MAK HILL Publications Research Journal of Medical Sciences

Research Article
doi: 10.36478/makrjms.2024.12.779.786

OPEN ACCESS

Key Words
Arid regions, anthropometric measurement, nutritional factors, environmental factors

Corresponding Author
Mukesh Kumar ,
Department of Anatomy, Pacific Medical University, Udaipur, Rajasthan, India
dr.mukeshchaudhary15887@gmail.com

Received: 10th October 2024
Accepted: 15th November 2024
Published: 30th December 2024

Citation: Dr. Mukesh Kumar, Dr. Hina sharma, Dr. Savita Gadekar and Rinu Jakhar, 2024. Impact of Nutritional and Environmental Factors on Anthropometric Measurements in Arid Regions. Res. J. Med. Sci., 19: 154-161, doi: 10.36478/makrjms.2024.12.779.786

Impact of Nutritional and Environmental Factors on Anthropometric Measurements in Arid Regions

[1]Dr. Mukesh Kumar, [2]Dr. Hina sharma, [3]Dr. Savita Gadekar and [4]Rinu Jakhar

[1-3]Department of Anatomy, Pacific Medical University, Udaipur, Rajasthan, India
[4]Department of Psychology, Manipal University, Jaipur, Rajasthan, India

Abstract
Diet, water and consumption of essential nutrients along with a friendly environment contribute to the overall development of the human body. However, in the arid region both the national and environmental factors play a significant role in anthropometric measurement. The introduction chapter provides a comprehensive background along with the main objective of the study. The significance and scope of the study have also been elaborated on in the chapter. The literature review chapter includes opinions and views of the scholar regarding the subject along with a literature gap. The methodology chapter encapsulates the secondary qualitative method while conducting the study in order to get valuable insight. The Findings and Results chapter outlines the major findings of impacts of both nutritional and environmental factors in arid regions for anthropometric measurement. Finally, the conclusion chapter frames the overall conclusion, adoption of policies and practices, and future recommendations with a concluding remark.

INTRODUCTION

According to Bodirsky, in various national records, the inclusion of diet and anthropometrics is absent which leads to biased strategies for public health[1]. The arid regions of the world are often featured by tough environmental conditions such as high temperatures, low quality of air and water scarcity. Living in these conditions can have adverse effects on the health of individuals to a greater extent. Thereby, the harshness of the environment can have a negative impact on anthropometric measurements and overall nutrition of the demographics. Further, it has been observed that the food system plays a pivotal role in altering the nutritional value and initiating climate change[2]. Thereby, it becomes essential to discuss the topic and find the exact relation between these factors which is affecting the anthropometric measurements

Research Objectives:

The objectives of the study are:

- To identify the impact of Nutritional Factors on Anthropometric Measurements
- To elaborate on the effects of Environmental Factors on Anthropometry
- To discuss the interconnection Between Nutrition and the Environment

Scope of the Study: The study is designed to investigate major environmental and nutritional factors that alter the anthropometric measurements of individuals. However, the primary motive of the study is to understand the context in terms of region. Hence, elaboration on this topic will be initiated based on arid regions of the world. The identification of the relation between environment, nutrition and physical growth is essential to discuss in order to take constructive measures for a better future. Further, the implication of policies and a public health program in the arid region plays a crucial role when it comes to awareness and education. Hence, the scope of the study is wide enough to include the exact reason for anthropometric disorder and what kind of initiatives can be taken in tough environmental circumstances. The role of proper diet, malnutrition, dehydration, air pollution, and dry regions, as well as their impact on humans, can be elaborated on in this study. The study undertaken by Gana, provides deep insight into the prevalence of hard climate and poor nutrition in the arid region and how localized solutions can be taken for better growth[3]. Therefore, this study will assess all the possibilities in navigating the issue along with framing result-oriented programmes.

Significance of the Study: The study is crucial in getting valuable insight into the role of nutrition and environment in the overall physical growth of an individual. Through proper assessment of the topic, it is possible to inform various healthcare sectors and public health governmental bodies about the effect of a tough climate on anthropometric measurement. Hence, adequate policies and measures can be adopted for public health development. Further, the findings of the study are crucial in recommending proper dietary patterns for people living in arid regions.

