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Causes and Correlates of Mortality and Morbidity Among Local Residents in Selected Barangays in Alabel, Sarangani Province, Philippines

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Abstract

This study investigated causes and correlates of mortality and morbidity as well as patterns of disease dispersal in barangay Poblacion and Spring, Alabel, Sarangani Province, Philippines. Using mixed methods approach, the study was able to identify a wide array of disease and non-disease causes of mortality/ morbidity in the two sites with respiratory infections, cardiovascular (CV) disorders, and cancer as prevalent causes for the former. Key qualitative findings were the following: over a third of the respondents lived close to dumpsites, raised livestock at home, and had very little formal education especially in Spring. Simple regression underscored associations between age, BMI, and years in school with disease incidence (DI) in both sites. Moreover, this study highlighted the importance of education in addressing health-related issues at the community level. Elevated BMI levels, on the other hand, can be ascribed to carbohydrate-rich, but protein-deficient diets of Sarangani households, while wide-scale glyphosate (herbicide) use in the farms was identified as a possible cause of cancers and respiratory disorders in Spring. In addition, higher numbers of CV cases in Poblacion are possibly due to lifestyle changes in this latter community as a consequence of urbanization. Finally, while this study was able to document diseases prevalent in these communities, their actual causation is difficult to establish owing to the fragmentary nature of the data and the small sample sizes used in the study. A larger study encompassing more barangays, a bigger number of respondents and using more predictors is thus warranted.

Keywords: *mortality, morbidity, disease incidence, education, barangay-level approach, Alabel, Sarangani Province*

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Introduction

Causes of morbidity and mortality, which are essential parameters in the documentation of the geographic burden of disease, are vital in crafting public health plans and intervention programs. These parameters also aid public health practitioners in evaluating health policies. In 2019, the number of deaths worldwide peaked at 55.4 million. Of this number, seven of the 10 leading causes were noncommunicable diseases including ischaemic heart disease, stroke, dementia, and diabetes. These seven causes accounted for 44% of all deaths or 80% of the top 10 (World Health Organization, 2020). By the end of 2021, the Philippines logged 768,504 deaths — the highest

mortality toll for a single year after World War II. Ischemic heart disease caused 110,332 of these, followed by COVID-19 at second with 75,285 reported deaths, thereby severely challenging the national health system. On the other hand, the leading morbidity-causing diseases in the country included acute respiratory infection (ARI), pneumonia, and hypertension - affecting 1.1% population in 2019.

In Region 12, the Department of Health (DOH-12) report declared hypertension as leading cause of morbidity or illness in 2020 with 26,887 out of 4,901,486 population (Census of Household and Housing, 2020) followed by acute respiratory infection (18,845), urinary tract infection (13,708) and upper respiratory tract infection. The other leading causes of morbidity were wounds (all types), influenza, pneumonia, bronchitis/ bronchiolitis, acute watery diarrhea, and diabetes mellitus. In terms of mortality or deaths, heart diseases topped the list (2,062), followed by hypertension, (1,469), renal disease (1,345), and pneumonia with (1,251). Completing the top 10 causes of mortality were cancer (all forms) (1,239), cerebrovascular accidents/stroke (1,141), diabetes mellitus with 999, myocardial infarction (605), chronic obstructive pulmonary disease (499), and tuberculosis (all forms) (435) (DOH, 2020).

In the province of Sarangani, Southern Philippines, registered deaths in the first quarter of 2020 totalled 626, or about 35 deaths monthly for every municipality (PSA Soccsksargen, 2020). In the province's capital town, Alabel, the Municipal Health Office recorded 56 deaths since the onset of COVID-19 alone. Factors contributing to death and morbidity among the population in the area are generally rooted in malnutrition and environmental risks (World Vision Development Foundation, Inc, 2022). The increasing percentage of mortality in Sarangani Province, from 9.06% in 2019 to 11.59%, in 2020 (PSA, 2020) is the problem investigated by this study. With a paucity of information about mortality/morbidity causes, actual causes of disease and deaths are not usually pinpointed, and eventually, the local community is unknowingly threatened with a physically vulnerable and dying population. In fact, Philippine News Agency (2018) showed that while the Philippines is losing more than P220 billion on inappropriate and ill-advised interventions, 29,000 children die each year due to malnutrition. This is because these interventions are unsuitable to situations at the grassroots level and are not evidence-based. Understanding the trends on death cases, diseases, their causes, their healthcare implications, their socio-economic impact, and factors contributing to their occurrence posit a need to be studied especially in a local setting since there is a diverse cause of disease worldwide.

Using a barangay-level approach, this study investigated the leading causes of death and morbidity in the municipality of Alabel, Sarangani Province. This research identified incidences and specific causes of mortality/morbidity in the barangays of Alabel. This way interventions that are specifically tailored to the health needs of the barangays Poblacion and Spring can be crafted. This is true in the study of Thomas et. al (2015) stating that mapping at the local level can guide more efficient allocation of resources, coordination of efforts and targeted interventions, which are particularly relevant for health management in resource-scarce settings.

The objectives of this study are as follows: (1) to identify prevalent diseases/disorders causing mortality and morbidity in Poblacion and Spring, Alabel, Sarangani Province, (2) to detect trends related to disease dispersal in Alabel, Sarangani Province, and (3) to determine the causes and correlates of mortality and morbidity among the local population in Poblacion and Spring, Alabel, Sarangani Province, using a village-level approach.

Identifying areas with a high occurrence of mortality and morbidity generally benefit the public from at least the household level. Study results promote best health choices that affect the behavioural dynamics of family members towards diseases. Through this study, important information about local diseases, their risk factors, and recommended public health interventions are made available to the community, consequently leading to collective health consciousness and active participation in local health policies. The study results can also guide national government and non-governmental institutions in allocating resources that address issues in the health system by focusing on sound morbidity and mortality data. In addition, study results can be used to support the development of health-related programs and in crafting feasible policies. This is important especially for less-studied areas like Alabel, where there is a paucity of information about mortality and morbidity. Overall, these results will bring the country closer to the attainment of Sustainable Development Goal 3 by United Nations, which underscores healthy life and well-being for all (Joint SDG Fund, 2023).

This study was conducted from August 2022 to May 2023. It covered mortality cases resulting from both communicable and noncommunicable diseases (i.e., hypertension, diabetes, animal bite, acute and chronic respiratory disease, pneumonia, arthritis, skin diseases, and diarrhoea) in adults aged 15 and above only. Moreover, only mortality and morbidity cases during the last five years (2017 to the first month of

2023) were included in the study. Household surveys in barangays Poblacion and Spring were carried out from January to February 2023.

Materials and Methods

Research Design

The study employed a multimethod research design (see Figure 1) to ascertain the causes and correlates of morbidity and mortality in barangays Poblacion and Spring, Alabel, Sarangani Province. Multimethod research is research that uses multiple forms of qualitative data (e.g., interviews and observations) or multiple forms of quantitative data (e.g., survey data and experimental data) (Creswell 2015). This design was viable for the study as it handled both quantitative and qualitative in achieving its objectives. It is also cross-sectional in nature and based on the emic (insider's view) approach.

