

# GLOBAL JOURNAL

OF MEDICAL RESEARCH: L

## Nutrition and Food Science

Fundamental Standards of Nutrition

Prevalence of Anemia among Pregnant

Highlights

Food Security and Food Sovereignty

Characterization & Analysis of Health

Discovering Thoughts, Inventing Future

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# Prevalence of Anemia among Pregnant Women Admitted to the Maternity at Guelendeng District Hospital in Chad

By Barnabas Kayalto, Zaïbana Bouna, Ban-Bo Bebanto Antipas  
& Abdelsalam Tidjani

**Abstract-** Anaemia and iron deficiency are major public health issues worldwide, particularly in children under five and pregnant women. It is an indicator of deterioration in both nutritional status and health. The aim of this study was to determine the prevalence of anemia among pregnant women admitted for consultation to the maternity ward at Guelendeng District Hospital, and to contribute to nutritional advice on good nutrition for pregnant women. The study took place from 05 May to 05 August 2023. It was a descriptive cross-sectional study of 67 pregnant women. Only consenting women who presented for hemoglobin and malaria tests were included in the study, with data taken from the consultation booklet or directly from their examination reports. The tests were carried out using a Mindray-BC 3000 photometer and hemocue. Of the 67 women, 50 presumed to be anemic were included in the study.

**Keywords:** prevalence, anemia, pregnant women, Guelendeng Hospital, Chad.

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# Prevalence of Anemia among Pregnant Women Admitted to the Maternity at Guelendeng District Hospital in Chad

Barnabas Kayalto <sup>α</sup>, Zaïbana Bouna <sup>σ</sup>, Ban-Bo Bebanto Antipas <sup>ρ</sup> & Abdelsalam Tidjani <sup>ω</sup>

**Abstract-** Anaemia and iron deficiency are major public health issues worldwide, particularly in children under five and pregnant women. It is an indicator of deterioration in both nutritional status and health. The aim of this study was to determine the prevalence of anemia among pregnant women admitted for consultation to the maternity ward at Guelendeng District Hospital, and to contribute to nutritional advice on good nutrition for pregnant women. The study took place from 05 May to 05 August 2023. It was a descriptive cross-sectional study of 67 pregnant women. Only consenting women who presented for hemoglobin and malaria tests were included in the study, with data taken from the consultation booklet or directly from their examination reports. The tests were carried out using a Mindray-BC 3000 photometer and hemocue. Of the 67 women, 50 presumed to be anemic were included in the study. The survey covering socio-demographic, socio-economic, socio-cultural and educational characteristics was processed using SPSS software, Statistics 25. Hemoglobin test results (Hb <11g/dl) confirmed that 27 of the 50 women presumed to be anemic were anemic. The study showed that the overall prevalence of anemia in the maternity ward of the hospital during the period was 54%, and 70.37% of these anemic women tested positive for malaria. Of the pregnant women included in the study, only 30% attended antenatal clinics in the first trimester, 50% in the second trimester and 20% in the third trimester. The study also revealed that the pregnant women consulted were not aware of the importance of nutritional advice.

**Keywords:** prevalence, anemia, pregnant women, Guelendeng Hospital, Chad.

## 1. INTRODUCTION

Anemia is a public health problem that affects a large number of people throughout the world, especially pregnant women. It is a condition characterized by a reduction in the number of red blood cells and a fall in the concentration of hemoglobin (Hb) in the blood to the threshold of 11g/dL in pregnant women (Hallberg *et al.*, 2001; WHO, 2001). Various markers are used to assess iron status: Hb can be considered as the circulating form of iron, while ferritin and transferrin receptor saturation levels reflect the state of the body's iron reserves. The interpretation of these markers is complex (Diouf *et al.*, 2015). It is a major public health problem in the world in general and in developing countries in particular (WHO, 2011; Sanogo, 2012; Diouf *et al.*, 2015). It affects more than 3.5 billion people in developing countries, or 38%, compared with just 8% in developed countries (Baily, 2017). Women of childbearing age, particularly pregnant women and children, are the groups at highest risk. The prevalence observed in developing countries is high: 50-60% of children aged 1-5 years, 20-40% of women of childbearing age and 35-75% of pregnant women (WHO, 2021). Table I shows the criteria used to classify anemia according to age and sex.

**Table I:** Criteria used to Classify Anemia According to Age and Sex

Hemoglobin rate (g/dl)	
Children < years	< 11
Women	< 12
Pregnant women	< 11
Men	< 13

Source: OMS, 2019

Table II shows the thresholds adopted by the WHO for reporting anaemia according to age, sex and gestational status.

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*Table II: Hemoglobin Levels for Diagnosing Anemia in the Mother (g/l)*

Population	Anemia*			
	No anemia	light <sup>a</sup>	moderate	severe
Children aged 6 to 59 months	110 or over	100-109	70-99	Under 70
Children aged 5 to 11 years	115 or over	110-114	80-109	Under 80
Children aged 12 to 14 ans	120 or over	110-119	80-109	Under 80
Non-pregnant women (15 years and over)	120 or over	110-119	80-109	Under 80
Pregnant women	110 or over	100-109	70-99	Under 70
Men (aged 15 and over)	130 or over	100-129	80-109	Under 80

Source: OMS, 2011

\*Hemoglobin level in grams per liter;

<sup>a</sup>When hemoglobin level it is light, the risks of maternal and foetal mortality are low (less or low)

Table III shows the thresholds proposed by the US Centers for Disease Control and Prevention (CDC) for reporting anemia during the weeks of gestation and the three trimesters of pregnancy.

*Table III: Thresholds for Reporting Anemia in Pregnant Women According to the CDC*

Pregnancy weeks	Hemoglobin level (g/dl)
16	10,6
20	10,5
24	10,5
28	10,7
32	11
36	11,4
40	11,9
Pregnancy trimester	
Second	10,5
Third	11

Source : (CDC, 2004)

The main cause of maternal anaemia in Africa is a lack of iron, which is essential for the formation of red blood cells, and folate. Between 70% and 80% of pregnant women in malarious regions are anemic (De Benoist *et al.*, 2008; Menon, 2016). However, nutritional deficiencies in certain nutrients such as vitamin A, folic acid and vitamin B12 can lead to anaemia (WHO, 2007). Worldwide, an estimated 50% of pregnant women suffer from anaemia. In developing countries, the prevalence of iron deficiency varies between 40% and 60%, or more than 500 million women of childbearing age. This prevalence is higher in areas where parasitic infections are highly endemic (WHO, 2011). Pregnant women's iron requirements increase during pregnancy, rising from 0.8 mg per day in the first trimester to 4.4 mg per day in the second trimester and 6.3 mg per day in the final trimester, which is why special attention needs to be paid to these women.

Although all infections can lead to anemia, intestinal helminth infections, malaria, schistosomiasis and acquired human immunodeficiency virus (HIV) infection are the main causes of anemia in the intertropical zone (Sylvianne, 2016).

Helminthiasis are parasitic diseases caused by intestinal parasitic worms known as helminths. Hookworm, ascariasis and trichocephalosis are the

intestinal helminth infections responsible for anaemia (Larocque *et al.*, 2005). Of these three parasitic diseases, hookworm infection, with predominantly digestive and haematological manifestations, has been the most widely described as responsible for anaemia (Smith and Brooker, 2010). It is widespread in all hot and humid, tropical and subtropical areas, mainly in sub-Saharan Africa and South-West Asia, affecting 576 to 740 million people (Bethony *et al.*, 2006). Hookworms are more anemic than roundworms and whipworms.

Malaria remains the most important parasitosis. 80% of malaria cases are recorded in sub-Saharan Africa (WHO, 2011), where *Plasmodium falciparum* is the most widespread and pathogenic species that can lead to severe anaemia (Menendez *et al.*, 2000).

Malaria infection during pregnancy is associated with anaemia, an increased risk of severe malaria and serious fetomaternal complications such as spontaneous abortion or prematurity (WHO, 2019). Gestational malaria is responsible for 20% of stillbirths in sub-Saharan Africa (Toussaint, 2012).

Schistosomiasis, the world's second most common parasitic endemic after malaria, bilharziasis or schistosomiasis is a chronic, debilitating disease. Over 90% of reported cases occur in sub-Saharan Africa, and the predominant species is *Schistosoma haematobium*

(Friedman et al., 2005). Four mechanisms have been proposed to explain this relationship. These include iron wastage, splenic sequestration of red blood cells, autoimmune haemolysis and inflammatory anaemia (Friedman et al., 2005).

Anaemia is one of the complications associated with Human Immunodeficiency Virus infection (Volberding et al., 2004). This complication most often affects women and children in sub-Saharan Africa (Calis et al., 2008). The anaemia observed during HIV infection may be due either to neoplastic infiltration of the bone marrow or to immunological phenomena responsible for haemolytic anaemia. HIV infection can also have an indirect effect on blood haemoglobin concentration by increasing the patient's susceptibility to various infections, particularly those caused by *Plasmodium falciparum*, which in turn causes anaemia (Verhoeff et al., 1999). Finally, the anaemia observed during this infection may be a side effect of antiretroviral drugs, mainly zidovudine, a drug in the nucleotide reverse transcriptase inhibitor class. Other causes of anaemia can be genetic. Genetic abnormalities responsible for anaemia include sickle cell disease and thalassaemia (Modell and Darlison, 2008), Glucose-6-phosphate dehydrogenase (G6PD) deficiency (Luzzatto et al., 2001) and ovalocytosis in regions where malaria is endemic in Africa and Asia (Bossi and Russo, 1996).

The consequences of iron deficiency in pregnant women could increase the risk of maternal morbidity and mortality, foetal mortality or the risk of having a low birth weight baby (WHO, 2008; Harvey et al., 2016).

Reducing the prevalence of iron deficiency is one of the major objectives of public health policies in developing countries. In conjunction with international organisations and non-governmental structures, they are seeking to implement interventions, the majority of which target young children and women of childbearing age (Diouf et al., 2015).

According to the same authors, anaemia and iron deficiency stem from a complex aetiology, and comprehensive action on all the factors involved (infections, parasitism, malnutrition) is surely the most effective approach, but undoubtedly the most difficult to implement today. Programmes focused on increasing dietary iron intake seem more accessible, although their large-scale implementation often remains a challenge. In addition to approaches aimed at encouraging the consumption of iron-rich foods by improving incomes and education, there is interest in supplementation and fortification programs (Mannar, 2006). In all cases, effective communication must be put in place as close as possible to the populations concerned to promote the success of the program, which always involves changing habits and convincing them of the merits (Mannar, 2006).

Given our current state of knowledge, very few studies have been carried out on the correlation between iron status and dietary habits in pregnant women at Guelendeng District Hospital.

This study aims to determine the prevalence of anaemia in pregnant women admitted for consultation to the maternity at Guelendeng District Hospital, and to contribute to nutritional advice on good nutrition for pregnant women.

## II. MATERIALS AND METHODS

### 1. Materials

#### 1.1 Study Area and Setting

The study was carried out in the town of Guelendeng. Located between 10°93'72 North and 15°52'83 East, Guelendeng District Hospital is situated in the north of the town, about 3 km along the Guelendeng-N'Djamena road. It is a public facility built in 2007 with co-funding from Chad and the European Union, and covers an area of 5,624 m<sup>2</sup>. It has been operational since 2010. It includes the following Departments: Medicine, Surgery, Maternity, Pediatrics, Nutrition Therapeutic Unit (UNT), Laboratory, Reference Consultation Room, Administration and Pharmacy block, accommodation for the District Medical Officer (MCD) and the midwife in charge of the maternity ward. The Guelendeng health district has an estimated population of 120,860, according to Chad's second General Population and Housing Census (RGPH2). It has twelve (12) health centers, two of which are non-functional. The maternity in this district was used as the setting for the study.

#### 1.2 Study Type and Period

This was a cross-sectional, forward-looking study covering a 3-month period from November 2022 to February 2023.

#### 1.3 Biological Material

The biological material consisted of all blood samples from pregnant women attending antenatal consultation at the maternity of the Guelendeng District Hospital, for whom a blood count examination test (NFS) had been prescribed and found to be positive (Hb level strictly less than 11g/dl).

#### 1.4 Laboratory Technical Equipment

The equipment to be used was packaged in such a way as to ensure that the blood samples taken were not contaminated. These included non-coagulating tubes, hypodermic needles, medical syringes, tourniquets, alcohol, cotton wool, gloves and a gown. The equipment consisted of a Hemocue and a Mindray-BC 3000 plus photometer. Blood samples were taken by laboratory technicians.



Mindray-BC 3000 plus photometer



Hemocue

## 2. Methods

### 2.1 Study Population

The study population consisted of pregnant women attending antenatal consultation at the maternity of the Guelendeng District Hospital.

#### Inclusion Criteria

The Study Included:

- All women who came to the maternity and had a positive pregnancy test (urine, blood or ultrasound);
- All pregnant women of any age who consented to the study, regardless of the age of their pregnancy;
- All pregnant women presenting clinical signs suggestive of anaemia or not, for whom a blood count examination test (NFS) was prescribed and whose result showed an Hb level strictly below 11g/dl.

#### Non-Inclusion Criteria

All women who did not meet the inclusion criteria were excluded from the study.

### 2.2 Sampling

Sampling consisted of exhaustive and consecutive recruitment of all pregnant women who met the inclusion criteria and were admitted to the maternity hospital during the 3-month study period. We were therefore able to recruit 67 pregnant women, 50 of whom were presumed anemic during the study period.

### 2.3 Ethical and Administrative Considerations

Initially, we obtained a research authorization from the Bongor Teachers' Training Higher School. We then went to the administration of the Guelendeng District Hospital to obtain authorization for a research placement. The verbal consent of the pregnant women surveyed was obtained before any data was collected, and we were bound by strict confidentiality.

### 2.4 Studied Variables

The main study variables were: socio-demographic and socio-economic characteristics, and anaemia and malaria test results.

### 2.5 Hematological Parameters

A blood count examination test (NFS) and hemoglobin levels were carried out at the Guelendeng

District Hospital laboratory. The blood count examination was carried out using an appropriate device called a Mindray-BC 3000 plus photometer, which automatically counts all the elements in the blood from a blood sample taken.

### 2.6 Conduct of the Study

During the study, we enlisted the services of a midwife who had been trained in the diet of pregnant women. After explaining the purpose of the research to the pregnant women and obtaining their consent, the women who met the inclusion criteria were interviewed using a survey form.

### 2.7 Pre-Testing

The survey form was pre-tested with 10 pregnant women of all ages who had undergone biological tests. This gave us an idea of how well the various questions were understood, and enabled us to reformulate the survey form.

### 2.8 Survey Form

A questionnaire structured in 2 main parts was used to collect the data:

- The first part dealt with the socio-demographic characteristics of the pregnant woman;
- The second part provided information on the socio-economic characteristics of the pregnant woman;

### 2.9 Data Processing and Analysis

Word 2010 was used to draw up the questionnaire and collect the data. Excel 2010 was used to draw the graphs. The data collected was analyzed using Excel 2010 and processed using SPSS, Statistics 25.

## III. RESULTS AND DISCUSSION

### 1. Results

We were able to survey a total of 67 pregnant women, 50 of whom showed signs of anaemia. The results of the hemoglobin tests (Hb level <11g/dl) confirmed that 27 women were anemic out of the 50 presumed to be anemic. These results are presented below in the form of figures and tables.



## 1.1 Socio-Demographic And Socio-Economic Characteristics of Respondents

### 1.1.1 Distribution of Pregnant Women with Anaemia by Age Group

Figure 1 shows the results of our survey by age group of pregnant women surveyed.

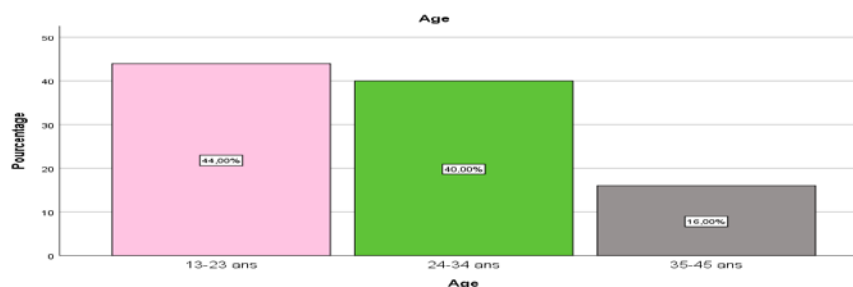


Figure 1: Age Groups of Pregnant Women Surveyed

The figure shows that the most represented age group is between 13 and 23, with 44%, followed by 25 to 34 (40%); the least represented age group is 35 to 45, with 16%. The anemic pregnant women at the extremes of age in the study were aged 13 and 45.

### 1.1.2 Financial Income Variable

Figure 2 shows the distribution of pregnant women surveyed according to their families' monthly financial income.

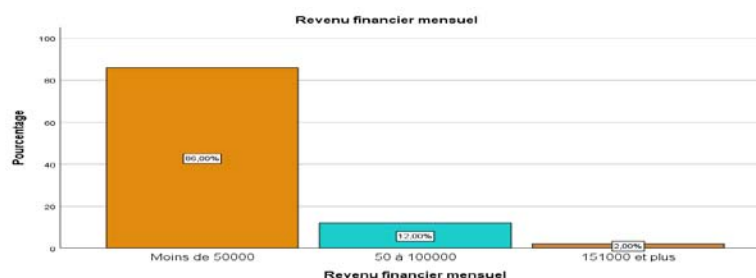


Figure 2: Financial Income of Women's Families

According to the results of the survey, 86% of the women come from families with a monthly financial income of less than 50,000 FCFA. This implies that the majority of women in the study come from poor and vulnerable families. This result also shows that 12% of the women in the study come from families with financial incomes of between 50 and 100,000 FCFA.

