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Research

Vegetable consumption and diet diversity among households with and without vegetable gardens in Quezon city, Philippines

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Background

Dietary diversity is key in determining the quality of a person's diet by including the consumption of several food groups. Vegetable gardening is a holistic approach to producing nutritious food and reducing food insecurity. Higher vegetable consumption is closely associated with better diet quality and dietary diversity score.

Objective

This study aims to analyze the vegetable consumption and diet diversity of households with vegetable gardens and households without vegetable gardens.

Methods

The study used a quantitative method and a descriptive and inferential research design. Given the specific profile of respondents, purposive sampling was employed. However, quotas per profile were set. The data were collected using quantitative tools such as guided questionnaires and a 24-hour dietary recall questionnaire.

Results

The mean of the diet diversity score of both vegetable gardeners and non-gardeners was 8.46. However, while 94.5% of the gardeners achieved a score of ⩾ 5, only 91.0% of non-gardeners did.

Conclusions

Vegetable gardeners may have a higher chance of meeting the recommended dietary diversity score of 5. Moreover, vegetable gardening aids in increasing the vegetable consumption of households due to the accessibility of fresh and nutritious vegetables, as compared to non-gardeners.

INTRODUCTION

Dietary diversity is essential in identifying the quality of a diet by assessing consumption and dividing it into food groups. Many recent studies have found that those with a higher dietary diversity score (DDS) tend to have a healthier food intake in all food groups (Kim et al., 2022). Additionally, in Japan, higher vegetable consumption is also positively associated with both better overall diet quality and reduced risk of the onset of non-communicable diseases (NCDs) (Kurisaki & Kushida, 2021). One study in Navajo found that gardening is greatly associated with healthy eating behaviors. Vegetable gardening produces nutritious crops, and gardeners tend to consume more fruits and vegetables (Ornelas et al., 2018). Home gardening also enhances households' food security by providing nutrient-dense food and better purchasing practices for food expenses (Rammohan et al., 2019).

Filipinos' vegetable consumption is less than the recommended vegetable intake of 400 grams by the World Health Organization (WHO), as per the Expanded National Nutrition Survey conducted from 2018 to 2019.

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It is worth noting that 26% of adolescents from 10 to 19 years old were stunted, and school-age children under the age of five may suffer from various types of malnutrition, such as being underweight, wasting, and obesity. Additionally, there is an increase in the trend of high fasting blood sugar among people aged 20 years and older, which can be an indicator of a higher risk of acquiring diabetes. Vegetable gardening shows an extensive list of benefits, such as increased vegetable intake, better DDS, and lower risk of NCDs (Philippine Council for Agriculture and Fisheries, 2022).

METHODS

CONCEPTUAL FRAMEWORK

The researchers formulated a conceptual framework to better understand the flow of the concepts of the study. Using several references, the variables below were considered in the study for an in-depth discussion of the different factors for home gardening.