Study Locale

This study was conducted in the municipality of Alabel, Sarangani Province, Southern Philippines. It has 13 barangays namely: Alegria, Bagacay, Baluntay, Datal Anggas, Domolok, Kawas, Ladol, Maribulan, Pag-asa, Paraiso, Poblacion, Spring, and Tokawal (Figure 3).

The household population of Poblacion (Coordinates: 6.1052, 125.2863) in the 2015 Census was 18,104, subdivided into 4,360 households or an average of 4.15 members per household. Young adolescents and those aged 14 and below comprised 5,818 or 32.14% of the barangay population. The economically active population (15-64 years old) constituted a total of 63.52% (11,500) while senior citizens aged 65 and above consisted of 4.34%.

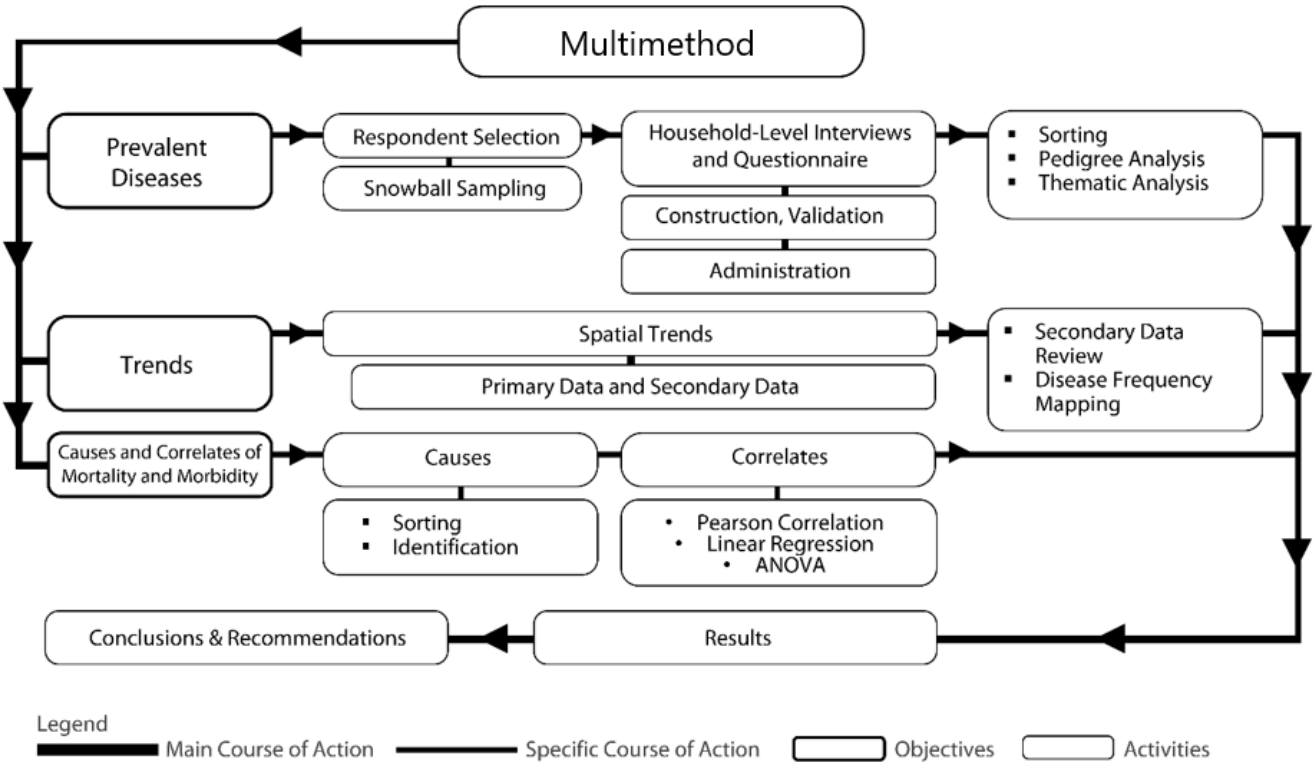
In barangay Spring (Coordinates: 6.0906, 125.3004), there were 980 households or an average of 4.52 members per household (2020 Census). Young adolescents and those aged 14 and below composed 36.88% (1,634) of the local population. The economically active population (15-64 years old) constituted a total of 59.39% (2,631), while senior citizens, aged 65 and above, made up 3.72% (165).

Sampling Technique

Respondent selection for in-depth interviews and the survey questionnaires followed snowball sampling to obtain a suitable number of respondents per barangay after a listing of

Figure 1

Flowchart of the methodology of the study.



households was obtained from barangay health offices. As per advice by the barangay health office, 30 households were chosen for each of the 2 barangays. Quantitative data from the respondents and secondary data were used in synthesis with thematic analysis and qualitative inferences of the interviews for correlation.

People who have shown symptoms of diseases/disorder, and their immediate family members/relatives in a household who have the disorder or who died of it, as indicated by the barangay health office were included in the study. Explicit consent was also a criterion for respondent selection. Inversely, single-member households, transients, newly wedded couples, and individuals who did not consent to the study were excluded.

Secondary Data Sources

The study utilized secondary data which included the recorded figures of death cases and causes of disease. Letters were hand-delivered to the Office of the mayor and Municipal Health Office of Alabel prior to the actual data gathering. Subsequently, secondary data was obtained from the Rural Health Unit of the municipality of Alabel on March 1, 2023 via the FHSIS Report. Data collected was foreseen to be utilized for triangulation, however, due to paucity of data, the office only provided the municipal-wide aggregated data for 2019, 2020, 2021, and 2022.

The semi-structured questionnaire constructed for this study was divided into three broad categories: (1) Demographic Profile (13 items), (2) Family History and Health (13 items), and (3) Household and Workplace Environment (10 items). This research instrument was validated prior to use by trying it out using a select group of respondents and by revising entries accordingly. Subsequently, the researcher and trained enumerators administered the questionnaire to the respondents face-to-face. As for the personal interviews, these were carried out face-to-face using an open-ended interview guide. Inclusive dates for the actual conduct of interviews were from January 30 to February 18, 2023, with a maximum of one hour per respondent. The abbreviated secondary data from the Municipal Health Office of Alabel were collected and compared for data triangulation.

Data Analysis

Quantitative data were sorted accordingly to ascertain trends in disease prevalence in barangays included in the study. Analyses include correlation analysis, linear regression, and ANOVA computed through jamovi (Sydney, Australia), a free and open international statistical platform. In the linear regression analyses, disease incidence was treated as the outcome variable and years in school, age, and BMI were considered as predictors. Moreover, qualitative data were classified according to thematic content and presented as tables, graphs, diagrams, and flowcharts. As for quantitative data from the questionnaires, were collated, analyzed, and subjected to correlation and linear regression analyses and descriptive statistics, where applicable.

