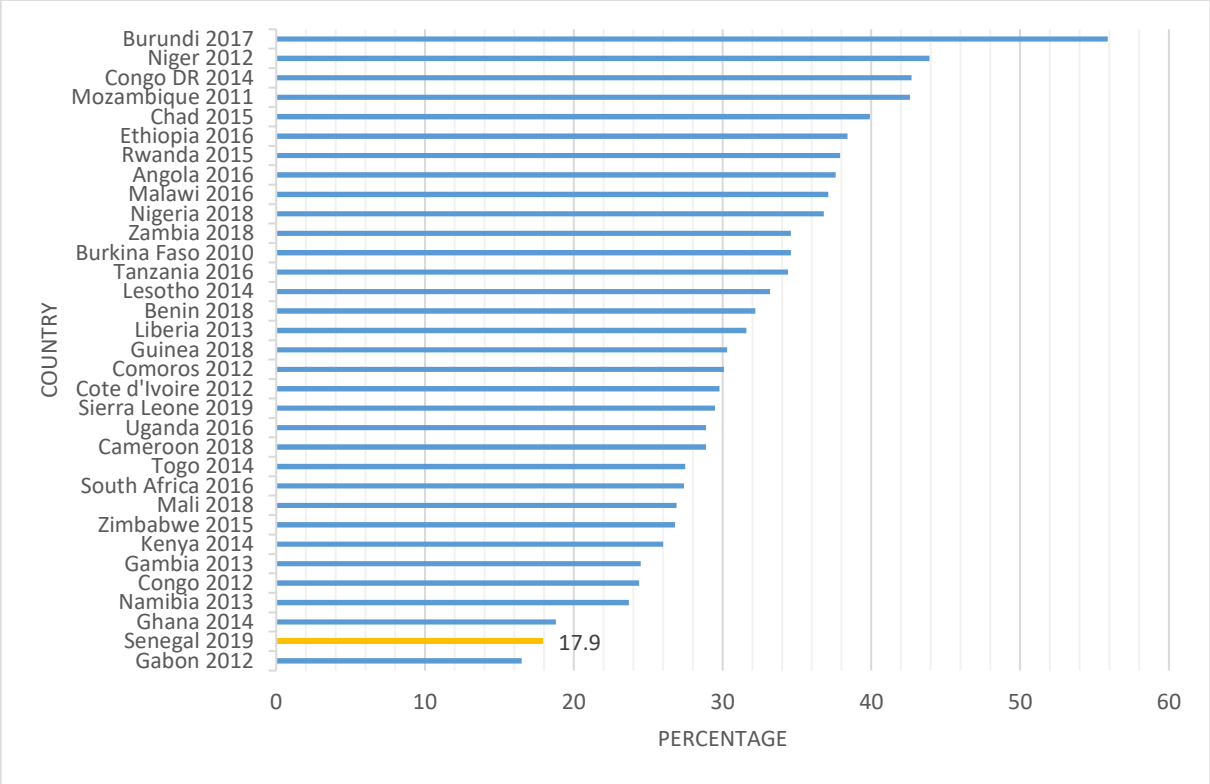


Figure 10: Percentage of children with stunt growth per country in Sub-Saharan Africa (Source**:** The DHS Program STATcompiler USAID, accessed 2022)

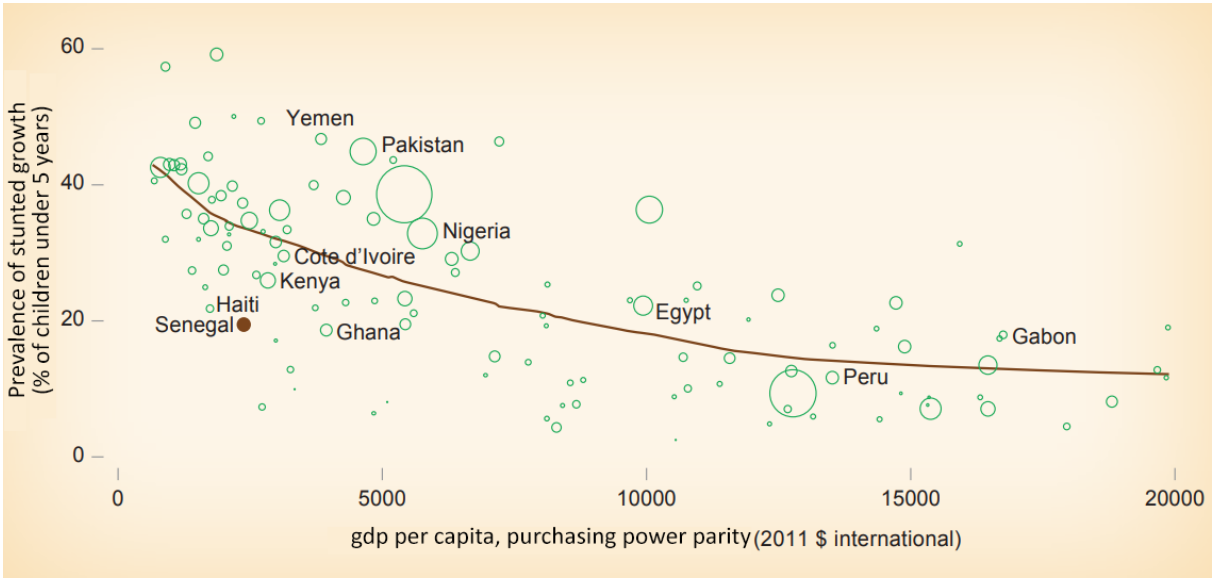


Figure 11: Prevalence of stunting in children by GDP per capita (source: Nene 2018)

However, the prevalence of anemia in children under 5 was 70.9%, which places Senegal in the upper part of the ranking of countries in Sub-Saharan Africa for which demographic and health surveys (DHS) data is available (Figure 12). A study carried out at by Sougou & Boëtsch (2016) even shows that many children do not consume fruit (52% of cases) and have a very late introduction of vegetables into their diet.

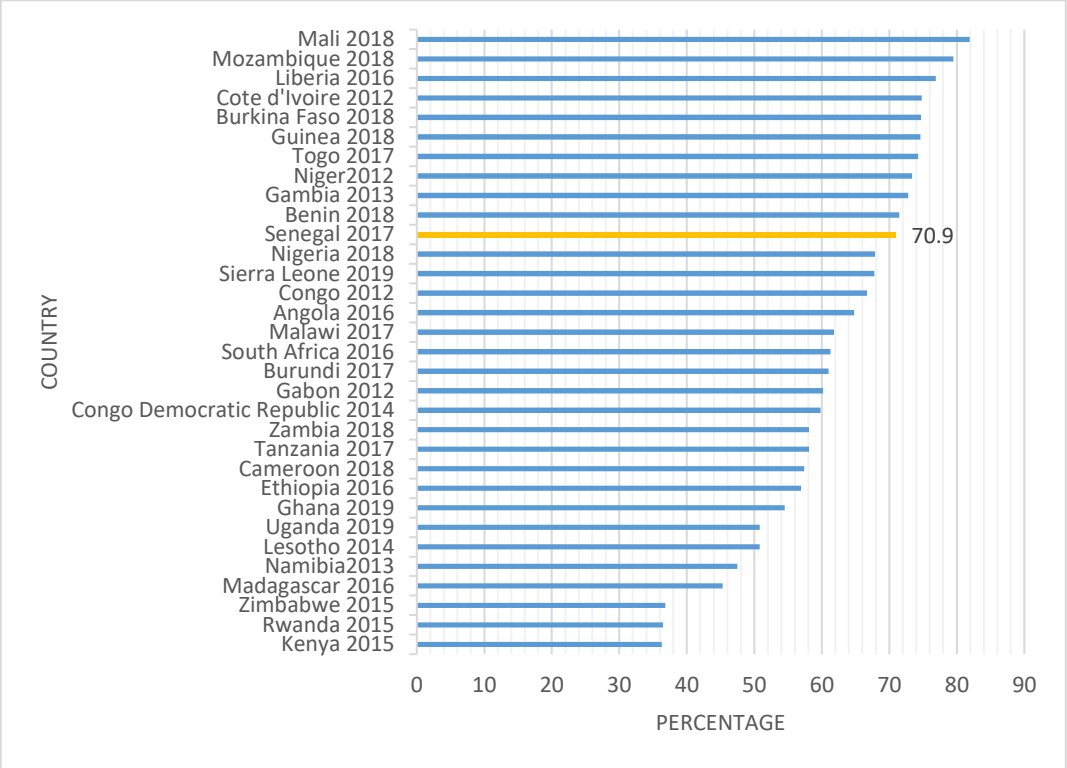


Figure 12: Percentage of children under age 5 classified as having any anemia in Sub Saharan Africa (Source: The DHS Program STATcompiler USAID, accessed 2022)

In addition, Senegal occupies a particularly critical place in Sub-Saharan Africa in terms of the prevalence of anemia among women aged 15 to 49, estimated at 54.1% in 2017, the latest date on which a DHS survey was conducted with such data for this demographic group. With the exception of The Gambia and Gabon, Senegal has the highest prevalence rate of anemia among women (Figure 13).

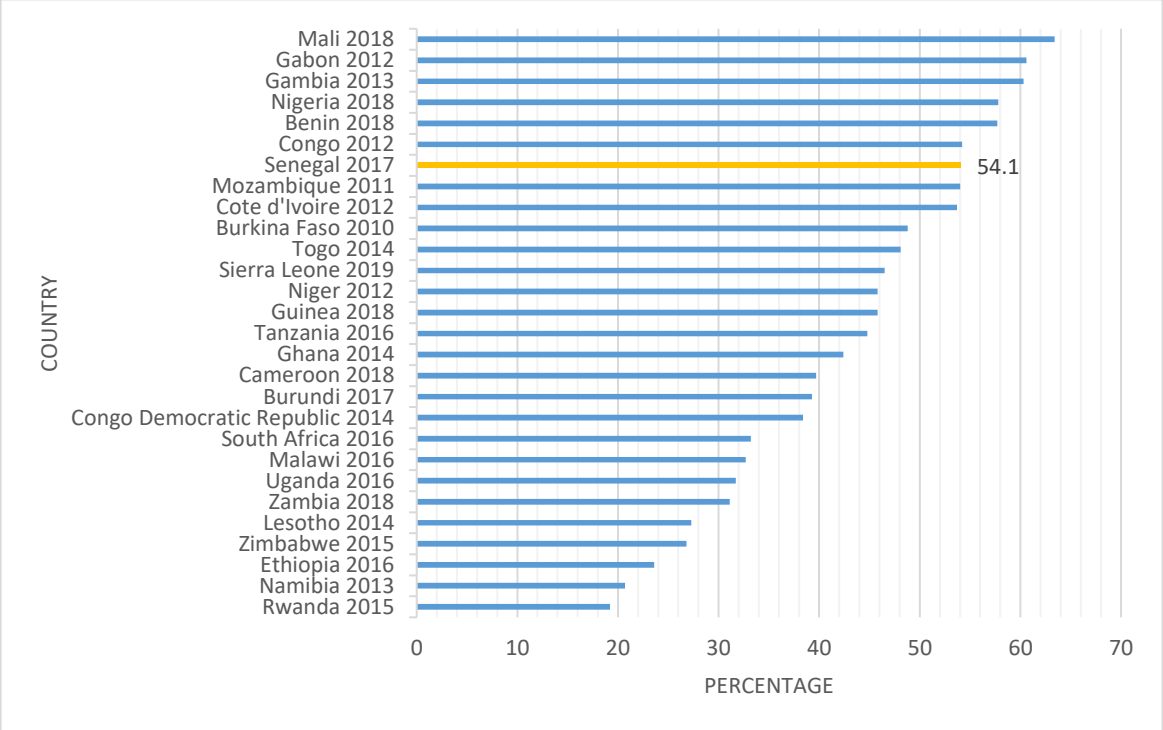


Figure 13: Percentage of anemia among women in Sub-Saharan Africa (Source: The DHS Program STATcompiler USAID, accessed 2022)

Despite the limited information, there are indications that overweight, obesity problems and associated NCDs are increasingly common in the country. Data indicates a rate of 21.3% of women who are overweight or obese (Figure 14). The WHO STEPS survey carried out in 2015 shows that high blood pressure affects 24% of the population; 2.1% have diabetes and 19% have high cholesterol (Nene 2018). Also, according to WHO (2014), diabetes, cardiovascular disease and cancer, taken together, cause nearly 20% of adult deaths in Senegal (Figure 15). In addition, other surveys carried out in the city of Dakar in 2009 and in the Region of Saint-Louis in 2012 revealed prevalence rates of type II diabetes of 17.9% and 10.8%, respectively (Duboz et al. 2012; Seck et al. 2015). Another survey conducted in 2010 in the city of St-Louis estimated that 46% of the population over the age of 15 suffers from hypertension, 36.6% from high cholesterol, and 15.7% from metabolic syndrome (Pessinaba et al. 2013).

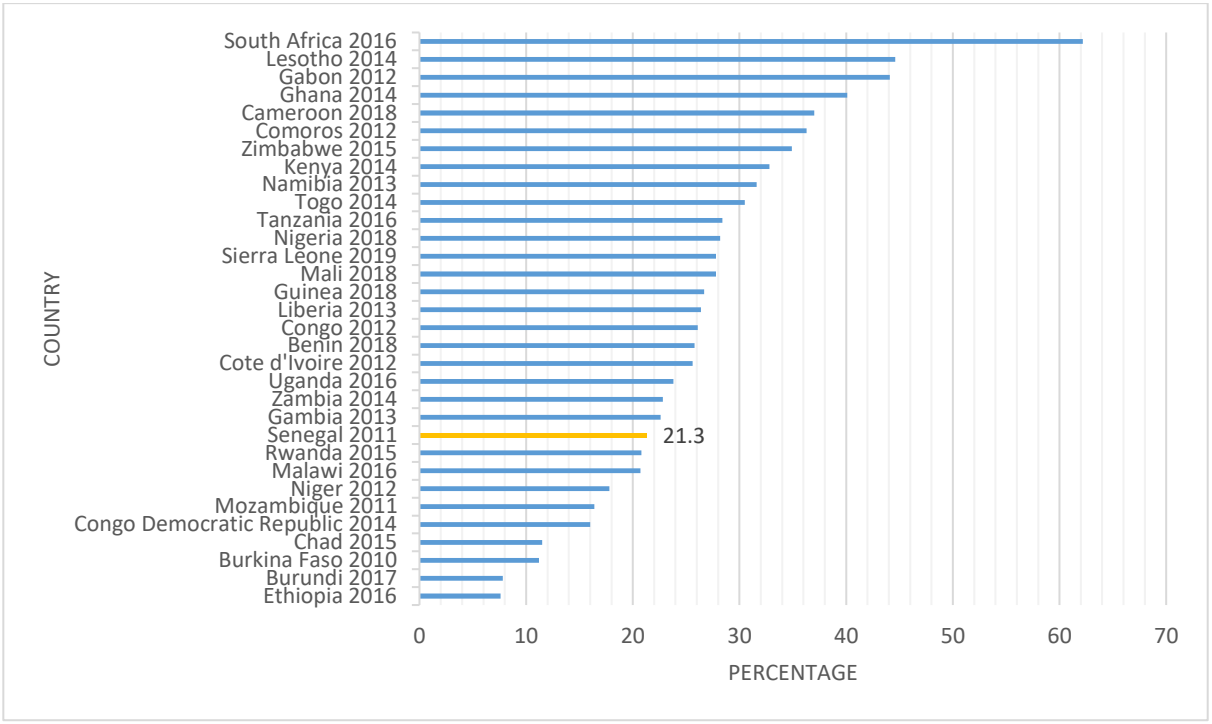


Figure 14: Women who are overweight or obese according to BMI (≥25.0) in Sub-Saharan Africa (Source: The DHS Program STATcompiler USAID, accessed 2022)

