Large scale food fortification in Nigeria: Opportunities and challenges: A position of the Nutrition Society of Nigeria

ABSTRACT

Food fortification is widely identified as a cost-effective strategy for addressing micronutrient malnutrition at scale. In Nigeria, food fortification with a focus on vitamin A, iron, zinc, iodine, and other micronutrient remains a major thrust of the effort to eliminate micronutrient malnutrition. Though the step is laudable, the persisting high burden of micronutrient malnutrition suggests the need to re-think the design and implementation of the fortification programmes. This re-thinking and revision of strategy are premised on various conditions including irregular food consumption data and changing dietary patterns, poor awareness of the benefits of fortified foods, poor compliance to fortification standards, and lack of functional information system on food fortification, among others.

Based on the current understanding of the nutrition and food fortification landscape in Nigeria, the Nutrition Society of Nigeria affirms that large-scale food fortification remains a cost-effective strategy to promote a healthy diet and adequate micronutrient intakes and commends the efforts of the various stakeholders especially the development partners and the government's promotion of enabling environment. However, re-thinking the implementation strategy and overhauling the fortification programme to ensure quality, transparency, and possibly digital transformation that can meet real-time data needs to guide decision-making is essential. Thus, it is necessary to ascertain the commonly consumed foods, the usually consumed portion sizes, and the current coverage of the various national micronutrient deficiencies interventions; strengthen social marketing programmes on proper handling and use of fortified foods; improve enforcement of compliance to fortifications standards; strengthen National Nutrition Information Management System to include food fortification information; explore strategies to increase the affordability of the premixes, and develop and implement a Monitoring and Evaluation framework of food fortification programmes.

Keywords: Food fortification, Micronutrient deficiencies control, Regulatory framework, Malnutrition

INTRODUCTION

Nigeria, with an estimated population of over 200 million people, is blessed with abundant human and natural resources. However, the country is listed among nations with a low human development index based on inadequate infrastructural development and a high level of poverty. At the World Bank income poverty threshold of US$3.20 per day, about 71% of Nigerian live below the poverty level [1]. Also, only 26.5% of the population has access to improved water sources and sanitation facilities [2]. In addition, Nigeria has the second highest burden of child mortality globally with about 844,321 deaths annually and an under-five mortality rate of 113.8 per thousand [3].

Malnutrition presently contributes to an estimated 45% of deaths among children under five years of age in developing countries including Nigeria [4]. It also increases children's risk of death from diseases such as malaria, measles, diarrhoea, and pneumonia [5]. Yet, progress in reducing the burden of malnutrition is very slow. Currently, one in three Nigerian children are stunted (too short for their age), and more than half of these children are severely stunted while 7% of the children suffer from wasting [6]. Consequences of stunting include increased morbidity and mortality, poor child development and learning capacity, increased risk of infections and non-communicable diseases, insulin

resistance and a higher risk of developing diabetes, hypertension, dyslipidemia, lowered working capacity and unfavourable maternal reproductive outcomes in adulthood [4, 7-8]. In addition, the high level of malnutrition impedes household and community development and perpetuates household poverty, thereby undermining the poverty alleviation programme of the Government. Undernutrition can lead to lifelong consequences, increasing the risk of impaired physical and cognitive development, and diminished productive capacity.

Micronutrient deficiencies cause 7.3% of the global burden of disease with iron and vitamin A deficiencies among the 15 leading causes of diseases worldwide [9]. Though there is a dearth of recent national data on vitamin A deficiency, less than half (46.3%) of Nigerian under-five children received vitamin A supplements and 41.3% consumed iron-rich foods [6]. About 30% of Nigerian children are affected by vitamin A deficiency (VAD), defined as serum retinol <0.70 mol/L [10]. Vitamin A Deficiency has been implicated in restricted growth, impaired immune response, and increased susceptibility to infections [11]. This is particularly germane at this period of the pandemic when vitamin A depletion is higher following COVID-19 infection [12]. Iron deficiency anaemia is a public health problem affecting 68% of under-five Nigerian children and 58% of women of reproductive age [6]. This may be connected to poor dietary practices among children with only 21.8% meeting the minimum dietary diversity, 23.9% meeting the required minimum meal frequency and 10.8% meeting the minimum adequate diet [6]. Likewise, pockets of studies have shown an increase in the prevalence of zinc deficiency from 20% in 2006 [10] to over 30% [13,14]. The high prevalence of diarrhoea in Nigeria at 13% further attests to an indication of high zinc deficiency among Nigerian children. Zinc deficiency is a risk factor with adverse long-term consequences on growth, immunity, and metabolic status [15]. These levels of micronutrient malnutrition are driving morbidity and mortality and generating economic losses equivalent to an estimated US$1.5 billion in GDP [16-17].

