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Dietary diversity: The case study of Arba Minch Zuriya district, Gamo zone, SNNPR, Ethiopia

BACHELOR'S THESIS

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Declaration

I hereby declare that I have done this thesis entitled Dietary diversity: The case study of Arba Minch Zuriya district, Gamo zone, SNNPR, Ethiopia, independently, all texts in this thesis are original, and all sources have been quoted and acknowledged by means of complete references and according to Citation rules of the FTA.

In Prague 15. April 2022

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Abstract

In this study, the diversity of diet, one of the important elements of high-quality diets, was investigated using the Women's Dietary Diversity Score (WDDS). The principle of this measuring tool was the counting of 9 different food groups consumed during the 24 hour recall period. The responses were obtained from 202 women in the Arba Minch Zuriya district, Gamo zone, SNNPR, Ethiopia. In addition to the dietary diversity score, sociodemographic characteristics such as household size, age, religion, and education level were also analysed. In developing countries, food diversification is low and diets are often based on only a few food groups. This causes a lack of important nutrients that are essential for human health and the human body. In this survey, the average number of food groups consumed was 3.08, which was considered low, according to the recommended minimum of food group consumption. The diet was based mainly on the consumption of starchy staple foods (100 % of respondents), dark green leafy vegetables (98.5 % of respondents), and other fruits and vegetables (87.1 % of respondents). The most commonly consumed food item was bread, cornbread, and corn kollo. Less than half of the respondents were between 26 and 30 years of age. The mean level of education was 4.36 years of schooling and the average household size was 5.69 members per household. 62 % of the respondents were Protestants, and the rest of the women (37 %) were Orthodox. A statistically significant effect on WDDS was observed between education level and the number of food groups consumed.

Key words: dietary diversity, Ethiopia, fruit, food, eating habits

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List of the abbreviations used in the thesis

DD	Dietary Diversity
DDS	Dietary Diversity Score
FANTA	Food Nutrition and Technical Assistance
FAO	Food and Agriculture Organization
FO	Field Officer
HDDS	Household Dietary Diversity Score
SNNPRS	Southern Nations, Nationalities' and Peoples' Regional State
VAD	Vitamin A deficiency
WDDS	Women Dietary Diversity Score
WHO	World Health Organization
WRA	Women of reproductive age

1. Introduction

1.1. Human nutrition

Human nutrition is one of the important environmental factors that affect human health. The way we eat is an integral part of our lifestyle and can have consequences for all areas of our lives. Food and fluids are essential for maintaining good health as they can supply our body with all substances it needs. Incorrect, insufficient or excessive nutrition deteriorates our health (Hrnčířová et al. 2012). A healthy diet helps protect against malnutrition and diet-related noncommunicable diseases such as heart disease, diabetes, stroke, and cancer (Shogo et al. 2021). In addition to the basic nutrients (macronutrients) - protein, fat, and carbohydrates, food also contains a number of other nutrients (micronutrients) which are important to human beings. These include vitamins, minerals, trace elements, fibres, and many others. Macronutrients should be supplied to the body in a certain ratio, which is called the triple ratio of nutrients. Of the total amount of energy we take in each day, 15 % should come from protein, 30 % from fat, and 55 % from carbohydrates (Hrnčířová et al. 2012).

Meals should be consumed during the day at regular intervals, preferably more frequently and in small portions. Irregularity leads to imperceptible overeating, obesity, fatigue, and reduced performance. From a health point of view, it is recommended that the daily ration of food be divided into five or six meals (approximately three-hour breaks between meals). Regular diet provides the body with substances necessary for its activity - nutrients. Nutrients are processed in the body and used as a source of energy, used to build tissues or to produce all substances necessary for its activity (Hrnčířová & Marádová 2018).

Along with regular intake, the diet should also be diversified. The impact of dietary diversity on nutrient and vitamin intake is one of the most important components of a healthy diet. Greater variety in the daily diet is associated with a greater intake of macro- and micronutrients (Mahdavi-Roshan et al. 2021). Lack of dietary diversity is a particularly serious problem for poor populations in developing countries because their diets are based largely on starchy foods and often contain little or no animal products and

few fresh fruits and vegetables. These diets based on plants tend to be low in the number of micronutrients, and the micronutrients they contain are often in a form that is not easily absorbed (Ruel 2003). Every day, the human diet should contain sufficient amounts of vegetables and fruits, legumes (e.g. lentils, beans), nuts, and whole grains (e.g. unprocessed millet, wheat, oats, maise, brown rice) (Shogo et al. 2021).

1.1.1. Macronutrients

1.1.1.1. Proteins

Proteins are the keystone of all living organisms on Earth. In the human body, they are found in many different forms in all tissues and have many different functions – structural (proteins in connective tissues and muscles, organs, and bone, e.g. collagen), enzymatic (e.g. digestive enzyme trypsin, which cleaves proteins in food), hormonal (e.g. known hormone insulin regulating blood glucose level), transport (e.g. hemoglobin-the main protein of red blood cells which transport oxygen from lungs to tissues and back in the form of CO_2), and the last function is protective (Hume 2005; Roubík 2018).

Proteins are essential for the origin and maintenance of life because they are the only source of nitrogen in the human diet and the only source of essential amino acids. Although proteins can be used like a source of energy, they are primarily used in the form of building substances for enzyme synthesis, hormones, regeneration of connective tissues, and more. If the diet is relatively well-balanced and contains enough carbohydrates and fats, only 20 percent of protein intake is decomposed in the organism to energy and the rest is preserved in body structure and tissues in the form of amino acids (Roubík 2018).

Protein is commonly found in animal tissues and their products (e.g. meat, eggs, and dairy products) and in vegetables such as cereals and legumes (Underwood & Galal 2011).

The recommended daily dose is 0.8 grams of protein per 1 kilogram of body mass (adult people). For children and people in recovery (after illness or injury), the amount of protein intake is higher (up to 1.5 g/kg) because of increased tissue growth and regeneration (Roubík 2018).

1.1.1.2. Carbohydrates

Carbohydrates are one of the main components of living organisms and the most widely used organic matter on the planet at the same time. For the human body, carbohydrates are the main energy intake. Carbohydrates are cleft and transported by metabolic processes to glucose. D-glucose is a nutrient for every human body cell and for some of them is a prevalent or exclusive energy intake (e.g. brain, red blood cells, bollock, retina, bone marrow and more). Carbohydrates are the only type of nutrients that are not essential for the human body and one cannot depend on them alone, because if they are deficient, vital organs and tissues would stop working. Because of this, humans have several mechanisms to create carbohydrates and glucose from protein and fats in the event of insufficient amounts in the diet, which is less efficient and unsustainable for the body in the long term. Another important and related function of carbohydrates is energy storage in the body. In addition, carbohydrates have a number of other important functions, for example, structural, together with proteins, they form so-called glycoproteins, which are, among other things, the basic component of cartilaginous tissues and joints and together with glycolipids, which are important components of all cell membranes in organism (Roubík 2018).

According to the number of sugar units, carbohydrates are divided into three basic groups - monosaccharides, oligosaccharides, and polysaccharides, to which is added a group of called complex carbohydrates. Monosaccharides contain one sugar unit and include, for example, glucose (grape sugar), and fructose (fruit sugar). Oligosaccharides contain 2-10 identical or different monosaccharides, examples are sucrose (beet and cane sugar) consists of glucose and fructose, lactose (milk sugar) consists of glucose and galactose, the carbohydrates in legumes (raffinose, stachyose, verbascose, etc.) contain galactose and others. Polysaccharides contain more than ten monosaccharides - starch, cellulose, pectin, inulin, etc. Complex carbohydrates also contain other compounds such as proteins, fats, and others (Hume 2005; Roubík 2018).

The most common simple carbohydrate (sugar) is sucrose. It is made from sugar beet or sugar cane and is usually called sugar. Carbohydrates are found in tabletop sweeteners and are added to many food products - baked goods, cereals, confectionery, chocolate, ice cream, sweetened beverages, etc.

Lactose is found in milk and dairy products. Glucose is found in syrups, fruits, and honey. Fructose is found in the same foods but in different amounts. Polysaccharide is a major component of cereals and cereal products, legumes, and potatoes. Indigestible polysaccharide (fibre) is found in fruits, vegetables, legumes, mushrooms, cereals, and products made from dark and wholemeal flours (Hume 2005).

1.1.1.3. Fats

Fats (lipids) have many functions in the body. In addition to providing energy, they regulate body temperature, participate in the metabolism of fat-soluble vitamins (A, D, E, K), and provide a source of essential fatty acids. We subdivide fats into unsaturated fats, which consist mainly of unsaturated fatty acids, which have a positive impact on human health, especially for the proper functioning of the brain and sex glands. The next one are saturated fats, composed mainly of saturated fatty acids and their excess in the diet has health benefits compared to unsaturated fatty acids as they increase cholesterol levels, increasing the risk of cardiovascular disease and cancer. The last one are trans unsaturated fats which have a negative effect on human health, even worse than saturated fats (Wanless & Judge 2010).