### 1.1.3 Level of Education of the Women Surveyed

Figure 3 shows the distribution of anemic pregnant women in the study according to their level of education.

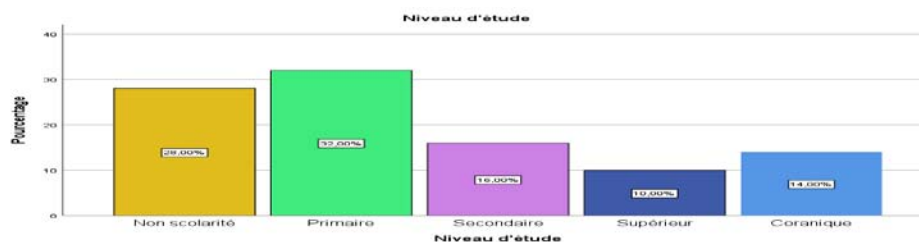


Figure 3: Educational Level of Women Surveyed

The results of the study show that almost a third of the women surveyed had attended primary school (32%), followed by those who had not (28%). These two groups account for 60% of pregnant women with anaemia. This may have an impact on the lack of knowledge about balanced diets to ensure good nutritional status for the woman and her unborn baby.

Next come women who have attended secondary school (16%) and Koranic school (14%). Pregnant women with anaemia who had attended higher education represented only 1/10 of the women in the study.

### 1.1.4 Variable Linked to Ethnic Origin

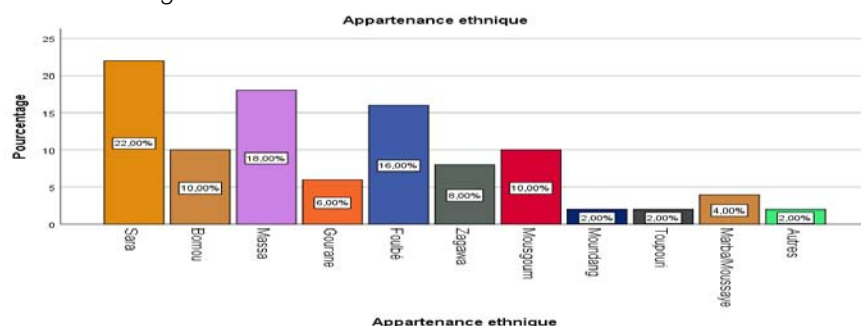


Figure 4: Ethnic groups met during the survey

The results of the study show that more than ten ethnic groups live together in the town of Guelendeng, with the majority of pregnant women with anaemia belonging to the Sara ethnic group (22%), followed by the Massa (18%). Next come the Peuhls (16%), followed by the Mousgoum and Bornou at 10% each. and others at 2% each. Zagawa women are represented in the survey at 8%, Gouranes at 6% and Marbas/Mousseys at

4%. The least represented ethnic groups in the study are the Moundang and Toupouri, with 2% each.

### 1.1.5 Antenatal Consultation

Figure 5 shows the distribution of anemic pregnant women according to their attendance at antenatal consultation.

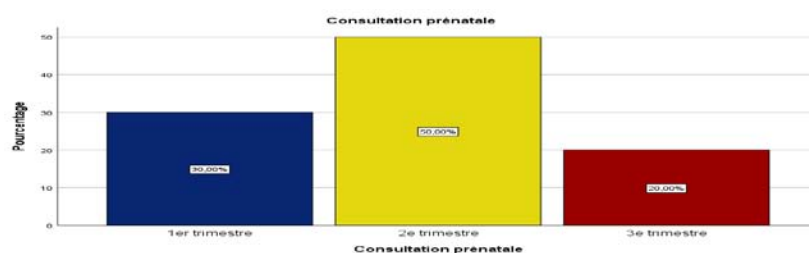


Figure 5: Antenatal Consultations for Pregnant Women with Anaemia

Figure 5 shows that most pregnant women (50%) do not attend antenatal clinics until the second trimester of their pregnancy, while 30% do so from the first trimester onwards, compared with 20% who attend in the third trimester.

### 1.1.6 Profession of Anemic Pregnant Women Surveyed

These results are shown in Figure 6 below.

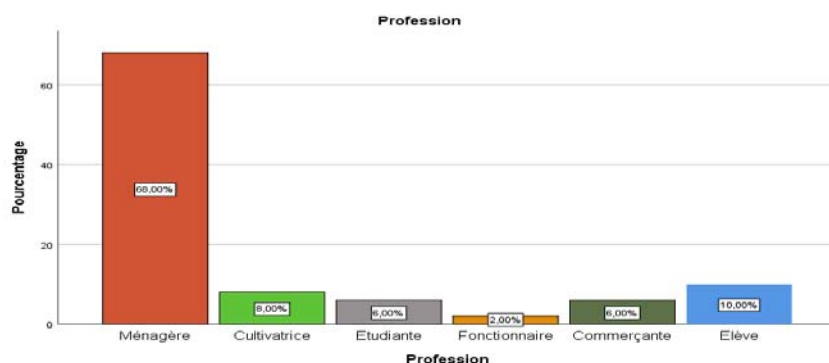


Figure 6: Profession of Respondents

The results summarized in Figure 6 above show that 68% of anemic pregnant women were housewives, followed by students (10%) and then farmers (8%). Pregnant women with anaemia who were students and shopkeepers each accounted for only 6% of the women

in the study. Only 2% of pregnant women with anaemia were civil servants.

#### 1.1.7 Variable Related to Water Supply Sources

Figure 7 shows the distribution of the women in the study by source of water supply.

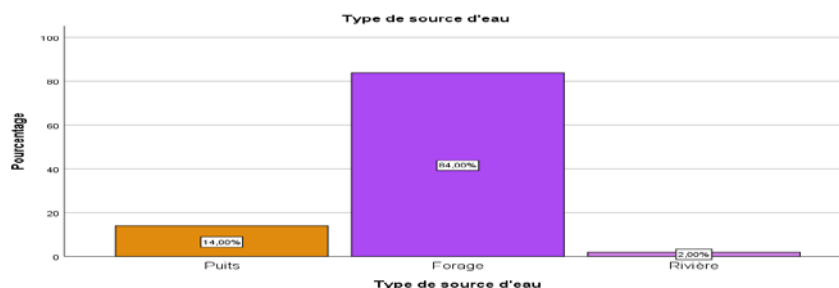


Figure 7: Sources of Water Supply

The figure shows that 84% of women get their water from boreholes, followed by 14% of women who get their water from wells. Of the women surveyed, 2% obtained their water from rivers.

#### 1.1.8 Variable Linked to the Type of House Lived in

Figure 8 shows the results of the survey according to the type of house lived in by the women surveyed.

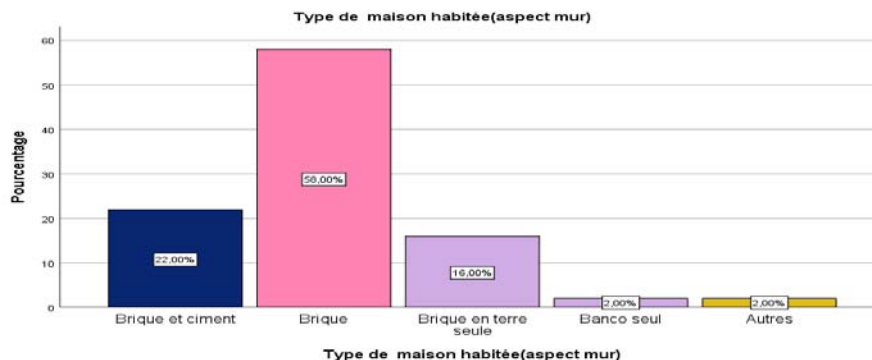


Figure 8: Type of House Lived in by Anemic Pregnant Women

The above results show that 58% of the women surveyed sleep in houses built of brick, 22% sleep in houses built of brick and cement. We also note that 16% of these women sleep in houses built of mud bricks, while 2% sleep in houses built of banco. In our opinion, houses built of mud bricks and banco, when not plastered smooth, are breeding grounds for mosquitoes.

#### 1.1.9 Variable Linked to the Number of People in the Respondent's Family

Figure 9 shows the distribution of women surveyed according to the number of people living in the respondent's family.

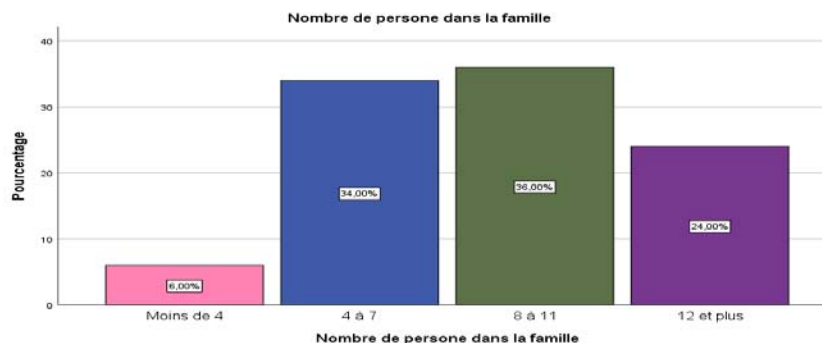


Figure 9: Number of People Living in the Respondent's Family

The results show that 36% of the women surveyed come from families with between 8 and 11 members, followed by 34% of pregnant women from families with between 4 and 7 members, and finally women living in families with 12 or more members (24%). The survey results show that only 6% of the women surveyed were from families with fewer than 4 members.

## 1.2 Hemoglobin Test Results

### 1.2.1 Hemoglobin Test Results Per 10 Pregnant Women Surveyed

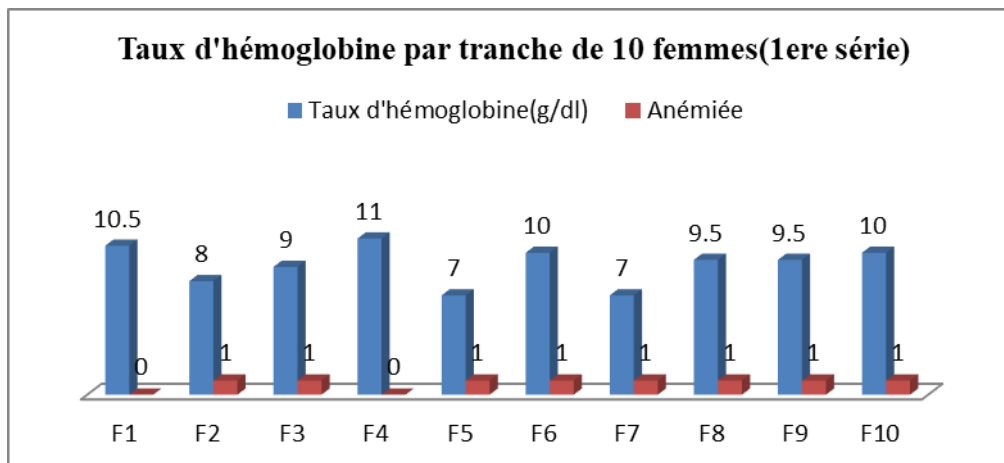


Figure 10: Results for the First Series of Ten Women

Figure 10 shows that hemoglobin levels varied from one woman tested to another, with a maximum of 11g/dl and a minimum of 7g/dl in the first series. Of the 10 women tested, 8 were anemic with hemoglobin levels < 10.5 g/dl.

### 1.2.2 Hemoglobin Test Results for the Second Series of 10 Women Surveyed

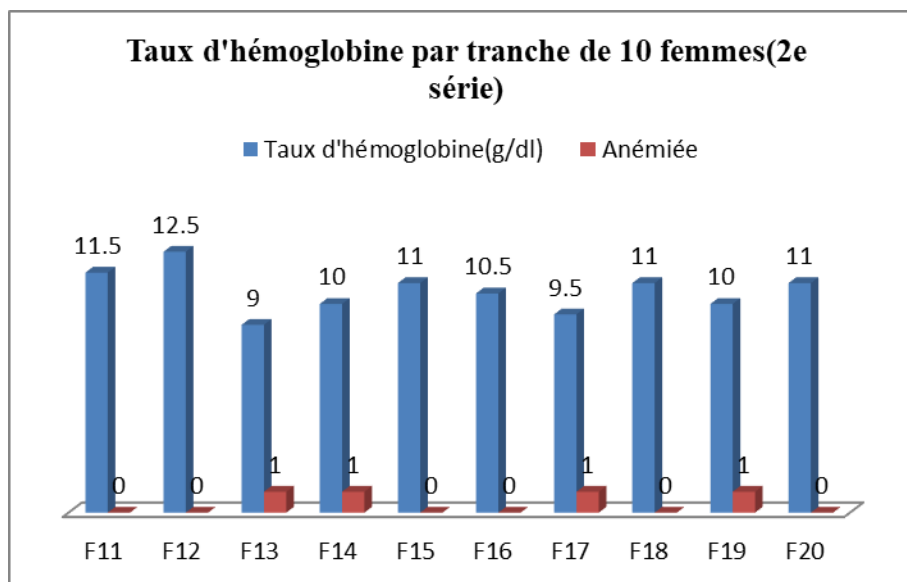


Figure 11: Results for the Second Series of 10 Women Surveyed

Figure 11 shows that hemoglobin levels varied from 12.5 g/dl to 9 g/dl in the second series, with 4 out of 10 women being anemic. Thus, out of 50 women in the study with signs of anemia divided into five series of ten women, 27 were confirmed as anemic.

### 1.3 Prevalence (P) of Anemia in Pregnant Women Attending The Maternity Ward of Guelendeng District Hospital

Prevalence is determined by the following formula:

$$P = \frac{\text{Number of anemic pregnant women}}{\text{Total number of women consulted for anemia}} \times 100$$

$$P = \frac{27}{50} \times 100$$

Applying the above formula, the calculated prevalence of anemic pregnant women at Guelendeng District Hospital is 54%.

### 1.4 Malaria Test Results

Figure 12 shows the results of the malaria test.

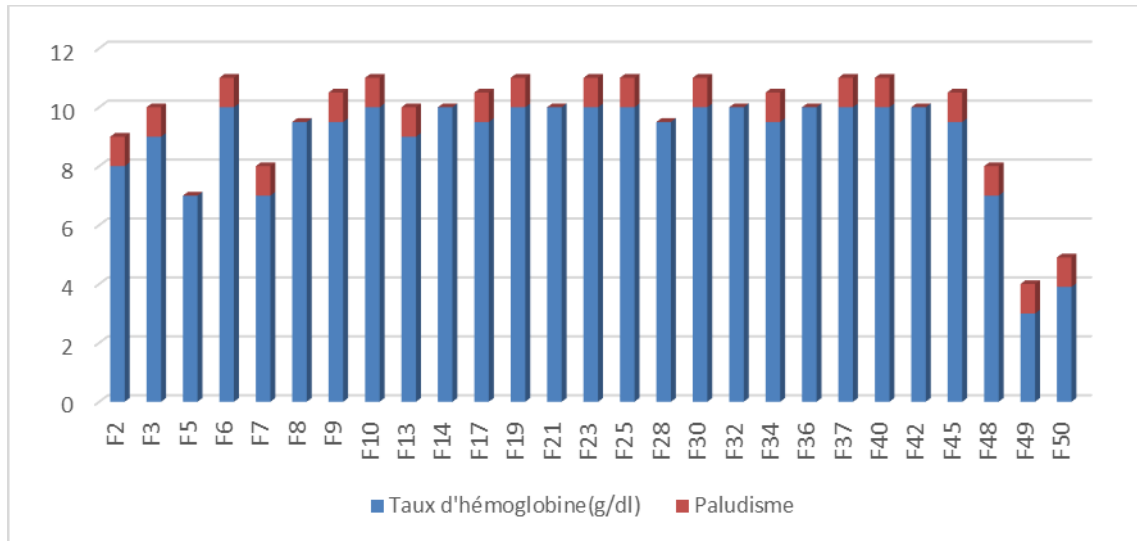


Figure 12: Results of the Malaria Test

According to the results of the study, of the 27 women with anemia, 19 tested positive for malaria, a percentage of 70.37%.

### 2. Discussion

The results of this study showed that the age group most represented among anemic pregnant women is the 13-23 age group (44%), followed by the 25-34 age group (40%). Early marriages from the age of 13 should be discouraged, as these women enter the intergenerational cycle of malnutrition. The 18 to 23 age group corresponds to the age group during which women are more active in terms of reproduction. Nadia *et al.* (2018) in Morocco observed a significant difference between the mother's age and the onset of anemia. They explain this significance by the fact that mothers have different eating habits depending on their age. Mothers who are very young (19 years) lack the maturity, skills and, above all, nutritional experience that would enable them to eat well and look after themselves.

According to the results of our survey, 86% of the women were from families with a monthly income of less than 50,000 FCFA. This implies that the majority of women in the study come from poor and vulnerable

families, and therefore lack the necessary means to obtain a sufficient, balanced diet that can prevent anemia. Income level is also associated with anemia prevalence: children from low-income families are more often anemic than those from better-off households (79.8% compared with 62.3%;  $p = 0.0015$  [Student's t test]) (Diouf *et al.* 2015).

In terms of level of education, almost a third of the women surveyed had attended primary school (32%), followed by those with no schooling (28%). These two groups account for 60% of pregnant women with anemia. This may have an impact on the lack of knowledge about balanced diets to ensure good nutritional status for pregnant women and their unborn babies. The mother's low level of education is a factor that favours the onset of anemia in pregnant women. This is due to the fact that they have little capacity to learn and practice the skills involved in good nutrition.