National Response to Addressing Micronutrient Malnutrition

Poverty in Nigeria is both an outcome and consequence of the high burden of malnutrition. This understanding forms the premise on which the Federal Government of Nigeria launched the National Policy on Food and Nutrition and Multisectoral Plan of Action on Nutrition, which is now incorporated as a Chapter under the Human Capital Development part of the National Development Plan (NDP) 2021-2025 [17]. The focus is to address the priority nutrition problems including extreme hunger across different sectors and different levels of Nigerian society at individual, household and community levels. The lofty goal was to reduce malnutrition by 50% in five years, however, periodic reports and studies have shown that the magnitude and dimensions of malnutrition are widening particularly micronutrient malnutrition [6, 18].

Several efforts have been directed at reducing the burden of micronutrient malnutrition in Nigeria, however, little progress has been made. Such efforts include the use of behavioural change communication in promoting appropriate dietary practices, supplementation, dietary diversification, and food fortification. The Federal and States Ministries of Information, Health, Agriculture and Rural Development, related agencies and parastatals, Academia, Nutrition Society of Nigeria and crops of development partners and Non-Governmental Organizations drive behavioural change communications and nutrition education across the nooks and crannies of Nigeria. Though this is not presently regulated, the National and States Committees on Food and Nutrition are generally assumed to have oversight functions to ensure the correctness and timeliness of information shared with the masses.

Supplementation especially for women of reproductive age, pregnant women and children under five years constitute an important component of health care provision through the health facilities and sometimes community outposts across Nigeria. Vitamin A supplementation for children and iron folate supplementation for women are part of routine services in public health facilities and are also administered as components of Maternal Newborn and Child Health week in May and November every year. Despite these services, many children and women of reproductive age remain unreached and are therefore missing out on the supplementation programme.

Dietary diversification is regarded as the most sustainable and cost-effective strategy to control malnutrition. The preponderance of poor dietary diversity in Nigeria is a pointer to inadequate micronutrient intake. Several strategies are being deployed to address this challenge including the promotion of homestead, school and community gardening, food demonstration to showcase efficient use of locally available but underutilised

foods and ingredients, and promotion of nutrition corners in health facilities, among others. The recently concluded food systems dialogues of the United Nations also emphasised the need to promote dietary diversification and recommended the adoption of homestead gardening to improve households' access to varieties of plant and animal source foods. Currently, many states are resuscitating the school gardening project as a strategy to promote young people's interest in food production and enhance skilled-based nutrition education in schools.

Food fortification, in which essential micronutrients are added during food processing, has been widely identified as a cost-effective strategy for addressing micronutrient malnutrition at scale. Food fortification is the industry or largely private sector-driven approach to control micronutrient deficiencies. It is one of the most appropriate preventive, sustainable and cost-effective strategies for preventing micronutrient malnutrition [19-21]. Evidence from other parts of the world have demonstrated improvement in maternal and child nutrition following food fortification including improved hematologic markers in children and women of the reproductive age [22], declined cases of anaemia in children and women [23], reduced incidence of neural-tube disorders [22], enhanced serum micronutrients levels [24] and reduced prevalence of vitamin A deficiency and anaemia [25].

Policy and Regulatory Framework for Micronutrient Fortification

The provision of access to vitamin A-fortified foods to the majority of children and mothers would remain a major thrust of the effort to eliminate VAD in Nigeria. Following a benchmark survey in 1995, wheat/corn flour, sugar and vegetable oil were identified as the vehicles for fortification with vitamin A because of their relative affordability, accessibility, and technical feasibility [26-27]. Fortification of these food vehicles is cost-effective, sustainable and capable of achieving high coverage, as even the most vulnerable population uses at least one of the vehicles daily, and there are effective distribution channels. Indeed, there is a strong case for food fortification because it could be practiced at three levels (household, community and industrial), and is able to have a wider reach of the vulnerable groups.