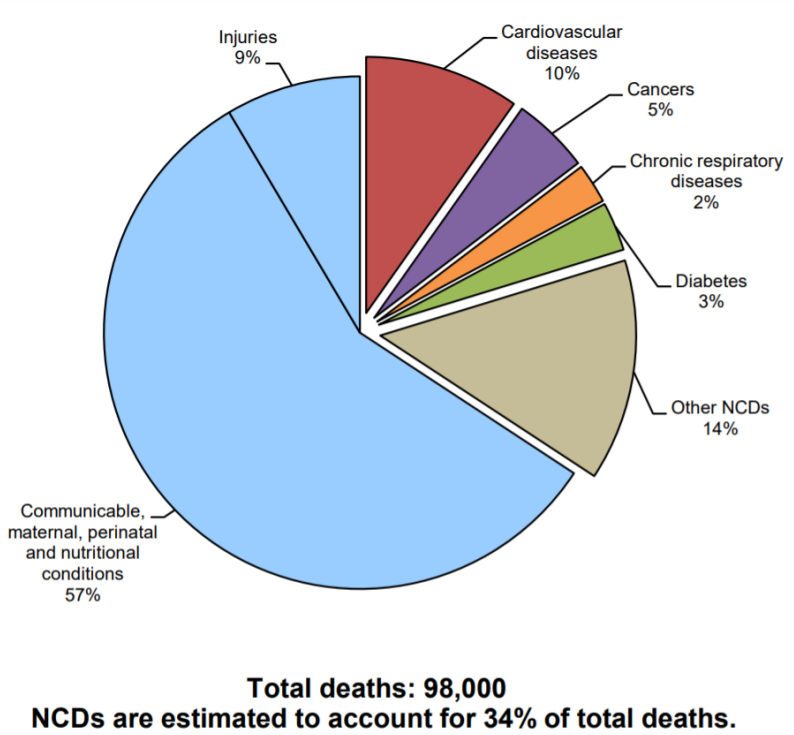


Figure 15: Proportional mortality in Senegal (% of total deaths, all ages, both sexes) (Source: WHO 2014)

Overall, Senegal's nutritional profile is marked by a moderate level of stunting in children and overweight, a high level of underweight and anemia, as well as a slightly high

level of overweight and obesity. Obesity in women is connected with increasing the incidence rates of NCDs , which is symptomatic of a country midway through a nutritional transition (Popkin et al. 2012). This phenomenon has been observed in countries which have experienced a rapid economic transformation leading to a nutritional transition marked by changes in the diet towards an increase in the consumption of fats, meat, refined sugar, and the progression to noncommunicable diseases associated with nutrition together with the insufficient physical activities as a result of changes in the lifestyle. (Popkin 1993, 1998, 2001).

3.3.1 Differences in nutritional status between rural and urban areas

Regarding stunt growth among children in Senegal, a difference between the north and south of the country can be observed. The northern and western regions of the country have low prevalence rates compared to southern and central regions. The following figure 16 shows the differences between regions in terms of stunting among children in Senegal for the years 2000, 2005, 2012 and 2014.

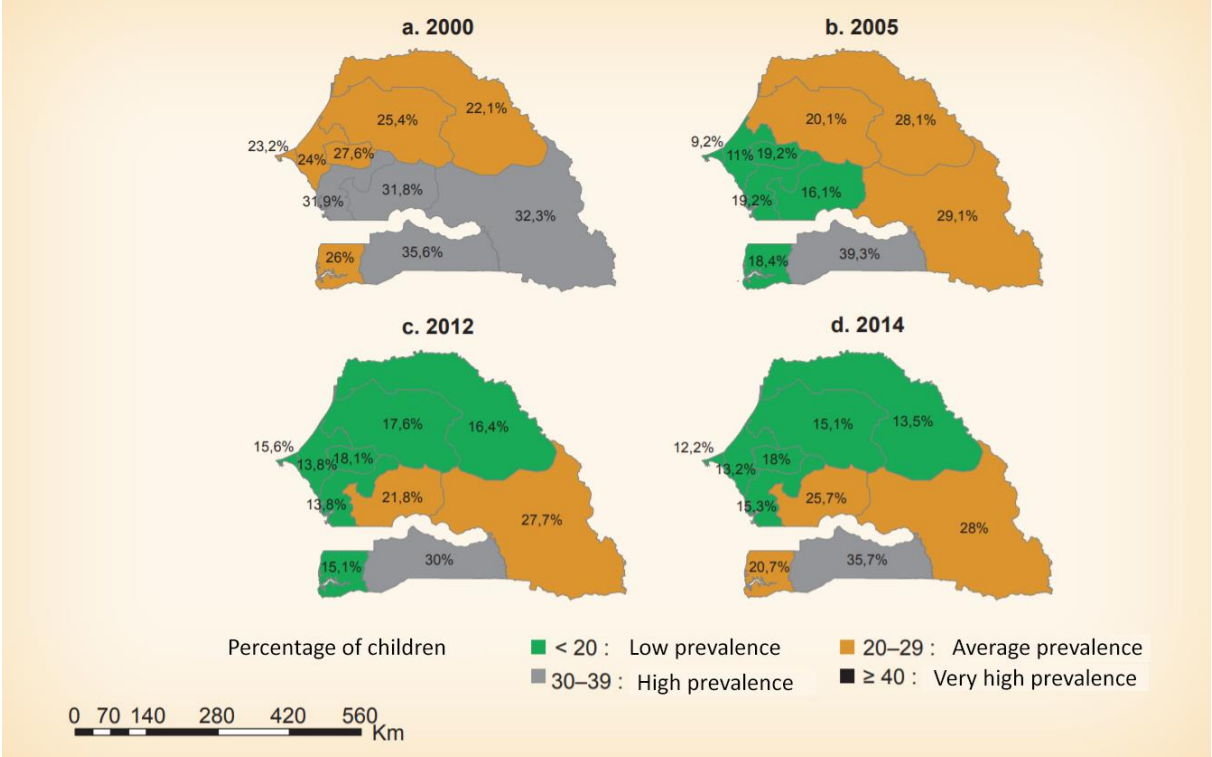


Figure 16: Prevalence of stunting among children under 5 by regions of Senegal, 2005–14 (Source: Nene 2018)

Prevalence of stunting among children was low in most of the upper half of the country in 2014. Prevalence was however much higher in the southern part of Senegal, reaching average to high levels.

This North-South difference in stunting rates has a correlation with the poverty rate (figure 3). The difference between northern and southern regions of Senegal has been accentuated during the past decade. Stunt growth experienced a stagnation between 2005 and 2014, however regional progressions have been uneven. Some regions recorded a sharp decline, while other regions recorded an increase or others no change at all. The remarkable decline in stunting among children recorded in Senegal can be explained by improvements in the availability of health services, infrastructures, maternal education and poverty reduction among others (Brar et al. 2020). Indeed, stunting in children in the regions of Dakar, Thiès, Fatick and Kaolack fell by more than half during this period. All other regions except St Louis and Kolda experienced a decrease in stunting in children. Since 2005, the northern regions have experienced a sustained decline in stunting among children, with the prevalence in St Louis falling from 50% to 14% in 2014. In contrast, the Kaolack region has experienced the opposite with a sustained increase in the prevalence of stunting in children between 2005 and 2014. Over the same period, progress in the western regions and in the regions of Diourbel and Fatick stagnated or was irregular. Tambacounda's situation did not see any improvement as well and Kolda has remained a region with high levels of stunt growth, which has further accentuated the differences between the north and the south of the country.

3.4 Nutritional status of the Czech population

European countries face many dietary problems. People here are consuming high amounts of saturated fat, trans fatty acids, salt and sugar (Micha et al. 2014), which are often consumed through sweetened beverages and highly processed foods. Conversely, fruit, vegetables and whole grains are under-consumed (WHO 2018). These factors have long been associated with increased incidence of NCDs.

NCDs are the leading cause of death in Europe. In 2015, cancer, cardiovascular disease, diabetes and chronic lung disease caused 89% of all deaths. There has been an increase of 3% since 2000 (WHO Regional Office for Europe 2017). Dangerous factors including alcohol consumption, unbalanced diet, cigarette smoking, and lack of exercise can increase the risk of NCDs. The Global Burden of Disease reported that 20% of all deaths are associated with an unbalanced diet (Gakidou et al. 2017).

The prevalence of overweight and obesity is rising sharply (WHO 2019).

The WHO estimates that 56.1% of the population was overweight in 2010, and since 2014 it had increased to 58%. Men are more likely to be overweight than women. The issue of overweight and obesity does not exclude children. A report published by WHO in 2014 found that 33% of European children aged 6-9 years old were overweight (Wijnhoven et al. 2014). Significant improvements regarding the health status of newborns and young children in Europe have been noted in recent years. It has the lowest number of newborn and children's deaths in the world. In addition, less hunger has been reported in children. (UNICEF et al. 2017). The Czech food pyramid can be found in Figure 17.

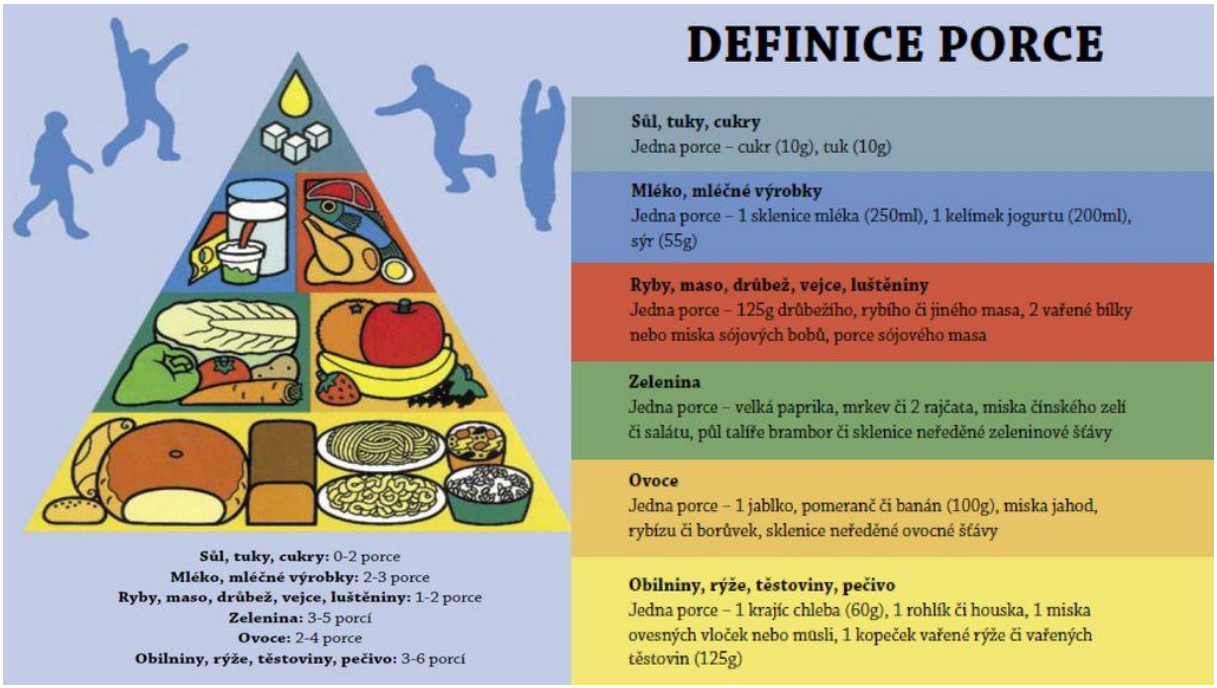


Figure 17: Czech food pyramid with daily portions (Ministerstvo Zdravotnicví České Republiky 2005)

4 Methodology

The practical part of this study was focused on the monitoring of the dietary habits of the population of Senegal using a food frequency questionnaire. The field research using a frequency questionnaire was conducted in two localities: the capital city, Dakar, located in the western part of Senegal, and Velingara, which is a town located in the Kolda Region, in the southern part of the country. The questionnaire used was acquired from the website of Faunalytics (2018), which is a nonprofit organization that provides animal advocates with access to the research and analysis of various animal issues by conducting essential research, maintain an online research library, and directly support advocates and organizations in their work.

4.1 Frequency questionnaire

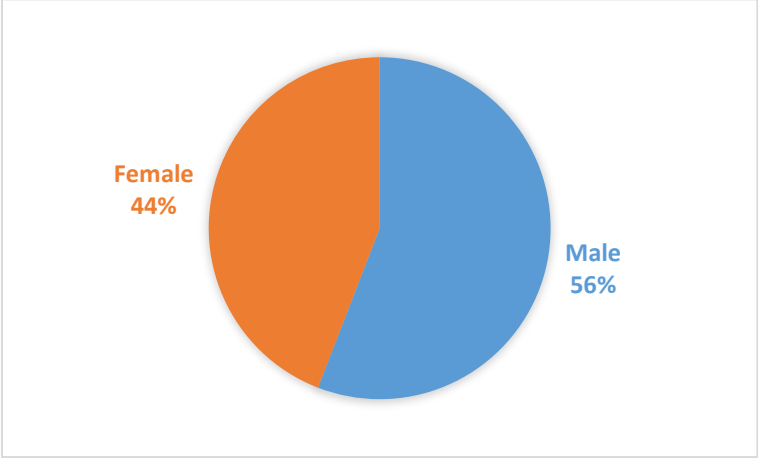
Food frequency questionnaires are adaptable instruments that can effectively be adjusted to address past or future diet. They can also be adjusted to be shorter and simpler to complete or longer and more informative. The questionnaire used in this thesis included a table listing the food groups and selecting the frequency of their consumption over a certain period of time (e.g. never, less than once a week, 1-3 times a week, 2-3 times a day etc.). Food groups should be chosen to match the expected dietary habits in the country of the study. The food groups included in the questionnaire were the following items: fruit, vegetables, tubers, chicken, fish, seafood, beef, pork, other meats, nuts, beans, dairy products, eggs, grains, sweets, soft drinks and caffeinated drinks (coffee and tea). Only one option for each of these food groups could have been selected by respondents.

The serving size was selected for each food group in order to obtain more accurate nutritional data of the consumed diet. Portions were entered using serving sizes for better practical example of a portion size (e.g., a can of tuna, one small chicken breast, etc.). It was a retrospective form of research, and the frequency of food consumption was focused on the past three months, so the respondents were asked to recall their diet in the past month and then select the frequency of consumption and portion size for each food group surveyed. The food frequency questionnaire contained several more questions designed to provide additional information on dietary habits and health status (e.g. number of meals per day, alcohol and cigarette consumption, kilometers walked per day etc.). It was therefore possible to observe how dietary habits correspond to the health recommendations of Senegal.

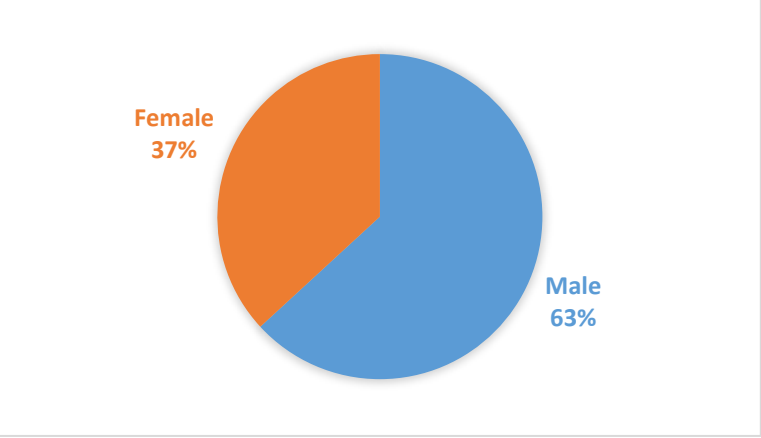
The questionnaire was translated in the French language in order to be understood by the Senegalese population.