The recommended amount is to maintain a total dietary fat intake of 20 to 35 percent for adults, 30 to 40 percent for children aged 1 to 3, and 25 to 35 percent for children aged 4 to 18 (Heneman et al. 2008).

1.1.2. Micronutrients

Micronutrients contain vitamins, minerals, and trace elements (Roubík 2018). Vitamins and minerals play an essential role in metabolism and have other functional roles. Although they are needed in small amounts, most vitamins are not synthesised in sufficient quantities in the human body and must therefore be obtained, together with essential minerals from food or other exogenous sources (Underwood & Galal 2011).

Micronutrient deficiencies are a common problem in agricultural crops, leading to both reduced yields and reduced nutritional quality of crops. The rapid depletion of micronutrients from the soil reserve due to increased food production has reduced micronutrient levels, which has brought about a sharp reduction in macronutrient productivity and efficiency (Shukla et al. 2019).

1.1.2.1. Vitamins

Vitamins are organic substances essential for the regulation of metabolic functions in cells and for the processes that release energy from food. Vitamins are not produced by the human body and are essential for normal bodily functions. Their deficiency in the diet leads to the characteristic and now well-defined manifestations of many diseases, and the addition of these substances to the diet results in the elimination of the disease and its symptoms (Kladenský 2017).

There are two main classes of vitamins: fat-soluble and water-soluble. Fat-soluble vitamins A (and carotenoids of provitamin A), E, D, and K require proteins or other water-miscible carriers for transport, are not easily excreted and are stored in body tissues in excess. The water-soluble vitamins are the B vitamins - thiamine (B1), riboflavin (B2), niacin, folate, pyridoxine (B6), cyanocobalamin (B12), pantothenic acid, and vitamin C. These vitamins are easily transported and excreted and accumulate in the body tissues only to a limited extent, i.e. they should be consumed almost daily to ensure their need (Underwood & Galal 2011).

Fat-soluble vitamins

Vitamin A (Retinol)

Vitamin A is a micronutrient important for the development and growth of the human body. It is essential for eye health, vision, and proper immune system (Busse et al. 2017). Vitamin A is present in dairy products (milk, butter, cheese, ice cream), eggs, liver, and other internal organs (kidney, heart), and many fish (sardines, tuna). Green leafy vegetables and carrots are also sources of vitamin A, on the other side, cereal grains contain a very small amount of this vitamin (Robert et al. 2001).

Dietary intake of vitamin A that is insufficient to meet physiological needs is a consequence of vitamin A deficiency. It may be aggravated by a high incidence of infections, especially diarrhea and measles. It is common in developing countries but rare in developed countries. Vitamin A deficiency (VAD) is a public health problem in more than half of the countries, particularly in Africa and South-East Asia. The most serious consequences of deficiency are seen in young children and pregnant women in low-income countries (FAO 2009). One of the causes of VAD is night blindness (in which it is difficult or impossible to see in relatively low light), which is common during

pregnancy (Tadesse et al. 2005). Vitamin A deficiency is also associated with higher childhood morbidity and mortality (Greiner 2013).

Vitamin D

Vitamin D is essential for proper skeletal structure and function. Reduced vitamin D intake plays an important role in immunity disorders and cardiovascular and cancer diseases (Hrdý & Novosad 2015). Vitamin D also regulates calcium and phosphorus metabolism. The body is able to self-produce vitamin D, namely, in the skin, with the participation of UV radiation. An important source is foods of animal origin (liver, fish liver oil, egg yolk) (Fajfrová 2011).

Vitamin E

Vitamin E is essential for normal cell metabolism. Its function is to protect cells from the harmful effects of free oxygen radicals (it provides protection of cells from oxidative damage) (Kladenský 2017). Sources of this vitamin include wheat germ oil, nuts, cereals, meat, eggs, milk, green leafy vegetables, and other vegetables (Akram et al. 2020).

Vitamin K

This vitamin is essential for proper function of the blood clotting process (Kladenský 2017). Important sources are green plants and algae (spinach, broccoli, legumes), liver, eggs, meat, and milk. Another source is the production of vitamin K by the activity of the intestinal microflora (Fajfrová 2011).

Water-soluble vitamins

Vitamin B1 (thiamine)

Thiamine is one of the key members of the B vitamin group, also referred to as vitamin B1, because it was the first vitamin of this group to be discovered (Kladenský 2017). The main functions of the body include involvement in carbohydrate metabolism and proper nerve function (Roubík 2018). The classic manifestation of thiamine deficiency is the development of beri-beri disease, which is manifested by inappetence, muscle weakness, decreased reflexes, and shortness of breath and can lead to heart failure (Fajfrová & Pavlík 2013). We can find thiamine in nuts, meat, potatoes, beans, and cereals (Akram et al. 2020).

Vitamin B2 (riboflavin)

Vitamin B2 belongs to the group of flavins (hence the name riboflavin). Flavins are an important part of the enzymes that carry out oxidation-reduction reactions in cells (cell respiration) and thus help provide the energy needs of the body's organs (Kladenský 2017). Riboflavin is found in dairy products and verdant green vegetables (Kladenský 2017 & Akram et al. 2020).

Vitamin B3 (niacin)

Niacin deficiency manifests as pellagra (rough skin) (Fajfrová & Pavlík 2013), dementia, and diarrhea (Roubík 2018). The main source of niacin is meat, tripe, fish, whole grain products, potatoes, and legumes (Kladenský 2017).

Vitamin B5 (pantothenic acid)

Pantothenic acid plays a key role in metabolism by participating in the production of one of the most important and widespread factors in metabolism, which is coenzyme A (CoA). Therefore, it interferes in a fundamental way in the metabolism of sugars, fats, and amino acids (Kladenský 2017). Symptoms of deficiency include fatigue and weakness, muscle cramps and hand tremors, neurological problems, and sleep disturbances. Dietary sources include meat, fish, yeast, cereals, legumes, eggs, and liver (Roubík 2018).

Vitamin B6 (pyridoxine)

It is one of the most important and significant vitamins ever. It is involved in the modulation of protein structure, especially the steroid hormone receptor and hemoglobin. Vitamin B6 deficiency is manifested by weakness, insomnia, inflammatory symptoms in the oral region mucosa, impaired cellular immunity, and increased incidence of infections. Vitamin B6 is widely distributed in the diet, and it is most abundant in meat and whole grain foods (Kladenský 2017).

Vitamin B7 (biotin)

Biotin helps in fatty acid synthesis, glucose utilisation, protein metabolism, and the utilisation of vitamin B12 and folic acid (Akram et al. 2020). Its deficiency symptoms include fatigue, muscle pain, muscle weakness, mental anorexia, dermatitis, and depression. The main dietary sources are egg yolk, milk, yeast, soy, legumes, liver, leafy vegetables, and peanuts (Roubík 2018).

Vitamin B9 (folic acid)

The main functions include red blood cell formation and nucleic acid synthesis (for DNA synthesis) (Roubík 2018). Clinical manifestations are anemia (anemia), skin anaemia, growth disturbances, and abortions are more common in. We can find this vitamin in leafy vegetables (lettuce, kale, spinach), broccoli, beans, beets, fruits and nuts, yeast, and liver (Kladenský 2017).

Vitamin B12 (cobalamin)

It is essential for the normal production of red blood cells in the bone marrow and nerve cells' growth (Akram et al. 2020). Vitamin B12 is the only one of the B vitamins that the body stores in reserve (especially in the liver), where it can last for several years if it is deficient (Kladenský 2017). This vitamin is not present in common plant food, we can find it in meat, milk, liver, fish, eggs, and cheese (Roubík 2018).

Vitamin C (ascorbic acid)

In the body, vitamin C acts as an antioxidant and helps protect cells from damage caused by free radicals. Free radicals are compounds that are formed when ingested food is converted into energy. The body also needs vitamin C to form collagen (a protein needed for wound healing). In addition, vitamin C improves the absorption of iron from plant foods and helps the proper function of the immune system, which protects the body from disease (NIH 2019). Severe vitamin C deficiency causes scurvy. The main symptoms of this disease include bleeding from the gums into the skin, into the muscles, joints, and internal organs, cramps, swelling, and psychologically manifested by depression (Kladenský 2017). The main source of vitamin C is fresh fruit and vegetables. High content of this vitamin is present in blackcurrants, red pepper, broccoli, kiwi, citrus, and other tropical fruits (Roubík 2018).

1.1.2.2. Minerals and trace elements

Minerals in nutrition are divided into two categories. Major minerals (sometimes called macrominerals) are needed in the diet and are found in larger quantities in the body. Trace minerals are needed in smaller amounts in the diet and are found in smaller amounts in the body. All major minerals and trace minerals are essential for nutrition.