The Ministry of Industry (under the Standards Organization of Nigeria - SON) has published standards for vitamin A in flour, sugar, and vegetable oil [27]. The development process of the standards involved all stakeholders at every step. Indeed, effective implementation of fortification with vitamin A started on September 1, 2002. This has been complemented with quality control by the National Agency for Food and Drugs Administration and Control (NAFDAC). The Government has substantially improved its capacity to regulate and control the market.

Food fortification in Nigeria has been given a high profile and relies on private sector implementation, drawing lessons from the success of the universal salt iodization. A combination of social marketing techniques and enforcement of quality standards will ensure effective demand for such products. It is hoped that 70% coverage of the target population (under-fives, pregnant women, and lactating mothers) with fortified flour, oil, and sugar will be achieved nationwide by 2025. In addition to mandatory fortification, voluntary and market-driven fortification is also popular and covers food items such as bouillon cubes, seasoning agents, water, drinks, beverages, and many other processed foods. In addition, the Federal Government supports targeted fortification with the use of multiple micronutrient powder as part of the micronutrient deficiency control strategy. Multiple micronutrient powders are single-dose packets of vitamins and minerals that can be mixed with home-prepared food without changing the dietary habits of children. It reduces the risk of anaemia, iron and vitamin A deficiencies and also eliminates several other micronutrient deficiencies. Despite this plethora of interventions, micronutrient malnutrition has remained an intractable problem in Nigeria.

Reflections on Nigeria's mandatory fortification programme

Mandatory food fortification is the Federal Government's effort to promote the addition of essential micronutrients to staple foods during processing. This was based on the evidence that large-scale food fortification is a cost-effective way to deliver micronutrients to population groups at scale and address micronutrient deficiencies. Nigeria's giant stride in this direction since the 1990s has ensured salt iodization, and mandatory fortification of sugar, vegetable oils, wheat and maize flour with micronutrients (Vitamin A, zinc, iron, folate). Though the step is laudable, the persisting high burden of micronutrient malnutrition suggests the need to

re-think the design and implementation of the large-scale fortification programme in Nigeria. This re-thinking and revision of strategy are premised on various conditions including changing dietary patterns, poor awareness of the benefits of fortified foods, and poor compliance to fortification standards, among others. Some reflections on how fortification has not effectively addressed micronutrient malnutrition in Nigeria are highlighted below.

• **Irregular food consumption data and changing dietary patterns**

Since 1995 when the food consumption survey was conducted to identify potential food vehicles for the fortification programme, no follow-up survey has been conducted despite the obvious change in the dietary pattern of the population. The identified food vehicles, flour, sugar and vegetable oil consumption have witnessed tremendous modification and price volatility that affected consumers' behaviour. Flour for example has witnessed policy change that mandates partial substitution of wheat with cassava flour, yet, how this modification has impacted on vitamin A content of common flour-based food products remains unclear. In a study among children in Ibadan, none of the mandatorily fortified foods made the top ten of the most consumed foods except biscuit, a flour product [28]. Likewise, a Global Alliance for Improved Nutrition (GAIN) commissioned project found that compliance level with the set fortification standards of fortified wheat flour, maize flour, vegetable oil and sugar was 22.3%, 25.0%, 29.5% and 92.0%, respectively [26]. This is a reflection that the consumption of most of the food vehicles is limited and the need for a holistic food consumption survey among the various population groups in Nigeria to ascertain the suitability of the current food fortification vehicles in Nigeria. The 2021 national food consumption and micronutrient survey offer the opportunity to ascertain such information and further mining of the survey data is essential.

• **Poor sensitization on the consumption of fortified foods**

A study on awareness of vitamin A fortified foods in Nigeria has shown that just about 50 per cent of the population were aware of vitamin A fortified foods [26]. The low level of awareness of vitamin A fortified foods also calls for an effective social marketing strategy to promote increased consumption of these foods. It is important to sensitize the consumers about the existence and the benefits of fortified foods. Parts of the efforts to sensitize the consumers may include the development of logos for easy identification of the various fortificants and their physiological benefits. Though some food companies are already engaging in this, strengthening, and driving behaviour change to increase consumption of fortified foods may serve as an incentive to promote compliance among the food fortification stakeholders. Some beverage producing companies in Nigeria emphasized fortification as a marketing strategy to attract consumers' patronage. Another set of stakeholders that requires sensitization is the retailers. Handling and storage conditions are known to affect the stability of fortificants; thus, the retailers need to be educated on the proper handling, keeping conditions and other factors that are necessary to ensure the stability of the fortificants and ensure optimum benefits for the consumers.