Half of the pregnant women (50%) in the study did not go for antenatal check-ups until the second trimester of their pregnancies, while 30% did so from the first trimester onwards, compared with 20% who went for check-ups in the third trimester. Regular antenatal check-ups for pregnant women, combined with the presence in maternity wards of midwives trained in the



nutrition of pregnant women, and the financial resources of families, is a winning bet in the fight against anemia.

The results of the study show that 68% of anemic pregnant women are housewives, followed by schoolgirls (10%). These women are financially vulnerable and dependent on their husbands' financial situation. Charlotte et al (2016) in Douala, Cameroon, obtained results contrary to ours. The majority of anemic pregnant women in their study had a higher level of education (279 cases or 67.2%). Salaried women were the most represented (240 cases or 57.8%) in their study.

In our study, 84% of women obtained their water from boreholes, followed by 14% from wells. Of the women surveyed, 2% obtained their water from a river. Helminthiasis and schistosomiasis, which are often linked to water, can cause anemia.

The results of the study show that 36% of the women surveyed come from families with between 8 and 11 members, followed by 34% of pregnant women from families with between 4 and 7 members, and finally women living in families with 12 or more members (24%). In most cases, a large family in Chad means not enough food for everyone.

Our calculated prevalence of 54% of pregnant women with anemia is higher than the average for Central Africa, according to the results of Diouf *et al.* (2015): health survey reports (DHS) indicate that, on average over 9 countries in the zone; 46.2% of women (pregnant or not) aged 15 to 49 are anemic. Our results are also superior to those obtained by Charlotte et al. (2016) in Douala, Cameroon: 415 pregnant women were recruited. The prevalence of anemia was 39.8%. On the other hand, the prevalence obtained in Morocco by Kazouini (2021) is higher than our result (272 cases of iron deficiency anemia, i.e. 85.5% of anemias recorded).

#### IV. CONCLUSION

At the end of our study, we can conclude that the prevalence of anaemia is high among pregnant women in the maternity ward of the Guelendeng District Hospital in Chad. It is within the range of WHO data for 2021 for developing countries. Almost three quarters of the anaemic women in the study tested positive for malaria.

The study also revealed that antenatal consultations by pregnant women were low, and of those who did attend, they claimed to be unaware of nutritional advice. Almost all the women in the study live in large families.

The low level of education, low monthly income, large families in which the women surveyed live and poor antenatal care are just some of the risk factors for anemia in pregnancy.

As women's attendance at antenatal clinics and maternity wards at Guelendeng District Hospital is low

and the study sample small, these results cannot be generalized to Chad.

#### ACKNOWLEDGEMENTS

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# Characterization and Analysis of Health Literacy and Adherence to the Mediterranean Dietary Pattern in Senior University Students

By Joana Rodrigues, Madalena Azaruja, Helena Loureiro  
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**Purpose:** To verify if there is a correlation between the Health Literacy levels and the level of Adherence to the Mediterranean Dietary Pattern in students from Senior Universities and to analyze the possible impact of sociodemographic factors on these variables.

**Materials and Methods:** The study sample was constituted by 114 students registered in Portuguese Senior Universities, in the Central Zone and Metropolitan Area of Lisbon. Participants were aged between 54 and 88 years old, with 79 individuals being female and the remaining 35 male.

**Keywords:** *predimed, health literacy, mediterranean dietary pattern, senior universities, seniors*

**GJMR-L Classification:** NLMC Code: W20.5



*Strictly as per the compliance and regulations of:*



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**Materials and Methods:** The study sample was constituted by 114 students registered in Portuguese Senior Universities, in the Central Zone and Metropolitan Area of Lisbon. Participants were aged between 54 and 88 years old, with 79 individuals being female and the remaining 35 male. It was applied to a sociodemographic questionnaire, the PREDIMED questionnaire, to assess adherence to the Mediterranean Dietary Pattern, and the HLS-EU-PT questionnaire to assess the level of health literacy. For statistical treatment, SPSS software version 27.0 was used.

**Results:** There were no significant results, however it was verified that most participants had a “problematic” level of Health Literacy and “low adherence” to the Mediterranean Dietary Pattern.

**Conclusions:** It is necessary to carry out more studies on this topic and more Health Education Programs, in order to highlight their needs and advantages, with the aim of promoting the population's health.

**Keywords:** *Predimed, health literacy, mediterranean dietary pattern, senior universities, seniors.*

## I. INTRODUCTION

Health Literacy (HL) is defined by the World Health Organization (WHO) as the “set of cognitive and social skills and the person's ability to access, understand, evaluate and apply health information, in order to promote and maintain a good health”(1). It is

already clear that a low HL is associated with worse health outcomes, particularly affecting minority populations, the elderly, people with a lower educational level and/or lower incomes. (2,3).

It is known that the Portuguese population is represented by a high percentage of elderly people, one of the groups with the lowest Health Literacy and worst health outcomes. From 2001 to the present (data from 2021), the age groups from 0 to 64 years old have decreased, while the group aged 65 and over has seen an increase of almost 4% (4.5). This aging pattern is common throughout Western Europe. In 2015, the growth of the age group of people aged 65 and over, in Portugal, ranked 10th, compared to other European countries. Projections predict that we will continue to see a clear worsening of the demographic aging process until 2080 (6). Therefore, working in this age group in Portugal becomes emerging, as it constitutes a considerably large and vulnerable group.

Despite the lack of attention given to this issue, UNESCO has already highlighted for about 30 years the importance of promoting educational and cultural activities for retired and/or elderly people, with the aim of ensuring them a better quality of life and also to ensure that societies benefit from their long experience. Local entities are therefore challenged to ensure the promotion of this type of activities for the senior population, in order to promote active ageing (6).

As nutrition is a crucial part of good health, it plays a decisive role in these results. Several studies have shown that there is a relationship between the Mediterranean Dietary Pattern and good health, since some components of this dietary pattern have been associated with a longer life expectancy and a lower incidence of chronic diseases. Thus, it has been possible to find an association between lower overall mortality and mortality from coronary heart disease and a longer life expectancy in Mediterranean countries (7).

These are two concepts of high importance and emergence of action, and the question also arises as to whether they are related in any way, since Health Literacy can influence health choices and habits, which may include food choices.

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a) *Background*i. *Health Literacy*

The most recent data regarding HL in Portugal, obtained after the evaluation carried out by the General Directorate of Health, between 2020 and 2021, within the scope of the Action Plan for Health Literacy 2019-2021, and framed in the consortium European "WHO Action Network on Measuring Population and Organizational Health Literacy" (M-POHL), reveal that 65% of respondents had "Sufficient" knowledge and only 5% had an "Excellent" level. It was also possible to understand that 22% and 8% revealed "Problematic" and "Inadequate" levels, respectively. In general, and compared to other European countries, such as Germany, Spain or Greece, Portugal had relatively lower Health Literacy rates. (1,8). Through the "Synthesis Report - Health Literacy in Portugal" from the Calouste Gulbenkian Foundation, from 2016, it is possible to verify that individuals aged 66 or over represent a vulnerable group with regard to this topic (8).

Knowledge, motivation and personal skills are essential for a good understanding of information and consequently improving HL. In turn, the level of this knowledge will also determine access to healthcare (1). Social determinants such as ethnicity, socioeconomic level, gender differences, culture, language and even academic qualifications have an influence on the level of HL. Thus, individuals with a low socioeconomic level and a low level of education have lower health knowledge, which in turn limits participation in disease screening and generates less understanding of the information received about a disease and its respective treatment (9). Therefore, it is of great importance to measure HL levels in populations, in order to constitute a starting point for planning health interventions as well as to support policies aimed at the specific characteristics of the population and respective knowledge (1).

It is possible to assess the relationship between food choices, whether at an individual, community or global level, and factors such as social context, food availability, policy formulation, marketing strategies, food prices, and food literacy (FL) levels (10). It has been proven that adults with low LS have greater difficulty in understanding issues in the area of Nutrition, such as following nutritional recommendations from health professionals, reading food labels and thus making informed decisions when purchasing these products (9). According to the Global Burden of Disease study, in 2019, the eating habits of the Portuguese represented the fifth risk factor that most contributed to the loss of years of healthy life due to illness. This increase in food-related illnesses has been associated with poor eating habits and low levels of knowledge and skills related to food (10).

HL appears to be associated with eating behaviors, however, the relationships found between LS and dietary intake have been contradictory. According to the study by *Chari et al.* (2014), it was shown that parents with low literacy are more likely to promote obesogenic food environments. In a study that included hypertensive and diabetic patients, no relationships were found between HL and adherence to the Low Salt Diet or Macronutrient Restricted Diets, respectively. On the other hand, it was found, in another study, that lower quality diets and greater intake of sugary drinks were more prevalent in adults with low HL levels, establishing an association between the variables (2,11-14). In an investigation carried out on patients undergoing kidney transplantation, it was found that higher levels off FL were associated with higher scores on the Mediterranean Diet adherence questionnaire as well as with high scores in the three HL domains (15).

ii. *Mediterranean Dietary Pattern*

The "Mediterranean Diet" (MD) concept became known through the "Seven Countries Study", led by Ancel Keys between 1958 and 1964. In this study, eating habits were compared in different countries, namely in the United States of America (USA), Japan, Finland, Netherlands, former Yugoslavia, Italy and Greece. In this way, it was possible to characterize this diet in relation to the foods that make up it, despite there not being a single MD, as the foods that make up this pattern vary between countries in the Mediterranean basin (7). Even so, in general, this dietary pattern is characterized by favoring the consumption of foods of plant origin, including a high amount of fruit and vegetables, whole grains, legumes, olive oil, oilseed fruits and a moderate intake of meat, fish and dairy products. Water is the main drink and wine should be consumed in moderation, only with main meals. This dietary pattern uses a healthy culinary base, using dishes cooked in water (soups, boiled, stews), preserving nutrients, and giving priority to fresh and seasonal products. Thus, it is a food model that promotes health and protects the environment and has been considered intangible cultural heritage of humanity since December 2013 (16,17).

In 2020, adherence to the MD was studied in Portugal, and it was found that 26% of the Portuguese population has "High Adherence" to the MD, which means that the percentage of "Low Adherence" is 74%. Therefore, the majority of Portuguese people do not follow this health-protective dietary pattern (17).

iii. *Portuguese Senior Population and Aging Process*

The aging process encompasses not only biological changes, but also social and psychological ones. Through the analysis of statistical data, relating to 2021, mentioned in the PORDATA database, it is possible to verify the increase in the Aging Index over the last few years, which translates into the number of

people aged 65 or over per 100 people under 15 years old. A value below 100 means that there are fewer elderly people than young people. In 2001, this index stood at 102.2, having increased to 182.1 in 2021. The longevity index has also been increasing, going from 39.3 to 47.9, respectively in the years mentioned. Thus, it is possible to witness an inversion of percentages in terms of the size of the senior population (individuals aged 65 or over), adults and young people, making the aging process a central problem in our societies, especially the more developed ones. Several challenges thus arise, encompassing social support structures, mainly in terms of health, pension and social security schemes and longevity, life trajectory and work (4–6).

In this light, Senior Universities have demonstrated an essential role in the acquisition and continuous updating of knowledge, improvement of skills and sharing of reflective and practical knowledge among the senior population (6).

#### iv. Senior Universities

The Senior Universities (SU) existing in Portugal differ from social centers and/or day centers in several aspects, being aimed at populations with different characteristics. In the SU, the population is physically and psychologically autonomous, showing some weakness in knowledge of new technologies, while in the centers, they present more physical and/or intellectual difficulties. However, aspects such as the creation of interpersonal relationships, socialization between peers, combating isolation and cognitive degeneration, are common aspects between both.

Due to the growing number of SU, in 2016, the need arose for official recognition through the creation of the Network of Senior Universities (NSU) as a representative entity for them, also holding the role of partner for the development of active aging policies and the social economy. (6.18).

SU students are mostly women (76%), aged between 60 and 70 years old, retired or domestic workers (80%) and with qualifications ranging from 4th class to PhD. At SU, courses are taught by specialists in different areas and most of the subjects taught are common to all Universities, including Sports, Arts, IT, Health and others (18).

## II. OBJECTIVES

### a) Main Objective

Check whether there is a relationship between the level of Health Literacy and the level of Adherence to the Mediterranean Dietary Pattern in students at Senior Universities.

### b) Specific Objectives

Analyze the impact of socioeconomic factors on adherence to the Mediterranean Dietary Pattern and on Health Literacy levels of students at Senior Universities.

## III. MATERIAL AND METHODS

### a) Study Design

An analytical observational study was developed and, regarding the timeline, it is classified as cross-sectional. This was a level II correlational descriptive study.

### b) Study Location

The development of the study was carried out in some Portuguese Senior Universities, namely the Senior University of Curia, the Senior University of Nelas, the Senior University of Gouveia, the Senior University Aposenior Coimbra and the Senior University D. Sancho I, in Almada.

### c) Duration and Period of Study

The duration of the study covered the academic year 2021/2022 and regarding the study period (analytical collection), it took place between the months of March and May 2022, inclusive.

### d) Target Population

This study encompasses any student enrolled in the selected Senior Universities, with a sample consisting of adults and elderly people. As for the inclusion criteria in the study, these were being registered as a student in one of the selected Senior Universities and presenting duly signed informed consent, with the lack of one of these defined as exclusion criteria.

### e) Sample Size and Characterization

Of a total of 2462 students enrolled in the US covered in the study, responses were obtained from 114 students. These students range in age from 54 to 88 years old, with 79 individuals being female and the remaining 35 being male. The majority have Portuguese nationality, with only one individual with Angolan nationality. Regarding the area of residence, only the Center Regions and Metropolitan Area of Lisbon are covered.

### f) Sampling type and Technique

The type of sampling applied was non-probabilistic and regarding the sampling technique, this was for convenience..

### g) Data Collection Instruments

Study data was collected through questionnaires completed online or in person, depending on the University. The platform chosen to apply the questionnaire in an online format was Google Forms. In the first instance, the individual's willingness to participate in the study of their own free will, without any ethical or moral prejudice, was questioned. Data collection comprised three parts, obtaining sociodemographic data, applying the PREDIMED questionnaire and applying the HLS-EU-PT47 questionnaire.

### i. Sociodemographic Questionnaire

With the aim of analyzing the sociodemographic data of the sample, a questionnaire was created, based on questionnaires used in other studies related to the theme of health literacy, in which the following parameters were collected: gender; date of birth; educational qualifications; nationality; residence zone; Senior University where he was enrolled (19,20).

### ii. Predimed questionnaire

The instrument used to assess adherence to the Mediterranean Dietary Pattern was the PREDIMED questionnaire. This is a validated questionnaire for the Portuguese population consisting of 14 questions related to the consumption/frequency of consumption of various foods included and not included in this pattern. For each question, scoring criteria are defined, based on compliance or non-compliance with the MD principles. Thus, for data analysis, responses that meet the criteria are scored with one point and those that do not meet the criteria are not scored. In this way, a final score is obtained that corresponds to the sum of the scores of the 14 questions. This score can vary between 0 and 14 points, with adherence to the Mediterranean Dietary Pattern defined at two levels: low ( $< 10$  points) and high ( $\geq 10$  points) (17).

### iii. Hls-Eu-Pt47 Questionnaire

The HLS-EU is an instrument to assess the level of Health Literacy by self-perception. This is a questionnaire with which, through a scale of four classifications (from "very difficult" to "very easy"), the participant indicates the degree of difficulty they feel in carrying out tasks relevant to individual health (19).

This instrument consists of 47 questions, grouped into three health domains ("Health Care", "Health Promotion" and "Disease Prevention") and four levels of information processing that influence decision-making (access, understanding, evaluation and use), which allows categorizing health literacy groups according to cutoff points. In order to guarantee the correct calculation of the indices and ensure comparison between them, the four calculated indices were organized on a scale from 0 to 50, in which 0 is the minimum possible Health Literacy and 50 is the maximum. Next, the following cutoff points are identified for the four levels: scores equal to or less than 25 points = Inadequate Health Literacy; scores between 25-33 points = Problematic Health Literacy; scores between 33-42 = Sufficient Health Literacy; and scores between 42-50 = Excellent Health Literacy (19).

It should be noted that only questionnaires with more than 80% of the items answered with specific indices (1 to 4 values) are considered valid (21).

This questionnaire has already been validated for the Portuguese population, with the original 47 questions being maintained, meaning that the HLS-EU-PT is similar in terms of psychometric properties to the

original scale. Therefore, it is an instrument that is suitable for analyzing the level of Health Literacy in the Portuguese population.

### h) Ethical Issues

All phases of the study respected the required ethical rigor to the maximum. The sources used as theoretical support were duly identified and referenced, respecting the rights of each author.

With regard to data collection, participants were previously informed about the objectives and methodology of the investigation, about the information to be collected and the purposes for which it would be used, as well as the methods of processing the information in order to guarantee the confidentiality and anonymity of data. Thus, participation in this research was part of a conscious decision-making process on the part of each individual, through the signing of informed, free and clarified consent, also having the possibility of refusing to participate without any prejudice, safeguarding the interests and rights of each participant.

Finally, formal emails were sent to the management of the Senior Universities requesting collaboration in the research, informed, free and informed consent documents were distributed to all participants and a favorable ethical opinion was also obtained from the Ethics Committee of the Polytechnic Institute of Coimbra (ECPIC).

## IV. STATISTICAL ANALYSIS

To perform the statistical analysis, the statistical software IBM SPSS Statistics version 27.0 was used.

In an initial phase, the HLS-EU-PT47 scores were calculated, through data processing and calculation of scores using the formula, in order to proceed with the classification (22).