Minerals are essential inorganic compounds that have no energy value. However, they contribute many indispensable functions in our body - they maintain homeostasis

(the stability of our body's internal environment), allow muscle contraction and movement, help supply all our cells with oxygen, and are part of thousands of different enzymes in the body (Roubík 2018).

Macrominerals are nutritionally important minerals and are classified as macronutrients because the average daily requirement of an adult should be greater than 100 mg/day. As the name suggests, trace elements are a basic group of minerals that are required in small amounts for everyday metabolic processes in humans. Therefore, they are considered trace elements because their daily requirement should be less than 100 mg, above this value can be toxic to health. However, deficiency of any of these trace elements can be serious and can lead to serious health problems (Roubík 2018; Akram et al. 2020)

Macro minerals include sodium (Na), potassium (K), calcium (Ca), magnesium (Mg), phosphorus (P), and sulphur (S). These substances play an important role in regulating osmotic pressure, thereby maintaining fluid balance in the body. Adequate intake of minerals can support the overall health of the body. Trace elements include mainly iron (Fe), zinc (Zn), iodine (I), cobalt (Co), fluorine (F), chromium (Cr), selenium (Se), copper (Cu), manganese (Mn), silicon (Si) and others (Blake 2007; Roubík 2018; Akram et al. 2020).

1.2. Food security

According to the United Nations' Committee on World Food Security, food security is defined as meaning that all people, at all times, have physical, social, and economic access to sufficient, safe, and nutritious food that meets their food preferences and dietary needs for active and healthy life (Russell et al. 2011).

According to this definition can be identified four main dimensions of food security: availability, accessibility, utilisation, and stability (FAO 2008). For complete food security, all four dimensions must be intact (Peng & Berry 2018).

Food availability is the physical existence of food from own production or to the markets. This term can be applied at the regional or national level. On the national level, it combines domestic food production, commercial food imports, domestic food stock, and food aid (Weingartner 2000).

Food accessibility is ensured when all households and all individuals living in these households have sufficient resources to get appropriate foods important for a nutritious diet. The dependence is also on the price of food items and on the level of household resources – capital, labour, and knowledge. Self-sufficiency in food production is not the only indicator to meet food needs. More important is the household's ability to generate sufficient income and which in combination with own production can be used to meet food needs. Food accessibility is also an indicator of social environment, physical environment, and policy environment because it determines the efficiency of households' ability to utilise their resources (Weingartner 2000).

Food utilisation is determined by food quality and safety, quantity of food, and the ability to convert food to energy. Adequate food utilisation requires different aspects such as a diet providing sufficient energy and essential nutrients, potable water, sanitation, health services, illness management, and suitable feeding practices (FANTA & WFP 2007).

The fourth area, stability, deals with the ability of a nation/society/household to withstand shocks to the food chain system, whether caused by natural disasters (climate, earthquakes) or man-made disasters (wars, economic crises) (Russell et al. 2011).

According to these dimensions, it may be seen that food security exists at a number of levels: (i) availability – national and regional, (ii) accessibility – household, (iii) utilisation – individual, (iv) stability – can be considered as a dimension of time affecting all levels (Peng & Berry 2018). More recent developments highlight the importance of sustainability, which can be considered as the long-term temporal (fifth) dimension of food security. Sustainability includes indicators at the transnational/regional level of ecology, biodiversity, and climate change, as well as socio-cultural and economic factors (Berry et al. 2015).

Lack of consistent access to sufficient food for an active and healthy life is defined as food insecurity. It is important to know that although hunger and food insecurity are closely related, they are different concepts. Hunger refers to a personal, physical feeling of discomfort, while food insecurity refers to the lack of available financial resources for food at the household level (US Department of Agriculture 2019). Food insecurity can occur in varying degrees of severity. Severe food insecurity is one extreme, but even moderate food insecurity is worrying. For those with moderate food insecurity, access to

food is precarious. They may have to sacrifice other basic needs just to be able to eat. When they do eat, it may be what is the most readily available or cheapest, which may not be the most nutritious food. Highly processed foods high in energy, saturated fats, sugars, and salt are often cheaper and more readily available than fresh fruit and vegetables. By eating these foods, daily calorie needs can be reached, but essential nutrients that keep your body healthy and functioning well are absent (FAO 2022). In addition, the stress of food insecurity and periods without food can lead to both malnutrition and overweight and obesity, and in many countries these forms of malnutrition occur together. Food insecurity can both directly (through compromised diets) and indirectly (through the impact of stress on infant feeding) cause child wasting, stunting, and micronutrient deficiencies (Sathe 2021).

1.2.1. Malnutrition

One of the consequences of food insecurity is malnutrition. The World Health Organization has defined malnutrition as the physical manifestation of hunger caused by a deficiency of one or more essential nutrients. It affects various human processes such as growth, pregnancy and lactation, cognition, resistance to disease, and healing. It also reduces people's ability to work and limits their physical performance (WHO 2018).

Malnutrition can be monitored by three main indicators: the weight of the individual relative to his/her age, the height of the individual relative to his/her age, and the weight of the individual relative to his/her height. The causes of malnutrition can be broadly divided into two groups, namely man-made or man-influenced causes and natural causes. Malnutrition brings many undesirable consequences, which, if the affliction is suffered at a young age, may be long-lasting and irreversible. It increases the risk of death and impairs cognitive development in children, which affects their future productivity. Malnutrition affects most children under the age of five. The most critical years are the first two years of life, when the infant is most developing and needs adequate intake of all necessary nutrients (Marini & Gragnolati 2003).

In malnutrition, a distinction can be made between stunting, acute and chronic malnutrition, and underweight. Low height-for-age is referred to as 'stunting'. It causes adverse long-term consequences for immune and vital functions in children, risk of

nutrition-related chronic diseases, and adverse cognitive and behavioural development (FAO, IFAD, UNICEF 2019).

More broadly, chronic malnutrition caused by a lack of certain nutrients at some point in early childhood is most often associated with poor socioeconomic status, especially in developing countries. The presence of stunting in growth in an individual or community is not addressed by simply providing the right amount of nutrients. The causes of chronic malnutrition become more complex when we consider how and when these nutrients are delivered (Reinhardt & Fanzo 2014).

On the other hand, acute malnutrition represents intake below the biological minimum that leads to imminent death (Lékaři bez hranic 2020). Acute malnutrition, most commonly manifested by wasting, often occurs in temporary or cyclical situations such as emergencies, seasonal depression, and environments with a high incidence of infectious diseases (Reinhardt & Fanzo 2014).

Another term closely linked to malnutrition is undernutrition. It is a condition in which people are exposed to insufficient energy intake from food over a long period of time. Their chances of leading a productive, healthy, and active life are impaired. It is estimated based on whether the amount of food available in a country can meet the minimum energy requirements of the population. The determination of the minimum energy intake threshold is highly individual and constantly evolving. It depends on gender, age, height, physical activity, the severity of climatic conditions, and the health status of the individual (Caballero 2005).

One of the valuable evaluation index and a useful indicator for assessing nutritional adequacy is Dietary diversity score (DDS). Dietary diversity constitutes a qualitative measurement of food consumption that accounts for household access to a variety of foods, and it is also an indicator of the nutritional sufficiency of the diet of individuals (Mahdavi-Roshan et al. 2021).

1.3. Dietary diversity score (DDS)

DDS is defined as the number of different food items or food groups consumed over a given period of time. It can be measured at more levels, through the use of a questionnaire (Ruel 2003). The process of measuring is based on counting the number of

food groups rather than the individual food items consumed. The foods and drinks mentioned by the respondent are divided into different standardised food groups. The reference period is most often the previous day or week, but it may also vary according to the type of survey (Kennedy et al. 2010).

1.3.1. Various dietary diversity scores

Table 1 shows different types of dietary diversity scores which can be used according to different aspects. Distinguishing elements are the level of the individual or household, gender and age groups or recall period (Kennedy G., Ballard T. 2010; FANTA 2016).

Table 1 Various dietary diversity scores (Kennedy G., Ballard T. 2010)

Name	Level	Number of food groups	Recall period
Household Dietary Diversity Score (HDDS)	Household	12 (aggregated from 16 items)	24 hour
Woman's Dietary Diversity Score (WDDS)	Women aged 15-49 years	9 (aggregated from 13 items)	24 hour
Dietary Diversity Score (DDS)	Household	7	Flexible
Individual Dietary Diversity Score (IDDS)	Children	8	24 hour

1.3.2. Calculation formula for the HDDS/WDDS

The HDDS/WDDS is calculated for each household/woman when the value ranges from 0-12 for households and 0-9 for women. If the respondent consumed the food group, the response was yes, if the respondent did not consume the food group, the response was no. The number of positive responses with value 1 (yes=1) and negative responses with value 0 (no=0) were then summed, giving a result on the dietary diversity of that household/woman. Table 2 and Table 3 show the calculation of HDDS/WDDS and its average value in the sample (Kennedy G., Ballard T. 2010).