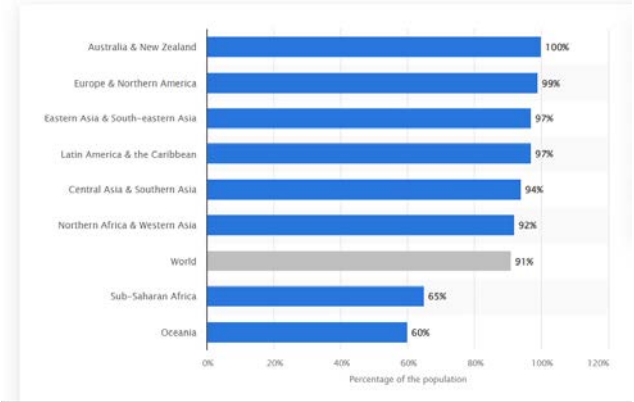

Fig. 1: Share of population with access to at least basic drinking water services worldwide in 2022

The figure represents the scarcity of water particularly in the arid region of sub-Saharan Africa. It can be observed that only 65%of people have access to safe drinking water in this region[4]. Being an arid region, the land experiences dry weather conditions and low rainfall along with high temperature and humidity. Hence, it becomes crucial to assess the environment of arid regions and provide proper recommendations in order to cope with water scarcity and prevent anthropometric disorder.

Literature Review:

The Impact of Nutritional Factors on Anthropometric Measurements: According to Yaprak, the nutritional position of an individual can be estimated by utilising a diversity of instruments. The relevant intervention can be selected depending on the status of the individual's disease and the effectiveness of treatment, leveraging measurement tools that regulate nutritional status[5]. Nutritional screening tests particularly developed for various patient groups such as the "Geriatric Nutritional Risk Index", "Malnutrition Inflammation Scores", and "Prognostic Nutritional Index" to screen and evaluate nutritional status. Due to unbalanced diets, malnutrition or vitamin shortages can cause stunted growth, underweight, or even obesity. "Anthropometric measurements of body weight, height, upper middle arm and upper middle arm circumference measurements of individuals were regularly taken and recorded by the responsible officers working in the hemodialysis unit"[4]. Anthropometric parameters, including height, weight,

body mass index (BMI), and body composition, are significantly influenced by nutritional factors.

As per the view of Thapa, nutrition plays an important role that contributes to a healthy lifestyle [6]. Food quality, dietary practices, and socioeconomic factors have a big influence on these metrics, emphasizing the necessity of balanced nutrition for the best possible physical growth and health."The anthropometric measurements including the weight and height of the participants were measured according to standardized procedures"[6]. Growth and development are supported by an adequate intake of micronutrients such as vitamins and minerals and macronutrients like proteins, carbs, and fats. While calcium and vitamin D provide an impact on bone formation and density, protein is necessary for the development of muscles and tissues.

Fig. 2: Estimation From Length of Foot and Hand

The Effect of Environmental Factors on Anthropometry: As opined by Sandamal, environmental conditions have an important impact on the physical improvement of young adults as well as their fitness level, which exhibits their athletic performance[7]. Anthropometric measurements are greatly impacted by environmental influences, which also impact body composition, growth, and development. "Environmental factors such as air temperature, humidity, wind, and precipitation are found to be the most environment-based influential factors for the physical development of players"[7]. Climate matters because body size and metabolic rates can be impacted by extremely high or low temperatures. Access to food resources is influenced by geographic location, which also impacts nutritional status and, in turn, height, weight, and BMI. Thus, it is vital to forecast the importance of environmental conditions on physical growth to anticipate the fitness level in various environmental regions.

As per the view of Jamil, "Environmental enteric dysfunction (EED)" is a forerunner of development which is faltering among children who are living in impoverished conditions. They are frequently revealed to enteropathogens and environmental toxins, contributing to low-grade inflammation which is chronic systemic and small bowel malabsorptive, inflammatory, and permeability derangements[8]. Physical development can be hampered by pollution and exposure to dangerous substances, particularly in young children. Anthropometric results are also influenced by socioeconomic factors, such as access to healthcare and living situations. Illnesses that hinder growth can result from inadequate sanitation. Optimal growth depends on multiple factors, including genetics and environmental conditions and prenatal conditions[8]. Genetics, nutrition, and environmental variables interact to shape anthropometric traits across groups, highlighting the importance of these elements.