All mortality and morbidity cases affecting adults 15 years and above, were tabulated accordingly in a Microsoft Excel (Seattle, USA) spreadsheet. The consolidated primary data were used to identify disease clusters and presented as a frequency map. The aggregated secondary data were utilized in establishing the choropleth disease frequency map at the municipal-level in reference to the observed disease clusters of primary data. Choropleth disease frequency map maps were generated using Microsoft PowerPoint (Seattle, USA).

Furthermore, a pedigree up to the third generation were constructed for Respondent SPR-029 to shed light on the mode of transmission of cancer that appeared to run in her family.

Ethics Requirement

The requirements for the approval of the Mindanao State University - Gensan Institutional Ethics Review Committee were submitted on July 4, 2022. The study received the approval from the Ethical Review Committee (IERC) on August 22, 2022 with one year validity (094-2022-MSUGSC-IERC). Consent of the respondents was likewise obtained before personal interviews. The collected data were kept in the strictest confidence to protect the respondents' identities.

Results and Discussion

Causes of Mortality and Morbidity (Based on Household Surveys)

Tables 1 and 2 show the prevalent diseases causing mortality and morbidity, respectively, in the studied population in Barangay Poblacion, Alabel, Sarangani Province based on frequency (count) order. For deaths, age-related physical debility predominated (14.3%) while non-communicable diseases (i.e. acute liver failure, cardiac arrest, cardiovascular disease, and myocardial infarction) individually accounted for 8.6% of total mortality rates. Diabetes accounted for approximately 5.7% of deaths. As for disease assessment, pneumonia (18.5%), rheumatoid arthritis (11.1%), hypertension, asthma, dengue, and gastrointestinal problems were the leading causes of morbidity.

Table 1

Causes of mortality in barangay Poblacion, Alabel, Sarangani Province from 2017 to 2022. (n=30)

Top 10 Diseases/Disorders causing Mortality	Counts	% of Total
Age-Related Physical Debility	5	14.3 %
Acute Liver Failure	3	8.6 %
Cardiac Arrest	3	8.6 %
Cardiovascular Disease	3	8.6 %
Myocardial Infarction	3	8.6 %
Diabetes	2	5.7 %
Aneurysm	1	2.9 %
Brain Tumor	1	2.9 %
Breast Cancer	1	2.9 %
Chronic Kidney Disease	1	2.9 %

Table 2

Causes of morbidity in barangay Poblacion, Alabel, Sarangani Province from 2017 to 2022. (n=30)

Morbidity	Counts	% of Total
Pneumonia	5	18.5 %
Hypertension	3	11.1 %
Rheumatoid Arthritis	3	11.1 %
Asthma	2	7.4 %
Dengue	2	7.4 %
Gastrointestinal Problem	2	7.4 %
Abnormal uterine bleeding	1	3.7 %
Appendicitis	1	3.7 %
Cerebral Palsy	1	3.7 %
Diabetes	1	3.7 %

The leading causes of mortality in Spring, Alabel, Sarangani Province (Table 3) were vehicular accidents (11.1%), colon cancer (8.3%), acute kidney failure (5.6%), and diabetes (5.6%).

Meanwhile, asthma (13.5%), abnormal uterine bleeding (8.1%), pneumonia (5.4%), tuberculosis (5.4%), urinary tract infection (5.4%), ulcer (5.4%), and visual impairment (5.4%), were the leading causes of morbidity in this study site (Table 4).

During these recent years, non-communicable diseases (NCDs), such as cardiovascular diseases (CVD), diabetes, chronic obstructive pulmonary diseases (COPD) and cancers have grown to pandemic scales with disproportionately higher rates in developing countries (Terzic, 2011). Moreover, Zumla & Ustianowski (2012) revealed that in tropical countries, apart from noncommunicable diseases, a severe burden of disease is caused by an array of different microorganisms, parasites, land and sea animals, and arthropods.

In this study, the primary causes of death in Poblacion were NCDs which affected 92.1% of the

Table 3

Causes of mortality in barangay Spring, Alabel, Sarangani Province from 2017 to 2022. (n=30)

Cause of Death	Counts	% of Total
Vehicular Accident	4	11.1 %
Colon Cancer	3	8.3 %
Acute Kidney Failure	2	5.6 %
Diabetes	2	5.6 %
Acute Liver Failure	1	2.8 %
Acute Respiratory Distress	1	2.8 %
Age-Related Physical Debility	1	2.8 %
Aneurysm	1	2.8 %
Bleeding Peptic Ulcer Disease	1	2.8 %
Cancer	1	2.8 %

total surveyed population. While NCDs were among the leading causes of morbidity, they were outnumbered by pneumonia (a communicable disease) in the same site. The World Health Organization reported that NCDs kill 41 million people each year - equating to 71% of all deaths globally. However, it is important to note that higher mortality rate does not really equate to epidemiology since communicable diseases have increased worldwide from 27.2% population in 1997 to 37.1% population in 2019 and has acquired an upward trend since 2004 up to the present (Baik et. Al, 2022).

Demographic Profile of Respondents

Figure 2 shows the demographic profile of respondents in barangay Poblacion and barangay Spring. 86.7% were females, 11.7% were males, and 1.7% identified themselves as non-binary. Catholicism was the predominant religion at 80% while Seventh Day Adventists (SDA) came second at 6.7%. Protestants and Iglesia ni Cristo were both

Table 4

Causes of morbidity in barangay Spring, Alabel, Sarangani Province from 2017 to 2022. (n=30)