4.1.1 Monitored population

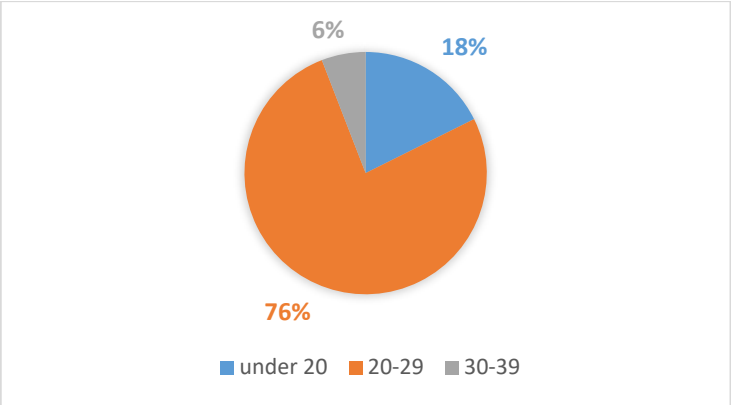
The study took place in two different localities. The first one is Dakar, the capital city of Senegal, and the second one is Velingara, a rural area located in the region of Kolda in the Southern part of the country. Questionnaires in both sampling areas have been randomly collected. Overall, 53 questionnaires have been collected, among which 34 have been collected in Dakar and 19 in Velingara. The gender distribution of respondents from each locality can be found in Graph 1 and 2, while the age distribution is shown in Graph 3 and 4.



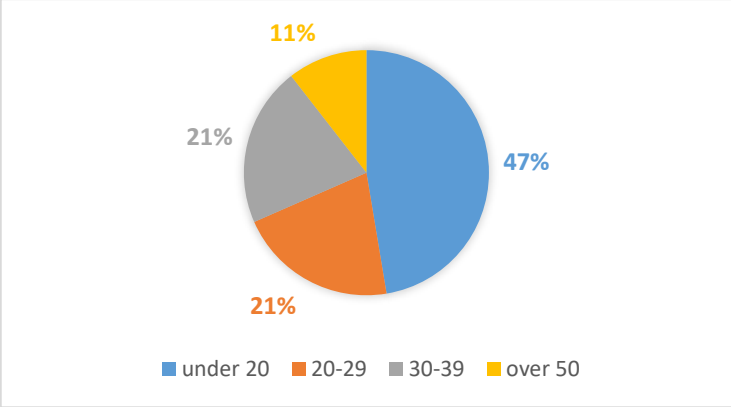
Graph 1: Gender distribution of respondents in Dakar



Graph 2: Gender distribution of respondents in Velingara



Graph 3: Age distribution of respondents in Dakar



Graph 4: Age distribution of respondents in Velingara

4.2 Data evaluation

Data evaluation was carried out using the calculation recommended by Faunanalytics (2018). Numerical values corresponding to the average frequency of consumption per day were chosen for each food group, and portion sizes were adjusted to similar numerical values. The average daily frequency of consumption was considered in the Table 2 and 30.

Table 2: Numerical values used to calculate frequency of consumption

Frequency of consumption	Never	Less than once per week	1-3 times per week	4-6 times per week	Once per day	2-3 times per day	4 times and more per day
Daily Frequency	0	0.07	0.29	0.71	1	2.5	4.5

Table 3: Numerical values used to calculate portion size

Serving size	1	½ or less	1 and ½ or more
Numerical value	1	0.5	1.5

In order to obtain the average frequency of consumption, the two values were multiplied together. Therefore, a respondent that consumed one and half serving of chicken four to six times a week would have an average chicken consumption of 0.71 x 1.5 = 1.065, which is barely above one serving per day.

The nutritional values of foods were obtained from the US FoodData Central USDA (2021), which is freely available online. It is an integrated data system that provides expanded nutrient profile data and links to related agricultural and experimental research. The FoodData Central provides reliable, web-based, transparent, and easily accessible information about the nutrients and other components of foods to meet the increasingly diverse needs of many audiences, including public health professionals, agricultural and environmental researchers, policy makers, nutrition professionals, healthcare providers, product developers, and the public at large.

In order to achieve the most objective results, the foods were selected following a study by Anderson et al. (2010) that identified the most consumed foods of 50 Senegalese respondents for each food groups. The most consumed food from the study has been selected for each food group, always corresponding to fresh and dry foods without culinary treatments. Selected foods can be found in Appendix 2

Nutritional data of individual foods found in the US FoodData Central USDA (2021) included: calories, protein, carbohydrates, fat, fiber, sugars, calcium, iron, magnesium, sodium, zinc, vitamin A, vitamin C, vitamin D, vitamin E, and cholesterol. The energy intake of the foods consumed was also compared. The average amount of consumed food groups was considered for later evaluation with the Czech Statistical Office data (National Institute of Public Health 2003). The nutritional data were further multiplied by the average daily portion size of each group (as explained above) and from the obtained values, the average nutrient content for each food group and average nutritional value of the diet of the respondents were determined. The values were rounded to two decimal places. The obtained nutritional value data were then compared with the dietary recommendations of (DACH 2022) and EFSA (2017). Data has been compared with references for moderately active students, which was the most

represented group. A mean between male and female values has also been selected. Furthermore, the data were compared with the values of frequency of consumption of certain food groups in the Czech Republic, which are published on the website of the Czech Statistical Office.

4.3 Statistical analysis

Data were statistically evaluated using one-sample t-test at 0.05 level of significance and processed in Statistica 12.

5 Results

5.1 Calorie and nutrient intake and comparison with recommendations

There was an important disparity in overall intake of calories and nutrients among the urban and rural inhabitants. Rural inhabitants from Velingara consumed significantly more calories overall than the urban population of Dakar (1346.57 more calories). The vast majority of macro and micronutrients consumed was also higher among rural respondents compared to urban population, apart from vitamin C (71.54 mg more for Dakar). Average protein intake in Velingara was almost the double of the intake in Dakar while more of the double of lipids was consumed by the rural population (Table 4).

Table 4: Caloric and nutrient intake comparison between Dakar and Velingara

Nutrients	Dakar	Velingara	Difference
Calories (kcal)	1484.93	2831.50	-1346.57
Protein (g)	70.90	140.91	-70.01
Carbohydrates (g)	182.42	312.99	-130.57
Sugars (g)	63.77	90.48	-26.71
Fibers (g)	14.48	30.34	-15.87
Lipids (g)	54.23	116.67	-62.43
Cholesterol (mg)	214.81	431.22	-216.42
Calcium (mg)	774.32	1414.69	-640.37
Iron (mg)	13.85	29.29	-15.45
Magnesium (mg)	263.85	606.54	-342.70
Sodium (mg)	1283.98	2517.05	-1233.06
Zinc (mg)	8.88	16.71	-7.83
Vitamin A (µg)	601.55	1334.89	-733.34
Vitamin C (mg)	119.98	48.44	71.54
Vitamin D (µg)	16.90	37.03	-20.13
Vitamin E (mg)	7.07	15.59	-8.52

Regarding comparisons with DACH's and EFSA's recommendations (Tables 5 and 6), results were mixed.

Concerning caloric intake, Dakar's consumption was severely under recommendations from DACH and EFSA. Macronutrients (protein, lipids and carbohydrates) were however in normal ranges. Sugar intake was slightly over the recommendations and fiber consumption was in accordance with DACH but lower than EFSA's recommendations. Energy intake among rural population was more adequate but was 300 kcal over DACH recommendation and 400 kcal over EFSA's. Macronutrient breakdown was overall similar to the one of urban populations (Graph 5, Graph 6), but the protein intake was overwhelming compared to recommendations, reaching on average almost three times the RDI (recommended daily intake). Sugar intake was close but slightly over recommendations, while fiber intake was significantly higher than RDI.

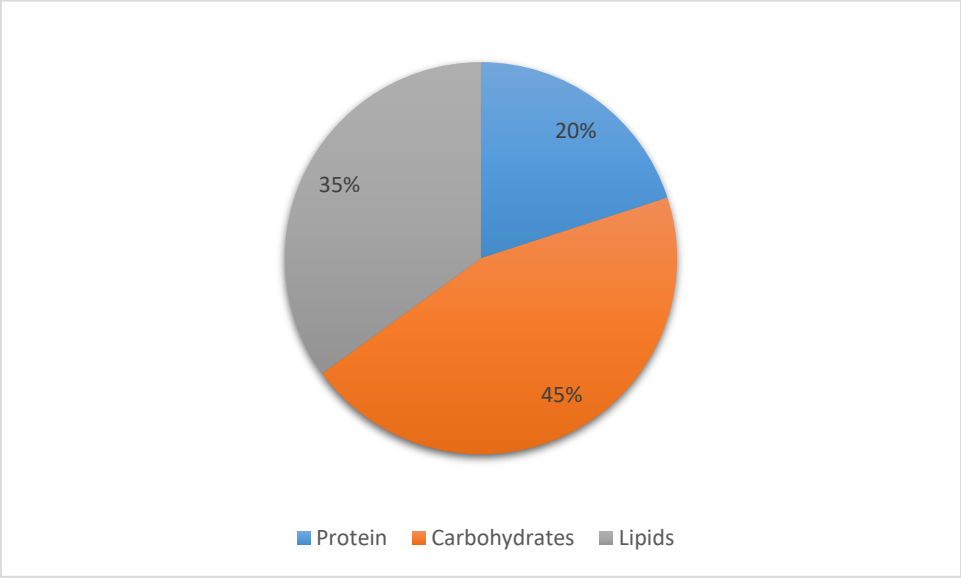
Regarding micronutrients, vitamins and minerals were generally close to recommendations for Dakar population, except for calcium, magnesium, vitamins A and E, which were insufficient. Rural consumption of micronutrients was however meeting recommendations for every micronutrient except vitamin C, which was not under half of the RDI. Sodium intake was however a concern for rural populations with 1000 mg over RDI.

Table 5: Caloric and nutrient intake in Dakar compared to recommendations

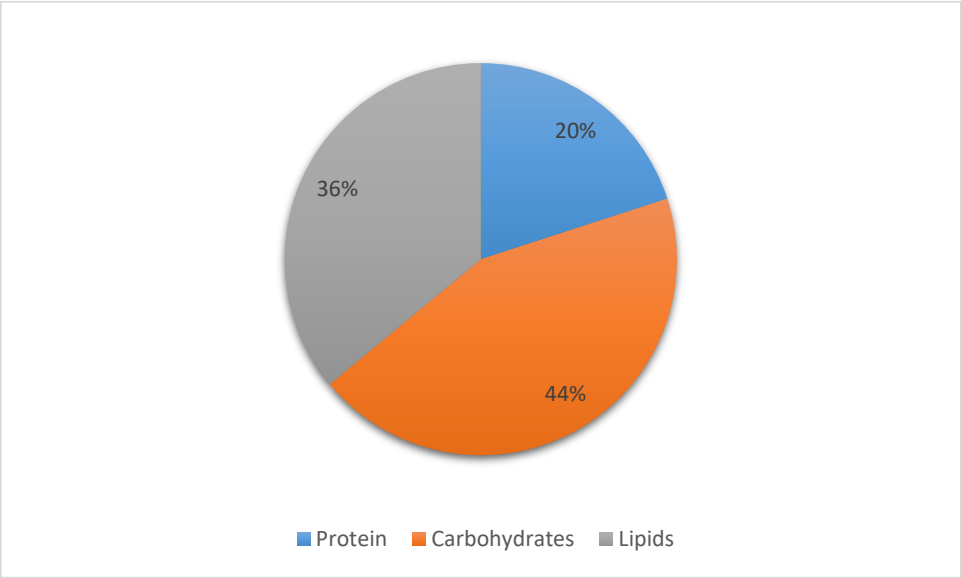
Nutrients	Value	DACH	Comparison with DACH	EFSA	Comparison with EFSA
Calories (kcal)	1484.93	2500	-1015.07	2412	-927.07
Protein (g)	70.90	52.5	+18,40	N/A	N/A
Carbohydrates (%)	49%	45-55%	In interval	45-60%	-1%
Sugars (%)	16%	10% max	+6%	10%	+3%
Fibers (g)	14.48	14,6 min	-0.12	25	-10.52
Lipids (%)	33%	30%	+3%	20-35%	+2%
Cholesterol (mg)	214.81	N/A	N/A	N/A	N/A
Calcium (mg)	774.32	1000	-225.68	975	-200.68
Iron (mg)	13.85	12.5	+1,35	13.5	+0,35
Magnesium (mg)	263.85	355	-91.15	325	-61.15
Sodium (mg)	1283.98	1500	-216.02	N/A	N/A
Zinc (mg)	8.88	8.5	+0,37	10.5	-1.62
Vitamin A (µg)	601.55	900	-298.45	700	-98.45
Vitamin C (mg)	119.98	102.5	+17,48	102.5	+17,48
Vitamin D (µg)	16.90	20	-3.10	15	+1,90
Vitamin E (mg)	7.07	13.5	-6.43	12	-4.93

Table 6: Caloric and nutrient intake in Velingara compared to recommendations

Nutrients	Value	DACH	Comparison with DACH	EFSA	Comparison with EFSA
Calories (kcal)	2831.50	2500	331.50	2412	419.50
Protein (g)	140.91	52.5	88.41	N/A	N/A
Carbohydrates (%)	44%	45-55%	-1%	45-60%	-1%
Sugars (%)	12%	10% max	+2%	10%	2%
Fibers (g)	30.34	14,6 min	15.74	25	5.34
Lipids (%)	37%	30%	7%	20-35%	2%
Cholesterol (mg)	431.22	N/A	N/A	N/A	N/A
Calcium (mg)	1414.69	1000	+414,69	975	+439,69
Iron (mg)	29.29	12.5	+16,79	13.5	+15,79
Magnesium (mg)	606.54	355	+251,54	325	+281,54
Sodium (mg)	2517.05	1500	+1017,04	N/A	N/A
Zinc (mg)	16.71	8.5	+8,21	10.5	+6,21
Vitamin A (µg)	1334.89	900	+434,89	700	+634,89
Vitamin C (mg)	48.44	102.5	-54.06	102.5	-54.06
Vitamin D (µg)	37.03	20	+17,03	15	+22,03
Vitamin E (mg)	15.59	13.5	+2,09	12	+3,59



Graph 5: Macronutrient percentage of consumed calories in Dakar



Graph 6: Macronutrient percentage of consumed calories in Velingara

5.2 Foods contributing to nutrient intake

Respondents were primarily getting energy from grains, regardless of the locality. Sweet and nuts came in second and third position for each area (Appendix 3). The most important animal source of calories were fish and diary for both localities.

Protein was mainly obtained from grains and fish. Urban area however got an important part of its protein from beef, while nuts had a bigger impact on protein in rural areas. Carbohydrates were primarily consumed through grains and sweets; however more soft drinks were consumed in urban areas. Sugar intake was dominated by soft drinks in urban area and sweets in rural. Fiber intake was predominantly from grains for both, then nuts and beans.

Lipids came mostly from nuts, then sweets, grains and diary. Cholesterol was consumed from fish and eggs for the most part.

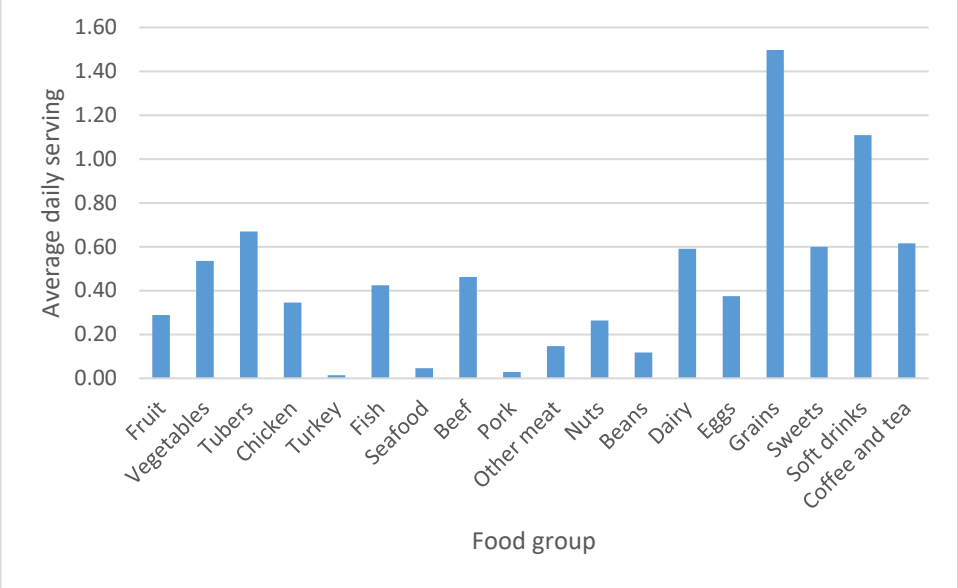
Calcium content was primarily obtained from grains, dairy and fish in both localities. Iron was obtained in majority from grains, then nuts, beans and fish. Magnesium was consumed through grains, nuts and beans in majority. Beef had the biggest contribution to zinc consumption in Dakar, while beans, grains and nuts were the biggest food groups among rural respondents.