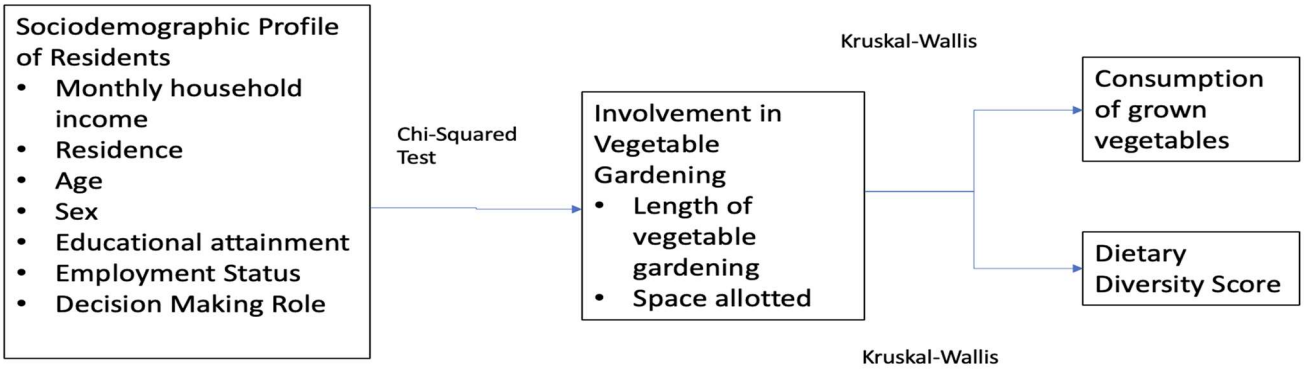

Figure 1. Conceptual Framework for the current study

Based on the related literature, the concepts related to the consumption of grown vegetables and dietary diversity score were related to the involvement of vegetable gardening. The section on the involvement of vegetable gardening can be divided into two parts: (1) length of vegetable gardening and (2) space allotted for vegetable gardening. On the other hand, involvement in vegetable gardening is dependent on factors such as the sociodemographic and socioeconomic profile of the participants, including sex, gender, income, educational attainment, and employment status.

There are still limited studies on the association between vegetable gardening and diet diversity locally in the Philippines. The main objective of the study was to determine the vegetable consumption and dietary diversity of households with vegetable gardens and households without vegetable gardens in an urban area of the Philippines.

STUDY DESIGN

The study used a quantitative method and a descriptive and inferential research design. The data were collected using quantitative tools such as guided questionnaires and a 24-hour dietary recall questionnaire. Statistical tests were run to determine the variables and their frequencies.

STUDY AREA AND PARTICIPANTS

Quezon City is the largest and most populated city, with almost 3 million inhabitants in a 2015 survey (ICLEI, n.d.). Moreover, the city is dominated by small to medium-scale businesses mostly in the field of marketing finished products and provision of basic services (About QC, n.d.)

Purposive sampling was utilized in this study. Inclusion criteria included: (1) participants were at least age 18 and above; (2) households were located in District 4, Quezon City; (3) participants were either the sole or primary decision-makers in the household; and (4) for those in the gardening group, households who have dedicated spaces in their households to growing vegetables. For the study and data analysis, respondents were categorized into Vegetable Gardeners (individuals who have vegetable gardens) and Non-gardeners.

Using the study of Grebitus (2021) as a guide, this study had 200 respondents from a household and an additional 10% buffers, totaling 220. There were 110 respondents that engaged in vegetable gardening and 110 that did not.

PROCEDURE FOR SELECTION OF PARTICIPANTS

The researchers coordinated with the Quezon City Health Department, Barangay Units in District 4, and Joy of Urban Farming to locate parts of Quezon City where there is a high prevalence of vegetable gardeners. With the help of the government staff, the researchers then personally visited the participants and conducted a house-to-house survey interview with the participants, starting with the screening questions to determine if they fit the criteria. Non-gardeners were selected haphazardly from different areas within the same district. Moreover, non-gardener participants were still asked to answer the screening questions to obtain their sociodemographic and socioeconomic profiles.

DATA COLLECTION

The research questionnaire and tools were reviewed and validated by three experts.

The researchers then conducted a pre-test in District 5, Quezon City, with 6 participants. The questionnaire comprised participants' information such as age, sex, barangay, employment, educational attainment, and income details. Acting as a screener, this section of the questionnaire included information on (I) If they were the decision maker of the household; (II) whether or not the participants practice vegetable gardening; (III) how long since the participants started gardening; and (IV) whether or not they consume the plants they grow. The part also included an open-ended question on the space they had

allotted for their vegetable garden. Parts 2 to 4 were only answered by those who participated in vegetable gardening. Otherwise, those parts were skipped.

The questionnaire included a list of possible vegetables planted, which were checked by the participants if applicable to them. Participants who were not vegetable gardeners skipped this part. Based on the study of Nogeire-Mcrae et al. (2018), the vegetables listed were tomato, cucumber, cabbage, potato, sweet potato, squash, peppers, lettuce, spinach, carrots, and onions. These vegetables are often found in local markets in the Philippines. Other common vegetables in the Philippines are chili, pechay, kangkong, sitaw, sayote, okra, ampalaya, eggplant, pechay, malunggay, and sigarilyas (Arnaldo, 2021), as well as patola and upo (Patrick, 2022).

The 24-hour Food Recall that was utilized in this study was based on the Food and Agriculture of the United Nations (FAO) (2018). It identified whether participants obtained the daily recommended vegetable intake of three to five servings (Food and Nutrition Research Institute - Department of Science and Technology, 2015).