Interconnection Between Nutrition and Environment: According to Mramba and Kahindi, practices of pond management including regular feed input, fertilisation, and stocking density provide a crucial impact on the water quality. Human development and health are significantly impacted by the relationship between nutrition and the environment. "The use of high-quality feed in an optimal amount reduces waste load and oxygen demand"[9]. Therefore, the properties of water quality should be retained for a healthy pond ecosystem at their optimal level. Food production and nutrient vailability are directly impacted by environmental conditions, including climate, soil quality, and water availability. Appropriate practices of pond management are significant for maintaining the healthy aquatic environment which is needed for effective production. "Apart from improving the efficiency of water use, these aquaculture methods reduce waste discharge to the environment"[9]. Malnutrition brought on by environmental scarcity impairs immunity, increasing a person's vulnerability to environmental disease. Because poorer people frequently lack access to wholesome food and live in environmentally demanding environments, socioeconomic inequities further accentuate this connection. "The efficacy of soil fertilizer application is lower than that of foliar fertilization under various environmental conditions, due to the direct provision of necessary nutrients to the leaves, relatively quicker absorption, independence of root activity, and soil water availability"[10]. While nutrient-rich crops are produced in locations with fertile land and a good environment, access to vital nutrients may be restricted in arid or polluted areas. Toxins introduced by pollution and environmental deterioration can lower the nutritional value and health of food. Addressing global health issues requires an understanding of this dynamic interaction. In order to promote healthy populations and ecosystems,

sustainable agriculture methods and fair food distribution systems can lessen the negative nutritional consequences of environmental stressors.

Literature Gap: A few limitations have been found in the article which was written by Mramba and Kahindi, that other water parameters were not sustained because of the unavailability of equipment. Additionally, water turbidity was implemented by utilising the "Secchi disc method", which provides a low accuracy level[10]. The severity and profile of histological abnormalities of EED gut exhibit a few differences towards 3 EED-endemic settings, although the histologic severity was not related to anthropometry[8]. It generally happens due to various enrollment criteria and cohort phenotypes which recommend more than one histologic way with geographic variation.

MATERIALS AND METHODS

Research Design: A research design is an essential tool which can be beneficial in providing a strategic plan to effectively answer the questions of the study[11]. The study has thus used a qualitative research design for a vivid understanding of the effectiveness of nutritional and environmental factors on anthropometric measurements of people in arid regions. A qualitative research design has been used as it can help in exploring and discovering new insights despite the limited sources of information on the study. Such a claim can be evidenced by the quotation: " It is a useful method in studying a phenomenon with limited accessible information as its nature is exploratory"[12]. Thus, this research design can be useful in providing an in-depth analysis of the nutritional and environmental impacts on the anthropometric measurements of people living in arid regions. Through this design, the study has been able to provide a flexible approach to understanding the significance of properly balanced diets in determining the healthy development of the body. However, Busetto, are of the view that using qualitative research design to understand the nutritional implications of anthropometry can be lacking as this design is still underdeveloped in health services[13]. Such a claim can be evidenced by the quotation: "While qualitative research is common in other fields, it is still relatively underrepresented in health services research"[13].

Data Collection Methods: The data has been collected using secondary sources such as scholarly articles and journals from Google Scholar. Only the relevant articles and journals have been chosen which have provided specific and necessary information on the impacts of nutrition in determining the anthropometric measurements of people residing in arid regions. A secondary data collection method has been beneficial for the study as it has helped in providing background information for a better understanding of the research topic. This can be evidenced by the quotation: "Thus, secondary data is an essential part of research that can help to get information from past studies as basis conduction for implementing a research or as the required background information"[14]. Thus, this has been beneficial in providing a baseline of anthropometry before retrieving the actual results.

Data Analysis: The secondary qualitative data has been analysed using thematic analysis as it can be extensively used by establishing various themes to uncover descriptive insights regarding the research topic. This can be evidenced by the quotation: "A rigorous thematic analysis approach can produce insightful and trustworthy findings"[15]. Thus, thematic analysis has been beneficial in systematically organising and analysing complex data sets by carefully reading the secondary data collected for gathering information on anthropometry. Besides, the usage of thematic analysis can be beneficial in establishing a valid, reliable, and flexible analysis of the study[15].

Limitations of the Methodology: Despite the effective use of a secondary qualitative method for gathering the necessary data to understand the impacts of nutritional and environmental factors in determining the anthropometric measurements in arid regions, there have been certain limitations regarding the methodological approaches. Even though qualitative data has provided a detailed description of anthropometric measurements, a quantitative research design using primary data could have been more effective in providing authentic and real-life results[11]. It could have been more effective in addressing the questions related to the interrelationship between nutrition, environment, and differences in anthropometric measurements of people in arid regions.

