



## Awareness and availability of micronutrients powders among mothers and caregivers of children aged 6 - 59 months in Zanzibar City

Rania Nahdi<sup>1</sup>, and Theobald C.E Moshia

Department of Human Nutrition and Consumer Sciences, College of Agriculture, Sokoine University of Agriculture, P.O. Box 3006, Chuo Kikuu, Morogoro, Tanzania

### Abstract

**Background:** Micronutrient powders (MNP) are designed to supplement micronutrients in foods consumed by children or pregnant women in settings where micronutrient deficiencies are prevalent. Organisations, including humanitarian agencies, the Ministry of Health, and non-governmental organisations distribute them. This study aimed to assess the awareness and availability of micronutrient powders (MNPs) among mothers and caregivers in Zanzibar City. The study specifically aimed to assess the understanding of MNPs among mothers and caregivers and to assess the use of MNPs among children in Zanzibar.

**Methods:** The study employed a longitudinal design, whereby data were collected at a single point in time over two months. A combination of qualitative and quantitative approaches was employed. Purposive sampling was used to identify sellers of MNPs sachets. A total of 365 respondents were surveyed, comprising two MNPs sellers in Zanzibar and 263 caregivers and mothers in Zanzibar. The former was interviewed face-to-face, while the latter completed a pre-tested questionnaire and checklists. However, the study involved three focus group discussions with customers of MNPs, namely mothers and caregivers, to collect data.

**Results:** The results indicated that most mothers and caregivers were unaware of the MNPs. The product was not readily available or used during the study period. Furthermore, there was a lack of clarity regarding the product among mothers and caregivers. The mothers and caregivers believed that the MNPs were a strategy for vaccinating their children and/or making them infertile.

**Conclusions:** Community health workers needed training to counsel mothers and caregivers appropriately. Further research is required to ascertain the beliefs and social norms regarding MNPs among parents of children under five in Zanzibar.

**Keywords:** Micronutrients powders, micronutrients, under-five-children, mothers and caregivers

### Introduction

Micronutrient powders (MNP) are designed to supplement micronutrients in foods consumed by children or pregnant women in settings where micronutrient deficiencies are prevalent (WHO, 2016). They are a form of home-based fortification whereby the micronutrients are sprinkled onto home-prepared foods before consumption. This makes them an easy-to-use form of fortification (Hodgins & Klemm, 2021). Various organisations, including humanitarian agencies, the Ministry of Health, and various non-governmental organisations, distribute them.

In Tanzania, the Feed the Future programme introduced the MNPs in 2013. The sachets were labelled "virutubishi" and distributed to local shops and health facilities through health workers. A

---

\* **Corresponding author:** Email: rnahdig3@gmail.com

single sachet cost 200 TShs. The World Health Organization (WHO, 2016) recommended consuming one sachet every other day.

According to the WHO (2008), an iron deficiency prevalence rate of 40% is considered a public health problem. Children under the age of five years are the most vulnerable social group to micronutrient deficiencies. Such children require micronutrients to facilitate their accelerated growth and development. Several studies have demonstrated the efficacy of home food fortification using micronutrient powders (MNPs) in enhancing iron status among children under the age of five (Adu-Afarwuah *et al.*, 2008; Christofides, 2006; Zlotkin *et al.*, 2003).

Notwithstanding the availability of MNPs in developing countries, their use in certain settings is limited (Ndemwa *et al.*, 2011). One reason for this is the lack of training of community health workers to guide mothers and caregivers on using MNPs and proper information regarding the product and its benefits (Kodish *et al.*, 2022).

A study conducted by Reerink *et al.* (2017) to examine MNP use and delivery strategies, with Tanzania identified as a key informant as an implementer, concluded that different mechanisms should be adopted to educate communities on the importance of MNPs. Such mechanisms should include community involvement and social behaviour change communication (SBCC) designs. A project entitled "Tuboreshe Chakula," implemented in Tanzania, has delivered training seminars to government health service providers and village health workers on the use of MNPs. Furthermore, mothers and caregivers were instructed on using MNP to enhance the quality of complementary foods and the location of MNP sachets (Secure Nutrition, 2015). This study assessed the awareness of MNPs among Mothers and Caregivers and the use of MNPs among under-five Children in Zanzibar

## Materials and Methods

### Study Area Description

The study was conducted in Zanzibar City, where iron deficiency anaemia was high (65.4%, TDHS, 2016). Zanzibar City is divided into three administrative regions: North, South and Urban West. The regions are subdivided into two districts each. The West B district has seven constituencies, 14 wards and 34 Shehias. The region's total population is 344,517, according to the 2022 Population and Housing Census (Census, 2022). The Zanzibar North Region borders the West B district to the north, the Central/South Region to the east, the Indian Ocean to the south, and the Zanzibar Urban District to the west. The district is characterised by a tropical climate, with 20° and 40° Celsius temperatures. Additionally, the district experiences a bimodal rainfall pattern, with a long rainy season spanning from March to May and a shorter rainy season from September to December each year. The district receives between 900 mm and 1,200 mm of rain during the long rainy season and 400 mm to 500 mm during the short rainy season (District Profile, 2017).

### Study design

The study employed a longitudinal design, collecting data at baseline, midline and endline within two months. The study's objective was to assess the awareness and availability of maternal and newborn health (MNH) products among mothers and caregivers of children aged between six and 59 months. The West B district was selected randomly from six districts where the study was conducted. The district is divided into seven constituencies, further subdivided into 14 wards and 34 Shehias. A list of reproductive and child health clinics was obtained and randomly selected. A combination of qualitative and quantitative approaches was employed.