Sodium came from grains and sweets in both areas. Vitamin A was obtained through vegetables in both areas. Vitamin C came mainly from soft drinks in both areas, but tubers and

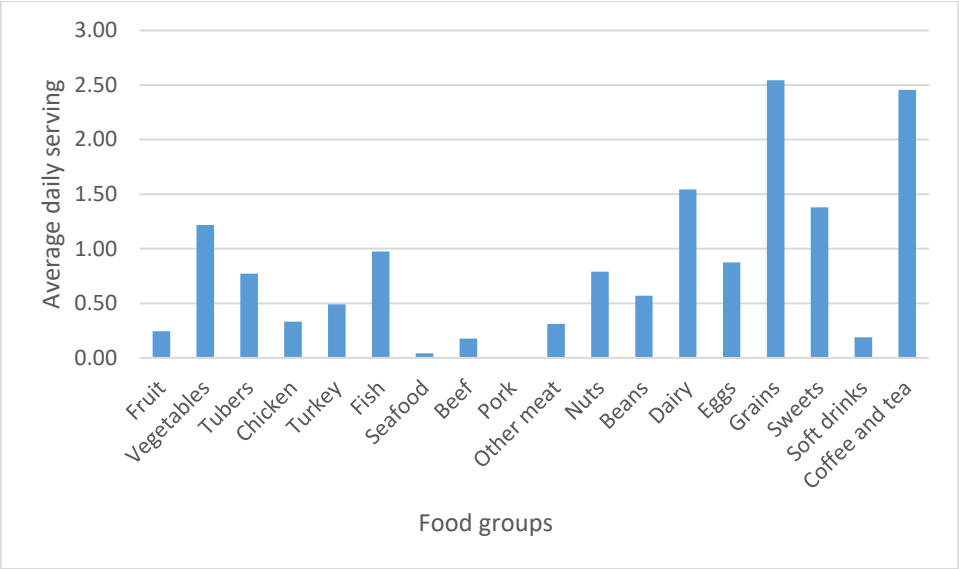
fruits had a more important place in rural area. Vitamin D came from eggs in both areas. Vitamin E vas obtained from nuts, sweets and fish.

5.3 Comparison of daily servings with West African and Czech food pyramid

The most consumed food group was grains (Graph 7 & 8) with more than 2.5 portions per day in rural areas and more than 1.5 portions in urban. Soft drinks take the second position in Dakar while coffee and tea is the second most consumed food group in Velingara. The most consumed meats were beef and fish in Dakar and mainly fish in Velingara. Turkey and pork were the least consumed meats in urban area, but turkey consumption was more important in rural area, with pork and seafood being the least consumed foods.



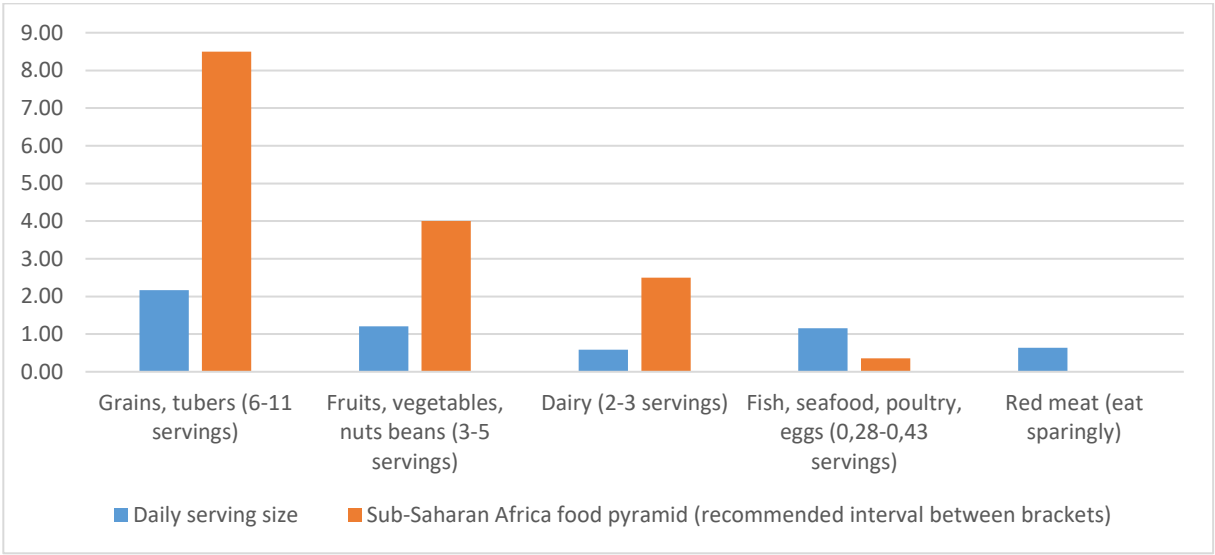
Graph 7: Average daily portion of respondents in Dakar per food group



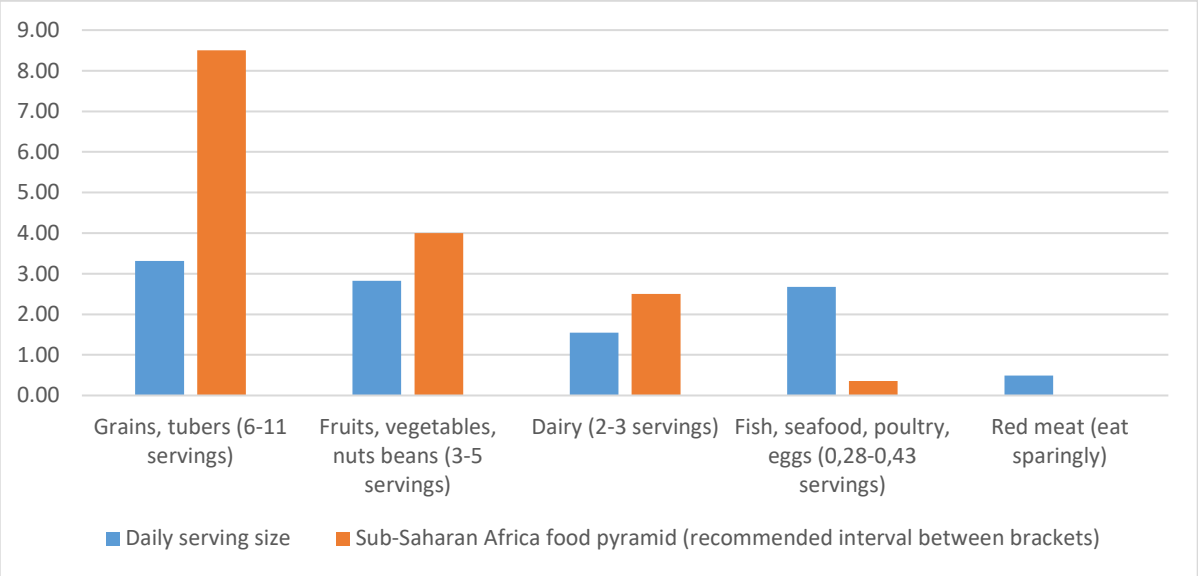
Graph 8: Average daily portion of respondents in Velingara per food group

Regarding comparison with the SSA food pyramid, all food groups were either under or over recommended servings for Dakar and Velingara (Graph 9 & 10). Animal proteins were overconsumed, while dairy and plant products were under the recommendations.

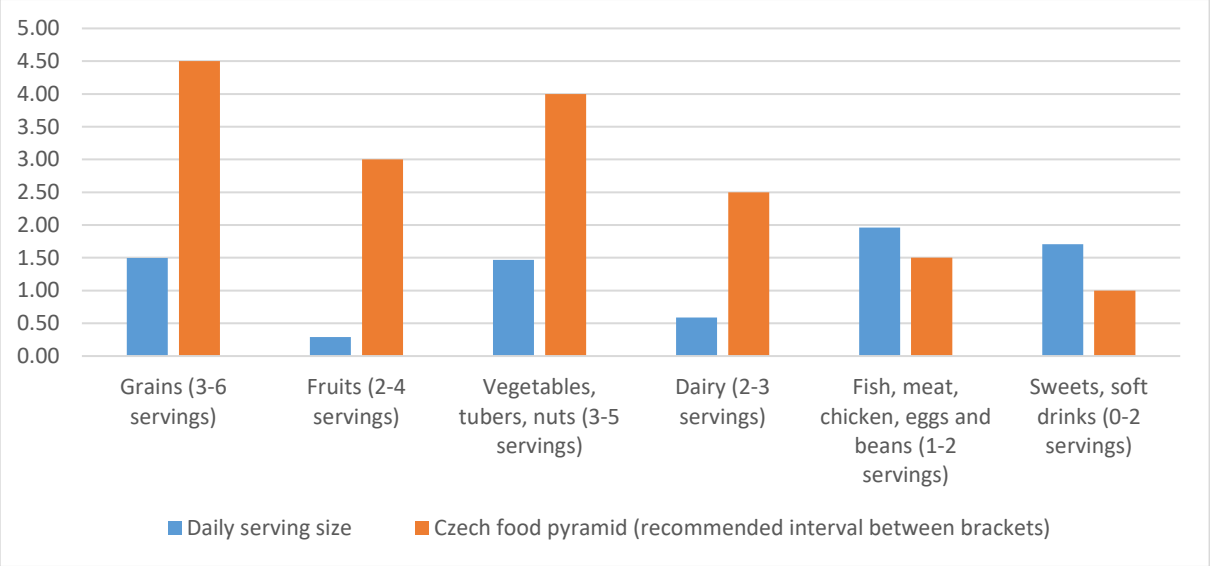
Concerning recommendations from the Czech food pyramid in Dakar (graph 11 & 12), the recommended portion for high protein foods (fish, meat, chicken, eggs and beans) of 1-2 servings was respected, as well as the portion for sweets and soft drinks. However, other values were underwhelming. For Velingara however, the only value in accordance with Czech food pyramid was the one for sweets and soft drinks.



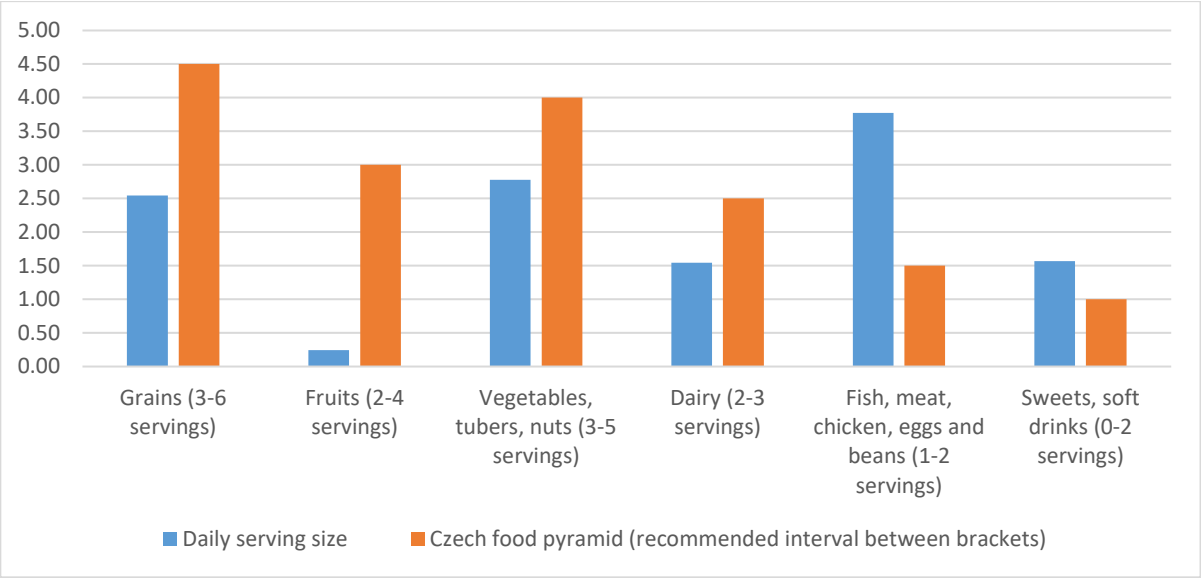
Graph 9: Comparison of Dakar average daily serving with the Sub-Saharan Africa food pyramid recommendations



Graph 10: Comparison of Velingara average daily serving with the Sub-Saharan Africa food pyramid recommendations



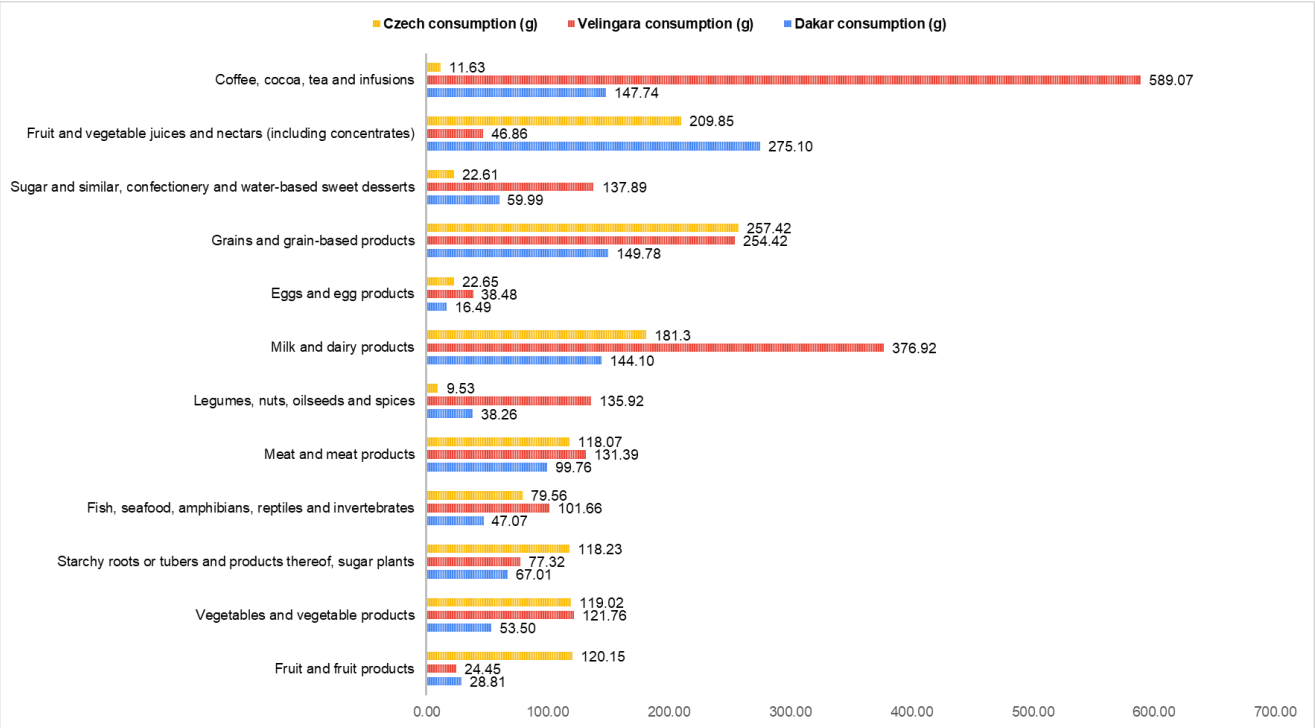
Graph 11: Comparison of Dakar average daily serving with the Czech food pyramid recommendations



Graph 12: Comparison of Velingara average daily serving with the Czech food pyramid recommendations

5.4 Comparison of Senegalese and Czech food consumption

The data from the Czech Statistical Office available in EFSA's comprehensive database showed similarities among certain food groups, but significant differences among others. Meat and egg consumption are almost at similar levels for all three areas, with a difference between maximum and minimum values of less than 35g. Caffeinated drinks and dairy products were by far more consumed in rural areas, while Czech Republic consumed more than four times more fruits than the Senegalese population. Vegetable consumption between Czech and Senegalese rural area was on similar levels, while Czech population consumed more tubers than Senegalese. Soft drinks were more consumed by Senegalese urban area, followed by Czech population while Senegalese rural area consumed over four times less. Sweets were mostly consumed by respondents from Velingara (6 times more than Czech population). Grains were on a similar level between Czech and Velingara population. Fish and seafood were more consumed by rural population of Senegal. Nuts and legume consumption was dominated by urban area, consuming more than 14 times more than the Czech population.



