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The Epidemiological Impact of Diet and Nutrition on Non-communicable Diseases: Insights into Over Nutrition and Undernutrition

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Author's contribution

The sole author designed, analyzed, interpreted and prepared the manuscript.

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Minireview Article

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ABSTRACT

Aims: To revisited the diet and nutrition based non-communicable diseases (NCD) with emphasize on undernutrition and over nutrition with its related factors

Discussion: The condition of weight related derangement such as unintentional weight loss or underweight, overweight and obesity are still a major NCD related health problem because these are rapidly emerging derangement in nutritional status from the epidemiological perspective. The paradox of nutrition transition shifts for global nutritional status due to excessive intake with sedentary lifestyle which occur since very early in life causing overweight and obesity, but on the other hand, undernutrition or even malnutrition due to insufficient intake and perhaps in combination with prolonged and persistent infection also happen. The burden persists, even keep raising, especially among vulnerable group of the community, namely women and children. Mostly, it is

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related to unhealthy dietary habits consists of overconsumption in sugar, saturated fat and cholesterol, and also salt, with restricted dose of vegetables and fruits. Once again, malnutrition is a silent but deteriorating condition which cover from undernutrition, overweight, and obesity. Nutritional imbalances can precipitate series of events consisting of insulin sensitivity which leads to insulin resistance, chronic oxidative stress, and its related inflammation- usually also happen chronic systemic and low grade, which can lead to NCD development.

Conclusion: From the epidemiology perspective, the persistent and even emerging diet and nutrition based NCD are important to tackle immediately because their effect, short and long term, which can affect the well being of vulnerable individuals, their community and even their country. Every preventive effort must be practiced by all stakeholder.

Keywords: Malnourished; overweight; malnutrition; Ultra-processed foods; cardiometabolic; co-infection.

1. INTRODUCTION

From an epidemiological perspective, noncommunicable diseases (NCDs) are a class of diseases with complex causes, long courses, and insidious onset. These diseases are a major health challenge in the 21st century, accounting for 74% of all deaths worldwide. NCDs are basically associated with five main risk factors: tobacco use, physical inactivity, unhealthy diets, harmful use of alcohol, and air pollution; but in this mini-review, discussion limited only to diet and nutrition based non-communicable diseases.

The main indicators of nutritional status, which measured using body mass index (BMI, formerly called the Quetelet index) (Zierle-Ghosh 2024), comprise the condition of weight related derangement such as unintentional weight loss or underweight, overweight and obesity (Weir 2024). Other condition related to nutrition is height related disorder namely short stature (Z-score of less than -2) (Rani et al. 2023). These are rapidly emerging derangement in nutritional status from the epidemiological perspective. The nutrition transition shifts for global nutritional status (Popkin 2006) can be divided into over nutrition related to excessive intake with sedentary lifestyle, which already started from younger age (Desalegn et al. 2023, Hanifah et al. 2023) while undernutrition or even malnutrition due to insufficient intake (Ersado 2023) and perhaps in combination with prolonged infection (Siagian 2023, Suryowati 2024). In some countries, there are paradox where both of these conditions took place at the same time (Soni and Singh 2018) and the burden keep raising, especially among vulnerable group of the community, namely women and children.

Global data revealed that roughly estimated one-third of the world's population is affected by malnutrition (Alem et al. 2023, Winichagoon and Margetts 2017), with more or less one billion individuals experiencing undernutrition due to insufficient intake of macronutrient (protein, carbohydrate) and also micronutrient consumption (Ahmad et al. 2023). There are some regions in the world which are battling the difficulty of the poor growth of children, deficiency of micronutrients but at the same time having adults with exceeding BMI (WHO 2024). The aim of this minireview is to revisited the epidemiological perspective regarding diet and nutrition based non-communicable diseases.

2. CURRENT SITUATION DIET AND NUTRITION BASED NON-COMMUNICABLE DISEASES

According to the 2023 WHO fact sheet (WHO 2023), Noncommunicable diseases (NCDs) morbidity roughly reach the number of 41 million individuals annually, it is equivalent to 74% of all deaths globally. Each year, 17 million individual mortalities due to NCD before reach the age 70; 86% of these premature deaths occur in low- and middle-income countries. Of all global NCD morbidity, 77% are happen in low- and middle-income countries.

There has also been an increase in trend of non-communicable disease (NCD) according to their populations which initially suffering undernutrition at the early stages of life, e.g., happened in early childhood (Soni et al. 2021) and whom their mothers suffering undernutrition before and during pregnancy (Arero 2022) and then turn to be overweight during adulthood, as this can be predicted (Field et al 2005).