### **Description of the study population**

The study included mothers and caregivers of children aged between 06 and 59 months attending RCH clinics. Additionally, sellers of MNPs in Zanzibar City were included in the study.

### **Sampling size and sampling procedure**

Mothers and caregivers of children aged between six and 59 months were identified from selected RCH clinics in the West B District. The sellers of MNPs were identified through purposive sampling. The total number of mothers and caregivers was calculated using a formula proposed by Fisher *et al.* (1991).

The sample size was calculated using the following formula:

$$N = Z^2 * Pq / d^2$$

N = the desired sample size

d = the degree of accuracy desired (precision level) (acceptable error 0.05 or 5%)

P = the prevalence of iron deficiency among under-five children in Zanzibar City (65%, TDHS, 2016)

Q = 1-P

Z = the standard normal deviate (which was 1.96, corresponding to 95% confidence)

The prevalence of anaemia in Zanzibar was 65%, the Z-statistic corresponding to a 95% confidence interval for a two-tailed test (1.96), and the degree of accuracy was 5% (0.05). A total of 350 mother-child pairs were included in the study. A further 35 under-five children were included in the sample, representing 10% of the total, to compensate for any loss to follow-up. Consequently, the sample size was 385 mother-child pairs. Twenty-two mothers or caregivers were lost to follow-up and thus unable to be assessed after the intervention. Consequently, 363 mothers of children aged between six and 59 months attending the RCH clinics in Zanzibar City participated in the study. Therefore, this study was responded to by 365 respondents, 363 mothers and caregivers of children and 02 sellers of MNPs in Zanzibar.

### **Data collection**

#### **Survey method**

In this study, the survey method was applied as the primary method for data collection, along with semi-structured questionnaires. The questionnaire was structured in such a way to answer research objectives; questions were made clear to all respondents. The researcher and trained enumerators submitted this to caregivers and mothers of children aged 6 to 59 months, introduced them to how to fill out and respond to questions, and then later collected them back for analysis. The socio-demographic characteristics of the mothers and/or caregivers were obtained using a pre-tested questionnaire by trained enumerators.

Prior to the commencement of data collection, the questionnaire was subjected to a preliminary evaluation. A sample of 12 mothers or caregivers of children aged 6-59 months was selected for pre-testing in Ilala Ward, Dar es Salaam. The questionnaire was administered to the mothers/caregivers at the RCH clinics during the clinic days through face-to-face interviews. Qualitative data was gathered through in-depth interviews and focus group discussions. The data collected was not numerical. Mothers and caregivers of children aged 6 to 59 months were asked to respond to general questions. Interviewers probed and explored the respondents to identify and define their perceptions, opinions, and feelings towards using MNPs and their benefits for their children.



### **In-depth interviews**

In-depth interviews were conducted with two MNP sellers in Zanzibar City. The interviewers invited the retail sellers to discuss their sales rates and the information they had about MNPs. The interviewer ensured the environment was conducive to a positive and productive conversation. The objective of the in-depth interviews was to elicit the following information: perceptions of MNPs, opinions on the benefits of MNPs, and the impact of under-five children's health and attitudes.

### **Focus group discussions**

This data collection method involves assembling key personnel who affect the study or are affected by the study to make joint discussions upon the study. In this study, three groups were purposely selected: the first comprised 7 respondents, the second comprised 5 respondents and the last with 8 respondents. These groups aimed to find different views on mothers' and caregivers' perceptions of factors that influence the usage of MNPs by their children during their RCH visits. Here, the researcher designed specific topics that formed the subject of discussion. The information sought included mothers and/or caregivers' values, culture, opinions and attitudes about MNPs. Likewise, each group discussed the topic under study transparently and came up with the findings that were analyzed and associated with other data collected through other methods to develop realistic findings.

### **Ethical consideration**

Permission and ethical clearance were obtained from the Zanzibar Health Research Ethical Committee (ZAHREC) and the District Health Officials where the study was conducted. Parents of eligible children were informed of the study's purpose, objectives, and benefits. Participation in the study was voluntary, and participants were free to withdraw from it at any time if they desired. Parents who agreed to participate signed a consent statement. Confidentiality was maintained, and personal information was not shared without consent.

### **Data Analysis**

Descriptive statistical analyses were applied to analyse quantitative data with a statistical package for social science (SPSS) software version 26. The findings from the descriptive part of this study were organized and presented in the form of words, numbers, frequencies and percentages using tables. The researcher used a data processing technique informed by Cohen, Manion, and Morrison (2007), emphasizing the relationship between data analysis and creation in qualitative research conducted through interviews. To identify significant themes, qualitative data was subjected to content analysis, which included organization, transcribing, coding, categorization, and interpretation.

## **Results**

### **Socio-demographic characteristics**

The study examined the socio-demographic characteristics of caregivers and mothers in Zanzibar City regarding their awareness and access to micronutrient powders (MNPs). The findings revealed a diverse range of educational levels, marital statuses, and numbers of children under the age of five in the participants' households, which reflected the varied demographic profile of the community (Table 1).