Table 2 Calculation formula for HHDS (Kennedy G., Ballard T. 2010)

HDDS (0-12)	Total number of food groups consumed by members of the household. Values for 1 through 12 will be either "0" or "1". SUM (1+2+3+4+5+6+7+8+9+10+11+12)
Average HDDS	$\frac{\text{SUM (HDDS)}}{\text{Total Number of Households}}$

Table 3 Calculation formula for WDDS (Kennedy G., Ballard T. 2010)

WDDS (0-9)	Total number of food groups consumed by women. Values for 1 through 9 will be either "0" or "1". SUM (1+2+3+4+5+6+7+8+9)
Average WDDS	$\frac{\text{SUM (WDDS)}}{\text{Total Number of Women}}$

1.3.3. Aggregation of food groups from the questionnaire to create HHDS/WDDS

The FAO has identified 16 major food groups that can be used to calculate different types of dietary diversity scores. Different levels require different numbers of food groups to be combined. Table 4 lists the 16 main food groups. Table 5 shows the 12 food groups determined from the 16 food groups used to calculate HDDS and the 9 food groups used to calculate WDDS are shown in Table 6 (Kennedy G., Ballard T. 2010).

Table 4 Main food groups (Kennedy G., Ballard T. 2010)

Question number(s)	Food group
1	Cereals
2	White roots and tubers
3	Vitamin A rich vegetables and tubers
4	Dark green leafy vegetables
5	Other vegetables
6	Vitamin A rich fruits
7	Other fruits
8	Organ meat
9	Flesh meats
10	Eggs
11	Fish and seafood
12	Legumes, nuts and seeds
13	Milk and milk products
14	Oils and fats
15	Sweets
16	Spices, condiments, beverages

Table 5 Food groups used for HDDS (Kennedy G., Ballard T. 2010)

HDDS	
Question number(s)	Food group
1	Cereals
2	White tubers and roots
3,4,5	Vegetables[1]
6,7	Fruits[2]
8,9	Meat[3]
10	Eggs
11	Fish and other seafood
12	Legumes, nuts and seeds
13	Milk and milk products
14	Oils and fats
15	Sweets
16	Spices, condiments and beverages

[1] Combination of vitamin A rich vegetables and tubers, dark green leafy vegetables and other vegetables

[2] Combination of vitamin A rich fruits and other fruits

[3] Combination of organ meat and flesh meat

Table 6 Food groups used for WDDS (Kennedy G., Ballard T. 2010)

WDDS	
Question number(s)	Food group
1,2	Starchy staples[1]
4	Dark green leafy vegetables
3,6 and red palm oil	Other vitamin A rich fruits and vegetables[2]
5,7	Other fruits and vegetables[3]
8	Organ meat
9,11	Meat and fish[4]
10	Eggs
12	Legumes, nuts and seeds
13	Milk and milk products

[1] Combinaiton of Cereals and White roots and tubers
[2] Combination of vitamin A rich vegetables and tubers and vitamin A rich fruits
[3] Combination of other fruits and vegetables
[4] Combination of meat and fish

1.3.4. Description of food groups and their importance

1.3.4.1. Grains, white roots and tubers, and plantains

This food group, also called as "starchy staples" is the largest source of energy in our diet and provides a vital supply of exogenous glucose, which serves as fuel for our brain and red blood cells. Despite this key role in human nutrition, starchy foods have come to be viewed negatively in recent years, as the consumption of large amounts of highly processed starch has been epidemiologically linked to a number of negative health outcomes such as diabetes and obesity (Gouseti et al. 2019).

Worldwide, especially in developing countries, starchy or high-carbohydrate foods are a major source of energy in the diet and a valuable source of micronutrients and fibre when consumed in a minimally processed form. These foods also contribute to the production of protein in the diet. There are several ways in which high intakes of cereals and grains positively affect overall nutrient balance and health. Many of the associated substances contained in these foods, such as cereal fibre, oligosaccharides,

phytoestrogens, and others, are now known to have beneficial effects on health. Carbohydrate-containing foods are also an excellent source of some vitamins and minerals and some of them, if consumed in sufficient quantities, can contribute significantly to protein intake. Although some substances provide a number of antinutrients such as phytates (which bind to some minerals and inhibit their absorption) (FANTA 2016), unrefined cereals and grains are considered good sources of micronutrients (VORSTER & NELL 2001).

This group includes cereals and grains such as maise, sorghum, wheat, rice, and oats in the form of breads, porridges, pasta, rice, corn, rice, samp and other products. Starchy foods, when are consumed in adequate amounts and supplemented with other types of foods, have a beneficial effect on human health. (Jenkins et al. 1988; FANTA 2016).

1.3.4.2. Pulses (beans, peas and lentils)

Pulses are one of the food groups which provide the highest concentration of zinc and iron and have high micronutrient density (FAO/WHO Expert Consultation 2005). They are rich in protein and good supply of carbohydrates (Food and Agriculture Organization 2016). This group contains beans, peas, and lentils from the plant family Fabaceae. When the seeds reach maturity, they are harvested and dried. They can be used as food or they are processed into food products. Plants harvested green or immature and eaten fresh in the pod are in the "other vegetables" group. Processed products like tofu, tempeh, and other soy products are also in this good group (FANTA 2016).

Pulses are suitable to Sub-Saharan Africa, because they can grow in arid lands and require very little water. Their unique ability to self-fertilise (adding nitrogen to farmland and improving crops around), their health benefits, and the high nutrition value made from this food group superfood for the future (Food and Agriculture Organization 2016).

The most common example of this food group is common bean, broad bean, chickpea, pigeon pea, cowpea, lentil, and soybean (FANTA 2016).

1.3.4.3. Nuts and seeds

Nuts are an important component in a healthy diet. They are rich in protein, dietary fibre, and energy. Nuts are also a good source of vitamins, especially E and B-complex

groups (with minerals like calcium, iron, magnesium, zinc, etc.). They contain also a variety of health benefits, they improve heart, blood, mental, eye, skin, bone, and oral health, they improve digestive function, memory, and metabolism, boost the immune system, help manage diabetes and more (Brufau et al. 2006).

Nuts and seeds have to be dried before consumption as a snack or added to traditional dishes, cakes, pastries, and cookies (Brufau et al. 2006).

This food group includes mostly tree nuts but also groundnut (peanuts) and may include certain seeds consumed in a certain quantity. This group also includes nuts and seed "butter", like groundnut (peanut), butter, cashew, or sesame butter (tahini). Oils extracted from nuts and seeds are not part of this food group (FANTA 2016).

Most commonly consumed nuts are almonds, brazil nuts, cashew nuts, hazelnuts, macadamia nuts, pecans, groundnuts (peanuts), pine nuts, pistachios, and walnuts (Brufau et al. 2006). The most commonly consumed seeds are sesame, sunflower, and pumpkin seeds (FANTA 2016).

1.3.4.4. Dairy products

Milk and dairy products are not only a vital source of nutrition, but they also create livelihood opportunities for farmers, processors, and other stakeholders in the dairy value chain (Hansen 1974). Worldwide, the milk of goats, sheeps, buffalos, and the most popular is cow's milk are used (Belitz et al. 2009). Other animals which produce milk make up only 0.2 percent of world milk production (e.g. donkey, camels, yak, reindeer, moose, llama, alpaca, etc.). Milk contains ten types of minerals (calcium, iron, magnesium, zinc, copper, selenium, sodium, manganese, potassium, and phosphorus), and fifteen types of vitamins (eg. Vitamin A, vitamin E, Vitamin C, vitamin D or vitamin B12 which is present only in animal sources foods, etc.) (Hansen 1974).

In this group are included almost all liquid and solid dairy products from milk-producting animals, soft and hard cheeses, yoghurt, and kefir. Butter, ice cream, cream and sour cream, sweetened condensed milk and "yoghurt drinks" are excluded, because of higher content of fat or sugar and lower content of dairy content (FANTA 2016).

1.3.4.5. Meat, poultry and fish

This food group is also called flesh food and we include here meat, poultry, or fish. Meat includes all red meats from animal sources, commonly beef, pork, veal, and lamb. Poultry is meat from chicken, turkey, and duck, and pheasants and other fowls. Fish are aquatic animals and most often are consumed fish which have fins, gills, and backbone, and skull. Shellfish is a subclassification of fish and includes mollusks (shellfish with a protective shell) and crutaceans (lobsters, shrimp, crabs, and other shellfish with horny covering) (Greer 2020). Other sources of this food group are wild birds and mammals (also called "bush meat"), frogs, snakes, and other amphibians and reptiles. Flesh food is an important source of high-quality protein, iron, vitamin B12, and zinc (FANTA 2016).

1.3.4.6. Eggs

This food group includes eggs from any type of bird – domesticated poultry and wild birds (FANTA 2016). Eggs are high in protein, they are a source of vitamin A, and they are rich in vitamin D and vitamin B12 (Ruxton et al. 2010).