Graph 13: Food intake in grams of the Czech, Dakar and Velingara population

5.5 Other information about respondents

The average weight/height/BMI of respondents from Dakar was 68.09 kg; 1m76; BMI 21.98 while Velingara had results of 64.26 kg; 1m72; BMI 21.91.

The possible relation between BMI and gender was tested:

- Null hypothesis: Gender has no influence on BMI
- Alternative hypothesis: Gender has an influence on BMI

Table 7: Mean, median and standard deviation of BMI

	Mean	Median	Standard deviation
BMI -Female	21.43	21.48	4.68
BMI - Male	22.19	21.9	2.38

The female group had lower values for the Variable BMI (*Mdn* = 21.48) than the male group (*Mdn* = 21.9). Mann-Whitney U-Test showed this difference was not statistically significant, *U*=39.5, *p*=.833, *r*= 0.05.

Regarding the eating frequency in Velingara, 55.88% respondents replied that they eat 3 meals per day, 38% of them eat only 2 meals per day, and the rest of them 6% eat 4 meals per day.

Table 8: Meal frequency in Velingara

Meal frequency (Velingara)	Frequency	%
3	19	55.88%
2	13	38.24%
4	2	5.88%
Total	34	100%
Invalid	0	0%
Total	34	100%

Respondents from urban questionnaires were asked the same question and replies were as follows: 15 (78.95%) of 19 consume 3 meals per day, 2 (10.53%), and the rest around 5.26% consume 4 or more meals per day. Majority of respondents consume 3 meals per day, villagers consume almost the same meal portions daily.

Table 9: Meal frequency in Dakar

Meal frequency (Dakar)	Frequency	%
3 per day	15	78.95%
2 per day	2	10.53%
more than 5 per day	1	5.26%
4 per day	1	5.26%
Total	19	100%
Invalid	0	0%
Total	19	100%

Regarding the meal preparation method, most respondents from Velingara (63.16%) prepared meals by boiling, while the urban population from Dakar was mostly frying its food (29.41%).

Table 10: Preparation method in Velingara

Preparation method	Frequency	%
Boiling	12	63.16%
Steaming	2	10.53%
Grilling	2	10.53%
Frying	2	10.53%
Roasting	1	5.26%
Total	19	100%
Invalid	0	0%
Total	19	100%

Table 11: Preparation method in Dakar

Preparation method	Frequency	%
Frying	10	29.41%
Boiling	6	17.65%
Grilling	3	8.82%
Sauteing	3	8.82%
Steaming	3	8.82%
Roasting	2	5.88%
Other	2	5.88%
Total	29	85.29%
Invalid	5	14.71%
Total	34	100%

Respondents in Dakar used mostly sunflower oil (44.12%), then peanut oil (35.29%) while respondents from Velingara used peanut and palm oil more often (47.37% and 31.58%).

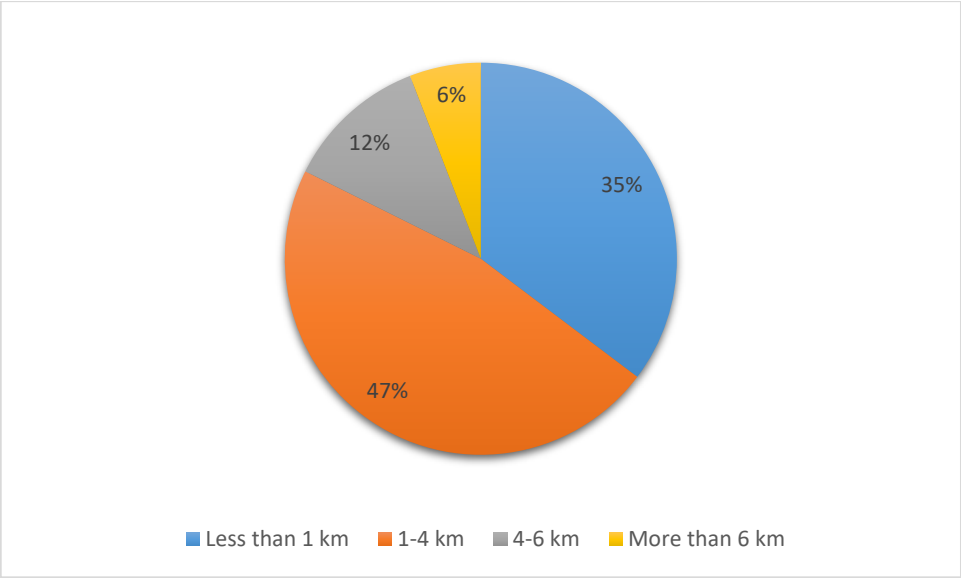
Table 12: Type of oil used in Dakar

Type of oil used	Frequency	%
Sunflower	15	44.12%
Peanut	12	35.29%
Soy	2	5.88%
Palm	2	5.88%
Olive	1	2.94%
Total	32	94.12%
Invalid	2	5.88%
Total	34	100%

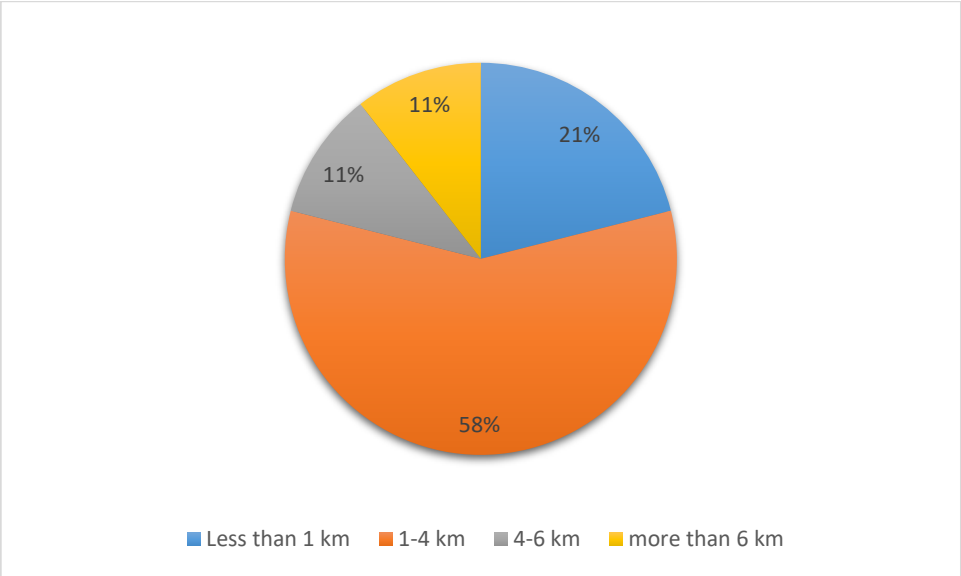
Table 13: Type of oil used in Velingara

Type of oil used (Velingara)	Frequency	%
Peanut	9	47.37%
Palm	6	31.58%
Sunflower	4	21.05%
Total	19	100%
Invalid	0	0%
Total	19	100%

Respondents from the rural area of Velingara walked more kilometers than the ones from the urban area of Dakar with only 21 % of respondents from Velingara walking less than 1 km against 35% for Dakar. The amount of people walking more than 6 km per day is also higher in the rural area (11%) compared the urban area (6%)

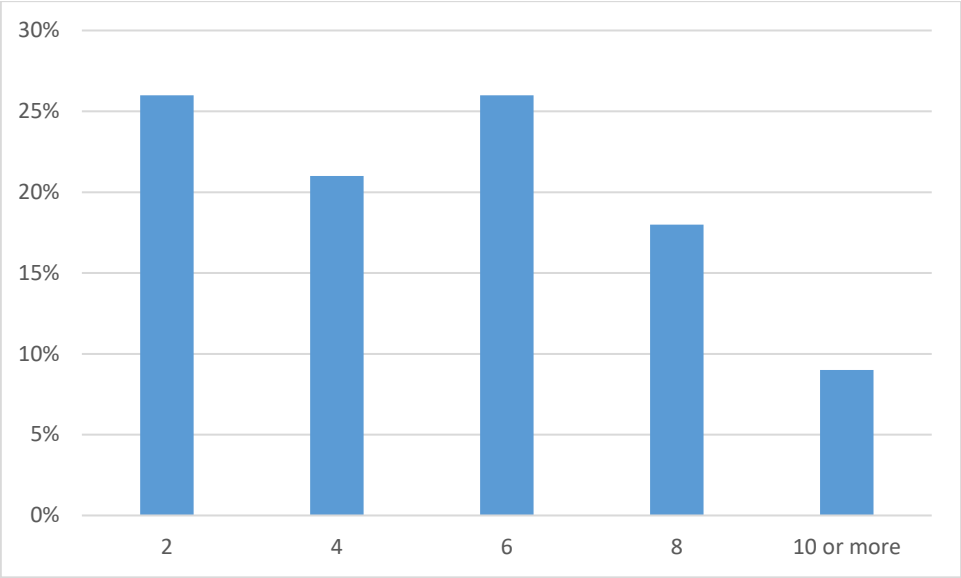


Graph 14: Kilometers walked per day by respondents of Dakar

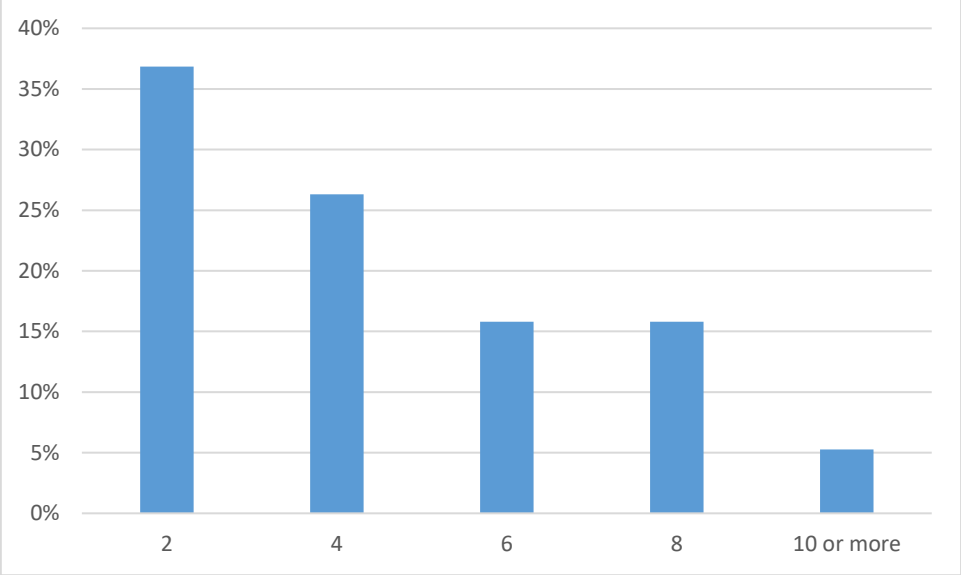


Graph 15: Kilometers walked per day by respondents of Velingara

Most urban respondents consumed 2 or 6 cups of water per day. Water consumption was lower in rural area with most respondents consuming 2 cups per day

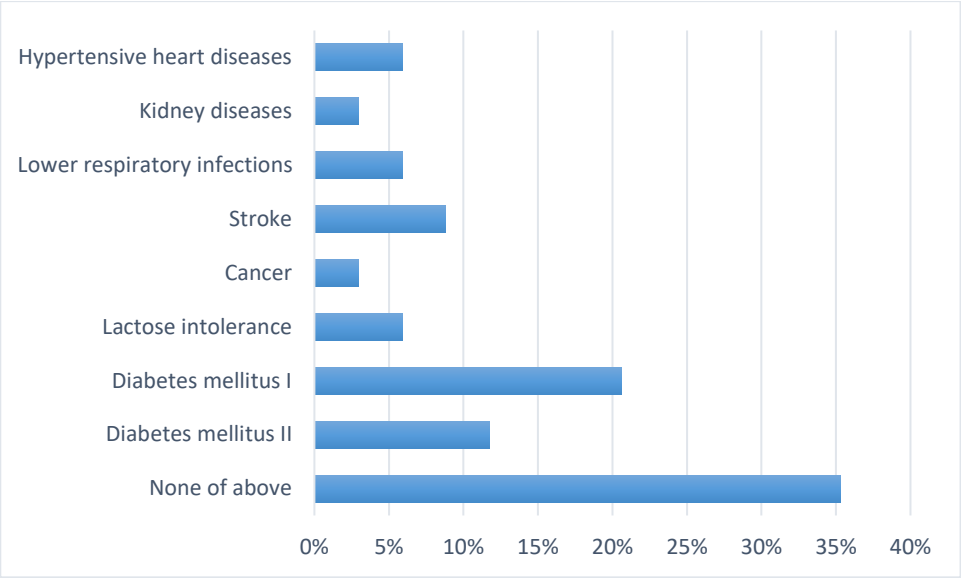


Graph 16: Number of cups of water consumed per day in Dakar

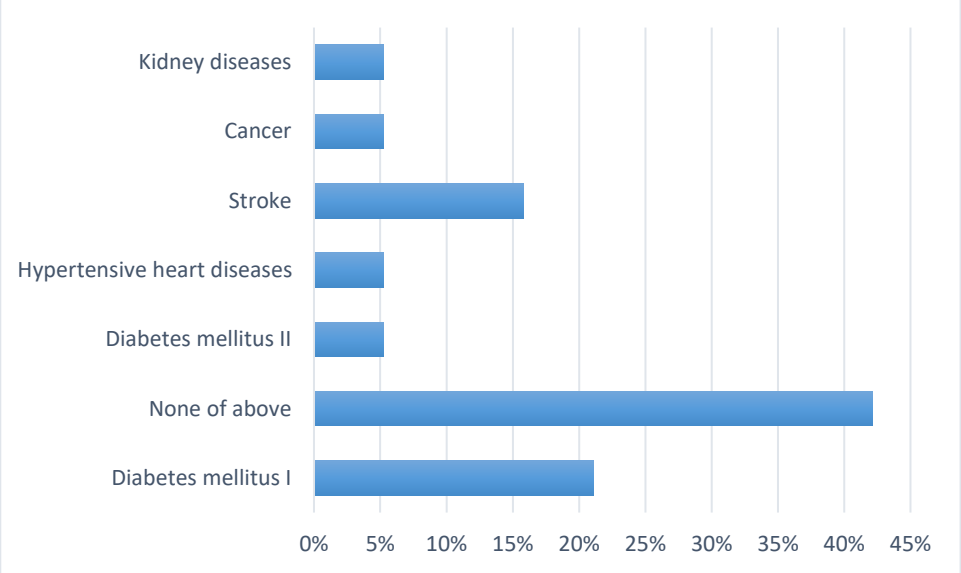


Graph 17: Number of cups of water consumed per day in Velingara

Most respondents were not experiencing any disease (35% for Dakar, 42% for Velingara), but diabetes mellitus 1 was the most present disease (21% for Dakar and Velingara).



