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Research Article

Nutrition as a Public Health Challenge: A world view

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Abstract

Background: Malnutrition is certainly a growing public health concern worldwide. This is worse in developing world more especially in countries where rain fed agriculture is being practised. Although two main categories of malnutrition are common such as underfeeding and overfeeding, both of them are equally important. Levels of socio-economic predispositions and inequalities coupled with cultural background have an influence in the occurrence of malnutrition.

Methodology: An extensive literature review on the subject was done to determine the extent of the problem, why does it happen, how, when, where, who is affected and what can be done about it.

Conclusion: An attempt to maintain equity and equality in various social groups at all levels may seem to be an epitome to address the issue while having a better understanding of the matter. This is where evidence based public health practice comes in.

Kew Words: malnutrition, public heath practice, socio-economic predispositions, equity and equality

1.Introduction

Malnutrition is a global burden with ill health consequences. It is a clinical syndrome with complex presentation - disproportionately affecting underprivileged ones, women and children are more affected worldwide but more in the developing world. Incidentally, in the developing countries nutrition related chronic illnesses are on the rise this is bound to have unpleasant outcomes. Novel foods [which can be genetically modified organism (GMO) or non-genetically modified] offer an option to food insecurity, some are used as functional foods in the management of inborn errors of metabolism however, caution is to be exercised as safety of most of the foods have not been tested and some do exhibit allergic potential especially the transgenic foods one can argue detrimental effects of transgenic organisms.

2.What is malnutrition?

Malnutrition refers to deficiencies, excesses or imbalances in a person's intake of energy and/or nutrients. The term malnutrition covers 2 broad groups of conditions. One is 'undernutrition'—which includes stunting (low height for age), wasting (low weight for height), underweight (low weight for age) and micro-nutrient deficiencies or insufficiencies (a lack of important vitamins and minerals). The other is overweight, obesity and diet-related noncommunicable diseases (such as heart disease, stroke, diabetes, and cancer). Therefore, malnutrition means 'bad nutrition'.

3.What are the consequences of malnutrition?

Malnutrition affects people in every country. Around 1.9 billion adults worldwide are overweight, while 462 million are underweight. An estimated 41 million children under the age of 5 years are overweight or obese, while some 159 million are stunted and 50 million are wasted. Adding to this burden are the 528 million or 29% of women of reproductive age around the world affected by anaemia, for which approximately half would be amenable to iron supplementation.

Many families cannot afford or access enough nutritious foods like fresh fruit and vegetables, legumes, meat, and milk, while foods and drinks high in fat, sugar, and salt are cheaper and more readily available, leading to a rapid rise in the number of children and adults who are overweight and obese, in poor as well as rich countries. It is quite common to find under-nutrition and overweight within the same community, household or even individual – it is possible to be both overweight and micro-nutrient deficient, for example.

A connection does exist between diet and diseases- or at least how our diet affects gene expression which in some instances disease progression can be put at bay; this is the main role of nutrigenomics which is solely interested in how nutrition affects the genome through "omics" technologies.

This paper begins by discussing some of the global nutrition problems and a snippet about novel foods and later delves into nutrigenomics.

2.Overview; global nutrition problems.

Globally, there are several pressing issues regarding malnutrition; which is a clinical syndrome manifesting in various ways making its definition difficult to provide(1). Although seen as a deficiency in some nutrients, over-nutrition is also a reality which is associated with increased morbidity and mortality more so in the developed countries.

Malnutrition effects are seen across the board, although particular groups are vulnerable such as the under five children, [where an estimated 41 million children are overweight or obese, while some 159 million are stunted and 50 million are wasted], adults [1.9 billion], and women of reproductive age affected by nutritional anemia(2).

4.1 The following are some of the world's challenges being faced:

Protein-energy malnutrition (PEM)

It is inadequate and/or complete lack of proteins and calories in various proportions, and it can be defined as unintentional loss of 10% or more of body weight in a period of six months or less and/or serum albumin levels of less than 3.5 grams per deciliter(3).

This is a major public health challenge, disproportionately it affects under-five population, prompt diagnosis and early management is required in order to lessen morbidity as under-nutrition puts children at greater risk of dying from common infections(4,5)[figure 1],