For descriptive statistics, measures of central tendency (mean and median) and measures of dispersion (standard deviation, minimum and maximum) were determined in relation to age, responses to the PREDIMED questionnaire and other sociodemographic variables.

Subsequently, at the level of hypotheses, the Chi-Square test, Student's t-test and the Kruskal-Wallis test were applied. For statistical inference, a confidence level of 95% was assumed for a maximum random error of up to 5%.

## V. RESULTS

The final sample was made up of 114 students, who completed all the questionnaires. However, it should be noted that, regarding the HLS-EU-PT47 questionnaire, eight of them were excluded because they did not meet the criteria for validation of this questionnaire (more than 80% of the questions answered with an exact answer).

In table 1 it is possible to characterize the sample in relation to Literary Qualifications. Thus, it was found that 22.8% of the participants had Basic Education (n=26), 23.7% had Secondary Education (n=27), and 42.9% of the participants had completed some degree of Higher

Education (n =49). The most prevalent level of Literary Qualification in females was Bachelor's Degree, with 43%, and in males, Secondary Education was prevalent in 34.3% of participants.

*Table 1:* Characterization of the Sample Regarding Literary Qualifications

Literary Qualifications		Gender		Total
		Female	Male	
Basic Education	n (%)	18 (69.2%)	8 (30.8%)	26
	% column	22.8%	22.9%	22.8%
Secondary Education	n (%)	15 (55.6%)	12 (44.4%)	27
	% column	19%	34.3%	23.7%
Non-Higher Professional Qualification	n (%)	5 (41.7%)	7 (58.3%)	12
	% column	6.3%	20%	10.5%
Bachelor`s Degree	n (%)	34 (85%)	6 (15%)	40
	% column	43%	17.1%	35%
Postgraduate	n (%)	3 (75%)	1 (25%)	4
	% column	3.8%	2.9%	3.5%
Master's degree	n (%)	4 (80%)	1 (20%)	5
	% column	5.1%	2.9%	4.4%
Total	n (%)	79 (69.3%)	35 (30.7%)	114
	% column	100%	100%	100%

With regard to the Residence Area, it can be seen in table 2 that the sample was characterized by containing 25.4% of participants residing in the Lisbon

Metropolitan Area (LMA) (n=29), 58.6% female ( n=17). The remaining 74.6% of participants lived in the Central area, with 72.9% being women (n=62).

*Table 2:* Characterization of the Sample According to Area of Residence and Age

Residence Zone		Gender		Total
		Female	Male	
Lisbon Metropolitan Area	n (%)	17 (58.6%)	12 (41.4%)	29
	% column	21.5%	34.3%	25.4%
Center	n (%)	62 (72.9%)	23 (27.1%)	85
	% column	78.5%	65.7%	74.6%
Total	n (%)	79 (69.3%)	35 (30.7%)	114
	% column	100%	100%	100%
Age		M ± SD	68.81 ± 6.35	71.4 ± 6.61
				69.62 ± 6.51

*Legend: M = Mean; SD = Standard Deviation*

The average age of the participants was 69.62 years, with the average age of females being slightly lower than that of males, 68.81 years and 71.40 years, respectively (table 2).

In table 3, it is observed that there were no significant differences in the HLS classification

depending on age ( $p>0.05$ ). Even so, it was found that the highest average age, 70.73 years, was more associated with the "Problematic" classification level.

*Table 3:* Differences in Classification in HLS-EU-PT Depending on Age

	HLS classification				Total	$p$
	Inappropriate	Problematic	Enough	Excellent		
n	12	62	25	5	104	0.226
M ± DV	67.17 ± 6.013	70.73 ± 5.848	69.16 ± 8.697	68.00 ± 4.899	69.81 ± 6.652	

*Legend: M = Average; SD =Standard Deviation; TestKruskal-Wallis (Significant correlation when  $p\leq 0.05$ )*

There were no significant differences in the classification obtained in the HLS-EU-PT questionnaire depending on gender ( $p>0.05$ ). Even so, it was possible to verify that the most common classification in

both genders was “Problematic”. It is also concluded that the “excellent” classification was the least prevalent in both genders (table 4).

*Table 4: Differences in Classification in HLS-EU-PT as a Function of Gender*

			Gender		Total	<i>p</i>
			Female	Male		
HLS Classification	Inappropriate	n (%)	11 (84.6%)	2 (15.4%)	13	0.511
		% column	14.9%	6.3%	12.3%	
	Problematic	n (%)	41 (66.1%)	21 (33.9%)	62	
		% column	55.4%	65.6%	58.5%	
	Enough	n (%)	17 (68.0%)	8 (32.0%)	25	
		% column	23.0%	25.0%	23.6%	
	Excellent	n (%)	5 (83.3%)	1 (16.7%)	6	
		% column	6.8%	3.1%	5.7%	
Total	n (%)	74 (69.8%)	32 (30.2%)	106		
	% column	100.0%	100.0%	100.0%		

*Caption: Test Chi-Square of Independence (Significant correlation when  $p \leq 0.05$ )*

As can be seen in table 5, the classifications of “Inadequate”, “Problematic” and “Sufficient” regarding the level of health literacy were higher in the central zone than in the LMA. This condition only did not occur in the

“excellent” classification, in which identical percentages were obtained for both areas. The results were not significant ( $p>0.05$ ).

*Table 5: Differences in Classification in HLS-EU-PT Depending on the Area of Residence*

			Residence Zone		Total	<i>p</i>
			LMA	Center		
HLS Classification	Inappropriate	n (%)	2 (15.4%)	11 (84.6%)	13	0.462
		% column	7.1%	14.1%	12.3%	
	Problematic	n (%)	16 (25.8%)	46 (74.2%)	62	
		% column	57.1%	59.0%	58.5%	
	Enough	n (%)	7 (28.0%)	18 (72.0%)	25	
		% column	25.0%	23.1%	23.6%	
	Excellent	n (%)	3 (50.0%)	3 (50.0%)	6	
		% column	10.7%	3.8%	5.7%	
Total	n (%)	28 (26.4%)	78 (73.6%)	106		
	% column	100.0%	100.0%	100.0%		

*Caption: Test Chi-Square of Independence (Significant Correlation when  $p \leq 0.05$ ); AML - Lisbon Metropolitan Area*

Next, the relationship between Literary Qualifications and the classification of the HLS questionnaire was evaluated (Table 6). It was found that there were no significant differences between the two ( $p>0.05$ ). Even so, it was possible to verify that the majority of participants have a “problematic” level of HL. In all educational qualifications, the classification with the lowest prevalence was the “excellent” level, except in Higher Education, in which the “inadequate” level had the lowest prevalence.

It should be noted that at all levels of educational qualifications, the majority of literacy levels were classified as “Problematic”.



**Table 6:** Differences in Classification in *HLS-EU-PT* According to Academic Qualifications

			HLS classification				Total	<i>p</i>
			Inappropriate	Problematic	Enough	Excellent		
Literary Qualifications	Basic	n (%)	4 (16.7%)	12 (50.0%)	8 (33.3%)	0	24	0.559
	Education	% column	30.8%	19.4%	32.0%	0.0%	22.6%	
	Secondary	n (%)	4 (16.7%)	15 (62.5%)	4 (16.7%)	1 (4.2%)	24	
	Education	% column	30.8%	24.2%	16.0%	16.7%	22.6%	
	Qualification	n (%)	1 (8.3%)	8 (66.7%)	3 (25.0%)	0	12	
	NHP	% column	7.7%	12.9%	12.0%	0.0%	11.3%	
	Higher	n (%)	4 (8.7%)	27 (58.7%)	10 (21.7%)	5 (10.9%)	46	
	education	% column	30.8%	43.5%	40.0%	83.3%	43.4%	
Total		n (%)	13 (12.3%)	62 (58.5%)	25 (23.6%)	6 (5.7%)	106	
		% column	100.0%	100.0%	100.0%	100.0%	100.0%	

Caption: Test Chi-Square of Independence; (Significant Correlation when  $p \leq 0.05$ ); NHP – Non-Higher Professional

Analyzing the relationship between age and the classification obtained in PREDIMED (Table 7) it is clear that there were no significant differences ( $p > 0.05$ ). The average age of participants with “high adherence to

MD” was slightly lower than that of those who revealed “low adherence”, with respective values of around 68 and 70 years.

**Table 7:** Differences in Classification in *PREDIMED* Depending on Age

PREDIMED Classification		N	M ± DV	<i>p</i>
Age	Low adherence	70	70.39 ± 6.636	0.107
	High adhesion	42	68.33 ± 6.167	

Legend: M = Average; SD = Standard Deviation; t-Student test (Significant Correlation when  $p \leq 0.05$ )

There were no significant differences in the classification obtained in PREDIMED depending on gender, however, it was observed that in both genders

there was a higher percentage of “low adherence”, this being higher in men than in women, with 71.4 % and 58.2%, respectively (Table 8).

**Table 8:** Differences in Classification in *PREDIMED* as a Function of Gender

			PREDIMED Classification		Total	<i>p</i>
			Low Adherence	High Adhesion		
Gender	Female	n (%)	46 (58.2%)	33 (41.8%)	79	0.180
		% column	64.8%	76.7%	69.3%	
	Male	n (%)	25 (71.4%)	10 (28.6%)	35	
		% column	35.2%	23.3%	30.7%	
Total	n (%)		71 (62.3%)	43 (37.7%)	114	
	% column		100.0%	100.0%	100.0%	

Caption: Test Chi-Square of Independence; (Significant correlation when  $p \leq 0.05$ )

Now evaluating the relationship between the classification obtained in PREDIMED and the area of residence (Table 9), it was concluded that there were no significant differences ( $p > 0.05$ ). It can be seen, however, that the prevalence of low adherence was higher in the center compared to the metropolitan area of Lisbon, with values of 78.9% and 21.1%, respectively. It is also noticeable that in the Lisbon metropolitan area there was a slightly disparate distribution of “high” and “low” adherence, with the percentage of low adherence

being slightly higher. In the Center area, the percentage of low adherence was considerably higher than that of high adherence, with 65.9% and 34.1%, respectively.

**Table 9:** Differences in Classification in PREDIMED Depending on the Area of Residence

			PREDIMED Classification		Total	p
			Low adherence	High adherence		
Residence zone	Lisbon Metropolitan Area	n (%)	15 (51.7%)	14 (48.3%)	29	0.174
		% column	21.1%	32.6%	25.4%	
	Center	n (%)	56 (65.9%)	29 (34.1%)	85	
		% column	78.9%	67.4%	74.6%	
Total			71 (62.3%)	43 (37.7%)	114	
			100%	100.0%	100.0%	

*Caption: Test Chi-Square of Independence; (Significant Correlation when  $p \leq 0.05$ )*

Next, the level of Literary Qualifications was compared with the Classification obtained in PREDIMED (Table 10). The results obtained were not significant ( $p > 0.05$ ). Even so, it was possible to verify that, in all levels of Literary Qualifications, the majority of

participants presented "low adherence" to the Mediterranean Dietary Pattern. It should be noted that the highest percentage of "low adherence" was found in "Basic Education" (76.9%) and the lowest in "Higher Education" (55.1%).

**Table 10:** Differences in Classification in PREDIMED Depending on Literary Qualifications

			PREDIMED Classification		Total	p
			Low adherence	High adherence		
Literary Qualifications	Basic Education	n (%)	20 (76.9%)	6 (23.1%)	26	0.302
		% column	28.2%	14.0%	22.8%	
	Secondary Education	n (%)	16 (59.3%)	11 (40.7%)	27	
		% column	22.5%	25.6%	23.7%	
	Non-higher professional qualification	n (%)	8 (66.7%)	4 (33.3%)	12	
		% column	11.3%	9.3%	10.5%	
	Higher education	n (%)	27 (55.1%)	22 (44.9%)	49	
		% column	38.0%	51.2%	43.0%	
Total			71 (62.3%)	43 (37.7%)	114	
			100%	100.0%	100.0%	

*Caption: Test Chi-Square of Independence; (Significant Correlation when  $p \leq 0.05$ )*

With the data presented in table 11, it was possible to verify that although the entire sample uses olive oil as the main source of fat for cooking, the majority (77.4%) consumes less than 4 tablespoons per day.

It was also found that 71.7% of respondents consumed more than two portions of vegetables per day. Regarding the consumption of fruit and legumes, most of the sample (59.4% and 50.9%, respectively) revealed that they consumed more than 3 portions of these foods per day.

It was also noticeable that the majority of the sample consumed fish or seafood more than 3 times a week and that more than 70% preferred white meat to red meat, with 67% saying they consumed less than one portion of red meat, hamburger or derivatives, per day. With regard to cooking methods, it was found that 66% of participants consumed meals cooked with a base of tomato, onion, garlic and olive oil more than twice a week.

Regarding the consumption of more sugary foods, the majority of respondents responded that they drank soft drinks less than once a day (87.7%) and

consumed sweet desserts, cookies and cakes less than 3 times a week ( 68.9%).

In the case of portions of oilseed fruits per week, 50.9% said they consumed less than 3 portions.

**Table 11:** Relationship between the Answers Obtained in the *PREDIMED* and Classification in *HLS-EU-PT47*

		HLS classification					
			Inappropriate	Problematic	Enough	Excellent	Total (% column)
How many tablespoons of olive oil do you consume per day?	<4	n (%)	11 (13.4%)	47 (57.3%)	19 (23.2%)	5 (6.1%)	82 (77.4%)
	>=4	n (%)	2 (8.3%)	15 (62.5%)	6 (25.0%)	1 (4.2%)	24 (22.5%)
How many servings of vegetables do I consume per day?	>=2	n (%)	7 (9.2%)	46 (60.5%)	19 (25.0%)	4 (5.3%)	76 (71.7%)
	>=2	n (%)	7 (9.2%)	46 (60.5%)	19 (25.0%)	4 (5.3%)	76 (71.7%)
How many servings of fruit do you consume per day?	<3	n (%)	4 (9.3%)	21 (48.8%)	15 (34.9%)	3 (7.0%)	43 (40.6%)
	>=3	n (%)	9 (14.3%)	41 (65.1%)	10 (15.9%)	3 (4.8%)	63 (59.4%)
How many servings of red meat, hamburgers or derivatives do you consume per day?	>=1	n (%)	4 (11.4%)	25 (71.4%)	6 (17.1%)	0	35 (33.0%)
	<1	n (%)	9 (12.7%)	37 (52.1%)	19 (26.8%)	6 (8.5%)	71 (67.0%)
How many sugary soft drinks do you consume per day?	>=1	n (%)	1 (7.7%)	9 (69.2%)	3 (23.1%)	0	13 (12.3%)
	<1	n (%)	12 (12.9%)	53 (57.0%)	22 (23.7%)	6 (6.5%)	93 (87.7%)
How many servings of legumes do you consume per week?	<3	n (%)	9 (17.3%)	27 (51.9%)	14 (26.9%)	2 (3.8%)	52 (49.1%)
	>=3	n (%)	4 (7.4%)	35 (64.8%)	11 (20.4%)	4 (7.4%)	54 (50.9%)
How many servings of fish or seafood do you consume per week?	<3	n (%)	5 (13.9%)	21 (58.3%)	8 (22.2%)	2 (5.6%)	36 (34.0%)
	>=3	n (%)	8 (11.4%)	41 (58.6%)	17 (24.3%)	4 (5.7%)	70 (66.0%)
How many times a week do you eat sweet desserts, cookies and cakes?	>=3	n (%)	2 (6.1%)	21 (63.6%)	10 (30.3%)	0	33 (31.1%)
	<3	n (%)	11 (15.1%)	41 (56.2%)	15 (20.5%)	6 (8.2%)	73 (68.9%)
How many servings of oilseed fruits (walnuts, hazelnuts, almonds, peanuts, etc.) do you consume per week?	<3	n (%)	7 (13.0%)	31 (57.4%)	15 (27.8%)	1 (1.9%)	54 (50.9%)
	>=3	n (%)	6 (11.5%)	31 (59.6%)	10 (19.2%)	5 (9.6%)	52 (49.1%)
Do you prefer to consume turkey, chicken, rabbit, or a vegetable alternative, rather than pork or beef?	No	n (%)	2 (9.1%)	14 (63.6%)	5 (22.7%)	1 (4.5%)	22 (20.8%)
	Yes	n (%)	11 (13.1%)	48 (57.1%)	20 (23.8%)	5 (6.0%)	84 (79.2%)
How many times a week do you eat meals cooked with tomatoes/tomato sauce, onion, garlic and olive oil?	<2	n (%)	2 (5.6%)	21 (58.3%)	11 (30.6%)	2 (5.6%)	36 (34.0%)
	>=2	n (%)	11 (15.7%)	41 (58.6%)	14 (20.0%)	4 (5.7%)	70 (66.0%)

Next, we attempted to relate the classification obtained in the HLS questionnaire with the classification in the PREDIMED questionnaire (Table 12). Thus, it was concluded that the majority of respondents have a "problematic" level of health literacy (58.5%) and revealed "low adherence" to MD (66%).

It was found that participants with "inadequate", "problematic" and "sufficient" health literacy levels were mainly associated with "low adherence" to the

Mediterranean dietary pattern, with the percentages of low adherence being 69.2%, 66, 1% and 68%, respectively.

It was also understood that participants with the lowest level of health literacy had the lowest percentage of "high adherence" to MD. Only among participants with an "excellent" level of health literacy was there a considerable increase in the percentage of "high

adherence" to the Mediterranean Dietary Pattern, with a result of 50% being obtained. Even so, the results were not significant with regard to the PREDIMED classification depending on the HLS-EU-PT classification ( $p>0.05$ ).