**Table 1: Socio-demographic characteristics of the caregivers/mothers**

Socio-economic attribute (N=363)	Number of respondents (Percent)
<b>Education level</b>	
No education	5 (1.4%)
Adult education	8 (2.2%)
Primary education	82 (22.6)
Secondary education	194 (53.4)
Diploma/certificate	41 (11.3)
University	33 (9.1)
<b>Marital status</b>	
Married (monogamous)	246 (67.8)
Married (polygamous)	93 (25.6)
Widowed	7 (1.9)
Divorced	8 (2.2)
Single	8 (2.2)
Other	1 (0.3)
<b>Number of under five children in household</b>	
One	262 (72.2)
Two	98 (27.0)
Three	2 (0.6)
Four	1 (0.3)

Table 1 indicates the education and marital status of the household heads. Approximately half of the participants had completed secondary school (53.4%, n=194), 22.6% (n=82) had completed primary education, 11.3% (n=41) had completed a diploma or certificate, 9.1% (n=33) had completed a university degree, 2.2% (n=8) had completed an adult education programme, and 1.4% (n=6) had no formal education. About 67.8% (n=246) of the respondents were married in a monogamous relationship, 25.6% (n=93) were married in a polygamous relationship, 1.9% (n=7) were widowed, 2.2% (n=8) were divorced, and 2.2% (n=8) were single. Most mothers/caregivers (72.2%, n=262) had one child under the age of five years in the household, while 27% (n=98) had two children under the age of five years, 0.6% (n=2) had three children under the age of five years, and 0.3% (n=1) had four children under the age of five years.

### Awareness of MNPs among mothers and caregivers

The study assessed mothers' and caregivers' awareness of Zanzibar City micronutrient powders (MNPs). The study aimed to ascertain whether respondents were aware of MNPs, where they had obtained this information, their usage of MNPs for children under five years of age, and the frequency with which they used MNPs for this age group (Table 2).

**Table 2: Awareness of MNPs among mothers and caregiver at baseline of the study**

Have you heard about MNPs (N=363)	No of respondents (Percent)
Yes	63 (17.4)
No	300 (82.6)
<b>If yes, where did you hear about MNPs?</b>	
Health professional	9 (2.1)

Relatives, family members, neighbours	48 (12.8)
Others	6 (1.7)
Not heard	300 (82.6)
<b>Have you ever used the MNPs for under five children</b>	
Yes	11 (3.0)
No	352 (97.0)
<b>If yes, how often did you use the MNPs for under five children</b>	
Once per week	8 (2.2)
Twice per week	3 (0.8)
Not used	352 (97.0)

Table 2 indicates that most mothers and caregivers at the study's baseline (82.6%, n=300) had not previously heard of MNPs. A mere 17.6% (n=64) had previously been aware of MNPs. The average number of respondents indicated that they had learned about MNPs from relatives, family members, and neighbours (n=48), while others reported that they had learned about MNPs from health professionals (n=9). Only 3% (n=11) of those who heard about MNPs used them. Among the respondents, 2.2% (n=8) reported using MNPs once weekly, while 0.8% (n=3) reported using them twice weekly. During the study's baseline period, none of the respondents used MNPs.

### Use of MNP sachets during the study period

The assessment conducted in Zanzibar City focused on utilising micronutrient powder sachets among mothers and caregivers. The objective was to assess the awareness and accessibility of MNPs in the community, focusing on Midline and Endline. This section presents the findings on the usage frequency and the number of respondents who incorporated MNP sachets into their routine during the study period.

**Table 3: Number of respondents who used MNPs sachets during the study period**

No. of MNP sachets per week (N=363)	Midline	Endline
	N (%)	N (%)
0	198 (54.5)	165 (45.5)
1	18 (5.0)	23 (6.3)
2	74 (20.4)	92 (25.3)
3	60 (16.5)	67 (18.5)
4	11 (3.0)	14 (3.9)
5	2 (0.6)	2 (0.6)

At the study's outset, none of the respondents had used the MNPs for the previous seven days. A more significant proportion of respondents (54.5%, n=198) did not utilise the MNPs during the study period. Of the respondents, 42.4% (n=84) indicated they were not interested in using MNPs, while 53.5% (n=106) reported that the shops selling them MNPs were conveniently located near their residences. Additionally, 4.0% (n=8) of respondents stated that they did not have access to a place to buy the MNPs. Only 16.5% and 3.0% of all respondents reported using three and four sachets per week, respectively, during the midline period. This figure increased slightly to 18.5% and 3.9% during

the ending period. Table 2 presents the number of sachets used by respondents throughout the eight-week study period.

### The reaction of the children to the use of food mixed with MNPs

This study examines an essential aspect of the efficacy of micronutrient powders (MNPs) in Zanzibar City: children's reactions to meals containing MNPs. It is, therefore, of great importance to understand their reaction, as this will inform the planning of effective micronutrient supplementation initiatives.

Table 4 presents the reactions and changes in appetites for the under-five children who were given foods mixed with MNPs. 165 children who consumed MNPs during the midline period were surveyed. Of these, 14.0% (n=51) expressed a positive sentiment towards the MNPs-fortified foods, 7.4% (n=27) exhibited an adverse reaction, and 23.9% (n=87) reported no discernible difference in the taste of the foods. Regarding appetite, 27.3% (n=99) of respondents indicated that children's appetite increased after four weeks of using MNPs, while 13.3% (n=48) reported no change in appetite.

