Role Of Malnutrition Towards Predisposing The Population Towards Non-Communicable Diseases (Ncds)

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Abstract: Providing adequate quantities of nutritious and quality food is becoming a huge challenge in wake of exponential growth in human population. This is resulting in undernutrition of economically deprived populations across various countries. Increasingly it is being observed that undernutrition from an early age is aggravating the chances of onset and progression of several commonly occurring Non-communicable disease (NCD) conditions. On the other hand, malnutrition arising out of imbalanced diet is also increasing incidences of NCDs such as obesity. Thus, malnutrition is turning out to be one of the vital parameters that are contributing significantly towards shift in disease epidemiology from infectious to chronic non-infectious ones. This paper is aimed towards understanding and analysing some of the cause-and-effect relationships between malnutrition and a few commonly occurring NCDs.

Index Terms: Nutrition policy, Non-communicable disease (NCD), Malnutrition, Balanced diets, Lifestyle transitions

1 Introduction

Noncommunicable diseases (NCDs) are chronic in nature, having prolonged duration and slow progression. Major types of noncommunicable diseases include cardiovascular diseases (like heart attacks and stroke), cancer, chronic respiratory diseases (such as chronic obstructed pulmonary disease/COPD and asthma), obesity and diabetes. The number of occurences of various types of NCDs has been increasing alarmingly across the globe [1]. The situation is deteriorating faster in developing and underdeveloped countries [2]. Estimates indicate that by the year 2020, around 80 percent of the global disease burden will be contributed by NCDs alone [3], [4], [5]. It is also estimated that approximately 17% increase will be observed in NCDs worldwide, with 27% increase in the African subcontinent itself 5. Currently, 50% of deaths occuring in the Asian subcontinent are contributed by NCDs [5]. In moe specific terms, developing countries account for over 67% of all cancer deaths, 80% of diabetes and cardiovascular deaths, and 90% of COPD deaths [6]. The term malnutrition refers to any state of nutritional imbalance in the body. Such imbalance may arise either due to presence of excess energy, proteins or micronutrients (referred to as overnutrition) or their insufficient amounts (referred to as undernutrition) in the body. The imbalance develops to such an extent that it affects the tissue or body form in a negative manner and often results in a diseased state [7].

2 Materials and Methods

Epidemiological shift towards occurrence of non-communicable diseases across all economical sections has led to the understanding that many contributing factors have evolved over the past several decades. Malnutrition (both unavailability and excess availability of nutrients) is increasingly turning out to be one these significant contributing factors.

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This study searched for, reviewed and analyzed into various publications, articles and reports which provided evidence linking occurrence of different NCDs with dietary habits and diets.

3 Findings

3.1 Malnutrition in some major NCDs

Several studies have shown that a correlation exists between nutritional levels of the population and emergence of NCDs [8], [9], [10], [11]. One of them clearly mentioned that undernutrition, overnutrition and sedentary lifestyles are the three most important risk factors contributing to NCDs [10]. Majority of these increases have taken place because of changes in overall global environment which include economic growth, urbanization, cultural intermixing, introduction of Western foods, ease of commuting and workplace related changes (both physical activity and stress). It is worth mentioning that most of the ready-to-eat Western diets are extremely rich in harmful and unhealthy food components such as saturated fats, refined starches, w-6 rich oils, sugars, salts and aerated drinks. An increasing percentage of urban population of the middle-income-group nations has also got addicted to these diets owing to their ease of availability. This has led to a huge rise in the number of NCDs in these countries as these foods have been found to predispose a person towards this cluster of diseases. Several studies have supported this correlation and have shown that occurence of many NCDs such as cancer, diabetes, ashthma and cardiovascular diseases coroborates with higher levels of prostacyclins, thromboxanes and leukotrienes, all of which are present in significantly high quantities in these diets [11], [12], [13], [14] . On the other hand, it has been found that diets that are enriched with fruits, vegetables, nuts and olive oil have protective action against NCDs [15] (WHO, 2005). Protective role of fruits and vegetables has also been observed in patients suffering from myocardial infarction [16], [17], [18], [19].