**Table 12:** Differences in the Classification in the PREDIMED Questionnaire Depending on the Classification in the HLS-EU-PT Questionnaire

			PREDIMED Classification		Total	p
			Low adherence	High adhesion		
HLS classification	Inappropriate	n (%)	9 (69.2%)	4 (30.8%)	13	0.852
		% column	12.9%	11.1%	12.3%	
	Problematic	n (%)	41 (66.1%)	21 (33.9%)	62	
		% column	58.6%	58.3%	58.5%	
	Enough	n (%)	17 (68.0%)	8 (32.0%)	25	
		% column	24.3%	22.2%	23.6%	
	Excellent	n (%)	3 (50.0%)	3 (50.0%)	6	
		% column	4.3%	8.3%	5.7%	
Total	n (%)	70 (66.0%)	36 (34.0%)	106		
	% column	100%	100.0%	100%		

Test Chi-Square of Independence; (Significant Correlation when  $p \leq 0.05$ )

The question coded as HLSQ38 corresponded to the question "Understanding the information on food packaging?". Even though the differences are not significant ( $p>0.05$ ), the results presented in table 10 show that the majority of respondents who classified the

HLSQ38 as "very difficult", "difficult" or "easy" had low adherence to MD, with 75%, 73.2% and 58.5%, respectively. The percentages of low and high adherence were only equal when they were associated with a "very easy" rating on question 38.

**Table 13:** Differences in the Classification of Question 38 of the HLS-EU-PT Depending on the PREDIMED Classification

			PREDIMED Classification		Total	p
			Low adherence	High adherence		
HLSQ38	Very difficult	n (%)	3 (75.0%)	1 (25.0%)	4	0.333
		% column	4.3%	2.5%	3.6%	
	Difficult	n (%)	30 (73.2%)	11 (26.8%)	41	
		% column	42.9%	27.5%	37.3%	
	Easy	n (%)	31 (58.5%)	22 (41.5%)	53	
		% column	44.3%	55.0%	48.2%	
	Very easy	n (%)	6 (50.0%)	6 (50.0%)	12	
		% column	8.6%	15.0%	10.9%	
Total	n (%)	70 (63.6%)	40 (36.4%)	110		
	% column	100.0%	100.0%	100.0%		

Test Chi-Square of Independence; (Significant Correlation when  $p \leq 0.05$ )

## VI. DISCUSSION AND CRITICAL ANALYSIS

Between 2020 and 2021, the General Health Direction (GHD) carried out an assessment of the Health Literacy of the Portuguese population, those over 16 years of age, and the "Health Literacy Survey" document referring to the data obtained was published. In this GHD assessment, it was found that there was a greater proportion of Portuguese with high levels of literacy, corresponding to the "Sufficient" or "Excellent" level, than with low levels, that is, "Problematic" or "Inadequate" level, having the majority (65%) obtained a "Sufficient" rating.

In contrast, in the sample of the present study, it was found that the majority (58.5%) had a "Problematic"

level of HL, considered low. It should also be noted that in the aforementioned document only 7.5% presented the lowest level of health literacy ("Inadequate"), while in this study this level was presented by 12.3%. This divergence in results may be justified by the fact that the present study included mostly elderly people, one of the most vulnerable age groups with regard to HL knowledge and with a greater probability of obtaining a classification of "Inadequate" or "Problematic" in the HL level, as demonstrated in two studies by *Espanha et al.* (8.23). Even so, the percentage of low levels of health literacy obtained in the present study was 70.8%, lower than that obtained by *Araújo, et al.* in the study carried out in 2018, 80%(24).

Also in the "Health Literacy Survey", HL levels were analyzed considering sociodemographic data, namely Gender, Age and Education. No association was found with Gender, however, it was found that LS levels were associated with Age and Education, with an increase in low LS levels being revealed as the age group increased and education decreased.(1). Also *Spain et al.*, *Araújo et al.* and *Luís L.* demonstrated that higher levels of education and younger age groups were associated with higher levels of LS(8.23–25). On the contrary, in the present study, no significant associations were found between the LS variable and the factors Gender, Age and Educational Qualifications. Even so, in relation to Literary Qualifications, it was observed that the least predominant classification was "Excellent" at all levels of education except for those with Higher Education, whose lowest prevalence of classification was the "Inadequate" level, which seems to be in line with according to the results of the aforementioned study.

Regarding the analysis of Adherence to MD, in the present study, the majority of participants reveal that they have a "Low Adherence" to MD, this percentage being 62.3%, which is in line with the results of *Spinelli's* study, carried out on the population elderly woman from the Algarve region, in which a percentage of "Low Adherence" to MD was also demonstrated (71%) higher than that of "High Adherence"(20). The same can be seen when comparing with the "Mediterranean Food Pattern Adherence Study", carried out by the GHD for the Portuguese population over 16 years old, in 2020, in which the "Low Adherence" rate is stood at 74% (17). According to the study by *Zaragoza Martí et al.*, carried out in a senior population in Spain in 2015, the percentage of "Low Adherence" to MD was 51.7%, demonstrating better adherence compared to current values, which may mean temporal evolution or cultural variation (26).

The GHD study also concluded that age appears to influence adherence to the Mediterranean Dietary Pattern (MDP), with the elderly age group having the lowest percentage of adherence, at just 19%, compared to 33% in the 16 to 34 age group. In this study, the percentage of individuals adhering to the MDP was higher, around 37.7%, which may be related to the fact that the sample included in this study was inserted in a very specific context (17).

Regarding the relationship between Adherence to MD and Gender, in the study by *Zaragoza Martí et al.*, no significant differences were identified between different genders, similar to the present study.(26). In *Spinelli's* study, the percentage of "Low Adherence" was focused on the Female gender, contrasting with the data from the "Study of Adherence to the Mediterranean Diet", in which men presented the lowest percentage of "High Adherence" (17.20).

According to *Gregório et al.*, it was concluded that individuals with higher education had better levels of adherence to MD, since the percentage of "High Adherence" was 11% higher in individuals with "more than the 12th grade"(17). Also in *Spinelli's* study, lower adherence was found among respondents with lower levels of education.(20). In the present study, there are no significant differences, although it was found that the highest prevalence of "low adherence" occurred at the lowest level of education (basic education), contrasting with the highest percentage of "high adherence", obtained at the highest level. of Qualifications (Higher Education), which seems to be in line with what is described in the literature.

Similar to what was found in the study carried out in the Algarve, despite the fact that a large proportion of respondents showed low adherence to MD, the responses obtained in PREDIMED were relatively satisfactory (20). The entire sample in the present study reported using olive oil as their main fat, in line with the literature that reports percentages in the order of 90%, and the majority complies with the recommendations regarding the consumption of vegetables, fruit and legumes (20.26). Despite the primacy of olive oil for culinary uses, the majority of respondents responded that they consume less than 4 tablespoons per day, which may be indicative of difficulties in controlling food portions. Additionally, the majority of the population does not measure the exact amount of fat they use, and it is likely that their perception of the amounts used is not correct.

When comparing the results obtained with the recommendations for fruit and vegetable intake, it is possible to state that the percentage of adequacy was higher in this study compared to the GHD study. While, in the general population, a percentage of 39% of adequate fruit consumption was found, in the population of Senior Universities, the value rises to 59.4%. The same occurred in the case of vegetables, with an even greater discrepancy in values (17). These results may be a reflection of the fact that most of the participants in this study live in rural areas and have their own crops.

Regarding the adequate consumption of fish and seafood, it was found to be complied with by 66% of the sample in this study, slightly below the 74% obtained in the study carried out in the elderly population of the Algarve (20). These results may be inherent to the difference in accessibility of these foods in coastal and inland areas. *Spinelli* also demonstrated, in 93% of respondents, a preference for white meat over red meat, a value higher than that obtained in the present study (70%) (20).

In relation to sugary foods, there was a preference for the consumption of sweet desserts, cookies and cakes compared to the consumption of soft drinks, which may be related to the fact that soft drinks gained a greater impact on the market after the





existence of other products. It was also found that of the individuals with an “excellent” HL level, none reported an inadequate consumption of soft drinks and desserts, sweets, cookies and cakes. These data seem to be in line with those found in the systematic review by *Alessandra Buja et al.*, in which it was found that three studies associated higher HL levels with lower sugar consumption (27).

Regarding understanding the information contained on food packaging, despite there being no direct relationship with adherence to the MD, it was observed that individuals with high adherence classify this task less often as “very difficult” or “difficult”. Even so, 40.9% of the sample revealed difficulties, a figure that could be higher in reality, as it was not determined whether the interpretation of each piece of information would be correct.

Still regarding the relationship between adherence to the MDP and the level of HL, it should be noted that, despite being independent of the “HLS classification” factor, there was a trend in the results, since the highest percentage of “low adherence” was associated with the lowest level of literacy. These results seem to indicate that, by increasing the levels of HL, the levels of adherence to the MDP would also increase, thus deducing the relevance of training interventions in this area, since it has already been demonstrated by *Kazuki Uemura et al.* that constant learning in the senior population promotes the improvement of HL and eating habits.(28).

## VII. STUDY LIMITATIONS

With the development of the investigation, several limitations emerged that influenced the collection of data as well as the results, and must be taken into consideration when interpreting the data presented. One of the limitations was the sample size, as there was low student adherence, which resulted in a reduced number of participants compared to expected, not being enough to obtain conclusions similar to those obtained if the entire target population participated. Therefore, it is not possible to extrapolate this data to the generality, as this data constitutes only a characterization of the reality of the participating students.

Another limitation is the ability to understand and correctly interpret the questionnaires applied, which may have been distorted in some cases, especially in the online version of the questionnaires. In future studies, we propose the evaluation of other variables that could influence adherence to the Mediterranean dietary pattern, such as family income, household size, marital status, among others.

## VIII. CONCLUSION

It can be concluded that the results obtained in this study were not statistically significant, which can be

explained, in general, by the fact that both the level of Health Literacy and Adherence to the MDP constitute variables influenced by several factors, which can be complex interconnect them in a “cause-effect” relationship. Even so, it was possible to verify that the sample, in general, had lower than desirable levels of Health Literacy, as well as low adherence to the MDP. These results may constitute a vulnerability for the health status of the individuals surveyed, since low HL translates into insufficient knowledge and skills to prevent disease and improve health status, thus influencing food choices.

There is a clear need for more health education programs, designed to respond to the specificities of each population and age group, in order to fill the gaps previously described. As eating habits are decisive for a good state of health, the Nutritionist plays an important role in promoting their improvement and adequacy. This type of interventions plays a beneficial role at the individual level, but also in a comprehensive way, for the general population, since populations with higher levels of HL are associated with better health states and, consequently, less impact on this resources. sector in question.

The measurement of the levels of the variables mentioned above must be carried out regularly, as they undergo constant changes and, in this sense, this study could contribute to the knowledge of the “state of play” in this population, functioning as a starting point for possible training interventions on topics specific, adapted to the needs of the population studied.

It is also concluded that it would be beneficial to carry out more studies in this area, with greater methodological robustness, particularly at national level, with a larger and more heterogeneous sample, with the aim of keeping this topic in the focus of political decision-makers as a priority action.

### List of Abbreviations

ECPIC - Ethics Committee of the Polytechnic Institute of Coimbra;

GHD - General Health Direction;

MD - Mediterranean Diet

MDP - Mediterranean Dietary Pattern;

HLS-EU-PT47 - Health Literacy Scale-European-Portugal 47 questions;

M-POHL - Measuring Population and Organizational Health Literacy;

FL - Food Literacy;

HL - Health Literacy;

NSU - Network of Senior Universities;

UNESCO - United Nations Educational, Scientific and Cultural Organization;

SU - Senior Universities;  
WHO - World Health Organization.

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## About the Fundamental Standards of Nutrition, Food Security and Food Sovereignty

By Mamuka Matsaberidze

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**Abstract-** Today, an estimated one billion people are hungry and undernourished, with detrimental effects on the growth and learning abilities of children and on the ability of adults to lead fully productive lives. Most of these people are in parts of the world where the food available to them is often contaminated or adulterated, increasing the risk of foodborne illness and pandemic gastrointestinal illnesses. Today's reality highlights the existential need for developing countries to improve food safety and quality measures and the challenges associated with meeting these needs. This review article addresses the need to improve food quality and safety systems in developing countries in the context of food security, public health and international trade, and provides evidence and tools to address these challenges using new approaches to capacity building and providing technical assistance on food and nutrition technologies.

**Keywords:** "malnutrition", "starvation", kwashiorkor, convention on the elimination of all forms of discrimination against women, the right to food guidelines, berlin declaration on open access to knowledge in the sciences and humanities, UFWH, GODAN, PUSH, ferruccio ritossa, stress proteins, pyroptosis, GS1, HACCP.

**GJMR-L Classification:** LCC Code: TX359, TX531, WB 400, WA 695



*Strictly as per the compliance and regulations of:*



# About the Fundamental Standards of Nutrition, Food Security and Food Sovereignty

Mamuka Matsaberidze

**Abstract-** Today, an estimated one billion people are hungry and undernourished, with detrimental effects on the growth and learning abilities of children and on the ability of adults to lead fully productive lives. Most of these people are in parts of the world where the food available to them is often contaminated or adulterated, increasing the risk of foodborne illness and pandemic gastrointestinal illnesses. Today's reality highlights the existential need for developing countries to improve food safety and quality measures and the challenges associated with meeting these needs. This review article addresses the need to improve food quality and safety systems in developing countries in the context of food security, public health and international trade, and provides evidence and tools to address these challenges using new approaches to capacity building and providing technical assistance on food and nutrition technologies.

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## 1. TO MEET THE NEEDS OF DEVELOPING COUNTRIES, IT IS NECESSARY TO COMBINE THE COGNITIVE RESOURCES OF THE ACADEMIC ENVIRONMENT

To define hunger among the population in the works of FAO, there is a division into the concepts of "hunger" and "malnutrition". The first is a chronic lack of calories in food, the second is the lack of any important nutritional elements - proteins and vitamins.

The term "malnutrition" (or, should be understood as the insufficiency of both general caloric and specific protein. This is due not to the severity of the consequences of both types of malnutrition for the human body (since the consequences of a lack of vitamins can be no less dangerous to health), but the causes and extent of their spread.

The quantitative criterion in the latter case turns into a qualitative one - the lack of both calories and proteins is a social problem, the solution of which requires significant changes in the entire socioeconomic

structure of the region where the population suffers from calorie or protein deficiency.

Lack of protein in food can cause severe dystrophy in children – *kwashiorkor* [1]. The occurrence of serious diseases (dysentery, food poisoning and etc.) is associated with nutrition. *Kwashiorkor* is a disease marked by severe protein malnutrition and bilateral extremity swelling. It usually affects infants and children, most often around the age of weaning through age 5.

The disease is seen in very severe cases of starvation and poverty-stricken regions worldwide. In the 1950s, it was recognized as a public health crisis by the World Health Organization.

However, there was a delay in its recognition, because most cases of childhood death were reported as being from diseases of the digestive system or infectious etiology.

Since then, various relief efforts were aimed at eradicating it. As scientists continued to investigate the natural history of the disease in children, they discovered something very striking.

Children who were dying from "digestive system diseases" and presenting with diarrhea, cough, coryza, and shortness of breath also were having symptoms of *kwashiorkor* during this time (pitting edema, anorexia, skin changes, etc.).

This finding led to the medical conundrum of whether *kwashiorkor* was the primary or the secondary cause of death. It was concluded to be the secondary cause of death because many cases of the disease would not have developed without the precipitating stress of diarrhea, dehydration, and other infectious diseases such as HIV and measles.

While *kwashiorkor* is a disease of edematous malnutrition, marasmus is similar in appearance. Marasmus is known also known as a wasting syndrome (malnutrition without edema). Children typically have a depletion of body fat stores, low weight for height, and reduced mid-upper arm circumference.

Other features of the disease can include thin, dry skin; a head that appears large relative to the body; an emaciated, weak appearance; bradycardia; hypotension; hypothermia; and thin, shrunken arms, thighs, and buttocks with redundant skin folds [1].

This problem reviews the evaluation and treatment of patients with *kwashiorkor* and highlights the

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role of the interprofessional medical and biological team in successfully managing this condition.

The diseases associated with protein-energy malnutrition include: cachexia, kwashiorkor and insanity. The most vulnerable group of the population in relation to the lack of protein is children, especially during breastfeeding and the first years of life - from 6 months to 4 years.

The disease of children, which developed as a result of protein deficiency - *kwashiorkor*. It is characterized by a slowdown in the growth and development of the child, a change in the color of the skin and hair, depigmentation, a change in the state of the mucous membranes, a deterioration in the functions of many systems, especially the digestive system.

In severe cases, edema and mental disorders are observed. In addition to children, pregnant women and nursing mothers suffer the most from hunger.

Protein deficiency occurs more often with a general lack of food, is accompanied by "hungry edema" and is characterized as alimentary dystrophy.

Having many children under conditions of malnutrition worsens the health of both mother and children. In cases where between two consecutive births of one mother passes less than two years, infant mortality doubles on average.

According to experts, the shortage of protein foods is most acute in the world food shortage. The situation is better with the production of carbohydrates and fats.

Today, the deficit of food protein is from 10 to 15 million tons per year. By 2050, it will reach 30 million tons. And already now, about half of the world's population suffers from protein deficiency, and this affects the health of generations and their mental development.

70% of all agricultural land in the world has already been given over to animal husbandry, and in general, 30% of all land has been developed for agricultural land in the world.

In other words, further expansion is no longer possible on a significant scale.

The right to food is an inclusive right. It's not just a right to a minimum intake of calories, protein, and other specific nutrients. It is the right to all the nutrients a person needs for a healthy and active life, as well as the means of accessing them.