Graph 17: Prevalence of disease among respondents of Dakar



Graph 18: Prevalence of disease among respondents of Velingara

Respondents from Dakar also reported drinking mostly water (61.75%) and soft drinks (29.41%) while respondents from Velingara drank mostly water (54.63%) and tea (37.46%). No respondent from Velingara consumed alcohol, while only 17.6% or respondents from Dakar consumed alcohol, Wine and spirits preferred (40% each) once a month or less (14.7 %). Only 3% of respondents from Dakar smoked, while no respondents from Velingara were smoking.

6 Discussion

Except for general guidelines aiming to reduce or increase the consumption of certain food groups, Senegal unfortunately does not have structured recommendations with RDI of calories and micronutrients (Nene 2018). The only food pyramid available to the population was the Sub-Saharan African food pyramid.

Regarding caloric and macronutrient consumption, no recommended intake has been made for Senegal, however the energy intake of Dakar population was significantly under the recommended intake from DACH of 2500 calories per day, while the urban population was closer to the value with a slight surplus. These results could lead to believe that respondents from rural areas would have a higher BMI, however it was not the case. BMI value was almost identical for respondents from urban and rural areas, falling in the normal range (Dragic et al. 2020). It could be explained by the fact that data showed that the population from the urban area was younger and had a higher activity level than the urban population. A study from Mbalilaki et al. (2007) also showed that rural population have considerably higher activity level and a better lipid pattern than urban population.

Protein amount was met in both areas, but the high protein content among rural population could be concerning. Rural population consumed almost three times, the RDI. Multiple studies (Friedman 2004; Bernstein et al. 2007) suggest that high protein diets might be detrimental to proper kidney function. However, a concrete amount unsafe to consume has not been defined, and more recent studies and meta-analyses found that no adverse effects can be linked to high protein diets among healthy subjects (Fenton et al. 2009; Cuenca-Sánchez et al. 2015; Shams-White et al. 2017). Plant and animal sources of protein were however almost equally consumed by rural population (65.09 grams of protein coming from plant sources against 68.44 grams from animal sources), but the urban population consumed significantly more animal sources of protein (37.87 grams against 29.82 g).

Lipid recommended intake defined by DACH and EFSA of 20 to 35% was met by respondents in both localities. Intake of unsaturated fatty acids in the form of fish would also be positively evaluated. EFSA recommends consuming an intake of at least one to two servings of fish or seafood per week for optimal health (EFSA Scientific Committee 2015). Because Senegal has access to the Atlantic Ocean, is bordered by the Senegal river and has fish as a staple of its cuisine, urban and rural population largely surpassed that amount, with 0.47 servings per day among the urban population (3.29 servings per week) and 1.02 servings per day for rural population (7.14 servings per week). Concerning cholesterol intake,

recommendations were not made by DACH and EFSA arguably because of the amount of scientific data showing the difficulty to correlate DC to risk for CHD (Fernandez & Calle 2010), but consumption from Dakar was in accordance with the previously defined 300 mg per day and Velingara's respondents consumed slightly over the amount. Regarding preparation method, most respondents from rural areas were boiling their food, which is better for overall health compared to frying food (most frequent cooking method in urban area), which has been strongly linked to higher risk of chronic diseases such as CVD, diabetes and hypertension (Gadiraju et al. 2015). The most consumed oils were sunflower oil in Dakar and peanut oil in Velingara. These oils have high thermal stability and are more recommended for high heat cooking (Alvarenga et al. 2018).

Carbohydrate consumption was practically met. Intake was in range with recommendations for Dakar and under by 1% for Velingara. Dietary fiber was consumed in adequate amount compared to DACH's recommendations in urban area and more than double of the recommended amount in rural area. An adequate fiber intake is essential for optimal digestion ability and nutrient absorption (Qi et al. 2018). Sugar intake was over recommendations, mainly coming from sweets and soft drinks. High sugar consumption might lead to increased risks of developing diabetes and CVD among consumers due to inflammation processes (Della Corte et al. 2018). That consumption might be concerning considering that diabetes mellitus I was the most prevalent disease among respondents.

Regarding micronutrients, most vitamins and minerals were consumed in insufficient numbers by respondents from Dakar except vitamin C, D and iron. On the contrary, respondents from Velingara consumed all micronutrients in sufficient amounts by DACH and EFSA's standards, except vitamin C. This might be explained by the 1346.57 kcal difference in consumption between the two localities. Indeed, a study from Damms-Machado et al. (2012) showed that a micronutrient deficiency is much more likely to occur when a low-calorie diet is consumed, compared to a higher calorie consumption. Sodium consumption was lower than DACH's recommended amount for Dakar respondents, but higher for Velingara's.

The low consumption of calcium occurring among respondents from Dakar could to osteoporosis, especially if an adequate amount of calcium has not been consumed during the childhood (Pravina et al. 2013). Inadequate amounts of magnesium may lead to an inability to acquire optimal benefits from vitamin D consumption, which could also lead to skeletal deformities, CVD or metabolic syndrome (Al Alawi et al. 2018; Uwitonze & Razzaque 2018). Zinc, vitamin A and vitamin E deficiencies might lead to a poor immune response and increase risk of infection (Huang et al. 2018; Lee & Han 2018; Mezzaroba et al. 2019).

The underconsumption of vitamin C found among respondents from Velingara might lead to tiredness, scurvy or other non-communicable diseases such as cancer due to its antioxidant effects (Padayatty et al. 2003; Rowe & Carr 2020).

In comparison, according to Tláskal (2018), insufficient amounts of vitamin D, vitamin A, vitamin E and folic acid was consumed overall by the Czech population. Anemia was also found in 10% of healthy infants and calcium deficiency in 10% of the population. Salt intake was on average twice higher than the recommended amount, with 10% of the population reaching three times the recommended allowance. Fiber intake was also not met by 20 % of the population.

Most recommendations emphasize the advantage of having a regular meal frequency and not skipping breakfast (Dallacker et al. 2018; Paoli et al. 2019). Data has shown that most respondents consumed 3 meals a day, which should correspond to breakfast, lunch and dinner. Therefore, the recommendations were met in this case.

Regarding water consumption, the most common recommendation was 8 cups per day (Valtin 2002). Most respondents were under that level, recommendations were therefore not met.

Regarding alcohol consumption, the intake should not surpass 20g per day according to the recommendations of the Society for Nutrition of the Czech Republic (0.5 l of beer, 200 ml of wine). Being a predominantly Muslim country, Senegal's alcohol consumption was nonexistent among respondents in rural area and very low among respondents from urban area (17.6 % consumed alcohol, among which 14.7% were consuming it once a month or less). The Czech Republic has the highest alcohol consumption of any European country. Consumption is reported at 16.6 liters per person per year compared to the European average of 12.45 liters (Anderson et al. 2012). Recommendation on alcohol consumption was therefore met.

Cigarette smoking was also very low, with only 1 respondent out of the 34 in urban area smoking regularly. Other respondents from Dakar and Velingara did not report smoking at all. No recommendation has been made about cigarette smoking except to not smoke or to stop smoking as fast as possible (Boyle 1997), therefore the low rate of cigarette smoking among respondents was rated positively.

6.1 Limitations of the Study

While using food frequency questionnaires, some responders might tend to overestimate or underestimate their eating habits due to personal reasons. Most respondents might also not remember the exact amount or frequency of food eaten. Recommended minerals and vitamins in daily serving are also defined according to gender, age, activity level, and so on, however, the most representative group was selected for this study. The evaluation of data was therefore limited due to these factors. Method of processing food e.g., cooking, frying, boiling also plays the role in persevering their nutritional values and might add unconsidered additional calories due to oil. Salt added to food was also not considered for the sodium amount due to its difficulty to assess. Sodium intake could therefore have been significantly higher than the data obtained, considering that most of the sodium consumption often comes from salt added during or after cooking (Bhat et al. 2020).

7 Conclusion

- The current study found that macronutrient recommendations were met by both localities. Micronutrient requirements were almost entirely met by respondents from the rural area, the only exception was vitamin C. However, insufficient intake was found among respondents from the urban area for several vitamins and minerals (calcium, magnesium, zinc, vitamin A and vitamin E). Calorie consumption was higher in the rural area than in urban.
- Positive points of the evaluation were mainly the high consumption of vegetable protein sources in Velingara (especially legumes and nuts), the very low rates of alcohol and cigarette consumption, and the high consumption of fish and seafood overall. Negative points were low fruit consumption in Velingara and Dakar, and low vegetable consumption in Dakar.
- The comparison with food pyramids showed that sweets and animal products were overconsumed overall compared to plant products.
- The comparison between the two areas of Senegal and data from the Czech Republic showed an overall lower consumption of the majority of food groups among the Dakar population except for legumes and nuts, sweets, and juices; and overall higher consumption of food groups from respondents from Velingara except for juices, grains, tubers, and fruits.
- From the results obtained we could classify the nutritional status of the urban population of Senegal as worse than the one of the Czech Republic, and the nutrition status of the rural population of Senegal as better than the Czech.
- Recommendations for further studies would be to repeat the experimentation on a larger scale, and to collect data from Czech urban and rural areas, to have more accurate results.

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9 List of abbreviations

ANSD: Agence Nationale de la Statistique et de la Démographie

CHD: Coronary heart disease

CVD: Cardiovascular disease(s)

DACH: Nutrition organization of Germany, Austria and Switzerland

DC: Dietary cholesterol

EDS: Enquête Démographique et de Santé Continue

EFSA: European Food Safety Association

EUFIC: European Food Information Council

FAO: Food and Agriculture Organization of the United Nations

NCD: Non-Communicable Disease

RDI: Recommended daily intake

SSA: Sub-Saharan Africa

USDA: United States Department of Agriculture

WHO: World Health Organization

10 Appendixes

Appendix I: Food frequency questionnaire in English

This questionnaire will be used for research and working on my diploma thesis in Czech Republic about analyzing the nutrition in Senegal. Filling it will take you about 10 minutes.

Think about your diet over the past three months, please select the responses that best describe how often you eat each type of food and how much of it you eat at a time. Select only the most often frequency and serving size per row.

Over the past month, how often did you eat the following?	Never	Less than once a week	1-3 times per week	4-5 times per week	1 time per day	2-3 times per day	4 or more times per day	What was your usual serving size, relative to the following?	1	½ or less	1 and ½ or more
Fruit (mangoes, apples, oranges etc.)								½ cup raw fruit, ½ mango or large orange			
Vegetables (carrot, salad etc.)								½ cup cooked or raw, 1 carrot			
Tubers (potato, cassava etc.)								1 small potato			
Chicken (fried chicken, in soup, grilled etc.)								100g, ½ large breast, 1 small breast, 2 drumsticks			
Turkey (fried turkey, in soup, grilled etc.)								100g, 6-8 very thin slices, 1-3 thick slices			
Fish (tuna, tilapia, sardines etc.)								100g, 1 can of tuna or sardines			
Seafood (shrimps, mussels etc.)								100g, 10 medium shrimps			
Beef (Steak, minced meat, jambon etc.)								100g, a piece about the size of your palm			
Pork (steak, soup, ham etc.)								100g, a piece about the size of your palm			
Other meat (lamb, duck, venison etc.)								100g, a piece about the size of your palm			
Nuts (peanuts, cashew nuts, almonds etc.)								¼ cup, 1 handful, 25 peanuts or 2 tablespoons of peanut butter			
Beans (niébé, peas, etc.)								½ cup of cooked beans, 2 handfuls of beans			
Dairy (milk, cheese, yoghurt etc.)								1 glass of milk, 1 cup of yoghurt, 3 slices of cheese			
Eggs (omelet, in salad, baked etc.)								1 egg, ¼ cup omelet			
Grains (bread, rice, pasta etc.)								1 slice of bread, ½ cup of rice or pasta			
Sweets (candies, cookies, cakes etc.)								1 slice of cake, 2 cookies			
Soft drinks (water, juice, coca-cola, etc.)								1 can of soda (350 ml)			
Coffee and tea (ataya, Touba coffee etc.)								1 small cup of Touba coffee, ¾ cup of coffee, 1 glass of ataya			

1. Your gender?

a) Male

b) Female

2. Your age?

a) under 20

b) 20-29

c) 30-39

d) 40-49

e) over 50

3. Your weight (in kilograms) :

……

4. Your height (in meters) :

……

5. How many meals do you eat per day?

a) less than 1 per day

b) 2 per day

c) 3 per day

d) 4 per day

e) more than 5 per day

6. How do you usually prepare your food? Please circle it.

frying	boiling
sauteing	roasting
grilling	steaming

7. What type of drinks do you prefer?

a) water

b) soft drinks

c) tea

d) lemonade

e) other

8. Which type of oil do you often use? You can choose more answers.

soya	peanut
coconut	corn
sunflower	macadamia
olive	linen
palm	rapeseed
sesame	mustard

Other and which one:

9. How many glasses (250 ml) of liquids (water, soft drinks, tea,..) you drink per day?

a) 2

b) 4

c) 6

d) 8

e) 10 or more

10. How often do you drink alcohol?

a) never

b) once a month or less

c) 2 to 4 times a month

d) 2-3 times a week

e) 4 or more times a week

11. What type of alcoholic beverages do you prefer?

a) beer

b) wine

c) spirits with more than 15% alcohol

d) do not drink

12. How many km do you walk per day?

a) Less than 1 km

b) 1-4 km

c) 4-6 km

d)more than 6 km

13. Do you smoke?

a) Yes, regularly

b) Yes, sometimes

c) No/Never

14. Did you or your close relative ever suffer from one or more diseases listed down below? Please circle it.

Diabetes mellitus I	Stroke
Diabetes mellitus II	Chronic obstructive pulmonary disease
Ischemic heart disease	Cancer
Lower respiratory infections	Tuberculosis
Hypertensive heart diseases	Lactose intolerance
Kidney diseases	Celiac disease
Cirrhosis	Crohn's disease/Ulcerative colitis

None of above

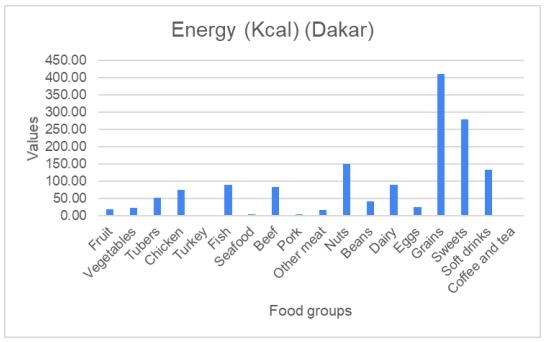
Thank you for your time, which you spent with the questionnaire. Your opinion is very important for my research.