3.2 Contributory factors of malnutrition in NCDs

3.2.1 Maternal malnutrition

This is a very vital parameter which has been found to play

significant role in predisposing the fetus towards NCDs [20]. Studies have shown that if the mother is deficient in micronutrients, such as vitamin B12, the newborn may be underweight at birth. In addition, he/she has a higher chance of developing diabetes, obesity or other NCDs in subsequent stages of life [21], [22], [23]. Overnutrition of the mother has also been found to be harmful as it increases chances of the child becoming obese in future [24]. The situation is worsened by the fact that majority of pregnant women do not follow the dietary recommendations suggested by the healthcare facilities [25].

3.2.2 Paternal diet

Although most of the available reports have highlighted the importance of maternal nutritional status, some recent studies have also been able identify the significance of paternal nutritional status in this context. One of these studies has identified paternal diet and health as contributory factors towards health of the offspring [26].

3.2.3 Lifestyle and behavioural malnutrition

Most of the lifestyle and behavioural patterns of individuals are influenced by their surroundings, and develop during early childhood and adolescent days. These include getting addicted to unhealthy diets, avoiding physical activities and attraction towards alcohol/smoking. All of them increase the risk of developing NCDs [27], [28]. Moreover, breastfed infants have been found to be at lower risk of suffering from obesity and diabetes in adulthood. Diets deficient in iron and vitamins as well as those emulating Western recipes increase the chances of occurence of obesity in future [29], [30].

3.2.4 Epigenetic factors

Role of epigenetic regulation in context of predisposing an individual towards NCDs is still poorly understood. Some significant level of research has started in this direction recently. Contributions from these studies have indicated that maternal factors can show epigenetic modulation of fetal genes [31], [32]. Maternal malnutrition has been reported to alter methylation pattern of genes of the offspring to the extent of predisposing the offspring to metabolic syndrome in future [33]. Moreover, exposure to mother's gestational diabetes during prenatal life has been found to alter epigenetic imprint of the fetus and make the individual more prone towards type2 diabetes in adulthood [34]. This notion has also been supported by animal model studies wherein epigenetic alterations favouring predisposition towards NCDs could be reversed by providing folic acid supplements during pregnancy [35]. Interestingly, it has recently been reported that MIR168a, a microRNA present in very high quantities in rice, has capability of inhibiting a protein which can remove low-density lipoproteins (LDLs) from blood [36].

4 INTERVENTION STRATEGIES

4.1 Nutritional Supplementation

During pregnancy, supplementation of vitamin deficiencies by administration of vitamin supplements and micronutrients have been found to be beneficial to both mother and child [37]. Significantly, a nutrient supplementation project named Mumbai Maternal Nutrition Project (MMNP) and undertaken in India has shown very promising results. In this project, providing a nutrient-rich healthy snack to pregnant women was found to reduce gestational diabetes in pregnant women to a large extent [38].

4.2 Behavioural and lifestyle related changes

Majority of the underdeveloped and developing countries are plagued by the fact that a huge gap exists in awareness levels in the society, both in context of education and health. The problem is aggravated by the fact that the female members, who should have been empowered maximally, are generally most deprived. It has been seen that self-efficacy is lowest among women belonging to disadvantaged sections and they have also been found to have most unhealthy food habits and other addictions [39], [40]. However, promising results have been obtained from those interventions on women of such backgrounds which highlighted the risk-benefit situations of using healthy food habits and behavioural practices [41], [42], [43]. According to The International Federation of Gyanecology and Obstetrics (FIGO), adopting healthy practices before conceiving can help to tackle the issue of maternal malnutrition effectively and provide downstream benefits to the offsprings too [44]. Several intervention programmes have also been launched for generating healthy dietary habits among adolescents and young adults and the results are quite promising [45], [46].

4.3 Better nutritional policies

It is well known that excellent health is a manifestation of having a well-balanced diet. Accordingly, a food and nutritional policy has been developed and recommended by WHO, International College of Nutrition and International College of Cardiology. The main components of this policy include collating comprehensive information on nutrition, understanding the contribution of each of the nutritional components in context of health, involving healthcare workers in the process of altering diet and lifestyle patterns of patients, designing and implementing effective surveillance mechanisms for monitoring of food intake pattern, nutritional status, physical activity status and behavioural patterns of individuals [8], [9], [10], [11].