The right to food can be described [2] as follows: The right to adequate food is realized when every human being, man, woman and child, alone or in community with others, at all times has the physical and economic means to access adequate food or has the means to do so receipt.

Sufficiency means that nutrition should meet nutritional needs, taking into account age, living conditions, health status, professional responsibilities,

gender, etc. person. For example, if children's nutrition does not contain the nutrients necessary for their physical and mental development, it is not sufficient.

Another example of malnutrition would be the consumption of energy-intensive and low-nutrient foods, which can contribute to obesity and other diseases.

Food intended for human consumption must be safe and free from harmful substances, in particular contaminants arising from industrial or agricultural production, including pesticides, hormones or veterinary drugs.

Adequate nutrition must also be culturally appropriate. For example, food aid that contains food that is religiously or culturally prohibited among recipients, or food that is inconsistent with their eating habits, will not be culturally acceptable.

Many people think that the right to food means that governments have an obligation to distribute free food to anyone who needs it.

They conclude that this would be impractical or could lead to dependency. This opinion is wrong.

The right to food is not a right to be fed, but primarily a right to self-sufficiency in a dignified manner. In other words, people are supposed to satisfy their own needs through their own efforts and using their own resources.

In order to be able to do this, a person must live in conditions that allow him to either produce food or buy it. Man needs land, seeds, water and other resources to produce his own food, and money and market access are needed to buy food.

The right to food obliges states to provide an enabling environment in which people can use their full potential to produce or purchase foods that enable them to provide themselves and their families with adequate nutrition.

However, if people are not able to feed themselves using their own means, for example, because of an armed conflict, a natural disaster, or while in prison, then the state itself must provide them with food.

The denial of the right to food does not stem from the lack of food in the world. It can be imagined that people face a denial of their right to food because there is not enough food to satisfy everyone. However, according to the FAO, the world produces enough food to feed the entire population of the planet [3].

The root cause of hunger and malnutrition is not lack of food, but lack of access to available food.

For example, people's access to food is hindered by poverty, social exclusion and discrimination not only in developing countries but also in some of the most economically developed countries where food is plentiful.

However, given factors such as population growth, the impact of possible climate change and

limited natural resources, governments must also make efforts in the long term to develop sustainable food production to ensure the availability of food for future generations.

The right to food is distinct from food security and food sovereignty. These three concepts, while somewhat overlapping, are nevertheless different. According to the FAO, food security exists “when all people, at all times, have physical, social and economic access to sufficient, safe and nutritious food that meets their dietary needs and food preferences and promotes an active and healthy life” [3].

This is a precondition for the full enjoyment of the right to food. However, the concept of food security as such is not in itself a legal concept and does not impose obligations on stakeholders, nor does it empower them.

Food sovereignty is an emerging concept whereby peoples determine their own food policies and patterns of food production (particularly agriculture and fisheries), determine the extent to which they want to be self-sufficient, and protect domestic food production and regulate trade in order to fulfillment of sustainable development objectives.

The concept of food sovereignty is proposed as a concept to promote an alternative agricultural model, trade policy and practice that works in the interests of people's rights to food and safe, healthy and environmentally sustainable food production. The right to food sovereignty is enshrined in a number of national laws [4].

However, there is currently no international consensus on this concept. The right to food is a human right recognized in international law that entitles individuals to have access to adequate food and the resources necessary for the sustainable enjoyment of food security.

The right to food places legal obligations on States to overcome hunger and malnutrition and to realize food security for all. The right to food also covers the cross-border obligations of states, including those related to trade.

For example, the International Covenant on Economic, Social and Cultural Rights places an obligation on States parties to take the necessary measures to ensure that the world's food supply is equitably distributed [5] in accordance with needs (art. 11, para. 2 b).

While it does not prescribe any particular model for achieving such distribution, it does oblige States to ensure that their trade and other policies serve this purpose.

The right to food is also recognized in other international conventions for the protection of specific groups, such as the Convention on the Elimination of All Forms of Discrimination against Women [6] (1979), the

Convention on the Rights of the Child [7] (1989) and the Convention on the Rights of Persons with Disabilities [8] (2006).

The right to food is also enshrined in some regional treaties, notably the Additional Protocol to the American Convention on Human Rights in the Area of Economic, Social and Cultural Rights, known as the San Salvador Protocol [9] (1988), the African Charter on the Rights and Welfare of the Child [10] (1990, 2003) and the Protocol to the African Charter on Human and Peoples' Rights on the Rights of Women in Africa [11] (2003).

Recognition of the right to food is also implied in the context of the realization of other rights. As interpreted by the African Commission on Human and Peoples' Rights, the right to food is implicitly protected by the African Charter on Human and Peoples' Rights [12] (1981) in the provisions relating to the right to life, the right to health and the right to economic, social and cultural development.

According to the Human Rights Committee, which oversees the implementation of the International Covenant on Civil and Political Rights (1966), the protection of the right to life requires states to take positive measures, in particular measures to eliminate malnutrition [13]. The Committee against Torture, which oversees the implementation of the Convention against Torture and Other Cruel, Inhuman or Degrading Treatment or Punishment (1984), has noted that the lack of adequate food in prisons can amount to inhuman and degrading treatment [14].

International humanitarian law also provides for the protection of civilians' and prisoners of war's access to food and water in times of armed conflict [15] and the prohibition of the deliberate use of civilian starvation as a method of warfare [16].

Under international criminal law, violations of these protections constitute war crimes. The deliberate creation of a famine, whether in wartime or in peacetime, can also qualify as genocide [17] or a crime against humanity [18].

A number of non-legally binding international human rights instruments, including recommendations, guidelines, resolutions or declarations, are also relevant to the right to food [19]. They are also called legal documents of a recommendatory nature.

They are adopted by States and used to guide the realization of the right to food [20].

One such legal instrument of a non-binding nature, which is also the most explicit and detailed, is the Voluntary Guidelines to Support the Progressive Realization of the Right to Adequate Food in the Context of National Food Security (hereinafter referred to as the Right to Food Guidelines).

The Right to Food Guidelines [21] were adopted by consensus by the FAO Council in November

2004. They are a practical tool to help realize the right to adequate food. While they are not legally binding in and of themselves, their purpose is to reflect existing human rights standards and provide useful guidance to States on how they can implement their existing obligations.

They cover the full range of measures that governments should consider at the national level in order to create an enabling environment for people to feed themselves in a decent manner and to create appropriate safety nets for those who are unable to do so, as well as measures to hold governments accountable before the copyright holders.

The Right to Food Guidelines are intended for both States parties to the International Covenant on Economic, Social and Cultural Rights and non-parties, and for both developing and developed countries.

States are encouraged to use the Right to Food Guiding Principles when developing their national strategies and programs to combat hunger and malnutrition.

The Right to Food Guidelines also provide for the involvement of non-governmental organizations (NGOs), civil society organizations and the private sector in promoting and strengthening the progressive realization of the right to adequate food.

The vast majority of people suffering from hunger and malnutrition live in rural areas in destitute and marginalized conditions, struggling to survive. About 50% of the people suffering from hunger are smallholders and 20% landless villagers [22]. Another 10% live off cattle breeding, fishing and forest management. The remaining 20% live in urban areas [23].

The rural poor often have limited access to sufficient productive resources, such as land, water, fertilizers and seeds, as well as markets, information and technology.

Very often, lack of access to land and other productive resources can lead to the denial of the right to food, as most individuals and households in rural areas depend on such resources either to produce food for their own consumption or as a source of income to buy the food they need. For example, denial of access to land may occur in the context of unfair competition for land from large agribusinesses, extractive industries or development projects.

With such competition, the rural poor are often at a severe disadvantage as a result of discrimination and violations of various human rights, including exclusion from decision-making and from access to justice. Sometimes the denial of access to land takes the form of forced evictions.

Even where they are able to produce agricultural products, lack of access to markets may prevent them from selling their produce and purchasing other food items needed for an adequate diet.

Lack of access to education, including vocational training, and to information and technology may also prevent them from improving productivity and protecting the environment or gaining knowledge about nutrition.

Landless workers, such as harvesters and agricultural workers, face denial of their right to food when they cannot afford adequate food and other basic needs due to excessively low wages. They also cannot enjoy the freedom of association needed to negotiate job security and decent wages.

Few countries have social security systems that work particularly well in rural areas. During times of economic hardship, rural poor people can face food insecurity. People living in poverty in urban areas are also highly vulnerable to violations of the right to food. Most of them provide themselves with food by buying food.

Therefore, paid work, including self-employment, is very important. When they find it difficult to find work, or when they receive meager wages that prevent them from purchasing food and other basic needs, such as health care, education and housing, this can undermine their right to food, as they have no other means to get food. For the self-employed, their access to food can also be negatively affected by discrimination in access to economic resources, such as credit, or access to market places.

When food is too expensive or their income too low, they may compensate by reducing the quality and quantity of food they eat, for example by choosing cheaper but less nutritious or less safe foods. In such cases, they cannot be considered to enjoy the right to food because the food they consume is insufficient.

Failures in the functioning of welfare programs or other safety nets, as well as their complete absence, further undermine the enjoyment of the right to food for those who have lost the means to provide for it themselves. As in rural areas, for people living in urban poverty, the inability to feed themselves is often attributed to social exclusion, in particular exclusion from education and training opportunities, access to information, decision-making in public affairs and from access to justice.

There is often a link between violations of the right to food in rural and urban areas. Hunger and malnutrition in rural areas are forcing people to move to urban areas in search of better living conditions. However, the right to food is often not realized in urban areas either.

The affected population may not be trained for employment in the jobs available in urban areas. Social protection schemes, even when they exist, may not be available to those who do not have proper documentation, such as residence registration, or who work in the informal economy.

According to the International Covenant on Economic, Social and Cultural Rights, States parties to it must take measures, including specific programs, to improve the methods of production, storage and distribution of food through the widespread use of technical and scientific knowledge, the dissemination of knowledge of the principles of nutrition and improving or reforming agricultural systems in such a way as to achieve the most efficient development and use of natural resources (Article 11).

The FAO Right to Food Guidelines provide detailed guidance on ensuring sustainable, nondiscriminatory and secure access to resources and assets, including labor, land, water, genetic resources for food and agriculture, services, etc. (guiding principle 8).

In order to guarantee the right to food to the poor in rural and urban areas, it is also necessary to ensure the realization of other human rights, such as freedom from forced eviction, the right to take part in public affairs and participate in rural development, freedom of association, the right to enjoy the benefits of scientific progress and its achievements, the right to work and other labor rights, the right to education and information, and the right to social security.

And the other hand, can the open data save the world from hunger? GODAN [24] is a British non-profit organization dedicated to the dissemination of open data. With the aim of making information about agriculture and food available, as the organization believes it helps to ensure food security in the world.

What is open data? Open data is data that is available to anyone for free use and re-publication without restrictions of copyright, patents or any other control mechanisms. *Open Data* can only be practical when it is shared in a way that people can understand. They need to be distributed in a standardized format and easily traceable to where the data was collected. Created in support of Open Data, GODAN's latest report is titled "Open Access and Open Data in PUSH Universities". PUSH<sup>1</sup> is an American organization known as Presidents United to Solve Hunger. GODAN<sup>2</sup> notes

<sup>1</sup> *Push Universities*: The sharing of research findings, as well as other data, is believed to increase the pace of innovation, research breakthroughs, and collaborative problem-solving. Often, however, these data are not readily available, visible, or accessible, resulting in needlessly duplicated research or critical gaps in information. This has led many public research funders (e.g., NSF, NIH & USAID), as well as private donors, to require public universities and other higher education institutions to develop or enhance data management plans that allow for open access and data sharing. While creating a culture with policies and infrastructure platforms that allows for open access and open data is a challenge, it is a challenge that is becoming increasingly necessary for universities to address [http://wp.auburn.edu/push/?page\\_id=1087](http://wp.auburn.edu/push/?page_id=1087).

<sup>2</sup> The Global Open Data for Agriculture and Nutrition (Godan) initiative seeks to support global efforts to make agricultural and nutritionally

that they currently have over 700 partners working with them, including national governments, non-governmental organizations, international organizations and the private sector.

Open Data has proven to be one of the most important tools for disseminating scientific knowledge, spurring collaboration and creating innovation around the world. If we want to see progress towards global food security, then we must think about innovation.

As leaders in the creation and storage of knowledge and data, universities are natural partners in this global effort. Land-grant universities, many of which are part of PUSH, are already sharing their knowledge and best practices in agriculture and nutrition. PUSH and UFWH<sup>3</sup> - Universities Fighting World Hunger, want to help highlight the importance of open data as a resource for ending world hunger. By engaging universities and students in the collection and analysis of Open Data, PUSH and UFWH encourage both scientists and future leaders to find innovative ways to fight hunger on a global scale. UFWH is a growing global network of universities working in partnership to amplify the voice of the rising generation - a voice calling for a world free of hunger and malnutrition.

With widespread hunger, malnutrition and climate uncertainty around the world, university research [25] is essential to addressing some of the world's most pressing problems.

In a dynamic and diverse field such as agriculture and nutrition, effective data-driven solutions can help ensure sustainable livelihoods and drive progress towards the Sustainable Development Goal of Zero Hunger.

Researchers collect, analyze and reuse data, and the new knowledge they create helps make important decisions. governments and industry, while university librarians organize and curate data in large repositories [26].

Unfortunately, much of this data has been lost or locked up in closed vaults kept within university walls. If all the universities in the world developed an open data policy and published their data, much more effective decisions could be made. PUSH can pave the way. Its 99 universities whose presidents have pledged to unite in this endeavor.

The global fight against malnutrition and hunger has a unique opportunity to show by example, to demonstrate that it really saves lives and can improve the well-being of every person around the world. On the other hand, open access (OA) to information is free (for

relevant data available, accessible, and usable for unrestricted use worldwide.

<sup>3</sup> UFWH is a growing, global network of universities working in partnership to amplify the voice of the rising generation - a voice calling for a world free from hunger and malnutrition. <http://wp.auburn.edu/ufrwh/>



users), fast, permanent, full-text access in real time to scientific and educational materials, implemented for any user in the global information network, carried out mainly to research peer-reviewed journals.

The Internet has fundamentally changed the practical and economic conditions for the dissemination of scientific knowledge and cultural heritage. The Internet has provided a first-of-its kind opportunity for a comprehensive and interactive presentation of human knowledge, including cultural heritage, with guaranteed access to it from anywhere in the world.

For example, the Berlin Declaration, the purpose of which is to support the development of the Internet as a functional tool for the global dissemination of scientific knowledge and human reflection, as well as to formulate the necessary measures that will be considered by policy decision-makers, research organizations, support and development funds, libraries, archives and museums. The Berlin Declaration on Open Access to Scientific and Humanitarian Knowledge<sup>4</sup> [27] whose mission of dissemination of knowledge will only be partially fulfilled if information is not available to society in a simple and universal form. Continuing the development of traditional methods, the development of new opportunities for the dissemination of knowledge via the Internet on the principle of open access (the Open Access paradigm) should be increasingly promoted.

Open Access is defined as a comprehensive source of universal knowledge and cultural heritage recognized by the scientific community. To realize the idea of a comprehensive and public presentation of knowledge, the Internet of the future must be characterized by such properties as stability, interactivity and transparency. Information and software should be freely available and have a high degree of interoperability.

Open access as a desired method ideally involves the active participation of every copyright holder in the field of scientific publications and every manager of cultural heritage. Publications that comply with the Open Access principle cover original research results, source data and metadata, source materials, digital versions of photographic materials and graphics, as well as other scientific works in multimedia form.

<sup>4</sup> Berlin Declaration on Open Access to Knowledge in the Sciences and Humanities, with mission of disseminating knowledge is only half complete if the information is not made widely and readily available to society. New possibilities of knowledge dissemination not only through the classical form but also and increasingly through the open access paradigm via the Internet have to be supported. We define open access as a comprehensive source of human knowledge and cultural heritage that has been approved by the scientific community. In order to realize the vision of a global and accessible representation of knowledge, the future Web has to be sustainable, interactive, and transparent.

## II. COMPLEX PROBLEM OF PROTEIN DEFICIENCY FOR HUMANITY

In the 21st century, the problem of protein deficiency nutrition for the global community continues to be existential. There is a tendency towards a decrease in the quality indicator of total protein, due to a quantitative decrease in animal proteins in the diet.

Based on an assessment of the amino acid composition, its adjustment taking into account the principles of mutual enrichment with the most rational ratio of nutrients, it is possible to create products whose biological value would approach the requirements of an ideal protein.

Correcting the qualitative inferiority of the protein component of food products is one of the main tasks in the meat processing industry, which is only possible by attracting the gold reserve of products of plant origin.

Of the nutrients necessary to meet human vital needs, the most valuable are proteins. The indispensability of their functions and the absence of mechanisms for the synthesis of a number of protein substances in the body clearly pose the problem of adequate protein nutrition to ensure human health and normal functioning.

The living and working conditions of modern man continue to place new demands on food: the need for fats decreases, and the need for protein increases. According to FAO/WHO, the norm of its consumption for humans is 90–100 g per day, including 60–70% protein of animal origin.

Proteins constitute the most expensive and scarce component of food rations, and therefore the desire to justify acceptable and realistic ways of direct use in nutrition of that part is quite obvious. Protein, which until recently was a food deficit and was utilized with low efficiency in animal husbandry.

Over the past years, the search for new sources of proteins, the development of technologies for protein preparations and the substantiation of ways of their rational use were implemented in a number of directions; for example, we can cite the industry of stress proteins production with their functional features.