**Table 4: Reaction and change of appetites of the children given food mixed with MNPs after 4 weeks**

Reaction to food mixed with MNP (N=363)	MIDLINE	ENDLINE
	Respondents (N)/ Percent (%)	
Liked	51 (14.0)	60 (16.5)
Disliked	27 (7.4)	37 (10.2)
No Difference	87 (23.9)	101 (27.8)
Not Used	198 (54.5)	165 (45.5)
<b>Change of appetite</b>		
Increased	99 (27.3)	137 (37.7)
Decreased	18 (5.0)	16 (4.4)
No Difference	48 (13.3)	45 (12.4)
Not Used	198 (54.5)	165 (45.5)

### Availability of MNPs in Zanzibar City

The distribution of MNPs in Tanzania was conducted by the Social Liberation and Empowerment Organization (SOLEO). SOLEO is the primary distributor of Virutubishi in Zanzibar. Two leading sellers of the product are in Zanzibar: one in Bwejuu and another in Fuoni Kwandundu. Bwejuu is situated in a location that is remote from the city centre. In contrast, Kwandundu is situated near the city centre, in an area that is easily accessible by road and has a concentration of shops. "Virutubishi" is available nationwide in pharmacies, supermarkets, and grocery stores. In Zanzibar, however, they were only available in two local shops, which made them less accessible to families in need.

SOLEO commenced the sale of MNPs in Zanzibar in March 2020. Both outlets are retail establishments selling other SOLEO food products, including composite maize flour, peanut butter,



and chocolate. One sachet was sold in Zanzibar at 200 Tanzanian Shillings (TShs). One package comprising 30 sachets was sold at 6,000 TShs.

### Frequency of MNP sales

During the interview, the interviewer asked the respondents about the frequency and trends of MNP sales at their respective shops.

The first interviewee responded that,

*Sure, at Fuoni Kwandundu, I've observed fluctuations in sales over the past year. From March to May 2021, I sold approximately 450 sachets of "Virutubishi" monthly. However, I did notice an increase in sales from June to August, reaching around 540 sachets per month. It's been quite variable, but I am hopeful for consistent growth.*

The second interviewee responded that,

*At Bwejuu, I've experienced a moderate level of sales for "Virutubishi." On average, I sell between 300 and 450 sachets monthly. It's been relatively steady, but I am always looking for ways to increase awareness and accessibility among parents in our community.*

However, regarding what influences parents/caretakers to buy MNPs from sellers' shops, respondents were asked to explain what reasons they think contribute to parents/caretakers preferring to buy smaller quantities of MNPs from their shop within the interview session.

The first interviewee responded that,

*Based on our interactions, it seems that many parents prefer buying a few sachets of MNP daily rather than purchasing the whole package of 30 pieces at once. I believe this could be due to financial constraints among families. So, I try to accommodate their needs by offering smaller quantities for purchase.*

The second interviewee responded that,

*From my observations, financial limitations play a significant role in parents' purchasing decisions. Many prefer to buy a few sachets at a time rather than investing in the entire package. I understand their circumstances and aim to provide flexible options to accommodate their needs effectively.*

The study conducted in Zanzibar City has revealed a concerning trend of low sales of micronutrient powders among caregivers. Both sellers asserted that sales were low. Fuoni Kwandundu sold approximately 450 sachets of "Virutubishi" from March to May 2021, with sales increasing to approximately 540 monthly sachets from June to August. In contrast, Bwejuu sold a maximum of 300 to 450 sachets of "Virutubishi" monthly. The sellers indicated that most parents and caregivers preferred to purchase a limited quantity of MNP daily rather than purchasing the entire package of 30 units. This may be attributed to a lack of sufficient funds.

Despite fluctuations in sales, both sellers noted relatively low figures. The preference for purchasing smaller quantities of MNPs daily rather than the entire package suggests that financial constraints are a significant factor among families.

## Discussion

### Socio-economic and Demographic Characteristics of the Respondents

The study's findings provide a detailed picture of the socio-demographics of mothers and caregivers in Zanzibar City, shedding light on their awareness and access to essential healthcare interventions such as micronutrient powders (MNPs). The diversity of educational backgrounds among participants, ranging from no formal education to university graduates, highlights the necessity of



tailoring informational campaigns about MNPs to accommodate varying levels of literacy and understanding. Similarly, the distribution of marital statuses, with a significant proportion being married (both monogamous and polygamous), widowed, divorced, or single, indicates the necessity of employing multifaceted approaches to reach different family structures effectively. Furthermore, the prevalence of households with one child under the age of five underscores the potential for targeted interventions to optimise the impact of MNPs on child nutrition and health outcomes.

These findings have implications for formulating policy and implementing healthcare practices to improve maternal and child health in Zanzibar. Policymakers and healthcare practitioners must recognise and address diversity within the community. Educational initiatives on MNPs must be tailored to suit the varying educational levels and marital statuses prevalent among mothers and caregivers. Moreover, interventions should consider the specific needs of households with multiple children under five, ensuring equitable access to MNPs and other essential healthcare services. By understanding and responding to the socio-demographic characteristics revealed in this study, policymakers can design more inclusive and practical strategies to enhance awareness, availability, and utilisation of MNPs, ultimately contributing to improved maternal and child health outcomes in Zanzibar City.

These findings are consistent with those of Khattak *et al.* (2017), which indicate that children of parents with higher education levels have better nutritional statuses than children of parents with lower education levels. This may be attributed to parents with higher education levels demonstrating greater awareness and higher income levels. Several studies have demonstrated a correlation between the nutritional status of children and their parents' literacy levels (Kunwar & Pilai, 2011; Burchi, 2012). Polygamous marriages result in more children, which places greater financial demands on the head of the household. Children who lived with both parents had better nutritional status than those with single parents (Odenchrants *et al.*, 2013).