An interesting phenomenon observed among children whose mothers were undernourished during pregnancy, there is increased risk of stunting during early life, but

then develop and suffer from non-communicable disease such as type 2 diabetes and eetven obesity during his/her adulthood life (Grey et al. 2021, Papathakis et al. 2016). Excessive and rapid weight gain in children (Arisaka et al. 2020) often associated to the elevated risk of cardiometabolic diseases (Arisaka et al. 2020, Chung et al. 2018) and uncontrolled obesity (Li et al. 2020, Lyons-Reid et al. 2021) later in life. Nutritional balance during pregnancy is very crucial (Marshall et al. 2022, Rees 2019) in order to avoid unwanted adverse pregnancy outcomes (Kibret et al. 2019) and the initial poor growth and development of children in the future (Papathakis et al. 2016, Marshall et al. 2022, Rees 2019).

Obesity among children and adults has definitely intensified and represents a global major health problem (Chesi et al. 2015). Prolonged exposure to unbalanced and unhealthy diet such as Ultra-processed foods (UPF) which contain low fibers but unfortunately enormous sugar, salt and fat (Mambrini et al. 2023) as one of the causative agent cardiometabolomic disease among adult. Greater exposure to UPF was associated with a higher risk of adverse health outcomes, especially cardiometabolic disease (Grey et al. 2021, Arisaka et al. 2020, Chung et al. 2018, Mambrini et al. 2023), certain mental health derangement such as depression and anxiety (Lane et al. 2022), and elevated mortality outcomes compares to other disease condition- a study measured those who consumed the highest amount of UPF had higher risk of mortality, for every 10 % of the energy intake from UPF consumption, an increase of 15 % in the hazard of all-cause mortality was observed (Ferreiro et al. 2021). All of these important results of different studies regarding diet and nutritional based non communicable disease are actually accommodate a rationale for future study regarding the development and evaluation of the effectiveness of using epidemiology approach (Khouri 2015) e.g., large population based study and in combination with public health measures, to aim and lessen or if possible to cut dietary exposure to ultra-processed foods for boosted daily human health status.

3. THE DANGER OF DIET AND NUTRITION BASED NON-COMMUNICABLE DISEASES

Unhealthy diets (Popkin 2006, Ahmad et al. 2023) and malnutrition (Ersado 2023, Alem et al 2023, Winichagoon and Margetts 2017, WHO 2024) are major risk factors for non-communicable diseases (NCDs), which are responsible for 71% of global deaths, annually (Khouri 2015). This invisible pandemic called NCDs (Bigna and Noubiap 2019, Piovani et al 2022) include several sedentary related diseases such as cardiovascular disease, some types of cancer, diabetes, hypertension, and stroke. Most of these disease related to unhealthy dietary habits (Al-Jawaldeh and Abbas 2022) are typically characterized by high ingredients in sugar (Witek et al. 2022), saturated fat and cholesterol (Billingsley et al. 2018), and also salt (Perera et al. 2023), and limited amount in daily consumption of vegetables and fruits (Woodside et al. 2023). Once again, malnutrition is a silent but deteriorating condition which cover from undernutrition, overweight, and obesity. Nutritional imbalances can precipitate series of events consisting of insulin sensitivity (Adeva-Andany et al. 2019) which leads to insulin resistance (Hirabara et al. 2023), chronic oxidative stress (Jiang et al. 2021), and its related inflammation- usually also happen chronic systemic and low grade (Ruiz-Nunez et al. 1013), which can lead to NCD development. A study reported that nutritional status in early life may also be related to future cardiovascular disease development (Alves et al. 2024). Cardiovascular disease risk factors, e.g., dyslipidemia, obesity, insulin resistance and hypertension, intensify the atherosclerotic process which begins in childhood and progresses throughout the life span (Guardamagna et al. 2012). The constant milieu of metabolic and neuroendocrine of the fetus is essential fetal programming in the formation of future body's "metabolic programming" (Alambert et al. 2017).