Slowing down and eliminating the trends of an ever-increasing gap between the demand and production of protein with the subsequent elimination of its deficiency is most realistically achieved in two ways - the intensification of traditional methods of production of protein-containing products and the utilization of new proteins for food purposes as an additional source of increasing the stock of food protein.

One of the richest sources of protein is vegetable raw materials. A large number of proteins of plant origin and relatively low production costs make it



possible to significantly compensate for the protein deficiency in human nutrition.

In the global food balance, plant proteins account for about 80%, and animal proteins for about 20% [28]. Plant sources are characterized by high protein content, low fat content, compared with animals, plant proteins have fewer sulfur-containing amino acids.

To obtain 1 kg of vegetable protein with intensive agricultural production consumes approximately 11 thousand kcal of fuel energy, per 1 kg of animal more than 75 thousand kcal. In livestock farming, unit labor costs are also 16 times higher: 53 kg per person hour, vegetable protein and only 3.2 kg of animal protein.

For economic reasons and promising functionality to solve the shortage problem to obtain complete dietary protein, it is necessary to use the entire variety of plants: oilseeds, legumes, grains, vegetables, vegetative organs of wild and cultivated plants.

### III. STRESS PROTEINS FROM PLANTS

The study of the reaction of the protein synthesizing system to stress in various living organisms has revealed the universality and conservatism of this phenomenon. Changes in the functioning of the genetic system are very similar among different eukaryotes, and in some cases have been identified in prokaryotes. Conservatism in the response of the protein synthesizing system of living organisms to stress clearly indicates that the biosynthesis of stress proteins is a fundamental and vital process that contributes to the adaptation and survival of organisms in extreme conditions.

The term "stress" (English stress - pressure, tension) was introduced into biological science by G. Selye in 1936 to characterize a similar reaction that occurs in the body under the influence of various stimuli. The state in which the body finds itself during such circumstances, is considered stressful and lasts from the beginning to the end of the stressor. Stressors include strong short-term exposure to environmental factors environments causing changes in sequence stages and reactions ending either in the adaptation of the living system to the damaging effects, or in the depletion of the reserve forces of the organism and its death.

As a rule, adaptive changes metabolic processes are the driving force evolution of organisms and the basis of survival in the environment. To understand the adaptation mechanisms of living organisms to unfavorable influences, responses at various hierarchical levels are studied levels, ranging from population to molecular. Particular attention is paid to studying features of protein biosynthesis under stress conditions.

The first information about reversible changes in protein system of living cells under the influence of high temperatures (up to 45 °C) appeared in the 60s XX-century Italian researcher Ferruccio Ritossa<sup>5</sup> discovered that under the influence of a temperature of 37 °C, giant puffs of *Drosophila* chromosomes.

It was later found that this phenomenon is associated with the de novo synthesis of a specific group of proteins, which are called "heat shock proteins" (HSPs). Today's synthesis HSPs in response to heat stress have been identified in a wide range of organisms - from bacteria to humans.

As a result of research carried out in a number of laboratories around the world, the spectrum of HSPs of various higher plants, in particular soybeans, corn, tobacco, carrots, lilies, cotton, etc., has been studied in detail. The synthesis of HSPs begins within 15 minutes after the action of a heat shock and lasts 6–8 hours.

Maximum synthesis of HSP occurs during the first 2.5 hours. As a result of heat shock, high and low molecular weight proteins are formed. Most HSPs synthesized in plants, unlike other living organisms, belong to the category of low molecular weight (molecular weight 15–18 kDa - kilodalton). High-molecular-weight plant HSPs are less diverse in compared to HSPs from insects, mammals and yeast. The process of HSP biosynthesis involves the nuclear and cytoplasmic genetic systems, while the proteins themselves are localized primarily in the cytoplasm, forming heat shock granules.

Heat shock granules allow the plant to maintain mRNAs necessary for rapid transition to repair processes. The formation of HSPs is preceded by de novo synthesis of heat shock mRNA, which occurs in the first 3–5 minutes of stress exposure and lasts from 1 to 4 hours, after which it gradually decreases [29].

Stress proteins (SPs) are a diverse group of proteins that are synthesized at increased levels when cells are exposed to either intracellular or extracellular stressful stimuli. They exhibit protective effects against stresses. Stress proteins include heat shock proteins (HSPs), RNA chaperone protein (RNPs), and proteins mainly function in the endoplasmic reticulum (ER): peptidyl-propyl isomerases, protein disulfide isomerases (PDIs) and the lectin-binding chaperone system.

SPs are ubiquitously expressed in all kind of cells, triggering signal cascades for neutralizing and eradicating the stresses occurring both intracellularly (e.g., pathogen invasion) and extracellularly (e.g., starvation, stimulation by cytokines/chemokines or hormones).

<sup>5</sup> Ferruccio Ritossa (February 25, 1936 – January 9, 2014) was an Italian geneticist best known for his discovery of the heat shock response in the model organism *Drosophila* (fruit flies) - [https://en.wikipedia.org/wiki/Ferruccio\\_Ritossa](https://en.wikipedia.org/wiki/Ferruccio_Ritossa).

Responses triggered by SPs can either activate pathways to promote cell survival or initiate cell death (i.e., apoptosis, necrosis, pyroptosis<sup>6</sup> or autophagic cell death) for eliminating the damaged cells to protect a particular organ/tissue under given conditions.

It is widely noted that the dysregulation of stress proteins is associated with a variety of human diseases, including cardiovascular diseases, neurodegenerative diseases (e.g., Parkinson's diseases, Alzheimer disease), stroke, human cancers and infectious diseases.

As SPs also attract a great interest as potential antiviral targets (e.g., COVID-19), interesting the present progress and challenges in this area of HSP-based drug development, as well as with compounds already under clinical evaluation [30].

Interest in the heat shock proteins (HSPs), as a natural physiological toolkit of living organisms, has ranged from their chaperone function in nascent proteins to the remedial role following cell stress.

As part of the defense system, HSPs guarantee cell tolerance against a variety of stressors, including exercise, oxidative stress, hyper and hypothermia, hyper and hypoxia and improper diets.

For the past couple of decades, research on functional foods has revealed a number of substances likely to trigger cell protection through mechanisms that involve the induction of HSP expression.

Summarized the occurrence of the most easily inducible HSPs and describe the effects of dietary proteins, peptides, amino acids, probiotics, high-fat diets and other food-derived substances reported to induce HSP response in animals and humans' studies [31].

The authors [32] of an extensive scientific review came to interesting conclusions regarding the function of stress proteins: Heat shock proteins (HSPs) encompass both extrinsic chaperones and stress proteins. These proteins, with molecular weights ranging from 14 to 120 kDa, are conserved across all living organisms and are expressed in response to stress.

The upregulation of specific genes triggers the synthesis of HSPs, facilitated by the interaction between heat shock factors and gene promoter regions.

Notably, HSPs function as chaperones or helper molecules in various cellular processes involving lipids

and proteins, and their upregulation is not limited to heat-induced stress but also occurs in response to anoxia, acidosis, hypoxia, toxins, ischemia, protein breakdown, and microbial infection.

HSPs play a vital role in regulating protein synthesis in cells. They assist in the folding and assembly of other cellular proteins, primarily through HSP families such as HSP70 and HSP90.

Additionally, the process of the folding, translocation, and aggregation of proteins is governed by the dynamic partitioning facilitated by HSPs throughout the cell. Beyond their involvement in protein metabolism, HSPs also exert a significant influence on apoptosis, the immune system, and various characteristics of inflammation.

The immunity of aquatic organisms, including shrimp, fish, and shellfish, relies heavily on the development of inflammation, as well as non-specific and specific immune responses to viral and bacterial infections.

Recent advancements in aquatic research have demonstrated that the HSP levels in populations of fish, shrimp, and shellfish can be increased through non-traumatic means such as water or oral administration of HSP stimulants, exogenous HSPs, and heat induction. These methods have proven useful in reducing physical stress and trauma, while also facilitating sustainable husbandry practices such as vaccination and transportation, thereby offering health benefits.

Hence, the present review discusses the importance of HSPs in different tissues in aquatic organisms (fish, shrimp), and their expression levels during pathogen invasion; this gives new insights into the significance of HSPs in invertebrates.

#### IV. INSTEAD OF A CONCLUSION

*Some evidence for decision making in food strategy and food science*

From a wide list of high-quality literature for making decisions and teaching both food and nutritional strategies, we can gratefully mention the monographic textbook compiled by Bibek Ray - "Fundamental food microbiology" (Third Edition) [33].

Introductory food microbiology is a required course for undergraduates majoring in food science. In some form it is also taught in several other programs, such as microbiology, public health, nutrition and dietetics, and veterinary science.

For the majority of food scientists, except those majoring in food microbiology, this single course forms the basis of the study of microorganisms and their interactions to food.

Food microbiology is probably the only course that provides information on the interaction of food and microorganisms.

<sup>6</sup> Pyroptosis has received more and more attention because of its association with innate immunity and disease. The research scope of pyroptosis has expanded with the discovery of the gasdermin family (the main effector of inflammatory regulated cell death (or pyroptosis)) - <https://www.nature.com/articles/s41575-023-00743-w>. A great deal of evidence shows that pyroptosis can affect the development of tumors. Pyroptosis is a double-edged sword for tumors. The rational use of this dual effect will help us further explore the formation and development of tumors, and provide ideas for patients to develop new drugs based on pyroptosis. <https://www.nature.com/articles/s41392-021-00507-5>

This book was written with the major objective of relating interaction of microorganisms and food in relation to food bioprocessing, food spoilage, and foodborne diseases.

Thus, it will be useful as a text in the introductory food microbiology courses taught under various programs and disciplines.

In addition, it will be a valuable reference for those directly and indirectly involved in food and microbiology, including individuals in:

- academic institutions;
- research institutions;
- federal, state, and local government agencies;
- food industries;
- food consultants;
- and even food lobbyists.

The subject matter is divided into seven sections. For undergraduate teaching, the first six sections can be taught as a semester course;

Section VII (Appendices) can be used as advanced information for an undergraduate course which contains materials that are either taught in other courses, such as advanced food microbiology, or food safety courses and laboratory courses.

Section I describes the history of food microbiology, characteristics of microorganisms important in foods, their sources, and significance. Section II deals with microbial growth and metabolism of food, and the significance of microbial sublethal injury and bacterial sporulation in foods.

Section III explains the different beneficial uses of microorganisms, which include starter cultures, bioprocessing, bio preservation, and probiotics.

Section IV deals with spoilage of foods by microorganisms and their enzymes and methods used to determine food spoilage. In addition, there is a chapter on problems and solutions of some emerging spoilage bacteria in refrigerated foods.

Section V deals with foodborne pathogens associated with intoxication, infections, and toxic infections and those considered to be opportunistic pathogens, as well as pathogenic parasites and algae. In addition, a chapter has been included on emerging pathogens and a chapter on indicators of pathogens.

Section VI discusses different methods used to control undesirable microorganisms for the safety and stability of food. A chapter on new nonthermal methods and a chapter on the hurdle concept in food preservation are included.

The materials in each chapter are arranged in logical, systematic, and concise sequences.

## V. GLOBALLY UNIVERSAL GS1 SYSTEM: ACCEPTED BY CONSUMERS, BUSINESSES AND GOVERNMENTS

Tracking the movement and location of goods is a set of measures that allows you to identify products throughout the supply chain in accordance with one or more criteria (for example, batch number or expiration date, etc.).

The focus is on tracking the movement of a product from its point of origin to its point of use.

Origin tracking allows you to determine the place of origin and associated characteristics of a specific product at any stage of the supply chain using several search criteria.

The globalization of trade, the increasing complexity of production processes and just-in-time supply chains, and the centralization of production and distribution processes require a fundamental reconsideration of most ways of delivering the "right" products to the consumer.

From an information process management perspective, the implementation of supply chain traceability systems requires all trading partners involved to systematically integrate the physical flow of materials, semi-finished and finished products with the information flow describing them.

All this requires a holistic view of the supply chain, which is best achieved by using a common language of business communication - the GS1<sup>7</sup> system.

Accepted by consumers, businesses and governments, this global, universal system provides a unique foundation to enable all required processes in traceability systems.

With the ability to globally uniquely identify trading and logistics units, participants and locations, the GS1 system is best suited for traceability.

GS1's unique global identifiers are the keys that provide access to all product history, application and location data.

## VI. THE GS1 DISCOVERY APP<sup>8</sup>

In contrast to one-dimensional brochures and PowerPoint presentations, this web app – with its interactivity and flexibility – will help users to engage with GS1 in a new, modern way.

The GS1 Discovery App is an easy-to-use tool that shows GS1 standards "in action" throughout the supply chain – and the interoperability that standards-based business processes bring. This way we can all speak the "language of business" in a fun and engaging way.

<sup>7</sup> <https://www.gs1.org/about>

<sup>8</sup> <https://discover.gs1.org>

What better way to tell the story of supply chain visibility than tracing the travels of select products, as they make their way from source to consumer. It is easy to understand and allows users to create and explore connecting stories that show how GS1 standards benefit business. The GS1 Discovery App can be accessed anywhere and anytime on all computers and tablets.

## VII. FOOD INDUSTRY AND THE IMPLEMENTATION OF HACCP SYSTEMS

The National Advisory Committee (USA) on Microbiological Criteria for Foods (Committee) reconvened a Hazard Analysis and Critical Control Point (HACCP)<sup>9</sup> Working Group in 1995.

The Committee again endorses HACCP as an effective and rational means of assuring food safety from harvest to consumption. Preventing problems from occurring is the paramount goal underlying any HACCP system. Seven basic principles are employed in the development of HACCP plans that meet the stated goal.

These principles include hazard analysis, CCP identification, establishing critical limits, monitoring procedures, corrective actions, verification procedures, and record-keeping and documentation. Under such systems, if a deviation occurs indicating that control has been lost, the deviation is detected and appropriate steps are taken to reestablish control in a timely manner to assure that potentially hazardous products do not reach the consumer.

In the application of HACCP, the use of microbiological testing is seldom an effective means of monitoring CCPs because of the time required to obtain results. In most instances, monitoring of CCPs can best be accomplished through the use of physical and chemical tests, and through visual observations. Microbiological criteria do, however, play a role in verifying that the overall HACCP system is working.

The Committee believes that the HACCP principles should be standardized to provide uniformity in training and applying the HACCP system by industry and government. In accordance with the National Academy of Sciences recommendation, the HACCP system must be developed by each food establishment and tailored to its individual product, processing and distribution conditions.

In keeping with the Committee's charge to provide recommendations to its sponsoring agencies regarding microbiological food safety issues, this document focuses on this area. The Committee recognizes that in order to assure food safety, properly designed HACCP systems must also consider chemical and physical hazards in addition to other biological hazards.

For a successful HACCP program to be properly implemented, management must be committed to a HACCP approach. A commitment by management will indicate an awareness of the benefits and costs of HACCP and include education and training of employees. Benefits, in addition to enhanced assurance of food safety, are better use of resources and timely response to problems.

### *Conflicts of Interest*

The author declares no conflicts of interest.

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# GLOBAL JOURNALS GUIDELINES HANDBOOK 2025

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# MEMBERSHIPS

## FELLOWS/ASSOCIATES OF MEDICAL RESEARCH COUNCIL

### FMRC/AMRC MEMBERSHIPS

#### INTRODUCTION



FMRC/AMRC is the most prestigious membership of Global Journals accredited by Open Association of Research Society, U.S.A (OARS). The credentials of Fellow and Associate designations signify that the researcher has gained the knowledge of the fundamental and high-level concepts, and is a subject matter expert, proficient in an expertise course covering the professional code of conduct, and follows recognized standards of practice. The credentials are designated only to the researchers, scientists, and professionals that have been selected by a rigorous process by our Editorial Board and Management Board.

Associates of FMRC/AMRC are scientists and researchers from around the world are working on projects/researches that have huge potentials. Members support Global Journals' mission to advance technology for humanity and the profession.

## FMRC

### FELLOW OF MEDICAL RESEARCH COUNCIL

FELLOW OF MEDICAL RESEARCH COUNCIL is the most prestigious membership of Global Journals. It is an award and membership granted to individuals that the Open Association of Research Society judges to have made a 'substantial contribution to the improvement of computer science, technology, and electronics engineering.

The primary objective is to recognize the leaders in research and scientific fields of the current era with a global perspective and to create a channel between them and other researchers for better exposure and knowledge sharing. Members are most eminent scientists, engineers, and technologists from all across the world. Fellows are elected for life through a peer review process on the basis of excellence in the respective domain. There is no limit on the number of new nominations made in any year. Each year, the Open Association of Research Society elect up to 12 new Fellow Members.



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ASSOCIATE	FELLOW	RESEARCH GROUP	BASIC
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The following is the official style and template developed for publication of a research paper. Authors are not required to follow this style during the submission of the paper. It is just for reference purposes.



### ***Manuscript Style Instruction (Optional)***

- Microsoft Word Document Setting Instructions.
- Font type of all text should be Swis721 Lt BT.
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- Paper title should be in one column of font size 24.
- Author name in font size of 11 in one column.
- Abstract: font size 9 with the word "Abstract" in bold italics.
- Main text: font size 10 with two justified columns.
- Two columns with equal column width of 3.38 and spacing of 0.2.
- First character must be three lines drop-capped.
- The paragraph before spacing of 1 pt and after of 0 pt.
- Line spacing of 1 pt.
- Large images must be in one column.
- The names of first main headings (Heading 1) must be in Roman font, capital letters, and font size of 10.
- The names of second main headings (Heading 2) must not include numbers and must be in italics with a font size of 10.