RESULTS AND DISCUSSIONS

Overview of Key Themes: In arid regions, nutritional deficiencies play an important role that provide a negative impact on the land and water. Due to climate change, land desertification and deterioration impede crop production. In the context of anthropometric measurements, environmental factors such as high temperatures, pollution, and inadequate sanitation provide an impact on water quality. Affected food and water adversely impact the development of the height and weight of individuals. Both nutrition and environmental factors provide a huge impact on the anthropometric indicators that can delay s development or stunting growth. In order to compare across different arid regions, it has been found that different aspects have been conducted to influence the measurements of anthropometric parameters.

Nutritional Deficiencies in Arid Regions: Through the dry fall, phosphorus supplies are substantial to reservoirs or lakes that are located in the regions of arid and semi-arid. Eutrophication is a usual problem for the dams which have been situated inside an agricultural or urban catchment with a greater source of untreated plant nutrients. This can adversely impact the recreational, hydro ecosystem, and other utilisation of water."Eutrophication is a major problem in such cases due to excessive nutrient loads which stimulate the growth of algae and invasive water hyacinth"[16]. The quality of water negatively affects the quality of soil and therefore, it provides a significant impact on the crops or plants which grow on it. Thus, timely and accurate information based on the quality of water is important to establish a sound policy and to implement effective quality enhancement, water pollution control, or programs of problem management. In arid and semi-arid regions, land desertification and deterioration impede crop production due to the climate change which has been occurring because of the intensity of drought seasons[17].

Table 1. Percentage of BMI distribution in adults (15-45 years) by gender of Jodhpur district

Distribution	Normal (>=18.5)		CED I (17-18.4)		CED II (16-16.9)		CED III (<16)	
Gender	M	F	M	F	M	F	M	F
Total	54.2	60.5	22.4	20.1*	10.5	10.6*	12.7	8.7*

*p< 0.01 between M & F

582 Chronic energy deficiency in adults

Table 2. Percent prevalence of nutritional deficiency signs

Clinical Nutritional Deficiency Signs	Present Study (%) N = 1540 15-45 years M	F	G.T	Non desert (%) N = 747 15-45 years G.T
Protein calorie Malnutrition				
Marasmus	0.3	0	0.2	NA
Vitamin A Deficiency				
Night Blindness	0.1	0.2	0.2	0.0
Bitot Spot	0.5	3.1**	1.8	0.5**
Vitamin B Complex deficiency				
Angular Stomatitis	0.6	1.5**	1.0	0.8
Cheliosis	2.1	3.0	2.6	0.2**
Glossitis	4.4	6.4	5.4	0.0
Vitamin C deficiency				
Gums Bleeding	2.1	2.8	2.5	NA
Teeth caries	7.7	9.3	8.5	30.1**
Mottled Enamel	39.6	36.9	38.3	4.4**
Anemia: pallor conjuctiva	27.4	43.9**	35.6	2.8**

*p< 0.01 **p< 0.05

Fig. 3: Nutritional deficiency still present in Arid region in the 20th centur

In these regions, with inaccurate infrastructure, poor people are mainly impacted by the negative impacts of climate change. "In semi-arid regions, poor crop harvests can result in months of food scarcity and socio-economic suffering for public, small-holder and subsistence farmers, ultimately causing malnourished conditions"[17]. The survey, represented in a paper written by Singh, showed that 45.8 percent males and 39.5 percent females showed chronic energy deficiency which was high and needed attention in the 20th century also[24].

Environmental Stressors on Anthropometry: Anthropometric measurements are greatly impacted by environmental stressors, which reflects their impact on human growth and physical development. Normal growth patterns can be disturbed by elements including high temperatures, pollution, inadequate sanitation, and restricted access to clean water. "Anthropometry can provide additional information about environmental deprivation in the household, as it is relatively sensitive to acute and chronic nutritional deficits"[19]. Extended exposure to polluted settings can cause developmental and respiratory problems that prevent children from growing taller and gaining weight. Under nutrition or stunting can be caused by food instability and nutritional insufficiency, which are frequently linked to environmental deterioration or natural disasters. Similarly, metabolism is impacted by exposure to chemicals in tainted food or water, which may result in altered body composition. "IUGR can be due to maternal, placental, fetal, nutritional, or other environmental factors that slow fetal growth"[19]. Vulnerable people are disproportionately affected by socioeconomic situations, which also intensify these stressors. Environmental factors may provide a positive impact on the increase of stress on carbohydrate metabolism[20].

