

Stunting and zinc deficiency among 3-5 years old Kankana-ey children in Kibungan, Benguet, Philippines

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ABSTRACT

Introduction: There is a dearth of public health and nutrition information available pertaining to the indigenous groups in the Philippines. Hence, this study described the prevalences of stunting and zinc deficiency, as well as factors associated with zinc status of 3-5 years old children among the Kankana-ey people, an indigenous group living in Kibungan, Benguet, Philippines. **Methods:** A cross-sectional design was used in the conduct of the study where 63 study participants were randomly selected from a chronological list of names of eligible Kankana-ey children by drawing lots. The mothers/primary caregivers of these children were interviewed to collect their socio-economic and demographic data, and dietary intake was assessed through three non-consecutive days 24-hour food recall. Height and weight of the children were also measured to determine their nutritional status. Lastly, blood samples were collected to determine the zinc status of the children based on serum zinc concentration, analysed through atomic absorption spectrophotometer. **Results:** Results showed that 54.0% and 50.8% of the Kankana-ey children had stunting and zinc deficiency, respectively. There was significant positive association between being exclusively breastfed and current zinc status ($p=0.001$). On the other hand, a statistically significant negative correlation was observed between zinc intake and zinc serum concentration ($r=-0.291$, $p=0.021$). **Conclusion:** Undernutrition among Kankana-ey children is a major public health concern in Kibungan, Benguet. Preventive actions must be taken to alleviate the severity of both stunting and zinc deficiency, and to mitigate possible consequences by strengthening the current nutrition and health programmes for indigenous groups, especially among young children.

Keywords: indigenous peoples, nutritional deficiency, nutritional status, zinc

INTRODUCTION

Stunting has long-term effects on individuals and societies, including diminished cognitive and physical development, reduced productive

capacity, poor health, and an increased risk of degenerative diseases such as diabetes. On the other hand, substantial evidence shows that zinc plays a critical role in biological processes, including

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cell growth, immunity, and metabolism. Thus, zinc deficiency restricts childhood growth and deprives the immune system, resulting in morbidity and mortality of young children.

Globally, stunting has gained attention due to a multitude of children suffering from its short- and long-term consequences. In 2012, approximately 162 million (25%) under five years old children were affected. These children have an increased risk of dying and suffering from other adverse consequences throughout life (UNICEF, World Bank & WHO, 2013). These numbers are even higher in low- and middle-income countries, particularly in the sub-Saharan Africa, Central Asia, and South Asia regions (Local Burden of Disease Child Growth Failure Collaborators, 2020). In the Philippines, although the national estimates of stunting has declined from 33.4% in 2015 to 28.8% in 2019, it is still considered to be moderately high (DOST-FNRI, 2021). At the provincial level, the estimate for stunting among children under five years old in Benguet, one of the provinces in the Cordillera Administrative Region (CAR) where most of its population are indigenous people, is at 22.7% (DOST-FNRI, 2021). Moreover, zinc deficiency is also a significant problem in the country. The national estimates for zinc deficiency among children under five years old also decreased from 21.6% in 2008 to 17.6% in 2013. However, CAR was included as one of the nine regions where zinc deficiency among children under five years old is considered a high public health concern, with a prevalence of 21.1% (DOST-FNRI, 2015).

Several factors are associated with stunting and zinc deficiency. For stunting, these include parents' education, household wealth index, toilet facilities, birth order (Kamal 2011), feeding practices (Rohner *et al.*, 2013), adequate provision of water and

sanitation, febrile respiratory infections, low birth weight, and maternal behaviour (Salvacion, 2017). Similarly, wealth status and dietary adequacy have also been identified as factors associated with zinc deficiency (Goyena *et al.*, 2021; Akhtar, 2013), along with stunting, lack of energy intake, low haemoglobin level, and discontinuing breastfeeding after 12 months (Goyena *et al.*, 2019).