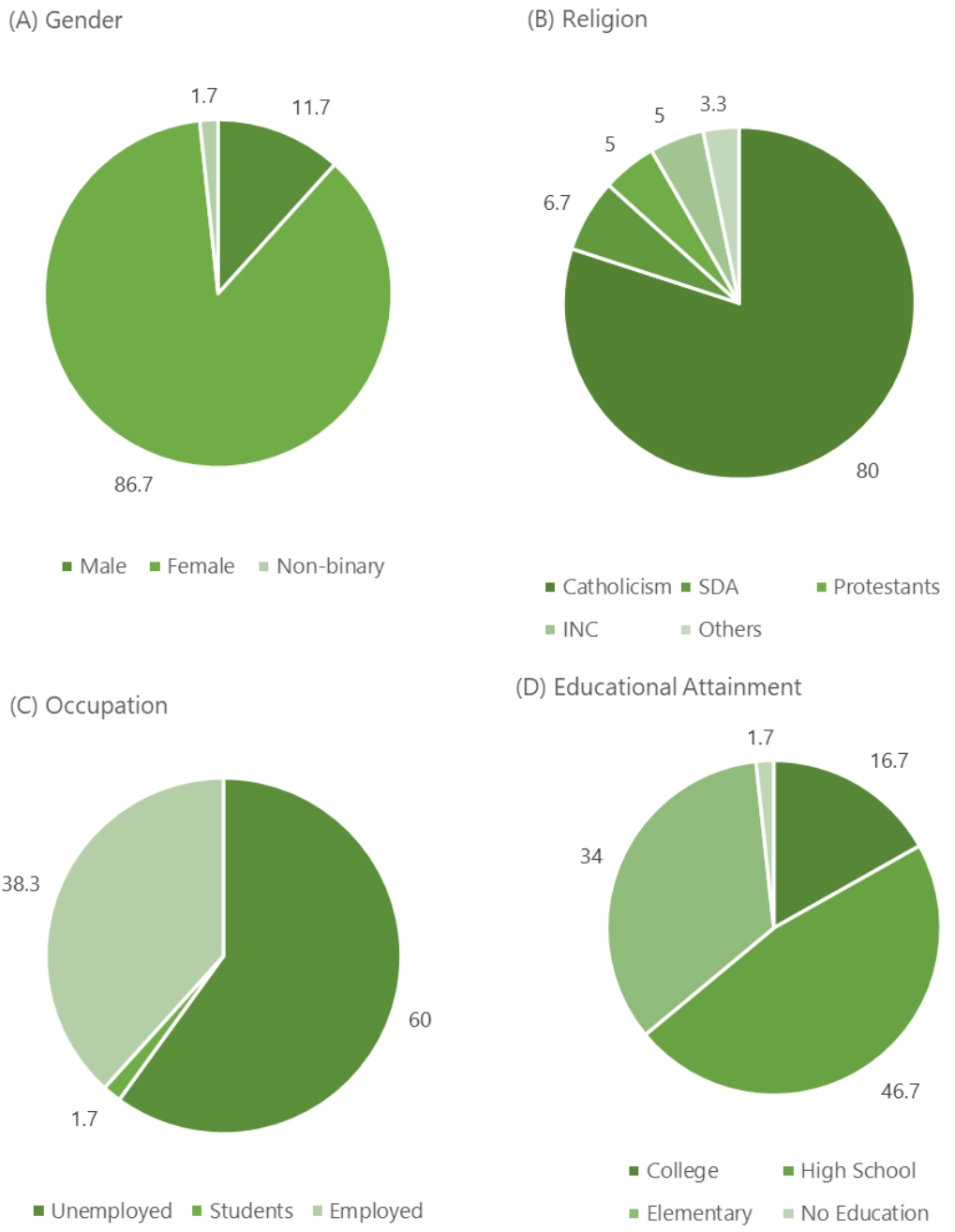
Morbidity	Counts	% of Total
Asthma	5	13.5 %
Abnormal uterine bleeding	3	8.1 %
Heart Disease	2	5.4 %
Pneumonia	2	5.4 %
Tuberculosis	2	5.4 %
UTI	2	5.4 %
Ulcer	2	5.4 %
Visual Impairment	2	5.4 %
Amoebiasis	1	2.7 %
Anemia	1	2.7 %

at 5.0% while other religions accounted for 3.3%. Around 46.7% of the respondents were married, 1.7% were separated, 18.4% were single, and 33.3% were widowed. Cebuano respondents peaked at 88.4% while Blaan, Bisaya, Ilocano, Ilonggo comprised the remaining 11.6%.

In terms of occupation, 60.0% of the respondents were unemployed (31.7% in Poblacion; 28.3% in Spring), 1.7% were students, and 38.3% were employed either in the government, farming and fishery, and other labor sectors. Sixteen point seven per cent (16.7%) reached college, 46.7% went to high school, 34.0% had primary education while 1.7% had no formal education at all. Hospitalization was seen to be the first option for medication and treatment at 75.0%

Figure 2

Demographic profile of respondents in two sites, barangay Poblacion and barangay Spring: (A) Gender, (B) Religion, (C) Occupation, (D) Educational attainment, (E) Marital Status, and (F) Ethnicity.



followed by health center consultation with 31.5%. About 91.7% went nowhere but home when asked for their third choice. Across the three top choices, clinic consultation averaged 7.23% while 4.5% (average), declared they went to nearby local healers.

Health-Related Profile of Respondents

Table 5 shows the mean, mode, and standard deviation, of the scale data. The mean of age for both barangay Poblacion and barangay Spring were 47.93 and 48.70, respectively. The weight, height, and BMI average were 59.13 kilograms, 155.45 cm, and 24.51 in Poblacion; and 56.80 kilograms, 155.36 cm, and 23.56 in barangay Spring. Disease incidence averaged 1.97/household and 2.33/household in Poblacion and Spring, respectively.

Generally, descriptive data gleaned for both sites showed relative differences with commonalities in profile ascribable to geographical proximity. Moreover, while the morbid population in both sites were adults aged 47-49, age data in Poblacion were more dispersed (SD=17.675) than in Spring (SD=13.358). Disease incidences in both sites were approximately two cases per household from 2017-2022.

Causes and Correlates of Disease Incidence

Qualitative Results

Hygienic and Sanitation Conditions at Home and at Work. A cursory inspection of the two study sites revealed that 11.7% in Poblacion and 5.0% of those in Spring resided in homes less than 100 meters from an open dumpsite or landfill (Figure 3). In addition, 30.0% of the residents in Poblacion and 31.7% of the residents in Spring maintained livestock in pens located in the vicinity of their houses. Livestock raised by the respondents' included swine, cattle, carabao, chicken, and duck (Figure 5).

In Poblacion, 41.7% had their own toilet, while 8.3% shared toilets with nearby households. In Spring, 1.7% defecated near or in bodies of water, 45.0% had their own toilet, while 3.3% shared a single toilet with 3-4 households. Consequently, 11.7% in Poblacion and 15.0% in Spring experienced contamination which led to outbreaks of water-borne diseases like diarrhea. These are however anecdotal reports that need to be verified scientifically. Industrial solvents (23.3%; n=60) and air pollution (21.7%; n=60) were observed to be the leading sources of environmental exposure for both home and workplace, in Poblacion and Spring. Decades of research have shown that air pollutants such as ozone and particulate matter (PM) increase the amount and seriousness of lung and heart disease and other health problems (US Environmental Protection Agency, 2023).

Socio-economic, Educational, and Other Related Factors. Respondents from the households with cases of mortality and morbidity were predominantly women. The predominance of women interviewed has social dynamic implications since men are traditionally assigned as breadwinners in these two studied populations.