• **Poor compliance with fortification Standards**

Evidence has shown there are challenges in enforcing compliance with fortification standards and post-factory handling of fortified foods which leads to rapid loss of nutrients, limited consumption of fortified foods and changing food consumption patterns [29-30]. Market-driven fortification of bouillon cubes remains widespread in Nigeria and about 80% of Nigerian households utilize bouillon cubes [31].

], yet it remains unregulated, and no standard has been set or agreed upon. This gap put Nigerian households at the instance of the manufacturers.

• **Lack of functional information system on food fortification**

Effective Large Scale Food Fortification (LSFF) rely on the availability of legislation, standards and regulations, industry fortification, regulatory monitoring and enforcement at imports (including premix monitoring), production and commercial levels, and consumer awareness and consumption of fortified foods. Some of these measures have been put in place in Nigeria however, implementation efficiency differs. Global best practices include the availability of functional information management systems. In Nigeria, there is a lack of up-to-date authoritative data on the compliance status of the mandated food products due to gaps in regulatory monitoring. Stakeholders need to agree on a standard methodology to determine fortification compliance to facilitate data comparison across

agencies and promote data harmonization and coordination. Data is required to demonstrate the progress and impact of food fortification and identify the existing gaps to guide decisions on LSFF in Nigeria. Data needs include the prevalence of micronutrient deficiencies, data on compliance with fortification standards for iron and B vitamins, and population reached with fortified foods. Nigeria also needs data on the premix supply landscape to estimate volume, quality, and key stakeholders.

There are opportunities to access data on the prevalence of micronutrient deficiencies through the ongoing National Food Consumption and Micronutrient Survey. Perhaps the survey will also show patterns of consumption of fortified foods in Nigeria. Harmonized efforts from stakeholders are required to ensure unified and open access to compliance data on food fortification in Nigeria. The state of the nation report on the status of large-scale food fortification in Nigeria, which is underway and led by the Global Alliance for Improved Nutrition, offers a potential opportunity to review available compliance data on food fortification. The Nutrition Society of Nigeria (NSN) can contribute to the generation of such a report by offering research and analytical experience to guide the process.

· Increasing the number of food fortification vehicles

A key feature of the nutrition situation in Nigeria is the wide disparity in the burden and severity of malnutrition across the geopolitical zone and along the rural-urban divide. It is widely known that the rural population largely rely on their production and local processing for the bulk of the food intake and as such large proportion of the rural residents in Nigeria may miss out of the benefits of a large-scale food fortification programme. It is therefore expedient to re-evaluate the food fortification programme in Nigeria to ensure optimum benefits for the rural population. In African countries like Malawi, Tanzania, and Senegal, a community-based or hammer mill fortification system has been successfully deployed which ensures micronutrient deficiencies control among the population that relies on locally processed foods [32] This is important at this time when self-sufficiency in food production is being promoted.

Presently, locally produced rice constitutes about 57% of total rice consumption in Nigeria [33], the increasing local production and acceptance by consumers provide a veritable platform for the use of rice as a food fortification vehicle in Nigeria. Other common foods such as cassava-based and cereal-based staples are not centrally produced and could benefit from hammer mill fortification. It is noteworthy that water fortification with zinc has been demonstrated in Nigeria, and a policy framework to increase the use of water to drive zinc fortification could be strengthened.

In a similar vein, the need to redefine the micronutrients of public health importance in Nigeria is germane. Traditional use of vitamin A, iron, zinc and iodine is acceptable but studies across the country have shown inadequate intakes of several other micronutrients []. The ongoing food consumption and micronutrient survey in Nigeria may be useful in identifying other micronutrients that are largely inadequate in the diets of Nigerians to expand the list of nutrients to be considered for food fortification programmes.

· Lack of a sustainable system for the local production of premix

One of the challenges of LSFF in Nigeria is the lack of a sustainable system for the local production of premix due to the cost of acquiring the required technology. Therefore, many manufacturers of fortified foods rely on imported vitamins and mineral premix and limited local suppliers. The high cost of tariffs and taxes, bureaucratic bottlenecks in clearing the micronutrient supplies, and high and fluctuating foreign exchange of Naira drive up the landing cost of the premix and invariably food fortification cost. There are concerns about the quality of both imported and locally manufactured premixes with very limited regulatory capacity and oversight to assess premix quality. There are also challenges with regulating monitoring and enforcement of food fortification standards in Nigeria due to poorly resourced agencies and a lack of functional institutional process compliance and quality monitoring along the import, production and distribution chain.