Furthermore, records on the health and nutritional status among indigenous people are limited despite constituting a significant proportion of the country's population. It is estimated that around 10% to more than 20% of the total population are indigenous people, and the majority reside in Mindanao (Asian Development Bank, 2002). The few dated studies on the health and nutrition of this segment of the population showed that preventable and treatable problems persist due to a lack of facilities and resources (Cariño, 2012). Hence, the health and nutrition of indigenous communities have been highlighted in various government programmes, encouraging the participation of non-government agencies and development partners for this effort (Asian Development Bank, 2002). However, other factors such as adverse political conditions and natural disasters continue to affect the well-being of the indigenous people in the country; they are affected by conflict and related injuries, and they are especially vulnerable to the health problems brought about by disasters such as typhoons. Children under five years old in these communities also suffer a higher risk of child mortality (UN-DESA, 2015). In a more recent study, data showed that stunting was significantly higher among under-five-year-old Filipino indigenous group children than their non-indigenous counterparts. There were lower proportions of children who met the recommended energy and other

important nutrients, such as protein, iron, calcium, and B vitamins, in this age group (Duante *et al.*, 2022).

Given the scarcity of data on the health and nutritional status of these communities, public health action planning can be strenuous and could lead to the non-specificity of programmes that meet the needs of the indigenous groups. Hence, this study aimed to determine the prevalences of stunting and zinc deficiency, as well as the factors associated with zinc status of 3-5 years old Kankana-ey children in Kibungan, Benguet, Philippines.

MATERIALS AND METHODS

Study design and participants

A cross-sectional design was used in this study to investigate the magnitude of stunting and zinc deficiency, as well as the factors associated with zinc status of the Kankana-ey young children in Kibungan, Benguet in the CAR. Eligibility criteria included children aged 3-5 years old with no special and/or disease-related conditions, including in-born organ diseases, genetic and hormonal diseases. Mothers and/or primary caregivers of participants served as the respondents of the study. They provided data relevant to the study objectives. The study was conducted in the municipality of Kibungan, Benguet, Philippines from August to September 2016.

Sampling

Of the total number of 353 eligible participants, a sample size of 63 was derived by setting the sample proportion to 0.30, level of confidence to 90%, and margin of error to 10%. Simple random sampling was used to select the 63 participants. The participants were randomly selected from a chronological list of names of eligible children by simple random sampling via drawing lots or lottery method.

Data and sample collection

In this study, there were seven data collection instruments employed and these included questionnaire, weighing scale, height board, centrifuge machine, syringes and vacutainers, Eppendorf tubes, and atomic absorptive spectrometer. A pre-tested, structured questionnaire was developed for this study to collect information on the socio-economic and demographic background of the Kankana-ey children. The indicators used for the socio-economic and demographic profile were age and gender of participants, medical history, and household characteristics (*i.e.*, household size and annual income per capita). Moreover, three non-consecutive 24-hour food recalls, twice for weekdays and once for weekend, were conducted to gather data on the participants' average zinc intake. The mothers or primary caregivers of the children were the respondents for the interviews. For anthropometric measurements, a stadiometer (Seca 206, Hamburg, Germany) and a weighing scale (Model 235 6M, Salter, England, UK) were used to measure the height and weight of the children. Prior to weighing, the scale was calibrated and measurements were taken twice to ensure the precision and accuracy of the data. Data were collected by trained and skilled local enumerators who spoke the language of the participants.

Following the guidelines of the Biochemical Assessment Service Laboratory (BASL) of the Department of Science and Technology – Food and Nutrition Research Institute (DOST-FNRI) for blood sample collection, five millimetres (ml) of blood were collected from the participants through venipuncture. The collection of blood samples was done in the morning by a registered medical technologist. The extracted blood samples were transferred to clean test tubes and were immediately

stored inside an ice chest with wet ice within two hours after collection. The collected samples were centrifuged for 10 minutes at 1500 revolutions per minute (rpm) to separate the serum from red blood cells. The serum samples were then transferred to 1 ml Eppendorf tubes using clean and unused plastic pipettes, and then stored immediately in a freezer at below 0°C. Upon completion of sample collection, the serum samples were transported to BASL for serum zinc analysis by atomic absorption spectrometry. The samples were secured in a water-sealed plastic bag and placed inside an ice chest full of ice packs to make sure that they were kept dry and cool until they reached the laboratory.