4.4 Better healthcare facilities and national policies

Keeping in view the alarming rate at which the NCDs are affecting people worldwide, the existing healthcare facilities must be equipped with infrastructural amenities so that they can take care of the patients from the initial stages. Healthcare personnel should also be trained so that they can be utilized as resources for disseminating awareness about healthy food habits and lifestyle at local levels. This approach, if successful, can also help in reducing the number of incidences of NCDs.
Government policies about food production, import of food materials, awareness programs on NCDs and resource allocation in proportion to burden of diseases would also prove highly beneficial.

5 CONCLUSION

Non-communicable diseases (NCDs) are expanding their spread rapidly causing higher morbidity and mortality than the infectious diseases. The situation is most grim in LMICs (Low-middle-income countries). Malnutrition has been identified as one of the major factors contributing towards onset and progression of NCDs. Thus, appropriate awareness and intervention strategies aimed towards minimising the damage

being done by malnutrition related issues is of prime importance.

CONFLICT OF INTEREST

None declared.

REFERENCES

[1] Terzic and Waldman S. Chronic diseases: the emerging pandemic. Clinical and translational science; 4(3): 225–226: (2011)

[2] D.O. Abegunde, C.D. Mathers, T. Adam, M. Ortegon and K. Strong. The burden and costs of chronic diseases in low-income and middle-income countries. Lancet; 370(9603): 1929–1938: (2007)

[3] Mathers C. D., Loncar D. Projections of Global Mortality and Burden of Disease from 2002 to 2030. Plos Medicine; 3(11): e442: (2006)

[4] Geneau R., Stuckler D., Stachenko S., McKee M., Ebrahim S., Basu S., Chockalingham A., Mwatsama M., Jamal R., Alwan A. Raising the priority of preventing chronic diseases: a political process. Lancet; 376(9753):1689–169: (2010)

[5] World Health Organization: Global action plan for the prevention and control of noncommunicable diseases 2013-2020. In. Edited by WHO. Geneva, Switzerland: WHO: 55: (2013)

[6] Fuster V., Kelly B. B., Vedanthan R. Promoting Global Cardiovascular Health Moving Forward. Circulation; 123(15):1671–1678: (2011)

[7] Stratton R. J., Green C. J., Elia M. Scientific criteria for defining malnutrition Disease-Related Malnutrition. An Evidence Based Approach to Treatment CABI Publishing Wallingford: (2003)

[8] WHO Study Group. Diet, Nutrition and Prevention of Chronic Diseases, WHO, Geneva: (1990)

[9] Joint WHO/FAO Expert Consultation. Diet, Nutrition and the Prevention of Chronic Diseases, WHO, Geneva, WHO Technical Report Series; 916: (2003)

[10] Singh R. B., Pella D., Mechirova V., et al. Prevalence of obesity, physical inactivity and undernutrition, a triple burden of diseases during transition in a developing economy. The Five City Study Group. Acta Cardiologica; 62: 119-127: (2007)

[11] Singh R. B., De Meester F., Pella D., Basu T. K., Watson R. Globalization of dietary wild foods protects against cardiovascular disease and all cause mortalities? A Scientific statement from the International College of Cardiology, Columbus Paradigm Institute and the International College of Nutrition. Open Nutraceuticals Journal; 2: 42-45: (2009)

[12] Simopoulos, A. Essential fatty acids in health and chronic diseases. American Journal of Clinical Nutrition; 70(Suppl 3): 560-69s: (1999)

[13] Simopoulos A. P. The importance of the ω-6/ω-3 fatty acid ratio in cardiovascular diseases and other chronic diseases. Experimental Biology and Medicine; 233: 674-88: (2008)

[14] Toda E., Toru T., Singh R. B., et al. Effects of Paleolithic-style diet with emphasis on ω-6/-3 fatty acids ratio on coronary artery disease: the tissue is the issue. American Medical Journal; (2012)

[15] World Health Organization. Preventing Chronic Disease: A Vital Investment World Health Organization, Geneva; (2005)