1.3.4.7. Dark green leafy vegetables

Foods from this group contain vitamins (A, C, and K), minerals (iron and calcium), fibre, and act as antioxidants in the body. These vegetables also contain carotenoids, which can inhibit the growth of certain types of cancer (Craig 2013).

All medium dark leafy vegetables (Chinese cabbage, bibb and romaine lettuce) and dark green leafy vegetables are rich in vitamin A and are placed in this group (only very light leaves like iceberg lettuce, are not). Other examples of vegetables in this group are: broccoli, carrot greens, chilli greens, pumpkin greens, kale, spinach, and more (FANTA 2016).

1.3.4.8. Other vitamin A-rich fruits and vegetables

In this group were included both vitamin A-rich fruits and vegetables, other than leafy greens. The most consumed fruits are ripe papaya and mango, passion fruit, several types of melon, and apricot. Unripe (green) fruits are considered as "other fruits" because they are not rich in vitamin A (FANTA 2016). There are several benefits of eating fruit

and vegetables, for example children's growth and development, longer life, healthy heart, lower cancer risk, better mental health, and more (FAO 2020).

1.3.4.9. Other vegetables

This food group included all vegetables not counted as dark green leafy vegetables or as other vitamin A rich vegetables. This group includes legumes only when the green or fresh pod is consumed (snow peas, fresh peas, green beans), stems, fruits, and flowers of plants that are consumed in the culinary system (e.g. cucumber, tomato, okra) (FANTA 2016).

1.3.4.10. Other fruits

In this group are included all fruits which are not considered as vitamin A rich fruits. Examples are: apple, banana, figs, lemon, orange, pineapple, pomelo, strawberry, watermelon etc. (FAO 2020).

1.4. Questionnaire survey on dietary diversity

To conduct a survey properly, it is important to consider the circumstances that influence this type of survey. These processes are described in this chapter.

1.4.1. Differences between household and individual level

The decision to collect data at the household or individual level depends on the purpose and objectives of the survey. Another consideration is the frequency of meals consumed outside the home. If meals are consumed outside regularly by one or more family members, the individual level is more appropriate in comparison with household level (Kennedy G., Ballard T. 2010).

Table 7 Main differences between use of questionnaire at household level and individual level (Swindale & Bilinsky 2006)

	Household level	Individual level
What is measured	Household economic access to food (dietary energy)	Quality of the diet of individual
Respondent	Person who is responsible for preparaion of the food for the HH on the previous day	Women aged 15-49 years or individuals other sex and age groups
Target of interest	The household = all persons living under the same roof	The individual
Included and excluded foods	Includes: foods prepared in the home and consumed inside/outside the home; or food purchased or gathered outside and consumed in the home Excludes: foods purchased outside the home and consumed outside the home	Includes: all foods eaten by the individual respondent, no matter where they were prepared and consumed

1.4.2. When to measure dietary diversity

For determination of the best time for measuring dietary diversity, it is necessary to take in to consideration if the household/individual is located in rural and agriculture-based communities or in non-agriculture communities. The best time for measuring in rural and agriculture-based communities is up to 5 months after harvest, when food supplies are still available. In non-agriculture based communities, seasonality does not play a role, any time of the year is suitable for this measure.

The repeated monitoring of food security should be at the same time of year, to avoid irregularities due to seasonal differences (Kennedy G., Ballard T. 2010).

1.4.3. Activity to undertake before beginning data collection

Before data collection, it is important to adapt the questionnaire to the local survey context. These steps are important for survey simplification and prevent of misunderstanding.

1.4.3.1. Translation of questionnaires

It is necessary to translate the questionnaire into the most appropriate local languages, the standard English version is not intended to be used directly. It is also important to agree on a meaning and terms used in the questionnaire like “household”, “meal”, “snack”, and decide on the most appropriate description (Kennedy G., Ballard T. 2010).

1.4.3.2. Technical issues

The issue of quantity: how much is enough to count as food group diversity

At the household level, it is not necessary to set minimum quantities, because at this level we measure the economic access to food. Therefore, even small quantities of a food item (a small portion of fish included in the mixed dish) will be counted.

The dietary diversity score at the individual level is concentrated on the micronutrient adequacy of the diet where food quantities of one tablespoon or less (<15g) are not counted (Kennedy G., Ballard T. 2010).

Food items which can be classified into more than one food group

Some food items can be classified in more than one food group. For example, hot pepper can be classified as “spices, condiments and beverages” or as “other vegetables”. The fish powder can be also classified as “spices, condiments and beverages” or “fish and seafood”.

In this case, it is important to take into consideration the typical amount of food consumed. If one small spoonful of dried hot pepper flakes is added to the dish, we consider the hot pepper as “spices, condiments, and beverage”. If several spoonfuls of fresh hot pepper are consumed as an accompaniment to the meal, in this case can be hot pepper included in “other vegetable” food group (Kennedy G., Ballard T. 2010).

Mixed dishes

Some foods are listed only according to their main ingredients. For example, bread belongs to the “cereals” even eggs, oil, or sugar are added in small amounts. However, many prepared dishes are mixed and contain more ingredients (added fats and oils, or small amounts of meat and vegetables). In the case of mixed dishes, it is important to

identify those, which are commonly consumed, and practise the recording of all ingredients mixed in the dish (Kennedy G., Ballard T. 2010).

1.4.3.3. Training of survey interviewers

After the translation and technical issues of the questionnaire are completed, interviewers should be trained to perform the interviews with respondents. Suitable training practice is role playing, which is ideal for familiarising interviewers with the environment and the procedure of completing the questionnaire. Important are also discussions, classroom instruction, and field practice (Kennedy G., Ballard T. 2010).

1.5. Nutrition and food security in Ethiopia

Ethiopia is a country located in the Horn of Africa with currently a population of 115 million (World Bank 2020). This makes Ethiopia the second most populous country in Africa and one of the poorest countries in the region. With a fertility rate of 4.1 births per woman (World Bank 2019), the country is projected to rank among the eight countries in the world with the highest population growth between 2017 and 2050, with an estimated population of 205.4 million (USAID 2019).

Due to its high population and agricultural power, Ethiopia is an important geopolitical and economic country. In recent years, there has been development mainly in the industrial and service sectors (USAID 2019), but the Ethiopian economy is still dependent on agriculture, which accounts for 40% of GDP, 80% of exports and an estimated 75% of the country's labour force. In rural areas, 55% of women and 83% of men work in this sector (USAID 2022a). Despite the importance of agriculture, only five percent of the land is irrigated and crop yields from small farms are below regional averages. Market linkages are weak, and the use of improved seeds, fertilisers, and pesticides remains limited (Tadesse et al. 2005).

Despite this, Ethiopia has made significant progress over the past decade, from economic growth averaging 10 percent per year (2007-2017) to halving the rate of extreme poverty and hunger (from 61 percent to 31 percent), food insecurity and malnutrition remain a major problem across the country. An estimated 20.4 million people are currently in need of food support (WFP 2021). Malnutrition accounts for more than 50 percent of all infant and child deaths in Ethiopia. The damage caused by

malnutrition during the first 1,000 days - from the beginning of a woman's pregnancy to a child's second birthday - is usually irreversible in terms of its negative impact on a child's health, cognitive development, physical growth, and school and work performance later in life. In Ethiopia, 27 percent of women are thin or malnourished and 38 percent of children are stunted (USAID 2022b). The main causes of malnutrition in Ethiopia are persistent food insecurity, poor maternal and child nutrition practices, high incidence of infectious diseases, and limited access to quality nutrition services. Household wealth, education, and family planning are also key factors affecting nutrition. In Ethiopia's lowland pastoral areas and densely populated highland woredas (districts) where food is scarce, droughts often occur, making it difficult to access and consume nutritious food (Tadesse et al. 2005; USAID 2022b).

In recent years, Ethiopia experienced a prolonged drought with three consecutive dry rainy seasons, the first time this has happened in forty years. Across the Horn of Africa (Ethiopia, Somalia, Kenya), 13 million people were affected by drought - in Ethiopia, 5.7 million people needed food aid at this time (WFP 2021). The effects of drought were recognised - both pasture and water were dwindling. In some southern areas, such as the Borena zone in Oromia region and the Dawa zone in Somali region, unusual livestock mortality has been recorded (Fews Net 2022). Lack of rainfall over several seasons has caused a domino effect that delays planting and harvesting cycles, thereby reducing food production and availability. In addition, farmers were forced to choose crops with shorter sowing cycles but lower yields, which in turn reduced the overall food availability for staple crops with longer sowing cycles and high yields, such as maise, sorghum and millet (Acaps 2018).

Food insecurity is also faced by internally displaced people who have had to flee their homes as a result of the conflict in the north and the severe drought in the south and south-east (WFP 2021). Conflict was extremely widespread across Ethiopia in 2021. Between June and September, conflict events were five times more frequent than in the same period in 2020 and claimed 13 times more victims than in the same period the previous year (Fews Net 2022). The conflict has also reduced food availability and market functioning, limiting access to a vital food resource. Aid workers transporting supplies to the region have also faced complications (Acaps 2018).