This part of the questionnaire determined the participants' diet diversity. Different food groups such as Cereals; Roots and Tubers; Vegetables; Fruits; Meat and Poultry Eggs; Legumes and Nuts; Milk and Milk Products; Oil and Fats; Sugar and Honey; and Miscellaneous were checked by the participants if consumed usually. To obtain the score, each food category was added and divided into the total number of households interviewed. Diet Diversity is a qualitative way to measure food consumption that predominantly shows how much the household or individual has access to various food groups (Household Dietary Diversity Score (HDDS)|INDDEX Project, n.d.).

$$\frac{Sum\ (HDDS)}{Total\ number\ of\ households\ surveyed}$$

DATA ANALYSIS

The statistical software SPSS version 27 was utilized to run the descriptive statistics (frequency and percentage). jamovi version 2.3 was used for the inferential statistics (chi-square and kruskal-wallis). The significance level was set at $p<0.001$.

ETHICAL CONSIDERATIONS

The researchers provided consent forms to the chosen respondents with complete information regarding the procedures that would be followed, potential risks and benefits, and their right to disagree with the terms. The study and materials were validated by three professionals in the nutrition field, namely, Christine Joyce A. Aguinaldo, RND; Kristine Andrea E. Blanco, RND; and Jirah Asa M. Sideco, RND.

RESULTS

Table 1 presents the study participants' sociodemographic and socioeconomic profiles. Results found that most gardeners were 55-64 years old, female, and were mostly high school graduates. Significantly, the gardeners' monthly incomes were mostly less than $363. The participants' age, sex, barangay, highest educational attainment, monthly income of the family, employment status, length of time of gardening, and vegetable consumption were significantly associated with vegetable gardening.

Table 1. Sociodemographic and socioeconomic profile of the participants

Characteristic	Gardener (n=110)	Percent (%)	X^2	P-value	Non-Gardener (n=110)	Percent (%)	Total
Age							
18-24	2	1.82%	193	0.001	8	7.27%	10
25-34	14	12.73%			14	12.73%	28
35-44	28	25.45%			22	20.00%	50
45-54	28	25.45%			31	28.18%	59
55-64	29	26.36%			22	20.00%	51
65-74	9	8.18%			10	9.09%	19
75-84	0	0			2	1.82%	2
85 and older	0	0			1	0.91%	1
Sex							
Female	85	77.27%	103	0.001	86	78.18%	171
Male	25	22.73%			24	21.82%	49
Barangay							
Up campus	16	14.55%	221	0.001	14	12.73%	30
Tatalon	15	13.64%			1	0.91%	16
South Triangle	12	10.91%			11	10.0%	23
Botocan	11	10.0%			12	10.91%	23
Krus Na Ligas	10	9.09%			6	5.46%	16
Damayang Lagi	10	9.09%			13	11.82%	23
Immaculate	9	8.18%			5	4.55%	14
Concepcion	7	6.36%			2	1.82%	9

Table 1 continued

Characteristic	Gardener (n=110)	Percent (%)	X^2	P-value	Non-Gardener (n=110)	Percent (%)	Total
Kalusugan	6	5.46%			4	3.64%	10
Doña Aurora	5	4.55%			0	0	5
Up Village	3	2.73%			4	3.64%	7
Old Capitol Site	1	0.91%			9	8.18%	10
Laging Handa	1	0.91%			4	3.64%	5
Obrero	1	0.91%			4	3.64%	5
Don Manuel	1	0.91%			0	0	1
Pinyahan	1	0.91%			14	12.73%	15
Valencia	1	0.91%			0	0	1
Kamuning	0	0			1	0.91%	1
Pinagkaisahan	0	0			4	3.64%	4
Sacred Heart	0	0			1	0.91%	1
Central Roxas	0	0			1	0.91%	1
Highest Educational Attainment							
High School	50	45.45%	736	0.001	61	55.45%	111
Bachelor's Degree	38	34.55%			40	36.36%	78
Grade School	9	8.18%			4	3.64%	13
Graduate or Professional Degree	6	5.45%			2	1.82%	8
Others	3	2.73%			2	1.82%	5
Senior High School	2	1.82%			0	0.00%	2
Not Applicable (did not answer)	1	0.91%			1	0.91%	2
No Grade Completed	1	0.91%			0	0.00%	1
***Monthly Income**							
Less than $363	89	80.91%	1064	0.001	81	73.64%	170
$364- $726	16	14.55%			17	15.45%	33
$727- $1,452	3	2.73%			4	3.64%	7
$1453- $2,904	0	0.00%			4	3.64%	4
$2,905- $4,538	1	0.91%			2	0.91%	3
More than $4,539	1	0.91%			1	0.91%	2
Not applicable	0	0.00%			1	0.91%	1
Employment Status							
Employed	51	46.36%	134	0.001	53	48.18%	104
Unemployed	40	36.36%			24	21.82%	64
Self-employed	18	16.36%			29	26.36%	47
Others	1	0.91%			4	3.64%	5