Households with members having no formal education or only reached elementary comprised 35.7%. Alabel Central Integrated SPED Center, the biggest elementary school in Alabel is situated in Poblacion which incidentally also has several secondary schools. Spring, on the other hand, only has one elementary school. The percentage of the respondents with tertiary education in barangay Poblacion is only 11.7% and 5% in barangay Spring that signifies a lower

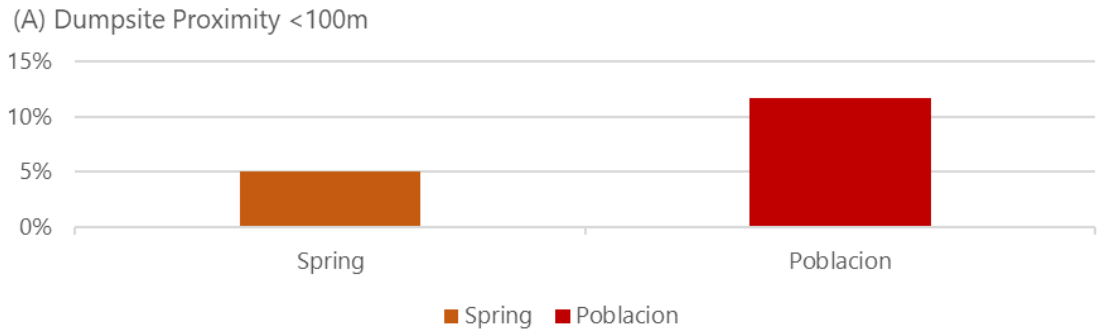
Table 5

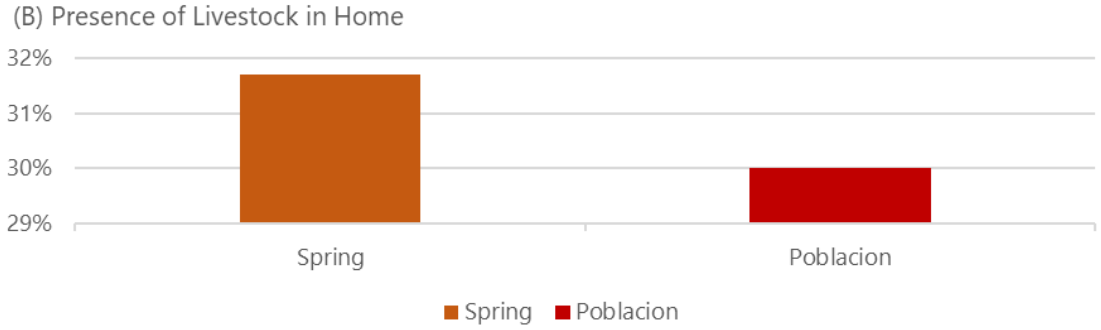
Descriptive statistical results of scale data. (n=30)

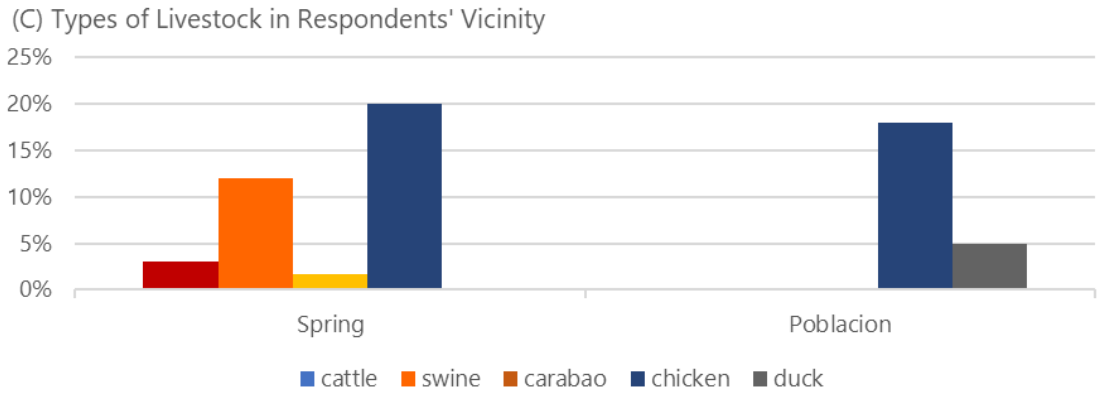
Scale Data	Site	Mean	Standard Deviation
Age	Poblacion	47.93	17.675
	Spring	48.70	13.358
Weight (kg)	Poblacion	59.13	13.261
	Spring	56.80	9.155
Height (cm)	Poblacion	155.45	6.848
	Spring	155.36	5.298
BMI	Poblacion	24.51	5.388
	Spring	23.56	3.775
Disease Incidence	Poblacion	1.97	0.890
	Spring	2.33	1.348

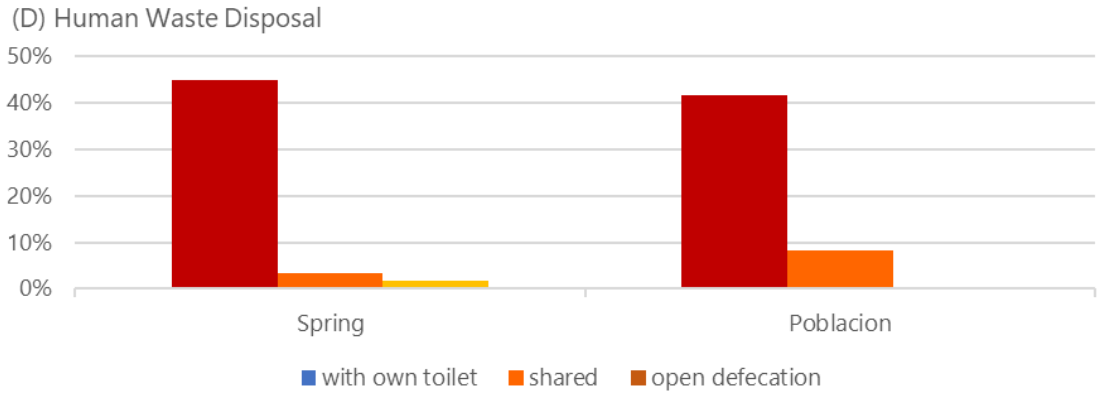
Figure 3

Differences in environmental conditions in Poblacion and Alabel: (A) Dumpsite proximity, (B) Presence of- (C) Types of Livestock in vicinity, and (D) Human Waste Disposal. (n=30)









percentage of respondents with tertiary education in barangay Spring. The difference can be attributed to the socioeconomic status of the urban Poblacion and rural Spring, and the proximity of the former to the municipal center. In the study of Oshio and Kan (2019), the role of educational inequalities as a predictor of disease incidence was highlighted.

Quantitative Results

Correlation Analysis. Correlation and regression analysis are fundamental statistical techniques used to explore relationships between variables. Correlation analysis helped identify the strength and direction of association of disease incidence and health-related predictors including years in school, age, and BMI. This method provided insights into the patterns and interactions within data.

Table 6 shows significant negative correlation for years in school (YIS) and disease incidence (DI). This relationship underscores the importance of information (that education provides) in counteracting DI at the household and community level.