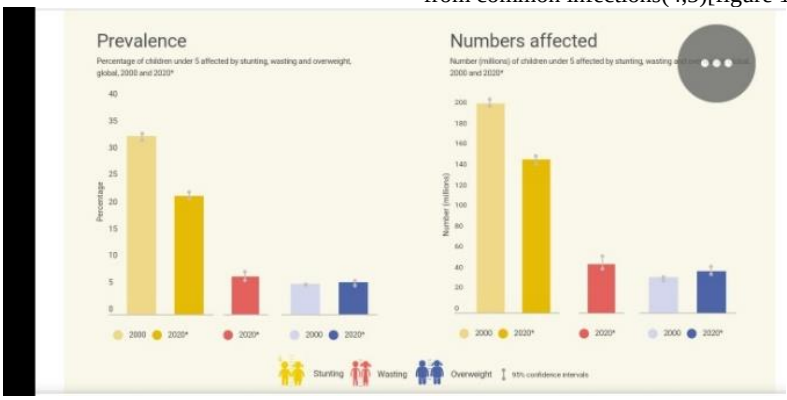

Figure. 1 Global burden of under-nutrition to the under-five population Source: UNICEF/WHO/World Bank Joint Child Malnutrition Estimates, 2021 Edition

poor cognitive development(6) when PEM is left uncorrected. To alleviate the burden screening tools have been developed for example, The Malnutrition Universal Screening Tool (figure 2),

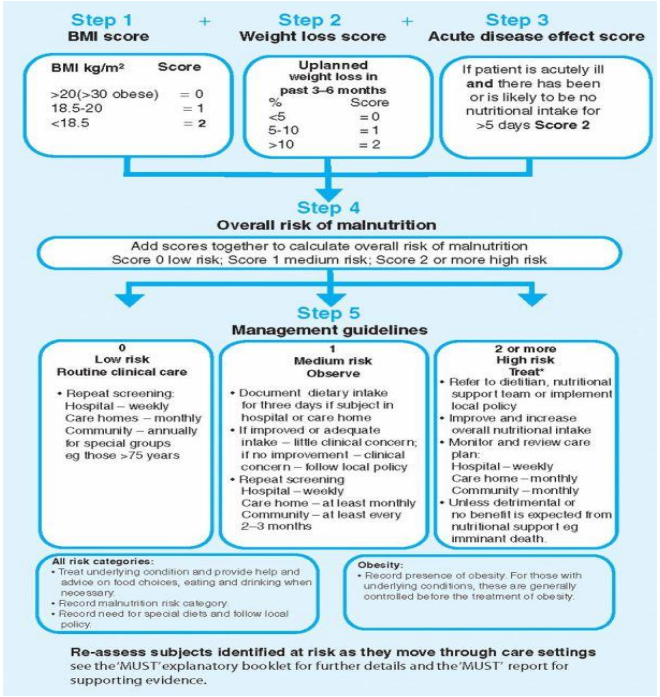

Figure 2. The Malnutrition Universal Screening Tool (MUST) BMI = body mass index and another reliable and easy to use tool is the mid-upper-arm circumference (MUAC) tape(7,8). Another plausible solution is to empower women by narrowing the

gender gap in literacy rate through educational programs.

The determinants of PEM are grouped into four major categories(4):

- Environmental factors including the physical and socioeconomic environment,
- Behavioral factors;
- Health-care service related; through poor monitoring of children's growth and limited resources.
- Biological factors; Child spacing, and there is certain range of age at which under-nutrition is likely to occur.
- Cultural factors - where a particular group of people is not allowed to take certain types of food, for instance children particularly girls stopped from eating eggs or women stopped from eating certain types of meat, be it a chicken, goat, or cows.

- Life styles - where certain groups of people are not allowed to eat meat perhaps influenced by religious beliefs, say for example vegetarianism without alternatives such as protein supplements. Much as the adults suffer to a great extent, the majority of sufferers on this group of people are the children because the choices are made by adults.

Source: Saunders J, Smith T. Malnutrition: causes and consequences. Clin Med (Lond) [Internet]. 2010 [cited 2022 Nov 12];10(6):624–7.

Micronutrient deficiencies (MNDs)

Sufficient intake of micronutrients is essential in ensuring normal metabolism and homeostasis. Deficiency of micronutrients has a detrimental effect on an organism, deficiency of some elements take time to manifest symptoms; nevertheless, prevention and early treatment is crucial in successful reversal of their purported damage.

- **Vitamins and trace elements**. The deficiency of vitamins and minerals in the diet has interconnected consequences. Those with serious consequences include zinc, iodine, iron and vitamin A deficiencies, a greater burden is seen in low-income countries; disproportionately affecting women of reproductive age and children(9–11). Other associated avitaminosis consequences include beriberi, rachitis, blindness, pellagra to mention a few.

Nutrition-related chronic diseases

- **Obesity** is objectively defined as a body mass index (BMI) ≥30 kg/m^2, and in pediatrics as a BMI ≥95th percentile(12). It results from an energy imbalance between calories consumed and the calories expended, creating an energy surplus and a state of positive energy balance resulting in excess body weight(13).
  Obesity is associated with a range of co-morbid conditions, including cardiovascular disease (CVD), gastrointestinal disorders, type 2 diabetes (T2D), joint and muscular disorders, respiratory problems, and psychological issues. Weight loss does contribute to a reduction in risk(14,15), although complex pathogenesis and interactions exist.
  Unfortunately, obesity is on the rise even in the developing countries(16,17). This represents a paradigm shift and it will have unforewarned outcomes in the nearest future if left unattended to.