On the other hand, the problem of recurrent micronutrients deficiency is also global health importance (Bailey et al. 2015), especially in the low to middle income countries (Liu et al. 2022). Important micronutrients that may be insufficient or even deficient namely iron (Animasahun and Itiola 2021), folic acid or folate (Khan and Jialal 2024), vitamin A (Hodge and Taylor 2024), vitamin D (Scott and Ebeling 2019), zinc (Mohammad et al. 2023) and iodine (Lazarus 2015). These micronutrients are vital for the body to function properly (Bailey et al. 2015, Liu et al. 2022, Animasahun and Itiola 2021, Khan and Jialal 2024, Hodge and Taylor 2024, Scott and Ebeling 2019, Mohammad et al. 2023, lazarus 2015), and their deficiency can have serious health consequences (Animasahun and Itiola

2021, Khan and Jialal 2024, Hodge and Taylor 2024, Scott and Ebeling 2019, Mohammad et al. 2023, lazarus 2015). Micronutrient deficiencies are a global health concern especially among specific vulnerable group of the population namely the preschool-aged children and women of reproductive age (Stevens et al. 2022, Nainggolan and Siagian 2019); affecting >30% of the world's population or in number roughly reached 2 billion individuals (Han et al 2019). early-life nutritional deficiencies carry life-long effects arbitrated via numerous mechanisms such as aberrant metabolic shift which further become metabolic programming (Suryowati 2024, Patel and Srinivasan 2010), stunting (de Sanctis et al 2021), remodeled body composition (Kirolos et al 2024), and the shift in gut microbiome composition due to the diminished number of normal microflora (Hibberfd et al. 2017, Sunarti 2022). However, until recently, this is remaining unexplored in the condition of multiple micronutrient deficient host or even worse, in the condition of co-infection.

Such unwanted deficiencies may be the direct consequences of poverty related condition (Siddiqui et al. 2020), such as low income or low level socioeconomic (Durao et al. 2020), poor housing, water, sanitation and hygiene practice (Ghosh et al. 2021), insufficient health care especially in low resource setting (Elhady et al 2023), and poor diet in term of quantity or quality (Espinosa-Salas and Gonzales-Arias 2024), and these further exacerbate poverty through prevented optimal intellectual development, lost wages due to inability to achieve higher skill and increased health care costs that can significantly reduce earning potential (Caulfield et al 2006).

A deficiency of such micronutrients may also lead to poor pregnancy outcomes in vulnerable women (Marshall et al. 2020, Kibret et al. 2019, Nainggolan and Siagian 2019), poor growth and development in children (Siagian 2023, Soni et al. 2021, Papthakis et al 2016), and other health disorders, including poor vision (essential nutrients like Vitamin A, Vitamin B1 (thiamine), Vitamin B12, Vitamin C, Vitamin D, Vitamin E, Zinc, and Folate (Vitamin B9) in maintaining eye well-being) (Murkey et al 2023), goiter due to Iodine deficiency (Can and Rehman 2024), cutaneous lesions which can be seen manifested in skin, nail and hair (Dibaise and Tarleton 2019), and possibly mental conditions which according to Zilienska et al " in particular, deficiencies in B vitamins family, i.e., B1, B6, B9, and B12, have been linked to depression, as they are essential for neuronal function (Zilienska et al. 2023). They also have a protective effect against hypercysteinaemia, associated with an increased risk of mood disorders". Zinc deficiency also worth to mention because it is indispensable for the nucleic acid metabolism and stability for protein synthesis, gene expression, cell division, and enzyme activity. An imbalance in the diet may lead to mild-to-severe of these micronutrients and its association with metabolic properties among individuals, especially children and adolescents, which may possibly be also attributed to gender, age, race and are still need to be explored, thus warranting future studies on the topic.

Some aspects related or even possibly become the determinants and preventive measures for undernutrition must be carefully considered. The condition of poor nutritional outcomes in children might be prevented with optimal birth spacing, which according to Ntambara et al that longer birth intervals (≥24 months) are significantly associated with decreased risk of childhood undernutrition and that an optimum birth interval of 36–48 months might be appropriate to reduce the prevalence of poor nutritional outcomes in children, especially underweight (Ntambara et al. 2023). Governments responsiveness (Ajijola et al. 2023) through the family planning programs (Johson et al. 2021) and its related policies can actively apply policymaking in order to achieve better and healthier maternal and children.

4. CONCLUSION

From the epidemiology perspective, the persistent and even emerging diet and nutrition based NCD are important to tackle immediately because their effect, short and long term, which can affect the wellbeing of vulnerable individuals, their community and even their country. Preventive measures must always be practiced by all stakeholder.

DISCLAIMER (ARTIFICIAL INTELLIGENCE)

Author(s) hereby declare that NO generative AI technologies such as Large Language Models (ChatGPT, COPILOT, etc.) and text-to-image generators have been used during the writing or editing of this manuscript.

COMPETING INTERESTS

Author has declared that no competing interests exist.

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