A study by Samuel *et al.* (2021) found that mothers aged 25 years and above were more likely to adhere to the use of MNPs than their younger counterparts. Several studies have demonstrated that families with children under five have better healthcare and consume healthier foods and supplements (Abuya *et al.*, 2012; Bhusal, 2022).

### **Concepts of mothers/caregivers regarding the importance of home fortification with MNP**

The study has revealed a significant discrepancy in the awareness and utilisation of MNPs among mothers and caregivers in Zanzibar City. With the overwhelming majority remaining unaware of MNPs, there is a clear need for intensified educational campaigns to disseminate information about the benefits and availability of MNPs, mainly targeting underserved communities. Furthermore, the low utilisation rate among those aware of MNPs highlights the necessity for raising awareness and ensuring the accessibility and affordability of MNPs. The reliance on informal sources for information suggests the potential for leveraging community networks in disseminating knowledge about MNPs.

These findings emphasise the need to integrate MNPs into existing healthcare services and promote their usage through culturally appropriate channels, thus bridging the gap between policy intent and community practices in addressing childhood malnutrition. None of the respondents had ever used the MNPs per the WHO (2016) recommendations. Most mothers and caregivers who had used the MNPs during the study period reported no difference in the reaction to food consumed after mixing with the MNPs. That appetite had been improved in some children. These findings are consistent with those reported by Kodish *et al.* (2022).

Additionally, there were similar misconceptions regarding MNPs among parents of under-five children, as reported by Kasankala *et al.* (2018). These were associated with low education among the mothers and caregivers (Samuel *et al.*, 2021; Liu *et al.*, 2022). Some of the misconceptions included the belief among mothers and caregivers that MNPs were a government strategy to control birth rates and that consumption of MNPs would render their children infertile (Secure Nutrition, 2015). One mother at the RCH clinic stated that the MNPs were a strategy devised by Western countries to vaccinate children against the coronavirus forcibly. Other misconceptions were related to the side effects of MNP consumption, such as diarrhoea, vomiting, and abdominal discomfort. This led the mothers/caregivers to believe that MNPs have adverse outcomes on their children's health (Kyei-Arthur *et al.*, 2020). Additionally, some mothers and caregivers believed that children would lose their appetite for food if they disliked food mixed with MNPs, even when food was not mixed with MNPs (Goyena *et al.*, 2019).

### **Coverage and availability of micronutrients powder**

The study provides a detailed understanding of the availability and utilisation of micronutrient powders (MNPs) among mothers and caregivers in Zanzibar City. Notwithstanding the notable awareness of MNPs, their availability remains constrained, with distribution predominantly managed by a single organisation. The fluctuating sales trends observed by shopkeepers indicate that some factors, including family financial constraints, influence demand for MNPs. This has led to a preference for purchasing smaller quantities. These findings emphasise the necessity of addressing accessibility constraints and tailoring distribution strategies to better align with the economic realities of caregivers. Policy interventions could focus on expanding distribution channels and exploring subsidy programmes to ensure equitable access to MNPs, aiming to enhance nutritional outcomes for under-five children in Zanzibar.

As per WHO (2011) recommendations, children under five should consume at least two sachets of MNPs per week. The results indicated a low level of coverage and utilisation of the product in Zanzibar, with only two regional outlets selling MNPs. A study in Kenya revealed that MNPs were utilized at a low rate among under-five children, in contrast to fortified foods, which were more readily available and consumed more frequently (Leyvraz *et al.*, 2018). Consequently, it was necessary to implement various distribution strategies for MNPs to encourage their usage. It is recommended that channels such as health facilities and community-based counselling be used to deliver education and the product (Jefferds *et al.*, 2015; Tumilowicz *et al.*, 2019). However, Schott *et al.* (2021) reported that a community-based MNP delivery system was more efficient.

One of the reasons for the cessation of MNP usage by mothers and caregivers was a shortage of the product (Tumilowicz *et al.*, 2019). In this study, the MNPs were not readily available in nearby pharmacies, retail outlets, or health centres. The sole retailers offering the product had purchased it from the SOLEO agent in Dar es Salaam. The cost of the product has been identified as a significant barrier to utilisation by Jefferds *et al.* (2010). During the interview, some mothers and caregivers indicated they could not purchase the product thrice weekly.

Additionally, some mothers and caregivers reported lacking sufficient support from their partners and in-laws. The social, cultural and behavioural factors of mothers/caregivers were identified as the primary cause of the failure of numerous nutrition interventions (Schnefke *et al.*, 2019). Health professionals in the RCH clinics did not promote the MNPs to mothers/caregivers during RCH clinics. This could be attributed to a lack of training on the part of the health workers.

Their primary responsibility is disseminating information and providing consumers with accurate guidance regarding MNPs (Creed-Kanashiro *et al.*, 2016; Locks *et al.*, 2018).