Cardiovascular diseases (CVDs)

- Cardiovascular diseases (CVDs) are the leading cause of death globally(18). It includes the following conditions: ischemic heart disease, cerebrovascular disease, thromboembolism et cetera. The risk factors are broad with intricate interactions; some of the major ones are the environment (including socioeconomic status) and genetic predisposition. Hypertension, obesity and smoking are some of major risk factors for the development of CVDs(19).

Nutrition and cancers.

- Cancer is the second most important cause of death globally, after CVD. The environment has an important role to play in carcinogenesis, one aspect is diet, dietary antioxidants have been associated with a reduced risk of several cancers(20). As observed by Kolonel, a higher rate of colorectal cancer ensued Japanese migrants to Hawaii within the first generation(21). “It is now established that cancer is principally caused by environmental factors, of which the most important are tobacco; diet and factors related to diet, including body mass and physical activity; and exposures in the workplace and elsewhere.”(20)

2.Novel foods.

Novel food is defined as “food that had not been consumed to a significant degree by humans in the EU before 15 May 1997”(22). In that “Novel food can be newly developed, innovative food, food produced using new technologies and production processes, as well as food which is or has been traditionally eaten outside of the EU”(22), of course the concept can be applied outside Europe, as it generally looks at the foods that has no history of consumption and or not commonly used in a particular locality. Main issue with novel foods is with the transfer of allergic potential, for example the nut allergen which occurred in 1990s from the transgene encoding a protein from Brazilian nut (**Bertholletia excelsa**)(23). The importance of novel foods cannot be overstated, some have anticancer properties(24), especially functional food that is design to manage certain inborn disorders of metabolism such as Phenylketonuria (PKU) (25), and combat malnutrition(26).

Another way of looking at it is that, novel foods can be genetically modified organism (GMO) or non-genetically modified. Caution needs to be exercised when using GMO as the breadth of the engineering results are yet to be observed.

2.What is nutrigenomics?

The human genome project provided the world with a better understanding of our genetic makeup as humans; this has greatly contributed to the identification of genes that are associated with particular diseases also aided to the establishing of genetic risk factors. It has provided a base for nutrigenomics- which can be considered as a branch of science that investigates the interaction between nutrition and the genome. This is achieved through ‘omics’ technologies, commonly transcriptomics, proteomics and metabolomics and the consequences of these genes–proteins–metabolites interaction(27,28).

The three omics disciplines are seen together, and they complement each other.

Transcriptomics

Transcriptomics is the comprehensive analysis of the transcriptome(29); the complete set of all ribonucleic acid (RNA)-which are produced by the cellular process of transcription from the genomic template, in a cell, tissue or organism(30). There are two key contemporary techniques in the field: microarrays, which quantify a set of predetermined sequences, and RNA sequencing (RNA-Seq)(29). Overall, transcriptomics has broadened the understanding of gene expression, interaction and how they are interconnected.

Proteomics

Proteomics is the study of a large number of proteins in biological systems(31): the science about proteome. Wilkins et al.,(32) defined it as “PROTein complement of a genOME” generally understood as the study of the interactions, function, composition, and structures of proteins and their cellular activities. Although a proteome is a direct product of the genome- it can change under different conditions and often exceed the number of genes present(32). It is central in the understanding of disease mechanism and identification of novel diagnostic methods, this is crucial for early disease detection, prognosis and the monitoring of disease development(33).

Metabolomics

As component of “omics” technology, metabolomics uses advanced analytical chemistry and statistical methods in order to study the metabolome; defined as a complete collection of metabolites found in a given organism(34). It is of importance in diagnostics(35), agriculture for crop improvement(36) hence affecting public health subsequently.

Nutrigenomics is important in that it aids clinical research, and is central in public health promotion through precision healthcare and personalized

nutrition(37,38). The following is how this discipline is a requirement for public health:

- Nutrigenomics guides the understanding of how diet/ nutrients affect gene expression(39). This has also been demonstrated by Dahlman et al., in the down-regulation of genes following caloric restricted diets in a randomized study: they concluded that "Macro-nutrients have a secondary role in changes in adipocyte gene expression after energy-restricted diets. The most striking alteration after energy restriction is a coordinated reduction in the expression of genes regulating the production of polyunsaturated fatty acids."(40)

2.Conclusion

Deplorable evidence of malnutrition is well documented throughout the planet and in that a large section of the underprivileged population get it first. Novel foods seem to offer relief in order to combat the enigma; that of food insecurity and largely in the management of inborn errors of metabolism. However, care should be exercised when introducing these foods for consumption as some have been associated with the transfer of allergic potential.

The environment has an important role to play in disease progression. Much of enlightening information is pouring from the science of nutrigenomics which is interested in the study of nutrition and its impact on the human genome.

Conflict of interest statement

The authors in this write up have no conflict of interest on carrying out this piece of work.

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