* Amount is converted from Philippine Peso to US Dollars.
* Data were run through the Kruskal-Wallis test

Presented in Table 2 is information regarding the participants' vegetable gardening, such as duration, consumption, and space. 90.%of the vegetable gardeners have been gardening for more than three months. All of the vegetable gardeners interviewed consumed the vegetables they produced. The table presents the amount of space the gardeners have allotted for their vegetable garden, ranging from one sqm to 70,000 sqm, with 1-10 sqm being the most prevalent (8.8%).

Table 2. Vegetable Gardening Information of the Participants

Characteristics	Number (N=110)	Percent (%)
Length of time of vegetable gardening		
3 months and more	99	90%
Less than 3 months	11	10%
Space Allotted for Vegetable Gardening		
Number of square meters	Number (n=110)	Percent (%)
1-10 sqm	19	8.8%
11-30 sqm	11	5%
31-50 sqm	13	5.9%
51-100 sqm	2	1%
101-500 sqm	10	4.7%
501-70,000 sqm	8	3.6%
Did not answer	48	71%

Table 3 shows that there was no significance between the role in decision-making within the household and vegetable gardening. This means that vegetable gardening may occur in either primary or sole decision-makers. Moreover, the period for vegetable gardening (three months and above or less than three months) had a significant difference, wherein the study found that most gardeners had already participated in gardening for more than three months. Lastly, consumption of the vegetables grown also had a significant result, wherein 100% of the gardeners stated that they consume the vegetables they grew. The following data was run through the Kruskal-Wallis test to determine whether one of the variables was more dominant than the other.

Table 4 displays a list of vegetables that were commonly grown. The most popular vegetable among them was Okra (32%), followed by Ampalaya and Pechay (31%). Meanwhile, carrots, Baguio beans, and potatoes were the least planted (1.4%, 0.5%, and 0%, respectively).

24-HOUR FOOD RECALL (VEGETABLE SERVING OCCURRENCE AMONG THE VEGETABLE GARDENERS AND NON-VEGETABLE GARDENERS)

Based on the 24-hour recall, the majority of vegetable gardeners (83.6%) and non-vegetable gardeners (87.2%) did not meet the recommended daily vegetable intake of 3-5 servings. However, it was found that there were more vegetable gardeners (14.5%) who met the recommended daily vegetable intake compared to non-vegetable gardeners (10.0%). However, this was not a statistically significant difference.

Table 3. Vegetable gardening information of the participants

Comparison of gardeners vs non-gardeners	df	x^2	P-Value	Decision	Interpretation
Role in Decision-Making within the Household	1	1.21	0.271	Accept Null Hypothesis	Not Significant
Period of Time of Gardening	205.962	0.94047	0.001	Reject Null Hypothesis	Significant
Vegetable Consumption	215.054	0.98198	0.001	Reject Null Hypothesis	Significant

** if P-Value is less than 0.01, Reject the Null Hypothesis. *Data were run through the Kruskal-Wallis test*

TEST OF SIGNIFICANT DIFFERENCES BETWEEN THE OCCURRENCE OF MEETING THE RECOMMENDED VEGETABLE SERVINGS IN RELATION TO VEGETABLE GARDENING

As shown in Table 5, the vegetable gardeners had more participants with higher diet diversity scores compared to the non-gardeners. Most vegetable gardeners (17%) have a diet diversity score of 8. On the other hand, most non-vegetable gardeners (15%) had a diet diversity score of 6 and 8. Additionally, there is a close gap between the gardeners and non-gardeners who attained the highest score of 12, which is 10.91% and 10%, respectively.