### Usage of MNPs in Zanzibar

The findings indicate a significant lack of awareness and accessibility of micronutrient powders (MNPs) among mothers and caregivers in Zanzibar City. The baseline data indicates a striking absence of MNP usage, with over half of the respondents not utilising MNPs during the study period. The primary reasons for non-usage are disinterest and limited availability due to geographical constraints or a lack of nearby vendors. Although there was a modest increase in MNP usage towards the end-line period, it remained considerably low. These findings underscore the pressing necessity for targeted initiatives to enhance awareness and improve the accessibility of MNPs, particularly in remote areas. It is recommended that policy initiatives focus on strengthening distribution networks and implementing educational campaigns to promote the benefits of MNPs and mitigate nutritional deficiencies among children in Zanzibar. At the study's baseline, most mothers and caretakers were not utilising MNPs. This was due to a lack of awareness and accessibility to the product. This finding was consistent with that reported by Dusingizimana *et al.* (2021) in Rwanda.

The availability of MNPs was constrained even though the qualitative data indicated a low purchase rate by parents, which resulted in a correspondingly low demand. One of the vendors expressed frustration regarding the low sales of the MNPs, mainly the "Virutubishi" product. This was due to a lack of product promotion in Zanzibar. A study conducted in Kenya concluded that there was a necessity for the promotion of MNPs to ensure their continued availability (Suchdev *et al.*, 2013). Furthermore, it is recommended that different strategies be employed to enhance the distribution channels and boost the uptake and adherence to the use of the product (Hodgins & Klemm, 2021).

Even though most parents were willing to utilise the MNPs following nutrition education and claimed to do so during the midline and end-line of the study, there was no significant increase in the sales rates reported by the sellers. The parents indicated the outlet location from which they purchased their MNPs, but after interviewing the sellers, they found no significant increase in MNP sales. Teshome *et al.* (2018) reported that parents and caregivers who self-reported home fortification practices overestimated their use and adherence to MNPs.

Sellers of MNPs in Zanzibar City reported that most parents purchased daily sachets rather than monthly packages due to their limited incomes. The purchase of individual sachets daily made it challenging to adhere to the recommended number of sachets per week due to the distance between households and shops. These findings were consistent with those of a study conducted in Rwanda by Dusingizimana *et al.* (2021).

### Conclusion

There was a notable increase in the awareness of mothers and caregivers regarding MNPs, their usage, and the benefits associated with them during the study. Most mothers/caregivers had never seen the product at the study's outset. This indicated a lack of coverage of public nutrition programmes regarding home-based food fortification and product availability. Furthermore, the level of education impacted the overall acceptance and understanding of the benefits of MNP usage. Mothers and/or caregivers with higher levels of education exhibited more positive attitudes towards the product. The head of the household and other family members, such as in-laws, influence the usage of MNPs and their acceptability.



### Recommendations

It is recommended that further promotion of the MNPs be undertaken in Zanzibar, particularly in health centres and RCH clinics, where mothers and caregivers of under-five children could benefit. Additionally, it was recommended that community health workers be trained to provide mothers and caregivers with accurate information about the MNP products.

### Strengths and limitations

The study increased awareness among mothers and caregivers regarding the usage and benefits of MNPs for their children. Most participants lacked awareness of the product, and all were consuming MNPs at the study's baseline. The study was conducted during the global pandemic 2020, which undoubtedly influenced mothers' and caregivers' perceptions of nutritional programmes. Some of the responses provided by mothers and/or caregivers may have been inaccurate.

### Competing Interests

None

### Acknowledgements

The authors wish to extend thanks to all mothers and caregivers who participated in the study. They also acknowledge the great support and cooperation from Zanzibar Health Research Institute, Tanzania, Sokoine University of Agriculture, and the administration. Finally, the authors acknowledge the efforts of the research assistants who agreed to help in data collection.

### References

- Adu-Afarwuah, S., Lartey, A., Brown, K.H., Zlotkin, S., Briend, A. and Dewey, K.G. (2008) Home fortification of complementary foods with micronutrient supplements is well accepted and has positive effects on infant iron status in Ghana. *Am J Clin Nutr*;87:929–38.
- Akpan, E., Hossain, S. J., Devine, A., Braat, S., Hasan, M. I., Tipu, S. M. M. U., Bhuiyan, M. S. A., Hamadani, J. D., Biggs, B. A., Pasricha, S. R. and Carvalho, N. (2022). Cost-effectiveness of universal iron supplementation and iron-containing micronutrient powders for anemia among young children in rural Bangladesh: analysis of a randomized, placebo-controlled trial. *The American journal of clinical nutrition*, 116(5), 1303–1313. Advance online publication. <https://doi.org/10.1093/ajcn/nqac225>
- Benta, A., James, C., & Kimani-Murage, E. (2012). Effect of mother's education on child's nutritional status in the slums of Nairobi. *BMC pediatrics*. 12. 80. 10.1186/1471-2431-12-80.
- Bhusal, U.P. (2022). Poor and non-poor gap in under-five child nutrition: a case from Nepal using Blinder-Oaxaca decomposition approach. *BMC Health Serv Res* 22, 1245. <https://doi.org/10.1186/s12913-022-08643-6>
- Burchi, F. (2012). Whose education affects a child's nutritional status? From parents' to household's education. *Demographic Research*: Volume 27, Article 23
- Christofides, A., Asante, K.P., Schauer, C., Sharieff, W., Owusu-Agyei, S. and Zlotkin, S. (2006) Multi-micronutrient sprinkles including a low dose of iron provided as microencapsulated ferrous fumarate improves haematologic indices in anaemic children: a randomized clinical trial. *Matern Child Nutr* 2:169–80