Anthropometric and zinc analysis

Data on age and height of the children were used to determine their nutritional status based on cut-off values of the World Health Organization (WHO) Child Growth Standards (WHO, 2006). Moreover, zinc intake of the participants was computed based on the Philippine Food Composition Tables (DOST-FNRI, 1997), and assessed based on the estimated average requirement (EAR) for 3-5 years old Filipino children [*i.e.*, male = 3.3 milligrams (mg), female = 3.2 mg]. Meeting the EAR indicates that a child has met the daily nutrient intake level, which is the median or average requirement of healthy individuals (DOST-FNRI, 2015). As for the analysis of serum zinc concentration, the International Zinc Nutrition Consultative Group or IZiNCG (2004) guidelines were followed in the assessment of zinc status of the children [*i.e.*, <65 micrograms per decilitre ($\mu\text{g}/\text{dl}$) is considered deficient].

Statistical analysis

Descriptive statistics (*i.e.*, frequency, percentage, and mean) were used to summarise the results. Moreover, chi-

square test of independence and Pearson correlation coefficient were used in determining the factors associated with zinc status of the Kankana-ey children. A 5.0% value ($p < 0.05$) was set to test the significance of results. The data in this study were analysed using the Statistical Package for Social Science (SPSS) version 22.0.

Ethical consideration

The study protocols were reviewed and approved by the Cordillera Regional Health Research and Development Consortium – Ethics Review Committee (CRHRDC) and the National Commission on Indigenous People (NCIP). Written and verbal consent were sought from the parents and children before actual data and blood sample collection.

RESULTS

Socio-demographic profile of the Kankana-ey children

Based on the findings, most of the participants fell in the age bracket of 54-60 months, were female, had normal birth weight, were exclusively breastfed, and had completed their recommended vaccination. Most of them belonged to households with five or more members, with an annual per capita income lower than the CAR annual poverty threshold (Table 1).

Prevalence of malnutrition among the Kankana-ey children

The results showed that most participants were stunted, zinc deficient, and had a zinc intake lower than the EAR. These results indicated that there are very high magnitudes of stunting and zinc deficiency among the Kankana-ey children, and these can be considered as a public health concern (Table 2). The mean zinc intake was 3.5 mg, while the mean zinc serum was 66.4 $\mu\text{g}/\text{dl}$ (41.0 $\mu\text{g}/\text{dl}$, 98.0 $\mu\text{g}/\text{dl}$).

Table 1. Profile of the Kankana-ey children and their households (*n*=63)

| <i>Characteristics</i> | <i>Frequency (n)</i> | <i>Percentage (%)</i> |
|--|--------------------------|---------------------------|
| Age (months) | | |
| 38 – 45 | 13 | 20.6 |
| 46 – 53 | 24 | 38.1 |
| 54 – 60 | 26 | 41.3 |
| Sex | | |
| Male | 29 | 46.0 |
| Female | 34 | 54.0 |
| Medical history | | |
| Low birth weight (<2500 g) | 6 | 9.5 |
| Exclusively breastfed | 33 | 52.4 |
| Undergone medication/hospitalisation for the past three months | 16 | 25.4 |
| Currently taking medication or food supplement | 10 | 15.9 |
| Completed immunisation | 61 | 96.8 |
| Household characteristics | | |
| Household size | | |
| <5 | 1 | 12.7 |
| ≥5 | 55 | 87.3 |
| †Annual per capita income (<PHP 19,483) | 42 | 66.7 |
| †343.19 USD (1 US dollar = 56.77 PHP) | | |

Association between selected profile of the children and serum zinc levels

The chi-square test of independence revealed that among the socio-demographic characteristics analysed, being exclusively breastfed was the

only variable that was significantly associated with zinc status of the Kankana-ey children. Those who were exclusively breastfed were more likely to have adequate zinc serum concentration as they became older children, while

Table 2. Prevalences of stunting, zinc deficiency, and inadequate zinc intake among the Kankana-ey children (*n*=63)

| <i>Indicators</i> | <i>Mean</i> | <i>Frequency (n)</i> | <i>Percentage (%)</i> |
|-------------------------|-------------|--------------------------|---------------------------|
| Nutritional status | | | |
| Normal height | | 29 | 46.0 |
| Stunted | | 34 | 54.0 |
| Zinc status | | | |
| Adequate (≥65µg/dl) | | 31 | 46.2 |
| Deficient (<65 µg/dl) | | 32 | 50.8 |
| Mean serum zinc (µg/dl) | 66.4 | | |
| Zinc intake | | | |
| ≥EAR† | | 26 | 41.3 |
| <EAR | | 37 | 58.7 |
| Mean intake (mg/day) | 3.5 | | |

†EAR – Estimated Average Requirement

those who were not exclusively breastfed were more likely to have low zinc serum concentration as they grew older. However, it is noted that there was a higher percentage of 38-45 months old children with adequate or normal zinc status compared to children 54-60 months old. Moreover, there were more children with adequate serum zinc concentration among those who were hospitalised in the past three months. Almost no difference in zinc status was observed among children with complete vaccination. Nutritional status based on height-for-age was also found to have no significant correlation with the zinc status of Kankana-ey children (Table 3).