A combination of conflict, poor rainfall, and poor macroeconomic conditions caused by high government spending drives up food prices across the country. High food prices limit the ability of many poor households across the country to purchase enough food to meet their needs, leading to underconsumption and subsequent malnutrition (Fews Net 2022).

2. Aims of thesis

The main objective of the thesis was to examine the dietary diversity and dietary composition among women in Arba Minch Zuriya district, Gamo zone, SNNPR, Ethiopia, and the factors that affect the variety of their dietary intake.

3. Materials and methods

3.1. Study area description

Arba Minch Zuriya is a district (woreda) in Gamo Gofa zone in Southern Nation, Nationalities and People Regional State (SNNPRS) in the southern part of Ethiopia (Figure 1). On the north is bordered by Dita and Chencha, on the south by Dirashe special woreda, on the west by Bonke, and on the east by the Oromia Region. On the southeast is bordered by the Amaro special woreda where are located two lakes and their islands, Abaya and Chamo. Nechisar National Park is located between these lakes (Getaneh 2019). The total population in 2019 was 164,529 and residents of Arba Minch Zuriya district were divided into 31 kebeles (smalles administrative units) (Bante et al. 2021). In Arba Minch Zuriya, 100 percent inhabitants were considered as rural in the division of 82,751 males and 82,929 females (CSA 2008). The annual temperature in the rural villages of this district is around 23.6℃ and the rainfall is around 950 mm (Astatkie 2011).

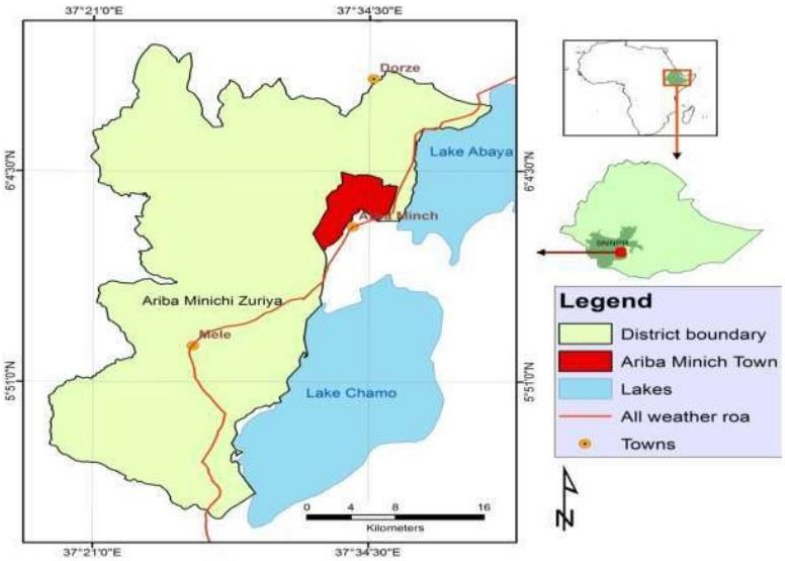


Figure 1 Map of Arba Minch Zuriya district (Molla & Fitsume 2017)

3.2. Data collection and sampling

The data collection in the form of a questionnaire survey was carried out from September to December 2020 in Arba Minch, Zuriya district, Gamo zone, SNNPR, Ethiopia, in the frame of the development project titled "Arba Minch Fruit Value Chain, Gamo zone, SNNPR, Ethiopia" funded by the Czech Development Agency.

Four kebeles (smallest administrative units) under the local administration of the Arba Minch Zuriya, concretely Chano Mile kebele, Chano Doriga kebele, Kola Shara kebele, and Chano Cheliba kebele (Figure 2), were chosen because of evenly distributed among the target area.

Figure 2 Four kebeles in the study area (Google 2022)

Data were collected from 202 women of reproductive age (15-49 years) from different households: 51 respondents were from Chano Mile kebele, 47 respondents from Chano Doriga kebele, 50 respondents from Shara kebele and 54 respondents from Chano Cheliba kebele. All respondents were randomly selected. Photo documentation of data collection is presented in Appendix 1.

The questionnaire was used after a pre-test survey with five women.

3.3. Assessment of dietary diversity

The questionnaire used for the survey (Figure 3) was a semi-structured type that contained close and open-ended questions based on Women's Dietary Diversity Score requirements. Guidelines for measuring woman's dietary diversity designed by FAO was adopted (Kennedy G., Ballard T. 2010). The food items were categorised into nine major food groups. A structured 24-hour dietary recall method was used.

The questionnaire was in English and was translated to the local language of the respondents. There were five main sections in the questionnaire: (i) sociodemographic information about the respondents, (ii) instructions for completion of the DD questionnaire, (iii) a table with different time periods for food consumption, (iv) DD table, and (v) explanation of unclear information.

Location: _____ Date: _____

Name, age, and gender of the respondent: _____

Level of education: _____ Household size and religion: _____

DIETARY DIVERSITY QUESTIONNAIRE

Please describe the foods (meals and snacks) that you ate or drank yesterday during the day and night, whether at home or outside the home. Start with the first food or drink of the morning.

Write down all foods and drinks mentioned. When composite dishes are mentioned, ask for the list of ingredients.

When the respondent has finished, probe for meals and snacks not mentioned.

Breakfast	Snack	Lunch	Snack	Dinner	Snack

Food group	Yes (1) or No (0)
Starchy staples (1)	
Dark green leafy vegetables	
Other vitamin A rich fruits and vegetables (2)	
Other fruits and vegetables	
Organ meat	
Meat and fish	
Eggs	
Legumes, nuts and seeds	
Milk and milk products	

(1) The starchy staples food group is a combination of Cereals and White roots and tubers.

(2) The other vitamin A rich fruit and vegetable group is a combination of vitamin A rich vegetables and tubers and vitamin A rich fruit.

Figure 3 Dietary diversity questionnaire used for survey (Kennedy G., Ballard T. 2010; Staš 2020)

3.4. Data analysis

WDDS was calculated according to guidelines for measuring woman's dietary diversity designed by FAO (Kennedy G., Ballard T. 2010) using equations as follows:

WDDS (0-9)= SUM (1+2+3+4+5+6+7+8+9) (1)

where values for 1 through 9 will be either "0" or "1"

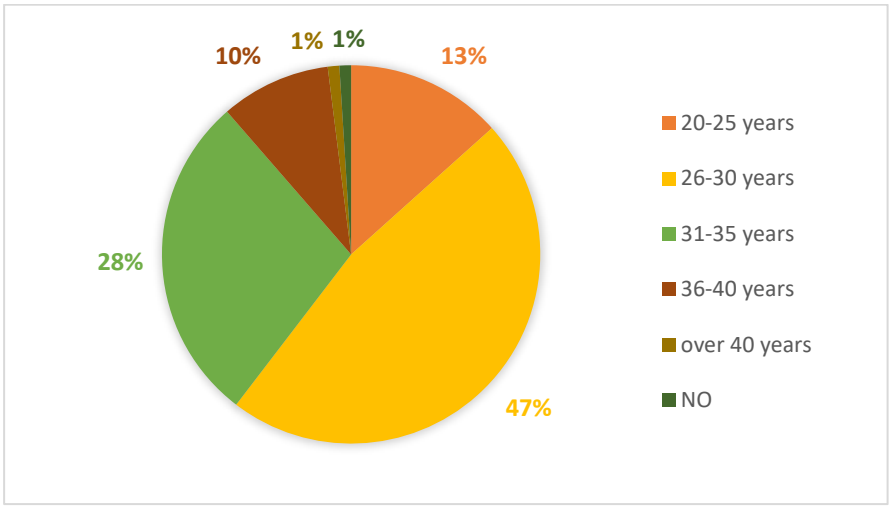
Average WDDS= SUM (WDDS)/ Total Number of Women (2)

Further, the data were analysed with MS Excel. IBM SPSS Statistics software version 22.0 (IBM, US) was used for multiple regression to predict a continuous dependent variable based on multiple independent variables.

4. Results and discussion

4.1. Social characteristic of women

A complete response was obtained from 202 women. The project aimed at women of reproductive age (WRA), so respondents were between 15 and 49 years of age. Figure 4 shows the age distribution of women. The mean age of the women was 29.64 years, with the range of 20 to 45 years. Almost half of the respondents were between 26 and 30 years. In 2019, the median age in Ethiopia was 19.5 (UNDP 2019), and the life expectancy at birth was 66.6 years which was higher than the mean in Sub-Saharan Africa, which was 61.5 in 2019. Between 1990 and 2019, Ethiopia's life expectancy at birth increased by 19.5 years (UNDP 2020).