- Creed-Kanashiro, H., Bartolini, R., Abad, M. and Arevalo, V. (2016). Promoting multimicronutrient powders (MNP) in Peru: acceptance by caregivers and role of health personnel. *Maternal Child Nutrition* 12: 152–63.
- Dusingizimana, T., Weber, J.L., Ramilan, T., Iversen P.O. and Brough, L. (2021). A Mixed-Methods Study of Factors Influencing Access to and Use of Micronutrient Powders in Rwanda. *Global Health: Science and Practice* 9(2):274-285; <https://doi.org/10.9745/GHSP-D-20-00422>.
- Goyena, E. A., Barba, V. C., Talavera, T. M., Paunlagui, M. M., Rola A. C. and Tandang N. A. (2019) Acceptance and Compliance With Micronutrient Powder and Complementary Food Blend Use by Filipino Mothers and Their Promotion by Community Workers Food and Nutrition Bulletin 40(2): 202 – 220.
- Hodgins, S. and Klemm, R. (2021). Micronutrient Powders for Infants and Young Children. *Global health, science and practice*, 9(2), 216–219. <https://doi.org/10.9745/GHSP-D-21-00263>.
- Jefferds, M. E., Ogange, L., Owuor, M., Cruz, K., Person, B., Obure, A., Suchdev, P. S., and Ruth, L. J. (2015). Formative research exploring acceptability, utilization, and promotion in order to develop a micronutrient powder (Sprinkles) intervention among Luo families in western Kenya. *Food and nutrition bulletin*, 31(2 Suppl), S179–S185. <https://doi.org/10.1177/15648265100312S210>.
- Jumiyati, Nutrition education improves mother’s Knowledge and Attitude in the provision of Complementary foods
- Kasankala, L., Kitunda, M., Mushumbusi, D., Meghji, W., Mgoba, M. and Towo, E. (2018). Knowledge and awareness on food fortification among mother/child caretakers of Kinondoni Municipality, Tanzania. *Asian Food Science Journal* 2: 1-13.
- Khattak, U.K., Iqbal, S.P. & Ghazanfar, H. (2017) The Role of Parents’ Literacy in Malnutrition of Children under the Age of Five Years in a Semi-Urban Community of Pakistan: A Case-Control Study. *Cureus*, 9, e1316. <https://doi.org/10.7759/cureus.1316>
- Kodish, S. R., Isokpunwu, C., Osunkentan, T., Imohe, A., Ejembi, C. L., Chitekwe, S., Wagt, A., & Mathema, P. (2022). Acceptance and compliance with micronutrient powder (MNP) among children aged 6-23 months in northern Nigeria. *PLOS global public health*, 2(10), e0000961. <https://doi.org/10.1371/journal.pgph.0000961>
- Kunwar, R., & Pillai, P. B. (2011). Impact of education of parents on nutritional status of primary school children. *Medical journal, Armed Forces India*, 58(1), 38–43. [https://doi.org/10.1016/S0377-1237\(02\)80011-9](https://doi.org/10.1016/S0377-1237(02)80011-9).
- Kyei-Arthur F., Situma R., Aballo J., Mahama A.B., Selenje J., Amoafu E. and Adu-Afarwaa S. (2020). Lessons learned from implementing the pilot Micronutrient Powder Initiative in four districts in Ghana *BMC Nutrition* 6, <https://doi.org/10.1186/s40795-020-00382-3>.
- Leyvraz, M., David-Kigaru, D. M., Macharia-Mutie, C., Aaron, G. J., Roefs, M. and Tumilowicz, A. (2018). Coverage and Consumption of Micronutrient Powders, Fortified Staples, and Iodized Salt Among Children Aged 6 to 23 Months in Selected Neighborhoods of Nairobi County, Kenya. *Food and nutrition bulletin*, 39(1), 107–115. <https://doi.org/10.1177/0379572117737678>.
- Liu, R., Ye, R., Leng, F., Sun, C., Wang, Q., & Zhou, H. (2022). High adherence and its influencing factors on multiple micronutrient powders (MNPs). *Maternal & child nutrition*, 18(1), e13278. <https://doi.org/10.1111/mcn.13278>.