Furthermore, when the association of zinc intake and zinc serum concentration was analysed, a statistically significant negative correlation ($r=-0.291$, $p=0.021$) was found. This result suggests that the Kankana-ey children with high zinc intake tend to have low serum zinc and

vice versa.

DISCUSSION

The study findings revealed that although majority of the participants had normal birth weight, a few of them had low birth weight. Birth weight influences child growth and development. It is also a determinant of adult health status (Barker *et al.*, 1993). Low birth weight is defined as an infant having a weight of less than 2500 grams (WHO) and is a risk factor for childhood morbidity and mortality. Based on the 2015 Updating Survey, the low-birth-weight prevalence in Kankana-ey children was lower than the national prevalence (14.0%) (DOST-FNRI, 2015). In terms of infant and young child practices, maternal breastfeeding practices were good. Almost all participants were breastfed, which was close to the national data, confirming 92% of children being

Table 3. Factors associated with zinc status of the Kankana-ey children

| Characteristics | Serum zinc (%) | | χ^2 | p-value |
|---|----------------|-----------|----------|---------|
| | Adequate | Deficient | | |
| Age (months) | | | | |
| 38 – 45 (n=13) | 61.5 | 38.5 | 1.292 | 0.524 |
| 46 – 53 (n=24) | 50.0 | 50.0 | | |
| 54 – 60 (n=26) | 42.3 | 57.7 | | |
| Undergone medication/ hospitalisation within the past 3 months | | | | |
| Yes (n=16) | 68.8 | 31.3 | 3.278 | 0.070 |
| No (n=47) | 42.6 | 57.4 | | |
| Completed required immunisation | | | | |
| Yes (n=61) | 49.2 | 50.8 | 0.001 | 0.982 |
| No (n=2) | 50.0 | 50.0 | | |
| Exclusively breastfed | | | | |
| Yes (n=33) | 69.7 | 30.3 | 11.642 | 0.001* |
| No (n=30) | 26.7 | 73.3 | | |
| Nutritional status | | | | |
| Normal height (n=29) | 41.4 | 58.6 | 1.317 | 0.251 |
| Stunted (n=34) | 55.9 | 44.1 | | |

*Significant at 5% level

breastfed. Breastfeeding is considered an unequalled way of providing ideal food for the healthy growth and development of infants.

The study also showed that one-fourth of the children were hospitalised in the past three months due to fever, diarrhoea, and severe cough. Hospitalisation puts a child nutritionally at risk since it can decrease appetite resulting in poor oral intake, and can induce vomiting and diarrhoea that can cause loss of electrolytes and essential nutrients in the body. Seemingly, the traditional values and culture of indigenous groups influence health and nutrition practices; hence, most children were not hospitalised as some relied on herbal medications, and cultural rituals to alleviate their condition (de Guzman, 2022). As for household characteristics, the Kankana-ey household size was more than the national average of 5. In terms of annual income per capita, almost two-thirds of the household had an income below the 2012 CAR poverty threshold, which is mostly sourced from sales of farm yields.

The study also showed that there was a high magnitude of undernutrition among the Kankana-ey children as more than half of the participants suffered from stunting and zinc deficiency. These findings are comparable with the national and provincial estimates wherein the prevalences of stunting and zinc deficiency among children under five years old are considered a public health concern (DOST-FNRI, 2021; Marcos *et al.*, 2015).