Recommendations

Large-scale food Fortification is an important strategy to promote a healthy diet and adequate micronutrient intakes. With the overwhelming evidence of the cost-effectiveness of large-scale food fortification across various countries, a higher reduction in the burden of micronutrient deficiencies in Nigeria is expected over the last three decades of mandatory food fortification and a series of voluntary and market-driven fortification. The efforts of the various stakeholders especially the development partners

and the government's promotion of enabling environment are commendable. However, re-thinking the implementation strategy is essential. There is a need to overhaul the fortification programme in Nigeria to ensure quality, transparency, and possibly digital transformation that can meet real-time data needs to guide decision-making. The various stakeholders especially the consumers should be actively sensitized to promote food choices that promote better nutrition outcomes. Private sectors need to be engaged to increase compliance with fortification standards and marketers' handling of fortified foods needs to be improved. The Nutrition Society remains committed to driving capacity building of key food system and food fortification actors, engage in high-level advocacy to create enabling environment for effective and expanded food fortification and increased compliance by the industries, and sensitizing the masses on appropriate handling and use, and increased demand for fortified foods.

The position of the Nutrition Society of Nigeria is that addressing the factors above could bring expected dividends of large-scale food fortification in Nigeria.

The following specific actions are hereby recommended

1. Further mining of ongoing national food consumption and micronutrient survey data to ascertain the commonly consumed foods and the usual portion sizes. This is essential to ensure the correctness of the food fortification vehicles and to model the potential contribution of the various fortification levels on the micronutrient intake. In addition, the national food consumption and micronutrient survey data should be used to ascertain the coverage of the various national micronutrient deficiencies interventions.
2. Social marketing and communication programmes should be strengthened to promote intensive sensitization of the marketers to ensure proper handling and appropriate storage conditions of fortified foods to preserve the fortificants and sensitization of the consumers to promote increased patronage and consumption of fortified foods
3. Improved enforcement of compliance to fortifications standards and regulation of voluntary and market-driven fortification using the Global Alliance for Improved Nutrition (GAIN) Fortification Assessment Coverage Tool (FACT). Also, the National Fortification Alliance (NFA) should collaborate with various stakeholders to advocate for and conduct stakeholders' consultation workshops to aggregate, review, analyze, and disseminate national compliance data on fortified foods with specific references to mandated micronutrients. It may also be necessary for the government to widen the list of micronutrients of public health importance based on identified needs. In addition, the private sector should consider wider voluntary fortification of foods.
4. Government should strengthen National Nutrition Information Management System to include food fortification information to monitor happenings and trends in the food fortification programme in Nigeria.
5. Fortification stakeholders through the National Fortification Alliance (NFA) should explore strategies to increase the affordability of the premix either through local production or engaging the Nigerian Customs Services, Standards Organization of Nigeria (SON), and National Agency for Food and Drug Administration and Control (NAFDAC) to address gaps in regulatory monitoring of micronutrients, high customs duties/landing cost, premixes and fortified foods at ports of entry and to address barriers in micronutrients and premix supplies.
6. The government should develop and implement a monitoring and evaluation framework to assess the quality of the implementation and delivery of the FF programme, and the degree to which it reaches targeted households and individuals, and achieves the nutritional goals.

Any recommendation for the Nutrition Society of Nigeria?

References

1. National Bureau of Statistics, (2020). https://theconversation.com/nigerias-poverty-profile-is-grim-its-time-to-move-beyond-handouts-163302. Accessed December 22, 2021
2. Federal Ministry of Water Resources (FMWR), Government of Nigeria, National Bureau of Statistics (NBS) and UNICEF. 2020. Water, Sanitation and Hygiene: National Outcome Routine Mapping (WASH NORM) 2019: A Report of Findings. FCT Abuja. Nigeria
3. UNICEF (2020). Child Survival – Nigeria. UNICEF Data Warehouse. https://data.unicef.org/resources/data_explorer/unicef_f/?ag=UNICEF&df=GLOBAL_DATAFLOW&ver=1.0&dq=NGA.CME_TMY0T4.&startPeriod=1970&endPeriod=2022
4. Black, R.E., Victora, C.G., Walker, S.P., Bhutta, Z.A., Christian, P., De Onis, M., Ezzati, M.,