A previous study done in Japan by Oshio and Kan (2019) corroborated this finding by stating that lower educational level is associated with higher incidences of diabetes and stroke among both men and women, and with hypertension among women. Using empirical data from OECD and the World Bank, Raghupathi & Raghupathi

Table 6

Pearson Correlation Analysis of Disease Incidence and Health-related Predictors

	Disease Incidence	**Years in School**	**Age**
Disease Incidence	—		
Years in School	-0.546*	—	
Age	0.126	-.567*+	—
BMI	-0.247	0.401	-0.147

Legend: Significance Level at $\alpha = 0.05$
*significant
+while significant, these relationships are irrelevant to the study

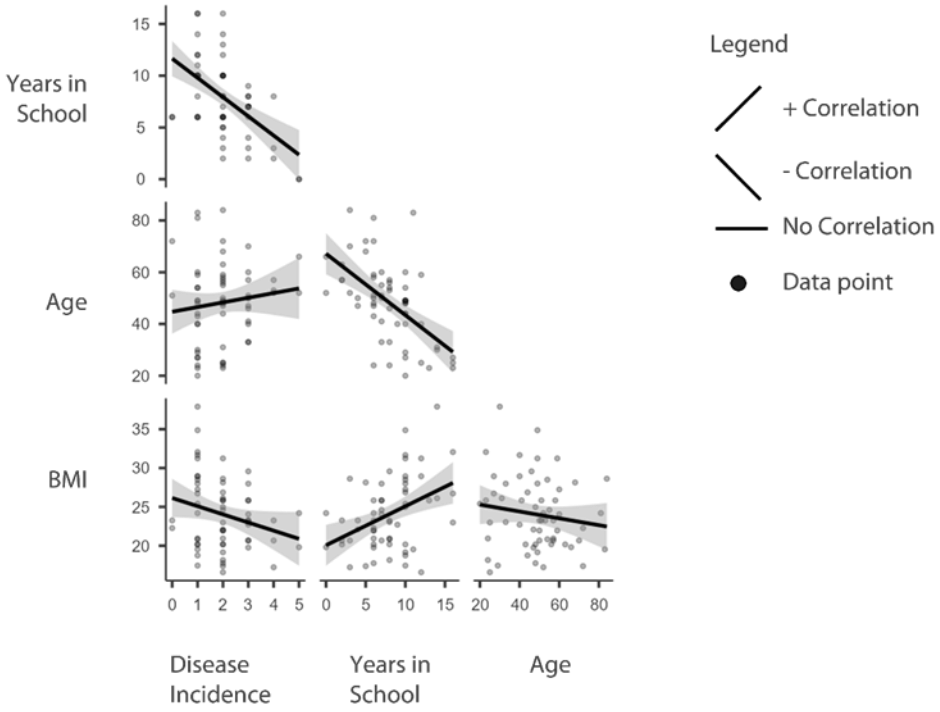
(2020) also showed that adults with higher educational attainment have better health and lifespans than their less-educated counterparts. Level of education is a key determinant of knowledge about disease and its transmission. This likewise significantly influences attitudes and practices, especially in initiatives involved in the integration of community efforts such as dengue control (Diaz-Quijano et. Al, 2018). Figure 4 presents a visual representation of trends obtained from correlation analysis using the same dataset.

Education emerged significantly among all other predictors with respect to disease incidence in the two barangays in Alabel. The health disparities across these barangays suggest implications for government, above all other, to target educational interventions that can reduce inequalities and improve health. Several respondents believed that they did not have the capacity to send themselves or family members to medical consultations due to limited finances, and the root cause of which is the lack of education. To quote Respondent SPR-002: *"Grade 5 ra uy; sa una kay murag wala sila'y pakialam. paeskwelahon unta ko sa akong mga kaliwat, aguy dili man musugot si Mama, maypag manguma daw mi"* (I just finished Grade 5, Sir. My relatives suggested that I went to school but my mother disapproved, saying that we should till the fields instead). This observation is quite prevalent in Spring – it being an agricultural area.

Additionally, BMI and age had very low negative and positive correlations with DI, respectively. Correlation between disease incidence and BMI can be ascribed to significantly higher values obtained for weight, especially in Spring. A casual glance at the respondents revealed that many were broader along the hip region and were relatively shorter in terms of height. These observations are corroborated by studies done by Manzo (2017) and Cosme (2019) that revealed high carbohydrate diets among Sarangani upland tribes. Very low protein content in household diets results in extreme protein malnutrition especially among children with growth stunting, bloated bellies and very slender legs and arms as visible symptoms. A study in Indonesia showed that stunting is directly caused by an inadequate nutrient intake of essential amino acids which play an important role in growth

Figure 4

Scatter plot of Disease Incidence and Associated Health-related predictors.



Note. Significance Level at α= 0.05

and development (Maulidiana & Sutjiati, 2021).

Linear Regression. Linear regression is used to quantify a linear association between disease incidence with at least one independent or explanatory variable by fitting a linear equation to observed data. R^2 indicates the percentage of the variance in the dependent variable that the independent variables explain collectively. It is always between 0 and 100%.

R^2 indicates the goodness of fit of this present model, $F(3,56)= 9.94$ at $p< .001$. The registered R^2 value means that only 34.8% of disease incidence in Poblacion and Spring, Alabel can be explained by the identified predictors or the independent variables (i.e. years in school, age etc). A significant percentage of changes in disease incidence (approximately 65%) is accounted for by predictors not factored in this study.

A closer look at the predictors shows that only years in school has significant impact on disease incidence at $p< .001$ (Table 13). These results are borne out by Pearson's Correlation Analysis (Figure 4) and Analysis of Variance (Table 9).

Based on 4-year disease incidence data (2019-2022) provided by the barangays, maps were constructed for cardiovascular diseases, cancer, and pulmonary diseases. As can be seen in Figure 6, pulmonary diseases predominated while cardiovascular diseases and cancer cases were rather insignificant in terms of numbers.

Mortality/morbidity choropleth frequency maps (Figure 8) were created for the two study sites based on 4-year municipal-wide accumulated

Table 7

Model Fit Measures

			Overall Model Test			
Model	R	R^2	F	df1	df2	p
1	0.590	0.348	9.94	3	56	< .001*

Table 8

Model Coefficients - Disease Incidence

			95% Confidence Interval		
Predictor	**Estimate**	**SE**	**Lower**	**Upper**	**p**
Intercept	4.5774	0.8372	2.9002	6.2548	< .001*
Years in School	-0.2044	0.0418	-0.2881	-0.1206	< .001*
Age	-0.0189	0.0093	-0.0374	-2.72e−5	0.046
BMI	-0.0019	0.0278	-0.0576	0.0539	0.947

Analysis of Variance

Table 9

Omnibus ANOVA Test

	Sum of Squares	**df**	**Mean Square**	**F**	**p**
Years in School	19.47218	1	19.47218	23.87441	< .001*
Age	3.38870	1	3.38870	4.15481	0.046
BMI	0.00366	1	0.00366	0.00448	0.947
Residuals	45.67411	56	0.81561		

Disease Frequency Map

Figure 5

Choropleth disease frequency map of cardiovascular diseases (1.66 cases/1000 person-year), cancer (0.16 cases/1000 person-year), and pulmonary diseases (23.23 cases/1000 person-year) in Alabel, Sarangani Province from 2017-2022. (N=88294, based on 2020 census; categorization follows equal interval classification method)