Aside from the high prevalences of stunting and zinc deficiency among young Kankana-ey children, the study also found that zinc status of the children had a positive association with being exclusively breastfed. There is evidence that the introduction of complementary foods before six months of age can lead to a deficiency of vitamins,

minerals, and essential fatty acids as this can affect the intestinal mucosal permeability in infants (Silva *et al.*, 2019; Machado *et al.*, 2014). Moreover, the early introduction of food could also increase the risk of diarrhoea, which can further contribute to malnutrition. Still, this does not thoroughly explain the possible relationship of the two variables as there is limited literature available that determines the relationship of past care given during infancy (*i.e.*, exclusive breastfeeding) with serum zinc concentration, which is an indicator of the current state of health and nutrition in children. Perhaps, the relationship between these two variables can be explored and established in future studies.

Contrary to other related studies conducted by Krebs *et al.* (2012), Naupal-Forcadilla *et al.* (2017), and Goyena *et al.* (2020) on the positive association of zinc status and dietary zinc intake among children, this study found a negative correlation between the two variables in Kankana-ey children. The typical meal in the CAR is composed of rice, meat, and vegetables, with meat and meat products as the highest contributors to their protein intake. The region also has the highest consumption of dried beans, nuts, and seeds (DOST-FNRI, 2016), and it was reported that cereals is one of their most consumed food groups. Despite consuming excellent sources of zinc such as meat (Sharma, Sheehy & Kolonel, 2013), the Kankana-ey children may also have possibly consumed a high amount of phytic acid from high consumption of cereals, beans, and nuts, thereby reducing the absorption of zinc among other micronutrients (Gibson, Raboy & King, 2018). Moreover, the current zinc deficiency in soils across the country, particularly in major rice production regions, could have also influenced the zinc status of the Filipino population (Palanog *et al.*, 2019).

Regional initiatives were implemented in partnership with international organisations, such as UNICEF, to combat stunting in Southeast Asia. Scaling Up Nutrition (SUN), a global movement led by 65 countries, aims to end all forms of malnutrition through the implementation of nutrition-specific strategies such as fortification and supplementation, and nutrition-sensitive strategies that focus on access to nutritious foods, clean and safe water, and healthcare services. At present, various national programmes that aim to combat stunting and zinc deficiency are being implemented, which implicitly targets the indigenous population in the country. These programmes include food production/gardening, school feeding, water, sanitation, and hygiene programmes, first 1,000 days programme, micronutrient supplementation, food fortification, and nutrition education for mothers (Herrin *et al.*, 2018; Goyena *et al.*, 2018). However, inaccuracies of nutrition surveillance reports, which are the basis for nutrition monitoring and evaluation of most national nutrition programmes, can result in leakage and under-coverage of nutrition intervention packages, especially among indigenous people (Ramirez, Viajar & Azaña, 2019). Perhaps, the results of this study could be used in an effective targeting system for nutrition intervention programmes.

To our knowledge, this study is the first to provide an overview of the prevalences of stunting and zinc status of the Kankana-ey children in Kibungan, Benguet. Its findings highlight the need for a concerted effort against the prevailing nutrition problems among this population. It should help public health practitioners and policy makers in developing and strengthening the current strategies to improve the nutrition and overall health of the indigenous people, particularly among young children.

Ample investment and resources are needed to reach all families and children, especially the indigenous people who are often sidelined in nutrition programmes. Moreover, more in-depth studies should be conducted to provide a complete picture of the nutrition situation of the Kankana-ey people in order to develop a more effective and appropriate public health approach.

CONCLUSION

The prevalences of stunting and zinc deficiency among 3-5 years old Kankana-ey children in Kibungan, Benguet are of public health significance. Underlying factors associated with the zinc status of the children were past care (*i.e.*, being exclusive breastfed) and dietary zinc intake. These results indicate that public health interventions are imperative to improve the nutrition and overall health of the Kankana-ey children. Strategies may include strengthening programmes on the promotion of breastfeeding, multiple micronutrient supplementation, accurate periodic growth monitoring, and nutrition education for mothers to improve their child's nutritional status, especially among indigenous groups.

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Authors' contributions

JSP, principal investigator, conceptualised and designed the study, led the study data collection, prepared the draft of the manuscript, and reviewed the manuscript; NPG, LSA, CVCB, JTD, advised on the study design, data analysis and interpretation, and reviewed the manuscript; JPA, KVM, contributed to the data analysis, drafting of the manuscript, and reviewed the manuscript.

Conflict of interest

The authors declare that there is no conflict of interest.

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