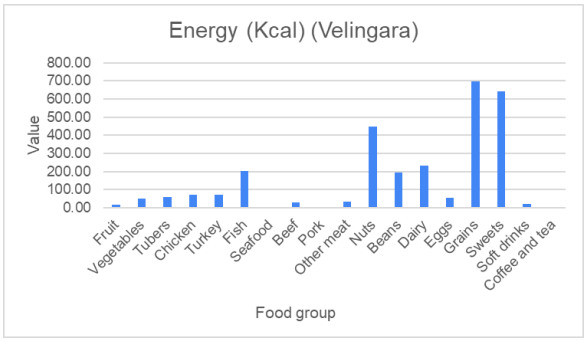
Appendix 2: Table of selected foods with code from USDA database and values

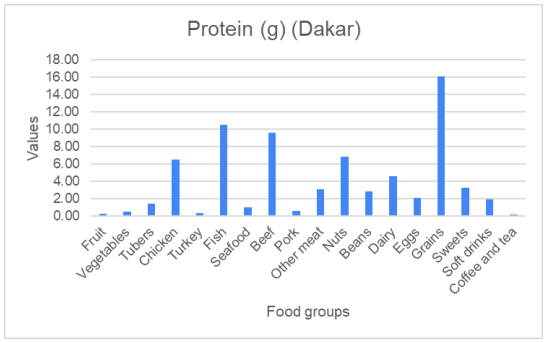
Food group	Selected food	Energy (Kcal)	Protein (g)	Carbohydrates (g)	Lipids (g)	Fiber (g)	Sugar (g)	Calcium (mg)	Iron (mg)
Fruit	Mango (9176) (100g)	60	0.82	15	0.38	1.6	13.7	11	0.16
Vegetables	Carrot (73101010) (100g)	41	0.93	9.58	0.24	2.8	4.74	33	0.3
Tubers	Potato (11352) (100g)	77	2.05	17.5	0.09	2.1	0.82	12	0.81
Chicken	Chicken (5006) (100g)	215	18.6	0	15.1	0	0	11	0.9
Turkey	Turkey (5165) (100g)	144	21.6	0.14	5.64	0	0.07	11	0.86
Fish	Yaboy *(Sardinella aurita) (1098981)* (100g)	208	24.6	0	11.4	0	0	382	2.92
Seafood	Shrimps (15270) (100g)	85	20.1	0	0.51	0	0	64	0.52
Beef	Beef (23461) (100g)	177	20.6	0	10.6	0	0	5	1.84
Pork	Pork (10218) (100g)	120	20.6	0	3.53	0	0	6	0.97
Other meat	Goat (17168) (100g)	109	20.6	0	2.31	0	0	13	2.83
Nuts	Peanuts (16087) (100g)	567	25.8	16.1	49.2	8.5	4.72	92	4.58
Beans	Cowpeas (16060) (100g)	343	23.8	59.6	2.07	10.7	3	85	9.95
Dairy	Whole milk (1211) (244g)	149	7.69	11.7	7.98	0	12.3	276	0.73
Eggs	Eggs (1123) (44g)	62.9	5.54	0.317	4.18	0	0.163	24.6	0.77
Grains	Bread (18064) (100g)	274	10.7	47.5	4.53	4	5.73	125	3.6
Sweets	Milk biscuits (53241500) (100g)	464	5.35	67.3	19.6	1.3	27.3	35	2.24
Soft drinks	Orange juice (61210000) (248g)	119	1.69	28.3	0.298	0.744	20.6	139	0.322
Coffee and tea	Coffee (92101000) (240g)	2.4	0.288	0	0.048	0	0	4.8	0.024

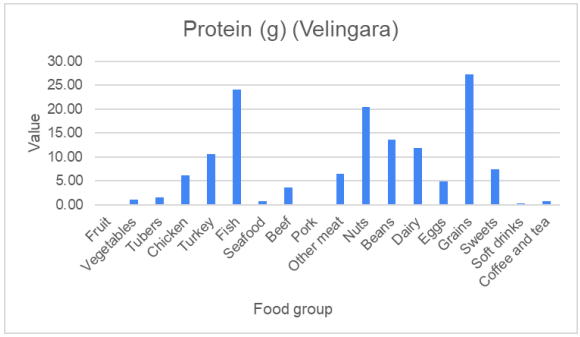
Food group	Selected food	Magnesium (mg)	Sodium (mg)	Zinc (mg)	Vitamin A (µg)	Vitamin C (mg)	Vitamin D (µg)	Vitamin E (mg)	Cholesterol (mg)
Fruit	Mango (9176) (100g)	10	1	0.09	54	36.4	0	0.9	0
Vegetables	Carrot (73101010) (100g)	12	69	0.24	835	5.9	0	0.66	0
Tubers	Potato (11352) (100g)	23	6	0.3	0	19.7	0	0.01	0
Chicken	Chicken (5006) (100g)	20	70	1.31	41	1.6	0.2	0.3	75
Turkey	Turkey (5165) (100g)	25	112	1.78	17	0	0.3	0.09	72
Fish	Yaboy *(Sardinella aurita) (1098981)* (100g)	39	307	1.31	32	0	4.8	2.04	142
Seafood	Shrimps (15270) (100g)	35	119	1.34	90	0	0.1	0	161
Beef	Beef (23461) (100g)	19	49	5.22	10	0	0	0.49	58
Pork	Pork (10218) (100g)	27	52	1.87	0	0	0.3	0.22	65
Other meat	Goat (17168) (100g)	0	82	4	0	0	0	0.34	57
Nuts	Peanuts (16087) (100g)	168	18	3.27	0	0	0	8.33	0
Beans	Cowpeas (16060) (100g)	333	58	6.11	2	1.5	0	0.22	0
Dairy	Whole milk (1211) (244g)	24.4	105	0.903	112	0	0.244	0.171	24.4
Eggs	Eggs (1123) (44g)	5.28	62.5	0.568	70.4	0	36.1	0.462	164
Grains	Bread (18064) (100g)	41	473	1.04	0	0	0	0.19	0
Sweets	Milk biscuits (53241500) (100g)	13	385	0.43	7	0	0	3.07	12
Soft drinks	Orange juice (61210000) (248g)	27.3	4.96	0.174	4.96	83.3	0.992	0.496	0
Coffee and tea	Coffee (92101000) (240g)	7.2	4.8	0.048	0	0	0	0.024	0

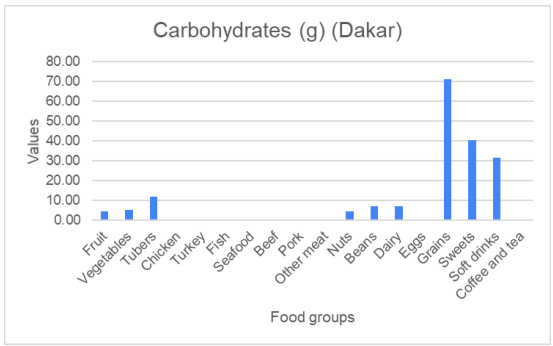
Appendix 3: Graphic representation of selected nutrients in food groups

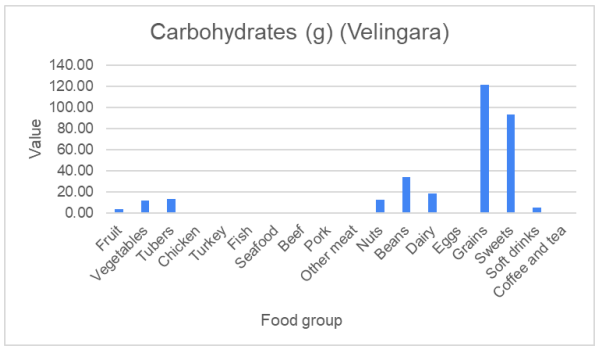


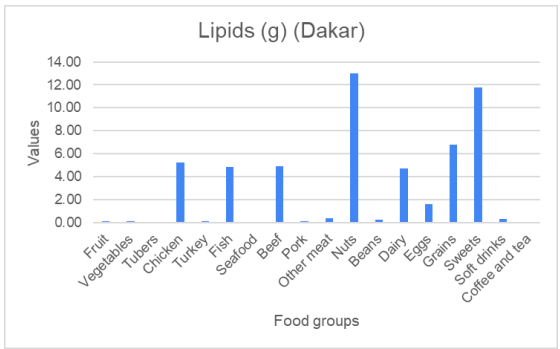


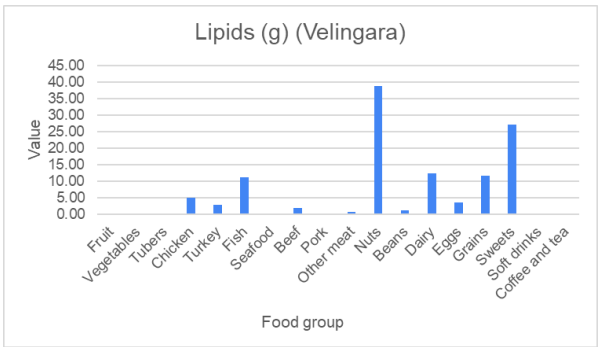


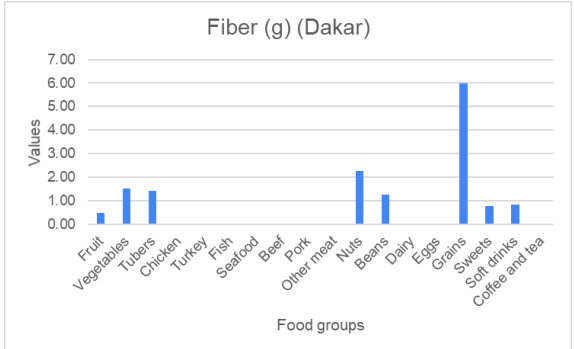


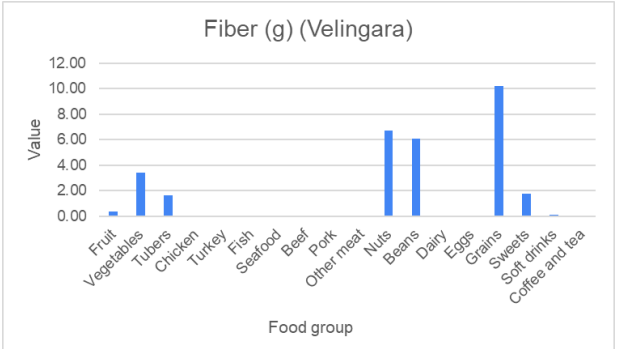


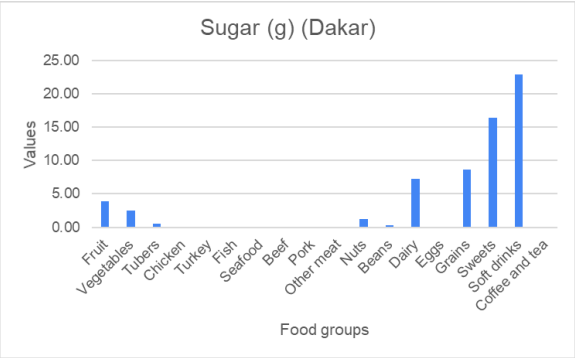


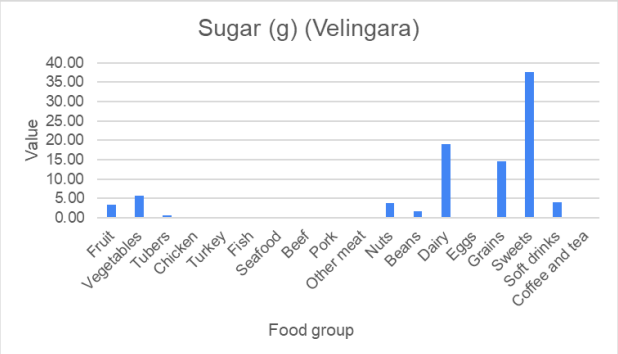


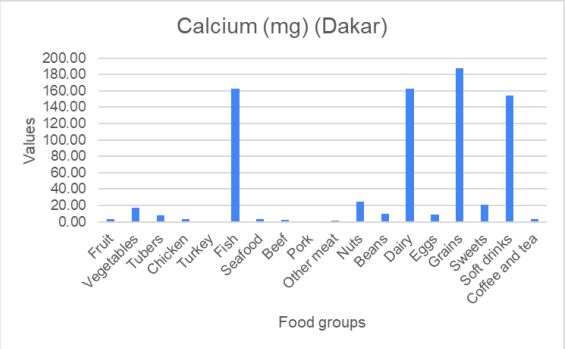


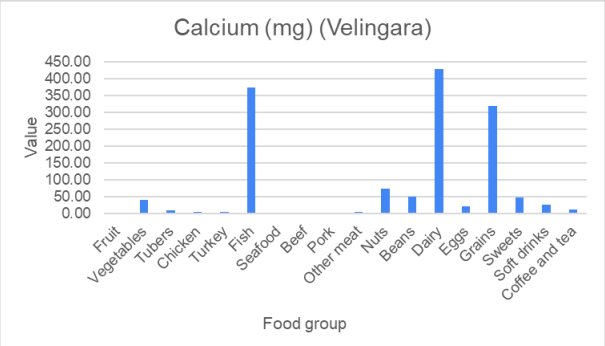


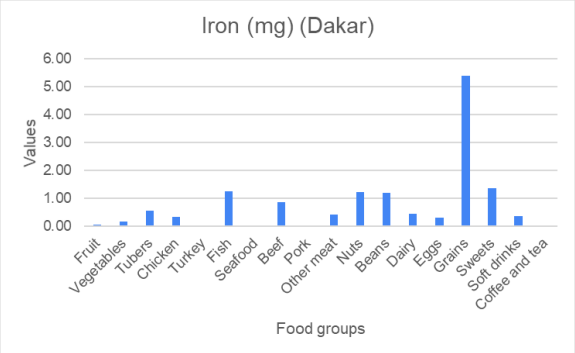


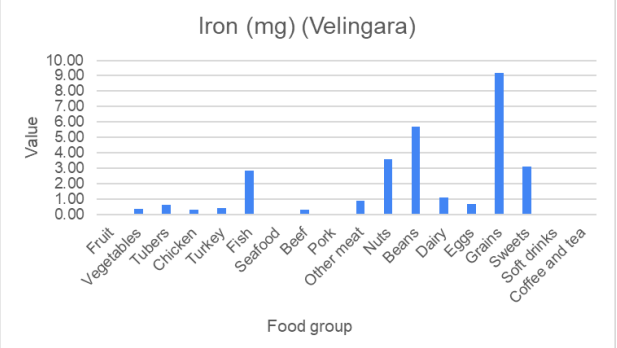

Sugar (g) (Dakar)
Values
25.00
20.00
15.00
10.00
5.00
0.00
Fruit
Vegetables
Tubers
Chicken
Turkey
Fish
Seafood
Beef
Pork
Other meat
Nuts
Beans
Dairy
Eggs
Grains
Sweets
Soft drinks
Coffee and tea
Food groups

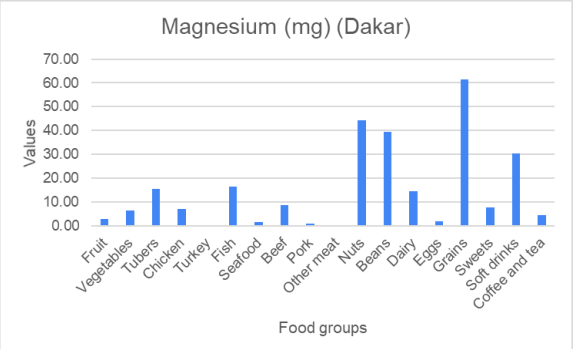

Sugar (g) (Velingara)
Value
40.00
35.00
30.00
25.00
20.00
15.00
10.00
5.00
0.00
Fruit
Vegetables
Tubers
Chicken
Turkey
Fish
Seafood
Beef
Pork
Other meat
Nuts
Beans
Dairy
Eggs
Grains
Sweets
Soft drinks
Coffee and tea
Food group

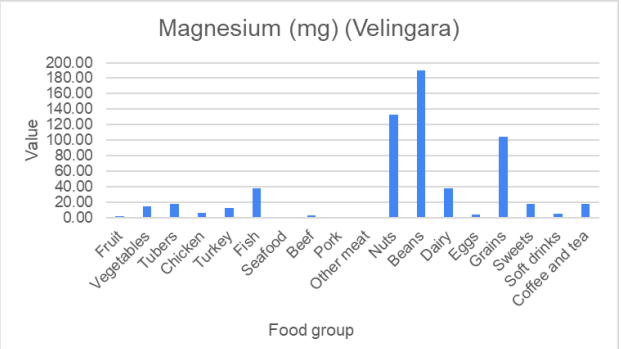

Calcium (mg) (Dakar)
Values
200.00
180.00
160.00
140.00
120.00
100.00
80.00
60.00
40.00
20.00
0.00
Fruit
Vegetables
Tubers
Chicken
Turkey
Fish
Seafood
Beef
Pork
Other meat
Nuts
Beans
Dairy
Eggs
Grains
Sweets
Soft drinks
Coffee and tea
Food groups

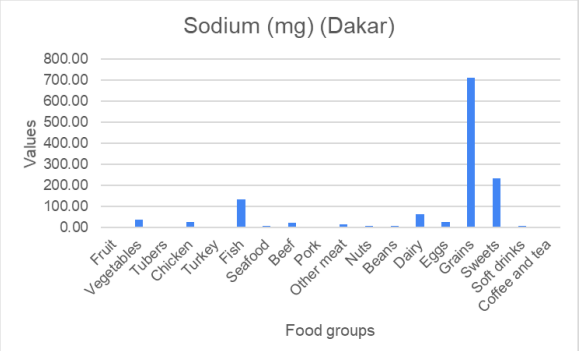

Calcium (mg) (Velingara)
Value
450.00
400.00
350.00
300.00
250.00
200.00
150.00
100.00
50.00
0.00
Fruit
Vegetables
Tubers
Chicken
Turkey
Fish
Seafood
Beef
Pork
Other meat
Nuts
Beans
Dairy
Eggs
Grains
Sweets
Soft drinks
Coffee and tea
Food group