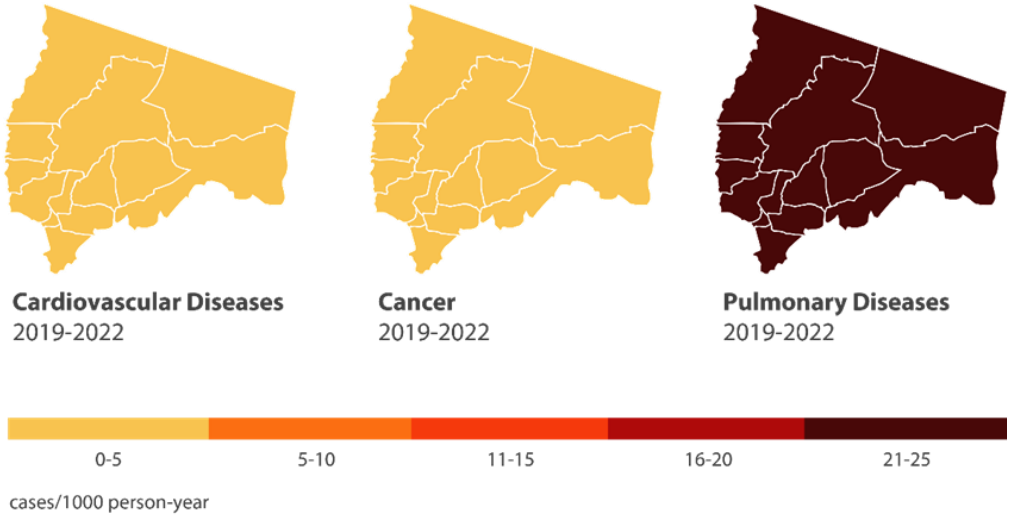
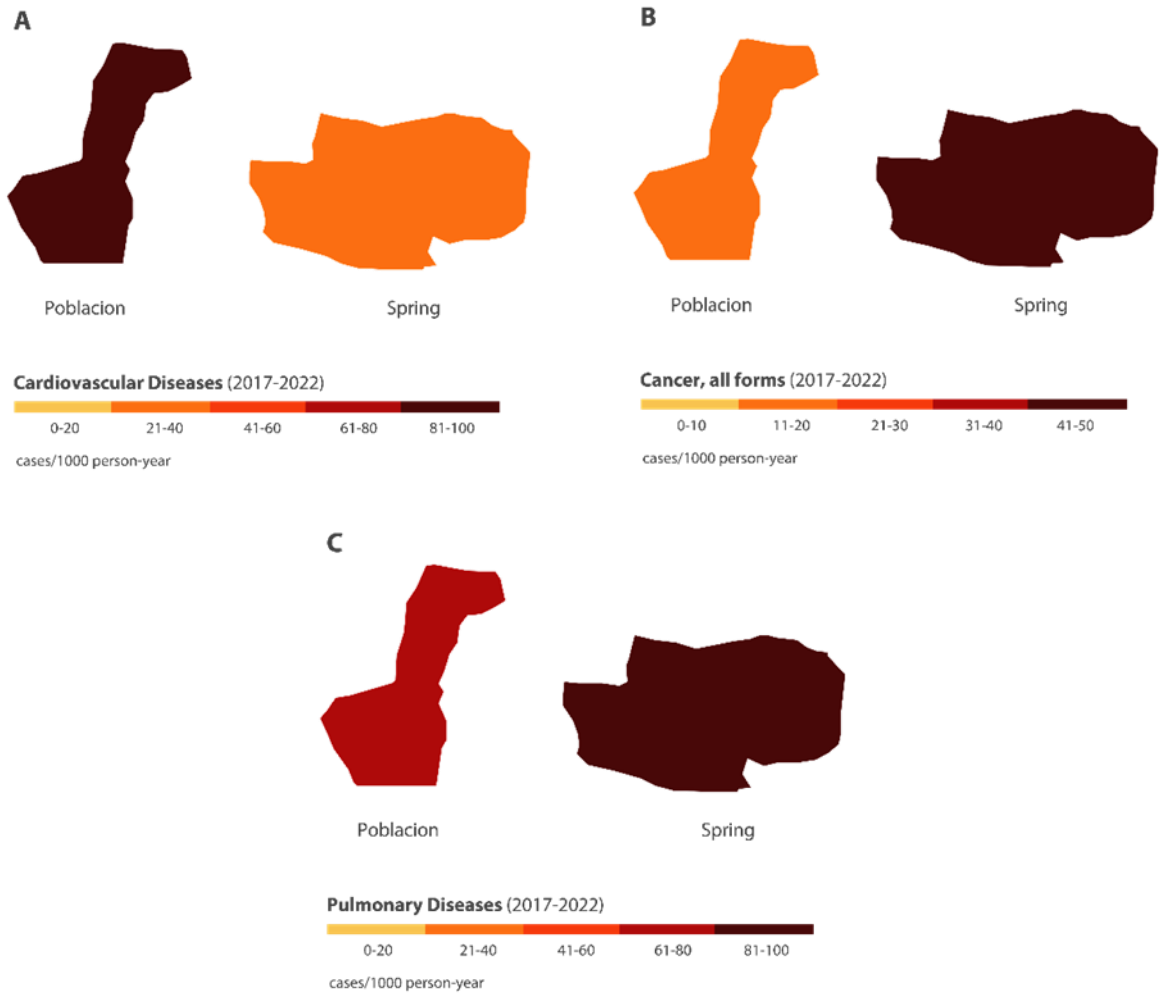


Figure 6

Choropleth disease frequency map of cardiovascular diseases (Poblacion - 93 cases/1000 person-year; Spring - 33 cases/1000 person-year), cancer (Poblacion - 13 cases/1000 person-year; Spring - 47 cases/1000 person-year), and pulmonary diseases (Poblacion - 67 cases/1000 person-year; Spring - 87 cases/1000 person-year), from 2017-2022. (n=60)