[1]

Figure 4 Age of respondents (n=202)

Education is one of the most important aspects of social and economic development. Education improves capabilities and is strongly associated with various socioeconomic variables such as income, lifestyle, and fertility for both individuals and society (EPHI & ICF 2021). In general, the higher the level of education of a woman, the more knowledgeable she is about the use of health facilities, family planning methods, and her children's health (DHS 2000). In Ethiopia, more than half of the adult population is illiterate. In 2019, the adult literacy rate (15 and older) was 51.8 percent (UNDP 2019). The blame lies on a lack of schools, unqualified teachers, a poor quality theoretical

[1] The expression of "NO" is number of respondents who did not respond

curriculum, and a lack of teaching aids (People in Need 2022). In the case of Arba Minch, the educational level index was based on the number of years of schooling, where less than 8 years of schooling were considered as primary education and up to 8 years as secondary education. As shown in Figure 5, all participants achieved at least two years of education, and only 5.6 percent of respondents reached secondary education. The mean level of schooling was 4.36, which was considered high compared to the mean years of schooling in Ethiopia, 2.9 years in 2019, and 5.8 in Sub-Saharan Africa in the same year (UNDP 2019). Between 1990 and 2019, the mean years of schooling increased by 1.4 years (UNDP 2020).

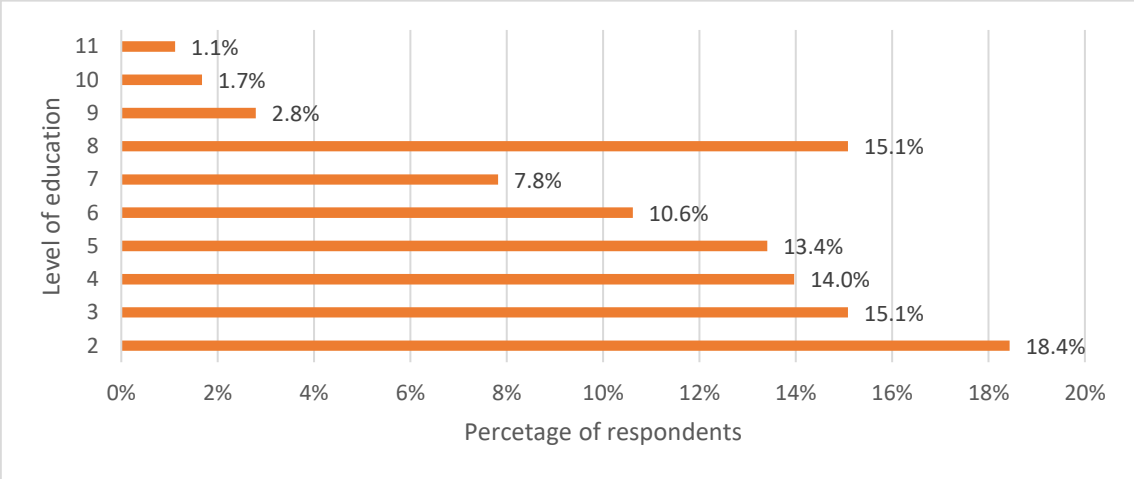


Figure 5 Educational level of respondents (n=202)

In 1994, the average household size in Ethiopia was 4.8 members per household (DHS 2000), and in 2011 it was 4.6 members per household (United Nations 2017). In 2019, the average household size in Ethiopia was 4.7 members (EPHI & ICF 2021). Ethiopia stands with average household size in the middle in comparison with its neighbours – South Sudan 5.9, Somalia 5.9, Kenya 3.9, and Uganda with 4.7 members per household (United Nations 2017).

In general, rural households in Ethiopia usually had 4.9 persons per household and were slightly larger than urban households (4.2 persons). Single-person households were more common in urban areas (13 percent) than in rural areas (4 percent). Only 7 percent of households had nine or more members (DHS 2000). Most Ethiopian households were men headed (78 %), with 22% headed by women (EPHI & ICF 2021). In the case of our respondents, the mean household size was 5.69, which was higher than Ethiopia's average household size (Figure 6).

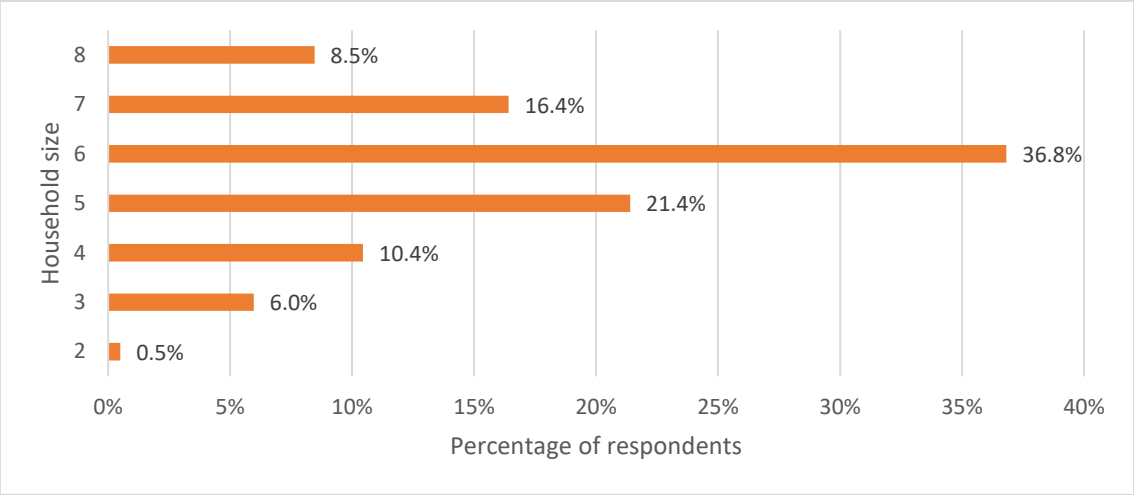


Figure 6 Household size of respondents (n=202)

At the time of the 2007 census, the religion of Ethiopia was classified under six categories (Orthodox, Protestant, Catholic, Muslim/Islam, traditional, and others). 43.5 percent of the total population was Orthodox Christian, 33.9 percent was Muslim, and 18.6 was Protestant (CSA 2008). Nowadays, most observers believe that the proportion of Evangelicals and Pentecostals in the population has increased since the census. Orthodox is predominant in the northern regions of Amhara and Tigray, while Islam is most prevalent in Afar, Somali, and Oromia regions. Established Protestant churches have the most adherents in the Southern Nations, Nationalities and Peoples (SNNP) and Gambella regions and parts of Oromia region. Groups that together make up less than five percent of the population include Eastern Rite and Roman Catholics, members of The Church of Jesus, Christ of Latter-day Saints, Jehovah's Witnesses, Jews, and followers of indigenous religions. The Rastafarian community has approximately 1 000 members and its members live mainly in Addis Ababa and in the town of Shashemene in the Oromia region (International Religious Freedom Report 2020). Figure 7 shows results from survey in Arba Minch Zuriya district.

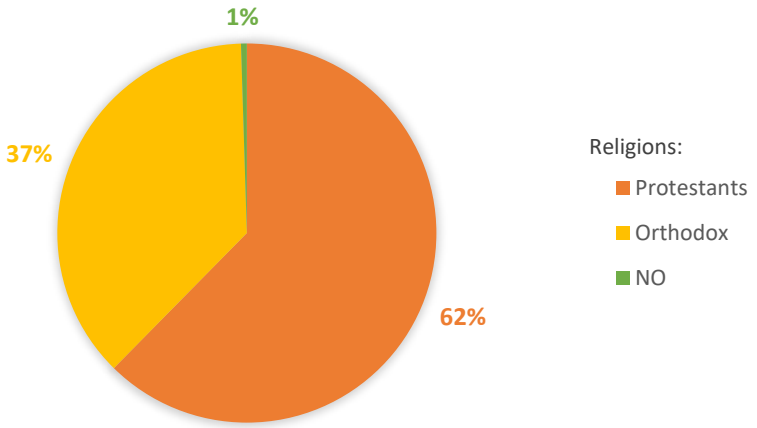


Figure 7 Religion of respondents (n=202)

4.2. Food consumed

According to WDDS, the most consumed food items and drinks were determined. All women from the four targeted areas consumed meals at least three times per day in the three main blocks – breakfast, lunch, and dinner. The additional snacks eaten between main meals were consumed once a day by 111 (54,95 %) of women, 25 (12,38 %) of women consumed two snacks per day, and 66 (32,67 %) of women did not consume any snacks during the day.

Most consumed drinks during the day were tea, coffee, and tea from coffee leaves. The most common food items consumed as the main meal were bread, corn, and cabbage. From the food group "white roots and tubers and plantains", potatoes, sweet potatoes, yam, and taro were consumed and from the "pulses" food group, pea and beans were consumed by women. From the food groups "fruits" and "vitamin A rich fruits", banana, papaya, and mango were consumed as snacks. As for condiments, chilli peppers, pepper, salt, ginger, garlic, dill, and onion were used. One of the food items consumed as a snack was corn kollo, one of the traditional foods prepared from maise (popped or roasted maise) (Yetneberk et al. 2000). More detailed information is shown in Table 8.