### ***Structure and Format of Manuscript***

The recommended size of an original research paper is under 15,000 words and review papers under 7,000 words. Research articles should be less than 10,000 words. Research papers are usually longer than review papers. Review papers are reports of significant research (typically less than 7,000 words, including tables, figures, and references)

A research paper must include:

- a) A title which should be relevant to the theme of the paper.
- b) A summary, known as an abstract (less than 150 words), containing the major results and conclusions.
- c) Up to 10 keywords that precisely identify the paper's subject, purpose, and focus.
- d) An introduction, giving fundamental background objectives.
- e) Resources and techniques with sufficient complete experimental details (wherever possible by reference) to permit repetition, sources of information must be given, and numerical methods must be specified by reference.
- f) Results which should be presented concisely by well-designed tables and figures.
- g) Suitable statistical data should also be given.
- h) All data must have been gathered with attention to numerical detail in the planning stage.

Design has been recognized to be essential to experiments for a considerable time, and the editor has decided that any paper that appears not to have adequate numerical treatments of the data will be returned unrefereed.

- i) Discussion should cover implications and consequences and not just recapitulate the results; conclusions should also be summarized.
- j) There should be brief acknowledgments.
- k) There ought to be references in the conventional format. Global Journals recommends APA format.

Authors should carefully consider the preparation of papers to ensure that they communicate effectively. Papers are much more likely to be accepted if they are carefully designed and laid out, contain few or no errors, are summarizing, and follow instructions. They will also be published with much fewer delays than those that require much technical and editorial correction.

The Editorial Board reserves the right to make literary corrections and suggestions to improve brevity.



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All manuscripts submitted to Global Journals should include:

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The title page must carry an informative title that reflects the content, a running title (less than 45 characters together with spaces), names of the authors and co-authors, and the place(s) where the work was carried out.

### **Author details**

The full postal address of any related author(s) must be specified.

### **Abstract**

The abstract is the foundation of the research paper. It should be clear and concise and must contain the objective of the paper and inferences drawn. It is advised to not include big mathematical equations or complicated jargon.

Many researchers searching for information online will use search engines such as Google, Yahoo or others. By optimizing your paper for search engines, you will amplify the chance of someone finding it. In turn, this will make it more likely to be viewed and cited in further works. Global Journals has compiled these guidelines to facilitate you to maximize the web-friendliness of the most public part of your paper.

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A major lynchpin of research work for the writing of research papers is the keyword search, which one will employ to find both library and internet resources. Up to eleven keywords or very brief phrases have to be given to help data retrieval, mining, and indexing.

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Choice of the main keywords is the first tool of writing a research paper. Research paper writing is an art. Keyword search should be as strategic as possible.

One should start brainstorming lists of potential keywords before even beginning searching. Think about the most important concepts related to research work. Ask, "What words would a source have to include to be truly valuable in a research paper?" Then consider synonyms for the important words.

It may take the discovery of only one important paper to steer in the right keyword direction because, in most databases, the keywords under which a research paper is abstracted are listed with the paper.

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Numerical methods used should be transparent and, where appropriate, supported by references.

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Authors must list all the abbreviations used in the paper at the end of the paper or in a separate table before using them.

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Authors are advised to submit any mathematical equation using either MathJax, KaTeX, or LaTeX, or in a very high-quality image.

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Tables: Tables should be cautiously designed, uncrowned, and include only essential data. Each must have an Arabic number, e.g., Table 4, a self-explanatory caption, and be on a separate sheet. Authors must submit tables in an editable format and not as images. References to these tables (if any) must be mentioned accurately.





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Figures are supposed to be submitted as separate files. Always include a citation in the text for each figure using Arabic numbers, e.g., Fig. 4. Artwork must be submitted online in vector electronic form or by emailing it.

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Verbs have to be in agreement with their subjects. In a research paper, do not start sentences with conjunctions or finish them with prepositions. When writing formally, it is advisable to never split an infinitive because someone will (wrongly) complain. Avoid clichés like a disease. Always shun irritating alliteration. Use language which is simple and straightforward. Put together a neat summary.

**14. Arrangement of information:** Each section of the main body should start with an opening sentence, and there should be a changeover at the end of the section. Give only valid and powerful arguments for your topic. You may also maintain your arguments with records.

**15. Never start at the last minute:** Always allow enough time for research work. Leaving everything to the last minute will degrade your paper and spoil your work.

**16. Multitasking in research is not good:** Doing several things at the same time is a bad habit in the case of research activity. Research is an area where everything has a particular time slot. Divide your research work into parts, and do a particular part in a particular time slot.

**17. Never copy others' work:** Never copy others' work and give it your name because if the evaluator has seen it anywhere, you will be in trouble. Take proper rest and food: No matter how many hours you spend on your research activity, if you are not taking care of your health, then all your efforts will have been in vain. For quality research, take proper rest and food.

**18. Go to seminars:** Attend seminars if the topic is relevant to your research area. Utilize all your resources.

**19. Refresh your mind after intervals:** Try to give your mind a rest by listening to soft music or sleeping in intervals. This will also improve your memory. Acquire colleagues: Always try to acquire colleagues. No matter how sharp you are, if you acquire colleagues, they can give you ideas which will be helpful to your research.



**20. Think technically:** Always think technically. If anything happens, search for its reasons, benefits, and demerits. Think and then print: When you go to print your paper, check that tables are not split, headings are not detached from their descriptions, and page sequence is maintained.

**21. Adding unnecessary information:** Do not add unnecessary information like "I have used MS Excel to draw graphs." Irrelevant and inappropriate material is superfluous. Foreign terminology and phrases are not apropos. One should never take a broad view. Analogy is like feathers on a snake. Use words properly, regardless of how others use them. Remove quotations. Puns are for kids, not grunt readers. Never oversimplify: When adding material to your research paper, never go for oversimplification; this will definitely irritate the evaluator. Be specific. Never use rhythmic redundancies. Contractions shouldn't be used in a research paper. Comparisons are as terrible as clichés. Give up ampersands, abbreviations, and so on. Remove commas that are not necessary. Parenthetical words should be between brackets or commas. Understatement is always the best way to put forward earth-shaking thoughts. Give a detailed literary review.

**22. Report concluded results:** Use concluded results. From raw data, filter the results, and then conclude your studies based on measurements and observations taken. An appropriate number of decimal places should be used. Parenthetical remarks are prohibited here. Proofread carefully at the final stage. At the end, give an outline to your arguments. Spot perspectives of further study of the subject. Justify your conclusion at the bottom sufficiently, which will probably include examples.

**23. Upon conclusion:** Once you have concluded your research, the next most important step is to present your findings. Presentation is extremely important as it is the definite medium through which your research is going to be in print for the rest of the crowd. Care should be taken to categorize your thoughts well and present them in a logical and neat manner. A good quality research paper format is essential because it serves to highlight your research paper and bring to light all necessary aspects of your research.

## INFORMAL GUIDELINES OF RESEARCH PAPER WRITING

### Key points to remember:

- Submit all work in its final form.
- Write your paper in the form which is presented in the guidelines using the template.
- Please note the criteria peer reviewers will use for grading the final paper.

### Final points:

One purpose of organizing a research paper is to let people interpret your efforts selectively. The journal requires the following sections, submitted in the order listed, with each section starting on a new page:

*The introduction:* This will be compiled from reference matter and reflect the design processes or outline of basis that directed you to make a study. As you carry out the process of study, the method and process section will be constructed like that. The results segment will show related statistics in nearly sequential order and direct reviewers to similar intellectual paths throughout the data that you gathered to carry out your study.

### The discussion section:

This will provide understanding of the data and projections as to the implications of the results. The use of good quality references throughout the paper will give the effort trustworthiness by representing an alertness to prior workings.

Writing a research paper is not an easy job, no matter how trouble-free the actual research or concept. Practice, excellent preparation, and controlled record-keeping are the only means to make straightforward progression.

### General style:

Specific editorial column necessities for compliance of a manuscript will always take over from directions in these general guidelines.

**To make a paper clear:** Adhere to recommended page limits.



### *Mistakes to avoid:*

- Insertion of a title at the foot of a page with subsequent text on the next page.
- Separating a table, chart, or figure—confine each to a single page.
- Submitting a manuscript with pages out of sequence.
- In every section of your document, use standard writing style, including articles ("a" and "the").
- Keep paying attention to the topic of the paper.
- Use paragraphs to split each significant point (excluding the abstract).
- Align the primary line of each section.
- Present your points in sound order.
- Use present tense to report well-accepted matters.
- Use past tense to describe specific results.
- Do not use familiar wording; don't address the reviewer directly. Don't use slang or superlatives.
- Avoid use of extra pictures—include only those figures essential to presenting results.

### **Title page:**

Choose a revealing title. It should be short and include the name(s) and address(es) of all authors. It should not have acronyms or abbreviations or exceed two printed lines.

**Abstract:** This summary should be two hundred words or less. It should clearly and briefly explain the key findings reported in the manuscript and must have precise statistics. It should not have acronyms or abbreviations. It should be logical in itself. Do not cite references at this point.

An abstract is a brief, distinct paragraph summary of finished work or work in development. In a minute or less, a reviewer can be taught the foundation behind the study, common approaches to the problem, relevant results, and significant conclusions or new questions.

Write your summary when your paper is completed because how can you write the summary of anything which is not yet written? Wealth of terminology is very essential in abstract. Use comprehensive sentences, and do not sacrifice readability for brevity; you can maintain it succinctly by phrasing sentences so that they provide more than a lone rationale. The author can at this moment go straight to shortening the outcome. Sum up the study with the subsequent elements in any summary. Try to limit the initial two items to no more than one line each.

*Reason for writing the article—theory, overall issue, purpose.*

- Fundamental goal.
- To-the-point depiction of the research.
- Consequences, including definite statistics—if the consequences are quantitative in nature, account for this; results of any numerical analysis should be reported. Significant conclusions or questions that emerge from the research.

### **Approach:**

- Single section and succinct.
- An outline of the job done is always written in past tense.
- Concentrate on shortening results—limit background information to a verdict or two.
- Exact spelling, clarity of sentences and phrases, and appropriate reporting of quantities (proper units, important statistics) are just as significant in an abstract as they are anywhere else.

### **Introduction:**

The introduction should "introduce" the manuscript. The reviewer should be presented with sufficient background information to be capable of comprehending and calculating the purpose of your study without having to refer to other works. The basis for the study should be offered. Give the most important references, but avoid making a comprehensive appraisal of the topic. Describe the problem visibly. If the problem is not acknowledged in a logical, reasonable way, the reviewer will give no attention to your results. Speak in common terms about techniques used to explain the problem, if needed, but do not present any particulars about the protocols here.



*The following approach can create a valuable beginning:*

- Explain the value (significance) of the study.
- Defend the model—why did you employ this particular system or method? What is its compensation? Remark upon its appropriateness from an abstract point of view as well as pointing out sensible reasons for using it.
- Present a justification. State your particular theory(-ies) or aim(s), and describe the logic that led you to choose them.
- Briefly explain the study's tentative purpose and how it meets the declared objectives.

#### **Approach:**

Use past tense except for when referring to recognized facts. After all, the manuscript will be submitted after the entire job is done. Sort out your thoughts; manufacture one key point for every section. If you make the four points listed above, you will need at least four paragraphs. Present surrounding information only when it is necessary to support a situation. The reviewer does not desire to read everything you know about a topic. Shape the theory specifically—do not take a broad view.

As always, give awareness to spelling, simplicity, and correctness of sentences and phrases.

#### **Procedures (methods and materials):**

This part is supposed to be the easiest to carve if you have good skills. A soundly written procedures segment allows a capable scientist to replicate your results. Present precise information about your supplies. The suppliers and clarity of reagents can be helpful bits of information. Present methods in sequential order, but linked methodologies can be grouped as a segment. Be concise when relating the protocols. Attempt to give the least amount of information that would permit another capable scientist to replicate your outcome, but be cautious that vital information is integrated. The use of subheadings is suggested and ought to be synchronized with the results section.

When a technique is used that has been well-described in another section, mention the specific item describing the way, but draw the basic principle while stating the situation. The purpose is to show all particular resources and broad procedures so that another person may use some or all of the methods in one more study or referee the scientific value of your work. It is not to be a step-by-step report of the whole thing you did, nor is a methods section a set of orders.

#### **Materials:**

*Materials may be reported in part of a section or else they may be recognized along with your measures.*

#### **Methods:**

- Report the method and not the particulars of each process that engaged the same methodology.
- Describe the method entirely.
- To be succinct, present methods under headings dedicated to specific dealings or groups of measures.
- Simplify—detail how procedures were completed, not how they were performed on a particular day.
- If well-known procedures were used, account for the procedure by name, possibly with a reference, and that's all.

#### **Approach:**

It is embarrassing to use vigorous voice when documenting methods without using first person, which would focus the reviewer's interest on the researcher rather than the job. As a result, when writing up the methods, most authors use third person passive voice.

Use standard style in this and every other part of the paper—avoid familiar lists, and use full sentences.

#### **What to keep away from:**

- Resources and methods are not a set of information.
- Skip all descriptive information and surroundings—save it for the argument.
- Leave out information that is immaterial to a third party.





**Results:**

The principle of a results segment is to present and demonstrate your conclusion. Create this part as entirely objective details of the outcome, and save all understanding for the discussion.

The page length of this segment is set by the sum and types of data to be reported. Use statistics and tables, if suitable, to present consequences most efficiently.

You must clearly differentiate material which would usually be incorporated in a study editorial from any unprocessed data or additional appendix matter that would not be available. In fact, such matters should not be submitted at all except if requested by the instructor.

**Content:**

- Sum up your conclusions in text and demonstrate them, if suitable, with figures and tables.
- In the manuscript, explain each of your consequences, and point the reader to remarks that are most appropriate.
- Present a background, such as by describing the question that was addressed by creation of an exacting study.
- Explain results of control experiments and give remarks that are not accessible in a prescribed figure or table, if appropriate.
- Examine your data, then prepare the analyzed (transformed) data in the form of a figure (graph), table, or manuscript.

**What to stay away from:**

- Do not discuss or infer your outcome, report surrounding information, or try to explain anything.
- Do not include raw data or intermediate calculations in a research manuscript.
- Do not present similar data more than once.
- A manuscript should complement any figures or tables, not duplicate information.
- Never confuse figures with tables—there is a difference.

**Approach:**

As always, use past tense when you submit your results, and put the whole thing in a reasonable order.

Put figures and tables, appropriately numbered, in order at the end of the report.

If you desire, you may place your figures and tables properly within the text of your results section.

**Figures and tables:**

If you put figures and tables at the end of some details, make certain that they are visibly distinguished from any attached appendix materials, such as raw facts. Whatever the position, each table must be titled, numbered one after the other, and include a heading. All figures and tables must be divided from the text.

**Discussion:**

The discussion is expected to be the trickiest segment to write. A lot of papers submitted to the journal are discarded based on problems with the discussion. There is no rule for how long an argument should be.

Position your understanding of the outcome visibly to lead the reviewer through your conclusions, and then finish the paper with a summing up of the implications of the study. The purpose here is to offer an understanding of your results and support all of your conclusions, using facts from your research and generally accepted information, if suitable. The implication of results should be fully described.

Infer your data in the conversation in suitable depth. This means that when you clarify an observable fact, you must explain mechanisms that may account for the observation. If your results vary from your prospect, make clear why that may have happened. If your results agree, then explain the theory that the proof supported. It is never suitable to just state that the data approved the prospect, and let it drop at that. Make a decision as to whether each premise is supported or discarded or if you cannot make a conclusion with assurance. Do not just dismiss a study or part of a study as "uncertain."



Research papers are not acknowledged if the work is imperfect. Draw what conclusions you can based upon the results that you have, and take care of the study as a finished work.

- You may propose future guidelines, such as how an experiment might be personalized to accomplish a new idea.
- Give details of all of your remarks as much as possible, focusing on mechanisms.
- Make a decision as to whether the tentative design sufficiently addressed the theory and whether or not it was correctly restricted. Try to present substitute explanations if they are sensible alternatives.
- One piece of research will not counter an overall question, so maintain the large picture in mind. Where do you go next? The best studies unlock new avenues of study. What questions remain?
- Recommendations for detailed papers will offer supplementary suggestions.

#### **Approach:**

When you refer to information, differentiate data generated by your own studies from other available information. Present work done by specific persons (including you) in past tense.

Describe generally acknowledged facts and main beliefs in present tense.

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Topics	Grades		
	A-B	C-D	E-F
<i>Abstract</i>	Clear and concise with appropriate content, Correct format. 200 words or below	Unclear summary and no specific data, Incorrect form Above 200 words	No specific data with ambiguous information Above 250 words
<i>Introduction</i>	Containing all background details with clear goal and appropriate details, flow specification, no grammar and spelling mistake, well organized sentence and paragraph, reference cited	Unclear and confusing data, appropriate format, grammar and spelling errors with unorganized matter	Out of place depth and content, hazy format
<i>Methods and Procedures</i>	Clear and to the point with well arranged paragraph, precision and accuracy of facts and figures, well organized subheads	Difficult to comprehend with embarrassed text, too much explanation but completed	Incorrect and unorganized structure with hazy meaning
<i>Result</i>	Well organized, Clear and specific, Correct units with precision, correct data, well structuring of paragraph, no grammar and spelling mistake	Complete and embarrassed text, difficult to comprehend	Irregular format with wrong facts and figures
<i>Discussion</i>	Well organized, meaningful specification, sound conclusion, logical and concise explanation, highly structured paragraph reference cited	Wordy, unclear conclusion, spurious	Conclusion is not cited, unorganized, difficult to comprehend
<i>References</i>	Complete and correct format, well organized	Beside the point, Incomplete	Wrong format and structuring



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