- Locks, L. M., Dahal, P., Pokharel, R., Joshi, N., Paudyal, N., Whitehead, R. D., Jr, Chitekwe, S., Mei, Z., Lamichhane, B., Garg, A. and Jefferds, M. E. (2019). Predictors of micronutrient powder (MNP) knowledge, coverage, and consumption during the scale-up of an integrated infant and young child feeding (IYCF-MNP) programme in Nepal. *Maternal & child nutrition*, 15(S5), e12712. <https://doi.org/10.1111/mcn.12712>
- Ndemwa, P., Klotz, C.L., Mwaniki, D., Sun, K., Muniu, E., Andango, P., Owigar, J., Rah, J.H., Kraemer, K., Spiegel, P.B., Bloem, M.W., de Pee, S. and Semba. R.D. (2011) Relationship of the availability of micronutrient powder with iron status and hemoglobin among women and children in the Kakuma Refugee Camp, Kenya. *Food and Nutrition Bulletin*, vol. 32, no. 3
- Odenrants, S., Bjuström, T., Wiklund, N. & Blomberg, K. (2013). Nutritional status, gender and marital status in patients with chronic obstructive pulmonary disease. *Journal of Clinical Nursing* 22(20): 2822 – 2829.
- Reerink, I., Namaste, S. M., Poonawala, A., Nyhus Dhillon, C., Aburto, N., Chaudhery, D., Kroeun, H., Griffiths, M., Haque, M. R., Bonvecchio, A., Jefferds, M. E. and Rawat, R. (2017). Experiences and lessons learned for delivery of micronutrient powders interventions. *Maternal and Child Nutrition* 13(1): e12495.
- Rehema, M. (2018). Efficacy of home-made foods fortified with micro-nutrient powder in reducing iron deficiency anaemia among children aged 6-59 months in Kilosa district. Dissertation for Award of MSc Degree at Sokoine University of Agriculture, Morogoro, Tanzania, 97pp.
- Roschnik, N., Diarra H., Dicko, Y., Diarra S., Stanley, I., Moestue, H., McClean, J., Verhoef, H. and Sian, E. C. (2019) Adherence and acceptability of community-based distribution of micronutrient powders in Southern Mali *Maternal and Child Nutrition* 15(S5): e12831.
- Ruel, M. T. (2003). Operationalizing dietary diversity - A review of measurement issues and research priorities. *The Journal of Nutrition* 133(11): 3911 – 3926.
- Said, F. A., Khamis, A. G., Habib, A., Yang, H., He, Z., and Luo, X. (2021). Prevalence and Determinants of Anemia among Children in Zanzibar, Tanzania: Analysis of Cross-Sectional Population Representative Surveys. *Children (Basel, Switzerland)*, 8(12), 1091. <https://doi.org/10.3390/children8121091>
- Samuel, A., Brouwer, I. D., Pamungkas, N. P., Terra, T., Lelisa, A., Kebede, A., and Osendarp, S. (2021). Determinants of adherence to micronutrient powder use among young children in Ethiopia. *Maternal & child nutrition*, 17(2), e13111. <https://doi.org/10.1111/mcn.13111>
- Secure Nutrition (2015). Tuboreshe Chakula [<http://www.securenutrition.org/resources/tuboreshe-chakula>] visited 11/01/2023.
- Schnefke, C. H., Tumilowicz, A., Pelto, G. H., Gebreyesus, S. H., Gonzalez, W., Hrabar, M., Mahmood, S., Pedro, C., Picolo, M., Possolo, E., Scarlatescu, O. A., Tarlton, D., and Vetter sand, J. (2019). Designing an ethnographic interview for evaluation of micronutrient powder trial: Challenges and opportunities for implementation science. *Maternal & child nutrition*, 15(S5), e12804. <https://doi.org/10.1111/mcn.12804>.
- Schott, W., Richardson, B., Baker, E., D'Agostino, A., Namaste, S., & Vosti, S. A. (2021). Comparing costs and cost-efficiency of platforms for micronutrient powder (MNP) delivery to children in rural Uganda. *Annals of the New York Academy of Sciences*, 10.1111/nyas.14621. Advance online publication. <https://doi.org/10.1111/nyas.14621>.
- Suchdev, P. S., Shah, A., Jefferds, M. E., Eleveld, A., Patel, M., Stein, A. D., Macdonald, B., and Ruth, L. (2013). Sustainability of market-based community distribution of Sprinkles in western





- Kenya. *Maternal & child nutrition*, 9 Suppl 1(Suppl 1), 78–88. <https://doi.org/10.1111/j.1740-8709.2012.00450.x>.
- Stoltzfus R. J. (2011). Iron interventions for women and children in low-income countries. *The Journal of nutrition*, 141(4), 756S–762S. <https://doi.org/10.3945/jn.110.128793>
- Tam, E., Keats, E. C., Rind, F., Das, J. K., and Bhutta, A. (2020). Micronutrient Supplementation and Fortification Interventions on Health and Development Outcomes among Children Under-Five in Low- and Middle-Income Countries: A Systematic Review and Meta-Analysis. *Nutrients*, 12(2), 289. <https://doi.org/10.3390/nu12020289>.
- Teshome, E.M., Oriaro, V.S., Andango, P.E.A., Prentice, A.M. and Verhoef, H. (2018). Adherence to home fortification with micronutrient powders in Kenyan pre-school children: self-reporting and sachet counts compared to an electronic monitoring device. *Public Health* 18:205 DOI 10.1186/s12889-018-5097-2
- Tumilowicz, A., Habicht, J. P., Mbuya, M., Beal, T., Ntozini, R., Rohner, F., Pelto, G. H., Fisseha, T., Haidar, J., Assefa, N., Wodajo, H. Y., Wolde, T. T., and Neufeld, L. M. (2019). Bottlenecks and predictors of coverage and adherence outcomes for a micronutrient powder program in Ethiopia. *Maternal & child nutrition*, 15(S5), e12807. <https://doi.org/10.1111/mcn.12807>.
- Tumilowicz, A., Schnefke, C. H., Neufeld, M. L. and Pelto, G. H. (2017). Toward a Better Understanding of adherence to micronutrient powders: Generating theories to guide program design and evaluation based. *Results Global Alliance* 1:e001123.
- World Health Organization (2008) Anemia What does this indicator tells us <https://www.who.int/data/nutrition/nlis/info/anaemia>
- World Health Organization (2016) WHO guideline: use of multiple micronutrient powders for point-of-use fortification of foods consumed by infants and young children aged 6–23 months and children aged 2–12 years <https://www.who.int/publications/i/item/9789241549943>
- Zlotkin, S., Arthur, P., Schauer, C., Antwi, K.Y., Yeung, G. and Piekarz, A. (2003) Home-fortification with iron and zinc sprinkles or iron sprinkles alone successfully treats anemia in infants and young children. *J Nutr* 133:1075–80.