Table 8 Food items consumed by respondents (n=202)

Food/drinks consumed											
Breakfast	Tea, coffe,tea from coffe leaves	Corn bread	Corn with cabbage	Chilli, pepper, ginger, garlic,dill	Corn with moringa	Corn bread with cabbage	Sweet potato	Potato	Corn kollo	Pea, beans, sorghum	Egg, milk
Snack	Coffe	Papaya	Corn kollo								
Lunch	Tea, coffe,tea from coffe leaves	Corn bread	Corn with cabbage	Chilli, pepper, ginger, garlic,dill , mint	Corn with moringa	Corn bread with cabbage	Sweet potato, Yam	Potato	Corn kollo	Pea, beans, sorghum	Egg, meat, milk, butter
Snack	Milk	Banana	Papaya	Mango							
Dinner	Tea, coffe,tea from coffe leaves	Corn bread	Corn with cabbage	Chilli, pepper, ginger, garlic,dill	Corn with moringa	Corn bread with cabbage	Sweet potato	Potato, taro	Corn kollo	Pea, beans, sorghum	Egg, meat, milk, butter
Snack	Coffe	Corn kollo	Corn bread								

4.3. Number of food groups consumed

Table 9 shows the number of food groups consumed by respondents in our survey. The range of consumption was from 2 to 4 food groups. More than 70 percent of the women (77.2 %) consumed 3 food groups, followed by 15.3 % of the consumption of the 4 food groups. Residues consumed 2 food groups (7.4%). The mean number 3.08 of food groups consumed was similar in all kebeles, the highest was in Kola Shara kebele. The recommended minimum dietary intake for women is the consumption of 5 from 9 food groups daily (SNNP Region 2020).

Table 9 Number of food groups consumed by respondents (n=202)

Number of food group consumed	Chano Mile (n=51)	Chano Doriga (n=47)	Kola Shara (n=50)	Chano Cheliba (n=54)	Total (n=202)	Total (%)
2	4	3	3	5	15	7.4
3	40	37	38	41	**156**	**77.2**
4	7	7	9	8	31	15.3
Mean	3.06	3.09	3.12	3.06	3.08	

4.3.1. Analysis of food groups consumed

Table 10 shows the analysis of food groups consumed by the respondents. There were nine food groups which were consumed at least by three women. All women consumed starchy staples during the day and dark green leafy vegetable food groups appeared at 98.5 percent of women. In the range between 86.3- 88 percent were consumed other fruits and vegetables. On the other hand, other vitamin A rich fruits and vegetables were consumed only by 23.8 percent of women in average, where the highest consumption was in Kola Shara kebele, and Chano Cheliba kebele. Legumes, nuts, and seeds were consumed by 20 women from 202 women in total. Consumption of organ meat and meat and fish food groups appeared in two kebeles–Chano Doriga and Kola Shara. In average, Kola Shara kebele has the highest consumation of food groups in comparison with others kebeles. The higher consumption may have been due to the location in which this kebele is located, which is close to a major road that increases the possibility of food availability in the local market.

Table 10 Analysis of food groups consumed (n=202)

	Chano Mile (n=51)		Chano Doriga (n=47)		Kola Shara (n=50)		Chano Cheliba (n=54)		Total (n=202)	
Food group	Frequency (n)	Percent (%)	Frequency (n)	Percent (%)	Frequency (n)	Percent (%)	Frequency (n)	Percent (%)	Frequency (n)	Percent (%)
Starchy staples	51	100	47	100	50	100	54	100	202	100
Dark green leafy vegetable	50	98	47	100	49	98	53	98.2	199	98.5
Other fruits and vegetables	44	86.3	41	87.2	44	88	47	87	176	87.1
Other vitamin A rich fruits and vegetables	10	19.6	8	17	15	30	15	27.8	48	23.8
Legumes, nuts and seeds	5	9.8	5	10.6	5	10	5	9.3	20	9.9
Eggs	4	7.8	2	4.3	4	8	5	9.3	15	7.4
Milk and milk products	1	2	4	8.5	3	6	3	5.6	11	5.4
Organ meat	0	0	2	4.3	1	2	0	0	3	1.5
Meat and fish	0	0	2	4.3	1	2	0	0	3	1.5

4.3.2. Influence of socio economic characteristics on WDDS

A multiple regression was run to predict WDDS from kebele, education, age and religion. There was linearity as assessed by partial regression plots and a plot of studentised residuals against the predicted values. There was independence of residuals,

as assessed by a Durbin-Watson statistic of 2.044. There was homoscedasticity, as assessed by visual inspection of a plot of studentised residuals versus unstandardised predicted values. There was no evidence of multicollinearity, as assessed by tolerance values greater than 0.1. There were no studentised deleted residuals greater than ±3 standard deviations, no leverage values greater than 0.2, and values for Cook's distance above 1. The assumption of normality was met, as assessed by a Q-Q Plot. The multiple regression model statistically significantly predicted WDDS, $F(5, 196) = 2.283$, $p < .05$, adj. $R^2 = .036$. Only one variable (education) added statistically significantly to the prediction, $p < .05$. Regression coefficients and standard errors can be found in Table 11.

Table 11 Multiple regression results for WDDS

WDDS	B	95% CI for B		SE B	β	R^2	ΔR^2
		LL	UL				
Constant	2.662***	1.930	3.393	.370		.063	.036*
Kebele	.025	-.040	.091	.033	.060		
Age	-.009	-.028	.009	.009	-.081		
Education	.043***	.011	.076	.016	.199		
Household size	.057	-.002	.115	.030	.146		
Religion	.055	.204	.204	.076	.056		

Note. Model = "Enter" method in SPSS Statistics; B = unstandardized regression coefficient; CI = confidence interval; LL = lower limit; UL = upper limit; SE B = standard error of the coefficient; β = standardized coefficient; R^2 = coefficient of determination; ΔR^2 = adjusted R^2. *p > .05. **p <.01. ***p < .0001.

These findings correspond to the results of similar studies where education level influences the dietary diversity score (Shamim et al. 2016; Adubra et al. 2019; Naspolini et al. 2021)

5. Conclusion

Dietary diversity improves energy and other essential nutrients, especially for people at risk of nutritional deficiencies. A Women's Dietary Diversity Score was used to determine women's dietary diversity in four kebeles in the Arba Minch, Zuriya district, Gamo zone, SNNPR, namely Chano Mile, Chano Doriga, Kola Shara, and Chano Cheliba kebele. Totally 202 women of reproductive age participated in this questionnaire survey. The social characteristics of the women within the 24-hour recall period were also analysed.

The diets of the respondents did not have adequate diversity to meet nutritional needs. The average dietary diversity score in this study was below the recommended amount. Respondents consumed 3.08 food groups on average, and the recommended minimum for women is the consumption of 5 from 9 food groups. Majority of the respondents (77.2 %) consumed three food groups, 15.3 % consumed four food groups, and 7.4 % consumed two food groups. None of the women reached consumption of five food groups.

100 % of the respondents consumed the starchy staple food group, where bread, corn bread, and corn kollo were eaten most often. This food group could negatively impact the human body in larger portions; on the other hand, it is energy-rich. The second food group most consumed (98.5 % of the respondents) was dark green leafy vegetables, and 87.1 % of the respondents consumed other fruits and vegetables in the food group. Only 23.8 % of respondents consumed fruits and vegetables rich in vitamin A from the important food group, where papaya and mango were the most common sources of this type of dietary intake. The intake of foods rich in vitamin A should be higher due to the positive effects of vitamin A on human health. Legumes, nuts, and seeds were consumed by 9.9 % of respondents. The rest of the food groups (eggs, dairy products, meat, and fish) were consumed minimally.

As a social characteristic, age, level of education, household size, and religion were identified. The age range of responded women is between 20 and 45 years, and almost half of them (47 %) were 26-30 years. The level of education was determined according to the years of education. The range of educational level was between 2 and 11 years. The mean level of education was 4.36, which was higher than the Ethiopian average

(2.9 years in 2019). On the other hand, the average household size of 5.69 members per household was higher in our survey than the Ethiopia average. Two types of religion were recognised in the case of Arba Minch. 62 % of the women were Protestants and the rest (37 %) were Orthodox. Among the social characteristics, education level had a statistically significant effect on WDDS.

In Ethiopia, different aspects influencing the consumption of different food groups and the associated dietary diversity have been identified. One of the determining factors has been the war conflict or unfavourable climatic conditions, especially drought, which hinder the cultivation of nutritious crops. In the case of the Arba Minch, Zuriya district, low education, large household size, and geographical location of the kebeles were also thought to play a significant role. All of these aspects should be improved along with the consumption of nutritious food.

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Appendices

Appendix 1: Photo documentation of questionnaire survey

Figure 8 Face-to-face interview (Staš 2020)

Figure 9 Women respondents of survey (Staš 2020)