Impact of Environment and Nutrition on Anthropometric Indicators: Body composition and human growth are measured by anthropometric markers, which are greatly influenced by environment and nutrition. Growth patterns can be impacted by environmental factors such as climate, pollution, and living conditions; exposure to chemicals and inadequate sanitation can result in stunting or developmental delays. Nutrition is important because, especially in children, under nutrition, wasting, or stunting can result from deficits in vital nutrients such protein, vitamins, and minerals. "Anthropometric indices can be used for risk identification, intervention, or impact evaluation on nutritional status or health; therefore, they will be called anthropometric health indicators (AHIs)"[21]. On the other hand, obesity may result from over nutrition in diets high in calories but low in nutrients. These impacts are amplified by

interactions between nutrition and the environment, such as food scarcity brought on by environmental deterioration. Better health and growth outcomes are guaranteed when these issues are addressed holistically.

Comparisons Across Regions: In the semi-arid region of Bahia, measurements of anthropometric parameters have been conducted in children between the ages of 5 to 12 years. In these populations, patients have suffered from obesity in comparison to the normal weight, noticeable altitude in CRP and Tg markers while there was a decrease in HDL titers[22]. This difference illustrates that childhood obesity plays an important role in the commonness of cardiovascular diseases and metabolism in children as well as adolescents[23]. On the other hand, less organic matter is found in the surface soils in the arid and semiarid regions of India. The percentage of organic sulphur is not much high in arid as well as semi-arid region soils, thus it is called humid region soils.

Recommendations:

Summary of Findings: The study on understanding the impacts of nutritional and environmental factors in arid regions has revealed that these factors have negatively impacted the anthropometric measurements of people living in these regions. It has further identified that human development and health are significantly impacted by the relationship between nutritional and environmental factors. The nutritional deficiencies along with the inaccurate infrastructure and poverty among the people have mainly impacted the anthropometric measurements of people in these regions. The findings have also suggested that the environmental stressors have greatly impacted the anthropometric measurements thereby affecting the human growth and physical development of people in the arid regions. Through a thorough review of the literature, it has been witnessed that growth and development are supported by an adequate intake of micronutrients such as vitamins and minerals and macronutrients like proteins, carbs, and fats. However, the environmental uncertainties and nutritional inadequacies among the people in the arid and semiarid regions have had negative implications on the anthropometric measurements of the people residing in these regions.

Implications for Policy and Practice: Environment and nutrition play an important role for individuals living in the arid region. However, the intervention of governmental bodies in order to make sustainable policy is crucial in shaping the development of human habitat in the region. Further, communities need to indulge in construction practices for a better environment, and nutritional and physical growth. In the arid region, the agriculture sector needs to be more active and include socio-environmental measures for saving water and soil at the same time. The importance of the agriculture sector can be outlined by the quotation "Agricultural sector plays a vital role to improve economic development, enhance food security, and alleviate poverty."[25]. Hence, the agricultural domain can engage in awareness programs pertaining to rainwater harvesting and water conservation. Rainwater harvesting is an effective method through which rainwater is stored and used later. This can be undertaken at large through governmental bodies and even in a localised fashion. Further, the stored water can be used for drinking after certain purification and normally it can be used for irrigation purposes. Thereby, the issue pertaining to scarcity of water which is one of the major contributors to anthropometric disorder can be navigated.

Recommendations for Future Research: The study has attempted to evaluate the impact of nutritional and environmental factors on anthropometric measurements in arid regions. However, there are certain recommendations that can be employed for future work.

Inclusion of Primary Data: Primary data in the form of interviews and surveys with individuals living in arid regions can provide valuable insight into the environment and condition of life. The association of first-hand feedback can enrich the study and expand the overall intellect.

Considering other Factors: The study has only considered environmental and nutritional aspects, whereas the inclusion of other subjects such as daily activities, healthcare facilities and agricultural perspective has the potential to outsource real picture of an arid region.

Employment of machine learning: Finally, employment of machine learning algorithms in order to understand the relation between environment, nutrition and anthropometric measurements can enhance the study.

CONCLUSION

The Study has extensively investigated the role of nutrition and environment in the course of anthropometric measurement. Only 65% of drinking water is available in the arid region across the globe. Hence, due to the scarcity of water people living in this region experience a deficiency in nutrition to a great extent. Further, due to environmental issues, the soil is unable to retain essential minerals which can outsource healthy crops and vegetables. Similarly, the quality of water is a great concern, due to which marine life is slowly disappearing in the arid region.

Thereby, all these factors are contributing to anthropometric issues such as low body composition, malnutrition and slow cognitive development. In conclusion, it becomes vital for governmental bodies to intercept and frame proper policies in regard to the environment. Further, a proper supply of nutrition and education pertaining to the importance of macro and micronutrients in the overall development is required.

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