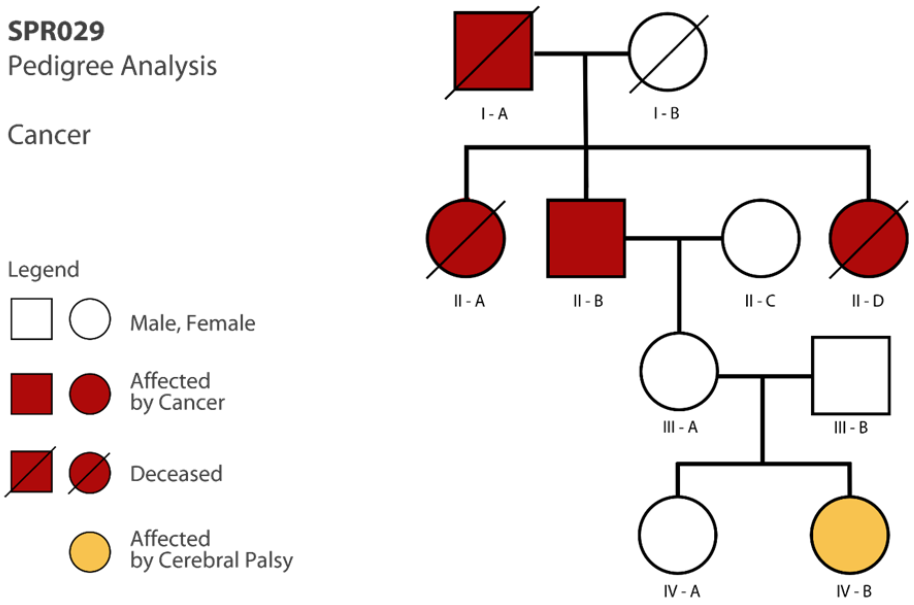
records (2019-2022). Cardiovascular diseases such as myocardial infarction, atherosclerosis, and stroke figured prominently in Poblacion, Alabel from 2019-2022. Cacciata et. Al (2021) showed that Filipinos with moderate to high-risk coronary artery disease were more likely to have cardiometabolic diseases (e.g. hypertension, hyperlipidaemia, diabetes, and obesity. Their findings revealed that coronary artery disease is the leading cause of death for Filipinos, accounting for about 32% of all Filipino deaths. On the other hand, acute respiratory infection and pneumonia were more common in Spring during the same period.

A surprising result was the preponderance of several forms of cancer among families in Spring. A pedigree featuring respondent SPR-029 as a proband is shown in Figure 7 to elucidate the mode of transmission of cancer for this family. SPR-029 is a 52-year-old male who was diagnosed with colon cancer in 2017. Colon cancer also caused death of family members I-A and II-A while nasal cancer manifested in the family with II-D.

While numerous studies have established that cancer is primarily caused by mutations in specific genes, environmental and other etiological factors, however, cannot be entirely ruled out. Moreover, Barangay Spring, being an agricultural community, has vast tracts of land planted to

Figure 7

Pedigree analysis of respondent SPR029 on colon cancer



*arrow indicates the proband

traditional and *Sige-sige* corn which requires extensive herbicide use. Glyphosate, an important component of herbicides, has low toxicity according to the EPA though accompanying substances needed for its delivery to plant tissues are highly toxic. Claims about the carcinogenic properties of glyphosate however can be inconclusive as proven by conflicting views in various literature. In one of such studies, glyphosate exerted a significant toxic effect on neurotransmission leading to neuronal death due to autophagy, necrosis, or apoptosis, as well as the appearance of behavioral and motor disorders (Costas-Ferreira et. Al, 2022). Incidentally, Spring had more pulmonary disease cases from 2017-2022 (Figure 8C). In the case report by Chen et. Al (2017), a 50-year-old non-smoking male farmer, with a history of contact with glyphosate, was diagnosed with acute fibrinous and organizing pneumonia (AFOP). A study in Thailand also revealed that exposure to glyphosate had a negative impact on oxidative stress and lung function in maize farmers who used glyphosate to control weed growth.

The presence of livestock pens around the household is another factor to reckon with when considering the causes of compromised respiratory health. Large animal farming exposures cause a spectrum of upper and lower respiratory tract diseases due to the complex diversity of organic dust, particulates, microbial cell wall components and gases that they release (May et. Al, 2012). However, studies on small-scale/backyard livestock pens affecting humans are scarce. In addition, smoking, observed in both study sites, was directly associated with lung diseases including chronic obstructive pulmonary disease, which includes emphysema and chronic bronchitis (CDC, 2021).

In general, the current epidemic of NCDs and CDs poses noxious health consequences to individuals, families, and communities, and threatens to overwhelm health systems. The occurrence of cardiovascular diseases, pulmonary diseases, and cancer in the study sites localizes this fact. The study results revealed that these diseases are largely due to genetic predisposition but can be exacerbated by environmental factors, diet, and lifestyle. Results of this study therefore underline the importance of a massive information drive and education to address morbidity at the household level. In the socioeconomic context, costs associated with NCDs and CDs make the control and prevention of these diseases a major development imperative for the 21st century. As is widely known, preventive measures are less costly than reactive measures especially at the community and national level.

Barangay Poblacion has a rural health center and the newly established St. Elizabeth Clinic, other barangays like Spring only have

barangay health centers that are ill equipped to provide holistic and comprehensive services to their constituents. Respondent SPR-001 became teary-eyed when she shared that due to the inaccessibility of health institutions and the lack of medical assistance, *"nakaya nako na akoy ray magtaod sa catheter sa akong ugangan Sir for 12 years.*" (I was able to administer my father-in-law's catheter all by myself for 12 years) (Appendix G). Improved healthcare through establishment of facilities and capacitating manpower are crucial steps the municipality has to consider. Reyes-Gibby & Aday (2005) amplified this call as they assessed access to care in rural Filipino populations. Through this landmark study, vital information will be made available to local governments for interventions geared towards the provision/upgrading of health programs that will improve access to care and routine monitoring of chronic illness in under-served, rural populations.

Conclusion

This study was carried out to identify prevalent diseases/disorders causing mortality and morbidity, to detect trends related to disease dispersal, and determine the causes and correlates of mortality and morbidity among the local populations in a relatively urban (Poblacion) and a rural barangay (Spring) in Alabel, Sarangani Province. Using a mixed-method approach, this study revealed both noncommunicable and communicable diseases (i.e. particularly cardiovascular diseases, cancer and pulmonary diseases) as the major causes of mortality and morbidity in Poblacion and Spring, Alabel. Moreover, differences in access to education, basic health care, technology and knowledge had resulted in socio-health disparities between the two barangays, which in turn, became manifested in the health conditions among locals in these areas.

The study likewise underscored the important role of information (education) in addressing these social and health-related inequalities. Given these results, the establishment of facilities/agencies that can screen and detect diseases, strengthening educational interventions that can improve health (i.e. incorporating basic health practices in the primary and secondary school curricula), providing equitable access to healthcare services to both lowland and upland dwellers, supplementing existing health force with more barangay health officers (BHW) to reach remote communities in Alabel are thus recommended as possible courses of action.

It is further recommended for researchers or the government to carry out similar studies but using more respondents and disease incidence indicators (i.e. glyphosate exposure, etc.) and along different time scales to ascertain disease trends. Expansion of the study to a municipality- or province-wide scale would provide a true picture of DI incidences for more concerted and comprehensive action by the LGU.

Author's Contribution

JP drafted most of the paper, participated in determining the experimental design, gathered the data, analysed the data, performed qualitative and quantitative analyses. FZ co-conceived the study, participated in data interpretation, and proofread contents. AG co-conceived the study in medical-epidemiological perspective and proofread contents. TS co-conceived the study in a medical research perspective and proofread contents.

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