Grantham-McGregor, S., Katz, J., Martorell, R. and Uauy, R., (2013). Maternal and child undernutrition and overweight in low-income and middle-income countries. The lancet, 382(9890), pp.427-451.
5. Caulfield, L. E., de Onis, M., Blössner, M., & Black, R. E. (2004). Undernutrition as an underlying cause of child deaths associated with diarrhea, pneumonia, malaria, and measles. The American Journal of Clinical Nutrition, 80(1), 193-198.
6. National Population Commission (NPC) [Nigeria] and ICF. 2019. Nigeria Demographic and Health Survey 2018 Key Indicators Report. Abuja, Nigeria, and Rockville, Maryland, USA: NPC and ICF.
7. Dewey KG, Begum K. (2011). Long-term consequences of stunting in early life. Matern Child Nutr. 7:5–18.
8. Soliman, A., De Sanctis, V., Alaaraj, N., Ahmed, S., Alyafei, F., Hamed, N., & Soliman, N. (2021). Early and long-term consequences of nutritional stunting: from childhood to adulthood. Acta Bio Medica: Atenei Parmensis, 92(1).
9. World Health Organization (2000). World Health Report. Geneva, Switzerland.
10. Maziya-Dixon, B. B., Akinyele, I. O., Sanusi, R. A., Oguntona, T. E., Nokoe, S. K., Harris, E. W. (2006). Vitamin A Deficiency Is Prevalent in Children Less Than 5 y of Age in Nigeria, The Journal of Nutrition, Volume 136, Issue 8, Pages 2255–2261, https://doi.org/10.1093/jn/136.8.2255
11. West, K. P., & Darnton-Hill, I. (2008). Vitamin A deficiency. In Nutrition and health in developing countries (pp. 377-433). Humana Press.
12. Sarohan, A. R., Akelma, H., Araç, E., & Aslan, Ö. (2021). Retinol depletion in severe COVID-19. medRxiv.
13. Abah, R. O., Okolo, S. N., John, C., & Ochoga, M. O. (2015). Prevalence of zinc deficiency among school children in a Rural Setting in North-Central Nigeria. Int J Pub Health Res, 3(5), 214-217.
14. Abolurin, O. O., Oyelami, O. A., & Oseni, S. B. (2020). A comparative study of the prevalence of zinc deficiency among children with acute diarrhoea in SouthWestern Nigeria. African Health Sciences, 20(1), 406-412.
15. Harika, R., Faber, M., Samuel, F., Mulugeta, A., Kimiywe, J., & Eilander, A. (2017). Are low intakes and deficiencies in iron, vitamin A, zinc, and iodine of public health concern in Ethiopian, Kenyan, Nigerian, and South African children and adolescents?. Food and nutrition bulletin, 38(3), 405-427.
16. World Bank. 2009. World Development Indicators (Database).
17. Federal Ministry of Finance, Budget and National Planning (2021). National Development Plan (NDP) 2021-2025 Volume I.
18. National Population Commission (NPC) (Nigeria) and ICF Macro (NPC/ICF) (2014) Nigeria Demographic and Health Survey 2013, National Population Commission and ICF Macro, Abuja, Nigeria [online] https://dhsprogram.com/publications/publication-fr293-dhs-finalreports.cfm.
19. Bhagwat, S., Gulati, D., Sachdeva, R., & Sankar, S. (2014). Food fortification as a complementary strategy for the elimination of micronutrient deficiencies: Case studies of large scale food fortification in two Indian States. Asia Pacific Journal of Clinical Nutrition, 23, S4– S11. https://doi.org/10.6133/apjcn.2014.23.s1.03
20. Method, A., & Tulchinsky, T. H. (2015). Food fortification: African countries can make more progress. Advances in Nutrition and Food Technology: Open Access, 2015, S22–S28.
21. Olson R, Gavin-Smith B, Ferraboschi C, Kraemer K. (2021). Food Fortification: The Advantages, Disadvantages and Lessons from Sight and Life Programs. Nutrients. 13(4):1118. https://doi.org/10.3390/nu13041118
22. Das, J., Salam, R., Kumar, R., & Bhutta, Z. (2013). Micronutrient for-tification of food and its impact on woman and child health: A systematic review. Systematic Reviews, 67, 2–24. https://doi.org/10.1186/2046-4053-2
23. Martorell, R., Ascencio, M., Tacsan, L., Alfaro, T., Young, M.F., Addo, O.Y., Dary, O. and Flores-Ayala, R., (2015). Effectiveness evaluation of the food fortification program of Costa Rica: impact on anemia prevalence and hemoglobin concentrations in women and children. The American journal of clinical nutrition, 101(1), pp.210-217.
24. Gera, T., Sachdev, H. S., & Boy, E. (2012). Effect of iron-fortified foods on hematologic and biological outcomes: systematic review of randomized controlled trials. The American journal of clinical nutrition, 96(2), 309-324
25. Ash, D. M., Tatala, S. R., Frongillo Jr, E. A., Ndossi, G. D., & Latham, M. C. (2003). Randomized efficacy trial of a micronutrient-fortified beverage in primary school children in Tanzania. The American journal of clinical nutrition, 77(4), 891-898.
26. Ogunmoyela, O. A., Adekoyeni, O., Aminu, F., & Umunna, L. O. (2013). A critical