[16] Fung T. T., Chiuve S. E., McCullough M. L., Rexrode K. M., Logroscino G., Hu F. B. Adherence to DASH- style diet and risk of coronary heart disease and stroke in women. Archives of Internal Medicine; 168: 713-720: (2008)

[17] Knoops K. T. B., de Groot L. C., Kromhout D., et al. Mediterranean diet, lifestyle factors and 10-year mortality in elderly European men and women. The HALE project. The Journal of the American Medical Association; 292: 1433-1439: (2004)

[18] He F. J., Nowson C. A., Lucas M., MacGregor G. A. Increased consumption of fruit and vegetables is related to a reduced risk of coronary heart disease: meta-analysis of cohort studies. Journal of Human Hypertension, 21: 717-728: (2007)

[19] Heidemann C., Schulze M. B., Franco O. H, et al. Dietary patterns and risk of mortality from cardiovascular disease, cancer, and all causes in a prospective cohort of women. Circulation; 118: 230-237: (2008)

[20] Morton S.B. Maternal nutrition and fetal growth and development. In Developmental Origins of Health and Disease; Gluckman, P.D., Hanson, M.A., Eds.; Cambridge University Press: Cambridge, UK; 98–129: (2006)

[21] Gluckman P.D., Seng C.Y., Fukuoka H., Beedle A.S., Hanson M.A. Low birthweight and subsequent obesity in Japan. Lancet; 369: 1081–1082: (2007)

[22] Black R. E., Allen L. H., Bhutta Z. A., Caulfield L. E., de Onis M., Ezzati M., Mathers C., Rivera J. Maternal and child undernutrition: Global and regional exposures and health consequences. Lancet; 371: 243–260: (2008)

[23] Yajnik C. S., Deshpande S. S., Jackson A. A., Refsum H., Rao S., Fisher D. J., Bhat D. S., Naik S. S., Coyaji K. J., Joglekar C. V., et al. Vitamin B12 and folate concentrations during pregnancy and insulin resistance in the offspring: The Pune Maternal Nutrition Study. Diabetologia; 51: 29–38: (2008)

[24] Robker R. L., Akison L. K., Bennett B. D., Thrupp P. N., Chura L. R., Russell D. L., Lane M., Norman R. J. Obese women exhibit differences in ovarian metabolites, hormones, and gene expression compared with moderate-weight women. Journal of Clinical Endocrinology and Metabolism; 94:1533–1540: (2009)

[25] Inskip H. M., Crozier S. R., Godfrey K. M., Borland S. E., Cooper C., Robinson S. M. Women's compliance with nutrition and lifestyle recommendations before pregnancy: General population cohort study. BMJ (Clinical Research); (2009)

[26] Radford E. J., Ito M., Shi H., Corish J. A., Yamazawa K., Isganaitis E., Seisenberger S., Hore T. A., Reik W., Erkek S., et al. In utero effects. In utero undernourishment perturbs the adult sperm methylome and intergenerational metabolism. Science (New York, NY); 345: 1255903: (2014)

[27] World Health Organisation. Global Health Risks: Mortality and Burden of Disease Attributable to Selected Major Risks; World Health Organisation: Geneva, Switzerland: (2009)

[28] Ezzati M., Riboli E. Behavioral and Dietary Risk Factors for Noncommunicable Diseases. New England Journal of Medicine; 369: 954–964: (2013)

[29] Kramer M. S., Kakuma R. Optimal duration of exclusive breastfeeding. The Cochrane Database of Systematic Reviews; (2002)