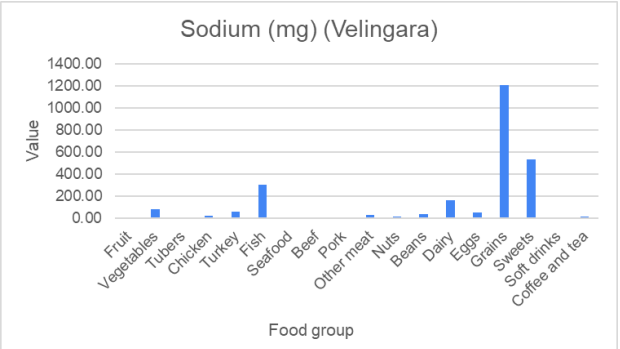

Iron (mg) (Dakar)
Values
6.00
5.00
4.00
3.00
2.00
1.00
0.00
Fruit
Vegetables
Tubers
Chicken
Turkey
Fish
Seafood
Beef
Pork
Other meat
Nuts
Beans
Dairy
Eggs
Grains
Sweets
Soft drinks
Coffee and tea
Food groups

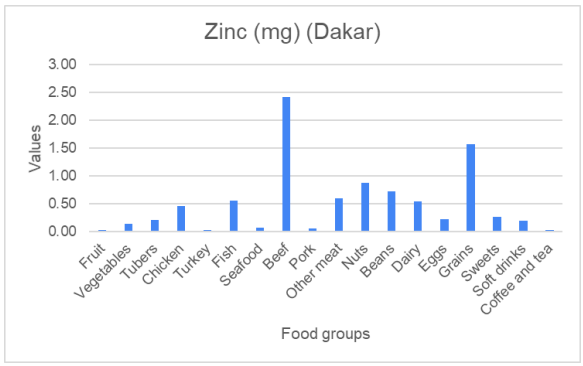

Iron (mg) (Velingara)
Value
10.00
9.00
8.00
7.00
6.00
5.00
4.00
3.00
2.00
1.00
0.00
Fruit
Vegetables
Tubers
Chicken
Turkey
Fish
Seafood
Beef
Pork
Other meat
Nuts
Beans
Dairy
Eggs
Grains
Sweets
Soft drinks
Coffee and tea
Food group

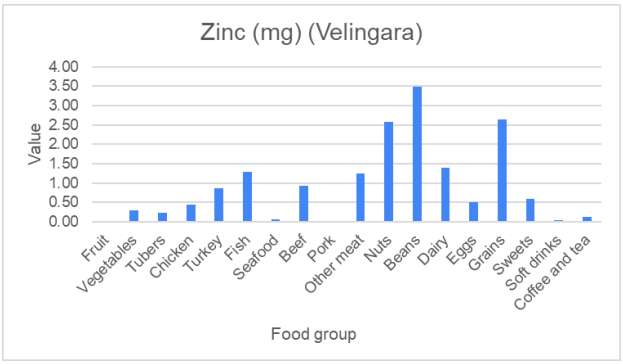

Magnesium (mg) (Dakar)
Values
70.00
60.00
50.00
40.00
30.00
20.00
10.00
0.00
Fruit
Vegetables
Tubers
Chicken
Turkey
Fish
Seafood
Beef
Pork
Other meat
Nuts
Beans
Dairy
Eggs
Grains
Sweets
Soft drinks
Coffee and tea
Food groups

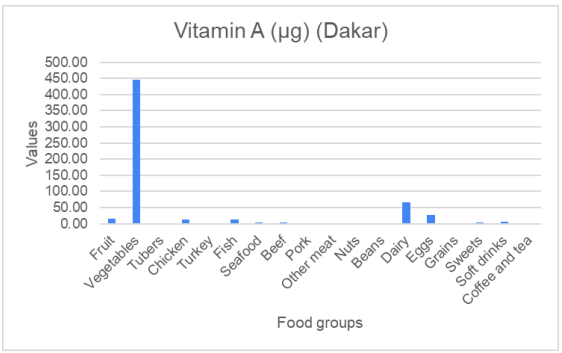

Magnesium (mg) (Velingara)
Value
200.00
180.00
160.00
140.00
120.00
100.00
80.00
60.00
40.00
20.00
0.00
Fruit
Vegetables
Tubers
Chicken
Turkey
Fish
Seafood
Beef
Pork
Other meat
Nuts
Beans
Dairy
Eggs
Grains
Sweets
Soft drinks
Coffee and tea
Food group

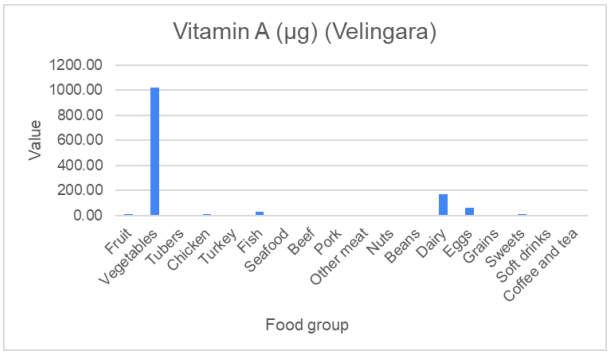

Sodium (mg) (Dakar)
Values
800.00
700.00
600.00
500.00
400.00
300.00
200.00
100.00
0.00
Fruit
Vegetables
Tubers
Chicken
Turkey
Fish
Seafood
Beef
Pork
Other meat
Nuts
Beans
Dairy
Eggs
Grains
Sweets
Soft drinks
Coffee and tea
Food groups

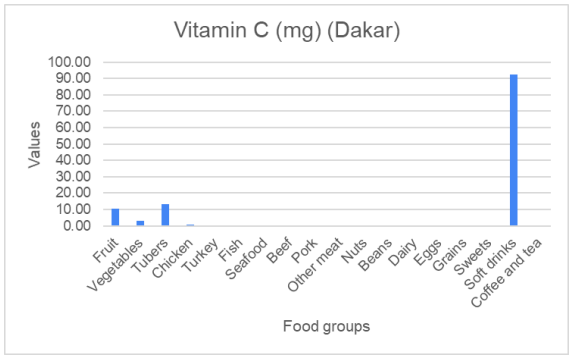

Sodium (mg) (Velingara)
Value
1400.00
1200.00
1000.00
800.00
600.00
400.00
200.00
0.00
Fruit
Vegetables
Tubers
Chicken
Turkey
Fish
Seafood
Beef
Pork
Other meat
Nuts
Beans
Dairy
Eggs
Grains
Sweets
Soft drinks
Coffee and tea
Food group

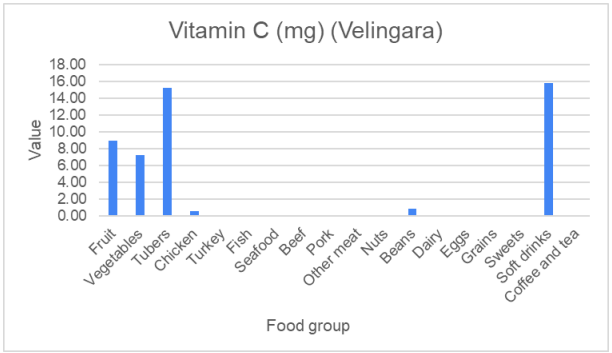

Zinc (mg) (Dakar)
Values
3.00
2.50
2.00
1.50
1.00
0.50
0.00
Fruit
Vegetables
Tubers
Chicken
Turkey
Fish
Seafood
Beef
Pork
Other meat
Nuts
Beans
Dairy
Eggs
Grains
Sweets
Soft drinks
Coffee and tea
Food groups

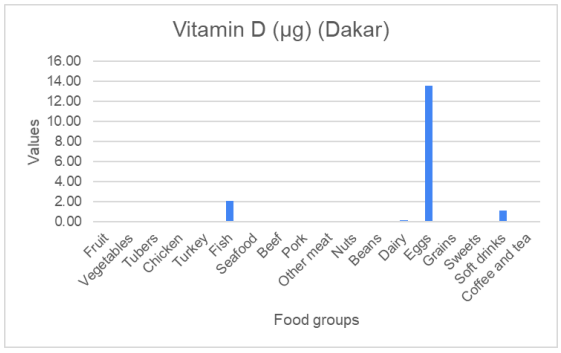

Zinc (mg) (Velingara)
Value
4.00
3.50
3.00
2.50
2.00
1.50
1.00
0.50
0.00
Fruit
Vegetables
Tubers
Chicken
Turkey
Fish
Seafood
Beef
Pork
Other meat
Nuts
Beans
Dairy
Eggs
Grains
Sweets
Soft drinks
Coffee and tea
Food group

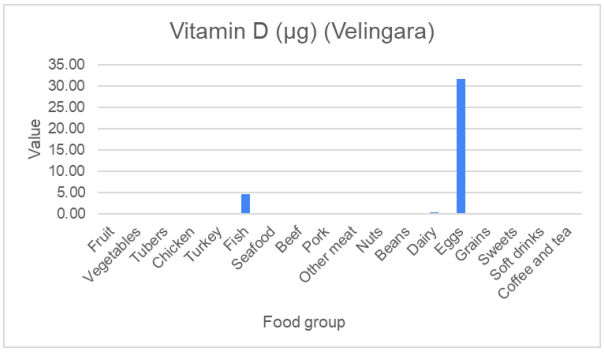

Vitamin A (µg) (Dakar)
Values
500.00
450.00
400.00
350.00
300.00
250.00
200.00
150.00
100.00
50.00
0.00
Fruit
Vegetables
Tubers
Chicken
Turkey
Fish
Seafood
Beef
Pork
Other meat
Nuts
Beans
Dairy
Eggs
Grains
Sweets
Soft drinks
Coffee and tea
Food groups

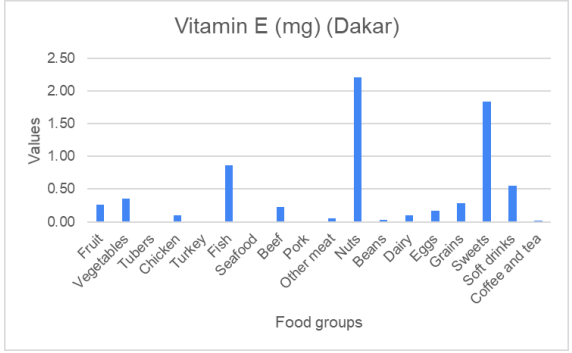

Vitamin A (µg) (Velingara)
Value
1200.00
1000.00
800.00
600.00
400.00
200.00
0.00
Fruit
Vegetables
Tubers
Chicken
Turkey
Fish
Seafood
Beef
Pork
Other meat
Nuts
Beans
Dairy
Eggs
Grains
Sweets
Soft drinks
Coffee and tea
Food group

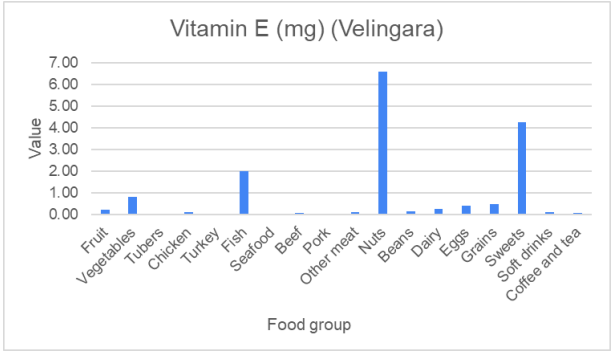

Vitamin C (mg) (Dakar)
Values
100.00
90.00
80.00
70.00
60.00
50.00
40.00
30.00
20.00
10.00
0.00
Fruit
Vegetables
Tubers
Chicken
Turkey
Fish
Seafood
Beef
Pork
Other meat
Nuts
Beans
Dairy
Eggs
Grains
Sweets
Soft drinks
Coffee and tea
Food groups

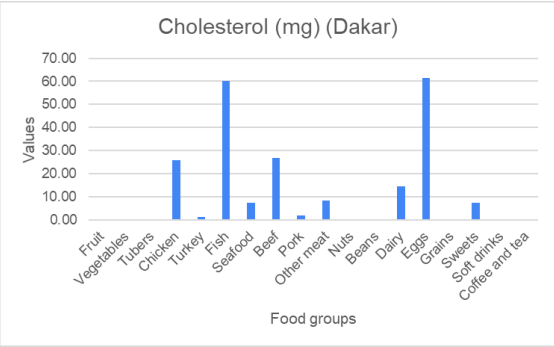

Vitamin C (mg) (Velingara)
Value
18.00
16.00
14.00
12.00
10.00
8.00
6.00
4.00
2.00
0.00
Fruit
Vegetables
Tubers
Chicken
Turkey
Fish
Seafood
Beef
Pork
Other meat
Nuts
Beans
Dairy
Eggs
Grains
Sweets
Soft drinks
Coffee and tea
Food group

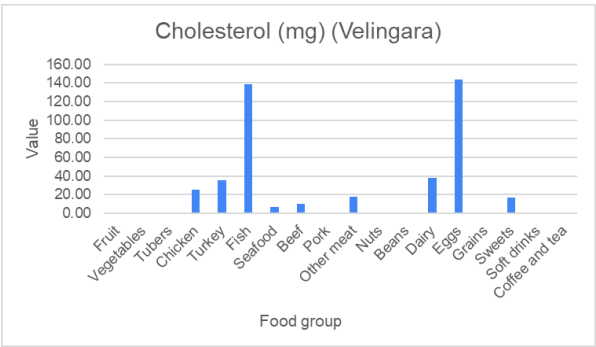

Vitamin D (µg) (Dakar)
Values
16.00
14.00
12.00
10.00
8.00
6.00
4.00
2.00
0.00
Fruit
Vegetables
Tubers
Chicken
Turkey
Fish
Seafood
Beef
Pork
Other meat
Nuts
Beans
Dairy
Eggs
Grains
Sweets
Soft drinks
Coffee and tea
Food groups


Vitamin D (µg) (Velingara)
Value
35.00
30.00
25.00
20.00
15.00
10.00
5.00
0.00
Fruit
Vegetables
Tubers
Chicken
Turkey
Fish
Seafood
Beef
Pork
Other meat
Nuts
Beans
Dairy
Eggs
Grains
Sweets
Soft drinks
Coffee and tea
Food group


Vitamin E (mg) (Dakar)
Values
2.50
2.00
1.50
1.00
0.50
0.00
Fruit
Vegetables
Tubers
Chicken
Turkey
Fish
Seafood
Beef
Pork
Other meat
Nuts
Beans
Dairy
Eggs
Grains
Sweets
Soft drinks
Coffee and tea
Food groups


Vitamin E (mg) (Velingara)
Value
7.00
6.00
5.00
4.00
3.00
2.00
1.00
0.00
Fruit
Vegetables
Tubers
Chicken
Turkey
Fish
Seafood
Beef
Pork
Other meat
Nuts
Beans
Dairy
Eggs
Grains
Sweets
Soft drinks
Coffee and tea
Food group


Cholesterol (mg) (Dakar)
70.00
60.00
50.00
40.00
30.00
20.00
10.00
0.00
Values
Fruit
Vegetables
Tubers
Chicken
Turkey
Fish
Seafood
Beef
Pork
Other meat
Nuts
Beans
Dairy
Eggs
Grains
Sweets
Soft drinks
Coffee and tea
Food groups


Cholesterol (mg) (Velingara)
160.00
140.00
120.00
100.00
80.00
60.00
40.00
20.00
0.00
Value
Fruit
Vegetables
Tubers
Chicken
Turkey
Fish
Seafood
Beef
Pork
Other meat
Nuts
Beans
Dairy
Eggs
Grains
Sweets
Soft drinks
Coffee and tea
Food group