evaluation of survey results of vitamin A and Fe levels in the mandatory fortified food vehicles and some selected processed foods in Nigeria. Nigerian Food Journal, 31(2), 52-62.
27. Food fortification Regulations (2021) National Agency for Food and Drugs Administration and Control (NAFDAC).
28. Sanusi, R.A., Wang, D., Ariyo, O., Eyinla, T.E., Tassy, M., Eldridge, A.L., Ogundero, A., Leshi, O., Lenighan, Y.M., Ejoh, S.I. and Aleru, E. (2022). Food Sources of Key Nutrients, Meal and Dietary Patterns among Children Aged 4–13 Years in Ibadan, Nigeria: Findings from the 2019 Kids Nutrition and Health Study. Nutrients, 14(1), p.200.
29. Ogunmoyela, O. A., Umunna, L., Aminu, F., Garrett, G., & Panagides, D. (2015). Results from a compliance study of food fortification in Nigeria and implications on regulatory monitoring. European Journal of Nutrition & Food Safety, 530-531
30. Jungjohann, S., Onyeagba, E., Opeoluwa, A., Nwachukwu, C., Ojo, M., & Mbuya, M. (2020). Methods and Outcomes of an Assessment of Foods Available to the Nigerian Population That Are Compliant with the Mandatory National Vitamin A Fortification Standards. Current Developments in Nutrition, 4(Supplement_2), 849-849.
31. UgwunnaUkegbu, A., Madukwe, O. O., Onyeonoro, U. U., Chukwuonye, I. I., Akhiemien, M., & Ogah, O. S. (2013). Food consumption patterns of adult population in Abia state, South East Nigeria: A community-based survey. Journal of Community Nutrition & Health, 2(1), 84.
32. Mildon, A., Klaas, N., O'Leary, M., & Yiannakis, M. (2015). Can fortification be implemented in rural African communities where micronutrient deficiencies are greatest? Lessons from projects in Malawi, Tanzania, and Senegal. Food and Nutrition Bulletin, 36(1), 3-13.
33. KPMG (2019). Rice Industry Overview. https://assets.kpmg/content/dam/kpmg/ng/pdf/audit/rice-industry-review.pdf accessed January 9, 2022.

Author Information
This position paper of the Nutrition Society of Nigeria has been duly adopted by the National Executive Council of the Society on February 10, 2022. Anyone interested in using portions of the position paper or republishing it should send a request or enquiry to the Nutrition Society of Nigeria at info@nutrionnigeria.org.

Statement of Potential Conflict of Interest
No potential conflict of interest

Funding/Support
The Society received funding support from Project ENAN – Engage Nutrition Academia in Nigeria, supported by the Bill and Melinda Gates Foundation.

Expert Committee on Position Paper
Bartholomew I. C. Brai (PhD)- Federal University, Oye-Ekiti
Wasiu Akinloye Afolabi (PhD) - Federal University of Agriculture, Abeokuta
Oluwaseun Ariyo (PhD) - University of Ibadan, Ibadan
James Oloyede (PhD)- FHI360, Maiduguri
Folake Anjorin (PhD)– Nutrition, Agriculture and Health Initiative, Abuja
Adedotun Owolabi - Division of Human Nutrition and Health, Wageningen University and Research, Wageningen, The Netherlands

Reviewers
Francis Aminu (PhD) - AlikoDangote Foundation, Lagos
Folake Olukemi Samuel (PhD) - University of Ibadan, Ibadan
Salisu Maiwada Abubakar (PhD)- Bayero University, Kano
Charles Nkwoala - Michael Okpara University of Agriculture, Umudike