[30] Hauck F. R., Thompson J. M., Tanabe K. O., Moon R. Y., Vennemann M. M. Breastfeeding and reduced risk of sudden infant death syndrome: A meta-analysis. Pediatrics; 128: 103–110: (2011)
[31] Gluckman P. D., Hanson M. A., Cooper C., Thornberg K. L. Effect of In Utero and Early-Life Conditions on Adult Health and Disease. New England Journal of Medicine; 359: 61–73: (2008)
[32] Gluckman P. D., Hanson M. A., Bateson P., Beedle A. S., Law C. M., Bhutta Z. A., Anokhin K. V., Bougneres P., Chandak G. R., Dasgupta P., et al. Towards a new developmental synthesis: Adaptive developmental plasticity and human disease. Lancet; 373: 1654–1657: (2009)
[33] Heijmans B. T., Tobi E. W., Stein A. D., Tobi E. W., Stein A. D., Putter H., Blauw G. J., Susser E. S., Slagboom P. E., Lumey L. H. Persistent epigenetic differences associated with prenatal exposure to famine in humans. Proceedings of National Academy of Sciences of the United States of America; 105: 17046–17049: (2008)
[34] Darnton-Hill I., Nishida C., James W. P. A life course approach to diet, nutrition and the prevention of chronic diseases. Public Health Nutrition; 7: 101–121: (2004)
[35] Godfrey K. M., Sheppard A., Gluckman P. D., Lillycrop K.A., Burdge G. C., McLean C., Rodford J., Slater-Jefferies J. L., Garratt E., Crozier S. R., et al. Epigenetic gene promoter methylation at birth is associated with child's later adiposity. Diabetes; 60: 1528–1534: (2011)
[36] Zhang L., Hou D., Chen X., et al. Exogenous plant MIR168a specifically targets mammalian LDLRAP1: evidence of crosskingdom regulation by microRNA. Cell Res; 22: 107-126: (2012)
[37] De-Regil L. M., Palacios C., Ansary A., Kulier R., Pena-Rosas J. P. Vitamin D supplementation for women during pregnancy. The Cochrane Database of Systematic Reviews; (2012)
[38] Potdar R. D., Sahariah S. A., Gandhi M., Kehoe S. H., Brown N., Sane H., Dayama M., Jha S., Lawande A., Coakley P. J., et al. Improving women's diet quality preconceptionally and during gestation: Effects on birth weight and prevalence of low birth weight—A randomized controlled efficacy trial in India (Mumbai Maternal Nutrition Project). American Journal of Clinical Nutrition; 100: 1257–1268: (2014)
[39] Barker M., Lawrence W., Skinner T., Haslam C., Robinson S., Inskip H., Margetts B., Jackson A., Barker D., Cooper C. Constraints on food choices of women in the UK with lower educational attainment. Public Health Nutrition; 11: 1229–1237: (2008)
[40] Greaves C. J., Sheppard K. E., Abraham C., Sheppard K. E., Abraham C., Hardeman W., Roden M., Evans P. H., Schwarz P. Systematic review of reviews of intervention components associated with increased effectiveness in dietary and physical activity interventions. BMC Public Health; (2011)
[41] Baird J., Cooper C., Margetts B. M., Barker M., Inskip H.M. Changing health behaviour of young women from disadvantaged backgrounds: Evidence from systematic reviews. Proceedings of the Nutrition Society; 68: 195–204: (2009)
[42] Michie S., Jochelson K., Markham W. A., Bridle C. Low-income groups and behaviour change interventions: A review of intervention content, effectiveness and theoretical frameworks. Journal of Epidemiology and Community Health; 63: 610–622: (2009)
[43] Phelan S. 2010. Pregnancy: A "teachable moment" for weight control and obesity prevention. American Journal of Obstetrics and Gynecology; 202: 135.e1–135.e8: (2010)
[44] Hanson M. A, Bardsley A., De-Regil L. M., Moore S. E., Oken E., Poston L., Ma R. C., McAuliffe F. M., Maleta K., Purandare C. N., et al. The International Federation of Gynecology and Obstetrics (FIGO) recommendations on adolescent, preconception, and maternal nutrition: "Think Nutrition First". International Journal of Gynaecology and Obstetrics; 131: S213–S253: (2015)
[45] Draper C. E., Micklesfield L. K., Kahn K., Tollman S. M., Pettifor J. M., Dunger D. B., Norris S. A. Application of Intervention Mapping to develop a community-based health promotion pre-pregnancy intervention for adolescent girls in rural South Africa: Project Ntshembo (Hope). BMC Public Health; (2014)
[46] Okorodudu D. E., Bosworth H. B., Corsino L. 2015. Innovative interventions to promote behavioral change in overweight or obese individuals: A review of the literature. Annals of Medicine; 47: 179–185: (2015)