DISCUSSION

78% of our gardeners were female. Chamratrithirong et al. (2020) found that most female participants who practice vegetable food gardening were middle-aged,) as they hold greater decision-making power and responsibilities for ensuring the household's food security. In the study by Cameron et al. (2021), most participants who practiced gardening were aged 45-54, 55-64, and 65-74. Mbombo-Dweda et al. (2021) also found that female respondents were more likely to practice vegetable gardening.

Table 4. Vegetables Grown by a sample of vegetable gardeners in District 4 Quezon City (N=110)

Type of Vegetable	Occurrence	Percent (%)
Dark and Leafy Green		
Alugbati *(Basella alba)*	66	60%
Kangkong *(Ipomoea aquatica)*	42	38.2%
Lettuce *(Lactuca sativa)*	31	28.2%
Malunggay *(Moringa oleifera)*	64	58.2%
Mustasa *(Brassica juncea)*	39	35.5%
Pechay *(Brassica rapa)*	68	31.1%
Saluyot *(Corchorus olitorius)*	5	4.5%
Talbos (sweet potato leaves)	13	11.82%
Marrow		
Ampalaya *(Momordica charantia)*	68	61.8%
Cucumber *(Cucumis sativus)*	14	12.7%
Eggplant *(Solanum melongena)*	64	58.2%
Okra *(Abelmoschus esculentus)*	71	64.5%
Patola *(Luffa acutangular)*	32	29.1%
Sayote (*Sechium edule)*	9	8.2%
Squash *(Cucurbita)*	21	19.1%
Upo *(Lagenaria siceraria)*	28	25.5%
Zucchini *(Cucurbita pepo)*	6	5.5%
Cruciferous		
Cabbage *(Brassica oleracea var. capitata)*	8	7.3%
Allium		
Onions *(Allium cepa)*	18	16.4%
Starchy and root		
Carrots *(Daucus carota)*	3	2.7%
Cassava *(Manihot esculenta)*	11	10%
Gabi *(Colocasia esculenta)*	24	21.8%
Potato *(Solanum tuberosum)*	0	0
Singkamas	7	6.4%
Sweet potato *(Ipomoea batatas)*	16	14.5%
Legumes and beans		
Baguio beans *(Phaseolus vulgaris)*	1	0.9%
Bataw *(Lablab purpureus)*	10	9.1%
Monggo *(Vigna radiata)*	7	6.4%
Sigarilyas *(Psophocarpus tetragonolobus)*	14	12.8%
Sitaw *(Vigna unguiculata sesquipedalis)*		
Snap peas *(Pisum sativum)*	45	40.9%
	4	3.6%
Fruit		
Chili	67	60.9%
Pepper	17	15.5%
Tomato	58	52.7%

Table 5. Diet Diversity Score of vegetable gardeners and non-gardeners

Diet Diversity Score	Gardeners (n=110)	Percent (%)	Non-Gardeners (n=110)	Percent (%)
12	12	10.91	11	10.00
11	13	11.82	4	3.64
10	12	10.91	12	10.91
9	11	10.00	16	14.55
8	19	17.27	17	15.45
7	15	13.64	13	11.82
6	12	10.91	17	15.45
5	11	10.00	10	9.09
4	3	2.73	5	4.55
3	1	0.91	1	0.91
2	1	0.91	0	0.00
1	0	0.00	2	1.82
0	0	0.00	2	1.82

**Diet diversity score was measured by dividing the sum of each participant's answer by the total number of participants surveyed.*
There was no difference in *Dietary Diversity Score between those who grew and do not grow vegetables (Kruskal Wallis 1.983, p=0.159).*

46% of our gardeners had their highest educational attainment in high school, whereas 35% had bachelor's degrees. Mbombo-Dweda et al. (2021) found that those without educational backgrounds and those who finished primary education were most likely to produce their own vegetables.

Aligned with the findings of Chamratrithirong et al. (2020), we found a higher incidence of vegetable gardening in those respondents with no formal education, wage laborers, and respondents earning less than 10,000 baht per month, which is equivalent to at least ₱16,000 (US $272).

Mbombo-Dweda et al. (2021) also found that respondents from the 4th Quartile (poorest areas) of the South African Multidimensional Poverty Index (SAMPI) were more likely to cultivate their own food, like vegetables. We found that 100% of the participants in the study consumed the vegetables they grew in their gardens. Ornelas et al. (2018) found that vegetable gardeners had a higher vegetable intake, as vegetable gardening is seen as an easy way to produce food.

Among the 35 listed vegetables, okra was the most commonly grown (32%), regardless of whether the participants planted multiple vegetables at once. In an article by Arnaldo (2021), okra is among the common vegetables found in the Philippines, along with chili, pechay, kangkong, sitaw, sayote, ampalaya, eggplant, pechay, malunggay, and sigarilyas, many of which were grown by the participants.

The study also included the 24-hour food recall of the participants, where the vegetable intake was mainly focused on. 87% of the non-gardeners and 84% of the gardeners were not able to meet the lower boundary of the recommended daily intake of 3 servings. However, this difference was not statistically significant. Other studies, such as Ornelas et al. (2018), have found that vegetable gardeners attain a higher level of fruit and vegetable consumption, primarily if they produce it themselves. Alemu et al. (2019) showed that the majority of the participants who practice vegetable gardening also consume the vegetables that they produce in their gardens.

Dibley et al. (2019) found that people with vegetable gardens have a higher diet diversity score. Blakstad et al. (2020) showed that women who have been growing vegetable gardens had a higher diet diversity score and were less likely to experience food insecurity.

Most gardeners had a diet diversity score of 5 or higher out of the 12 food groups. Both vegetable gardeners and non-gardeners had the same mean of 8.46 for the diet diversity score. Dibley et al. (2019) and Blakstad et al. (2020) consider a score of 5 as an acceptable diet diversity score for individuals, meaning that they must consume five or more food groups per day. 95.46% of the gardeners had a score of 5 and above, meaning that they met the recommended diet diversity. On the other hand, only 90.91% of the non-gardeners met a score of 5 and above. With this information, it can be presumed that vegetable gardeners may have a higher chance of meeting the recommended diet diversity.

Barrameda (2017) showed that urban gardening helps people consume nutritious food that can be accessed, especially if they have vegetable gardens. Cabalda et al. (2011) found households without vegetable gardens usually have a lower dietary diversity score and lower vegetable consumption compared to those with vegetable gardens.

The fact that we found very few differences in consumption between the gardening and non-gardening groups may relate to the fact that our samples were not randomly selected. Thus, the gardening group may have had lower consumption if not for the fact that they had gardens, but our study design does not provide relevant information on this issue.

STUDY LIMITATIONS

Our main limitation was in using purposive rather than probability sampling. Thus, the implications of comparisons between the two groups are uncertain. Another limitation of the present study is that the results may not be the same in other districts and cities. Another limitation is the potential errors inherent in the 24-hour food recall method. The sociability bias occurs when respondents give interviewers the answers they believe are desirable. Recall errors, though low compared to other dietary assessment methods, can still occur.

Using a checklist based on the most common ones grown in the Philippines rather than using an open-ended question may have missed some other vegetables being grown. Most Filipinos also consider root crops to be vegetables, which were included in the questionnaire. In terms of nutrition, root crops were considered to be a starch or carbohydrate source as compared to the nutritional components of vegetables like carrots, broccoli, spinach, etc. Moreover, how large the size of their vegetable gardens was based on their estimates, not exact measurements.

CONCLUSION

All the vegetable gardeners interviewed consumed the vegetables they grew. The study revealed that sociodemographic and socioeconomic factors such as age, sex, location, and socioeconomic status were associated with vegetable gardening. Most of the participants, whether vegetable gardeners or non-gardeners, did not meet the

recommended daily intake of vegetables from the Food Exchange List made by DOST FNRI based on their 24-hour food recall. There was no significant relation between vegetable gardening and vegetable consumption among the gardeners. Similarly, there was no significant relation between the dietary diversity scores of vegetable gardeners vs. non-gardeners.

AUTHOR CONTRIBUTIONS

Conceptualization: E.G.T., B.M.A.A., D.A.A.D., L.S.F.S., T.N.P.M., and K.B.H.C.; Investigation: E.G.T., B.M.A.A., D.A.A.D., L.S.F.S., T.N.P.M., and K.B.H.C.; Project administration: E.G.T.; Supervision: E.G.T., F.E.P, and D.G.S.; Writing – review & editing: E.G.T.

CONFLICT OF INTEREST

The authors of this research declare no conflict of interest.

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