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Prevalence of Worm Infestation and Associated Risk Factors among Rural and Urban Lower Primary School Going Children in Kasama District, Northern Province, Zambia

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Abstract

Regardless of the many health promotion communications and public health interventions that the Government of the Republic of Zambia continues to provide to its citizens via the Ministry of Health that are directed at the prevention and reduction of worm infestation in Kasama District, Northern Province of Zambia, a lot of lower primary school going children still continue to miss school attendance in order to access health services due to worm infestation cases which have continued to be on the increase in both rural and urban areas. The high levels of poverty and other related risk factors in such resource-limited areas have put many of these children at increased risk of worm infestation. Thus, this study investigated the relationship between those risk factors and the prevalence of worm infestation in both rural and urban areas with respect to area of residency of the children. The study used retrospective quantitative methods in eliciting information from data sources from six health facilities in Northern Province covering a 2year period (2018-2020). Consequently, 120 children were identified and included in the study. Thereafter, data were analyzed using a statistical package for the social sciences (SPSS v19). Findings indicate; low socio-economic status and areas of residency were the main contributing risk factors in rural than urban areas. Therefore, recommendations on the country's policies towards mass deworming programs and basic hygiene in lower primary school going children were availed to government after completing the study.

Keywords: *Residency, Primary School Children, Prevalence, Worm Infestations, Zambia.*

Introduction

The health of lower primary school going children is a significant investment in ensuring the well-being of any country's future [1]. But despite the high burden of worm infestations in Zambia, this public health issue is often overlooked particularly among the lower primary school going children that are in essence the most vulnerable and are at increased risk of more severe infections, malnutrition, cerebral impairment, or even death attributable to worm infestations. Worm infestation is a key public health concern in both rural as well as urban communities of developing countries like Zambia [2]. Globally, with over 4 billion people infected with worm infestations, over 500 million are currently sick, of which the majority are lower primary school going children [3]. The most common worm infestations globally reported are Ascaris lumbricoides that stand at 20%, Hookworms at 18%, Entamoeba histolytica at 10% and *Trichuris trichuria* at 9% [4]. These worms are highest in prevalence and hence are among the major causes of illnesses in developing countries, particularly in sub-Saharan Africa among lower primary school going children. This is largely associated with the poor socioeconomic status and hence poor sanitation of these children [5]. In developing

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countries like Zambia, the lack of safe drinking water and inadequate health facilities have contributed to worsening of the situation [6]. Worse still, there are a good number of rural communities in Zambia that continue to practice open defecation which result in several intestinal infections coupled by the presence of dirty running waters in the rainy seasons [7]. It is therefore imperative to identify those risk factors attributable to worm infestations in such communities and provide appropriate strategies as well as policies for suitable healthcare interventions for age groups in lower primary schools [8].

In many low-income countries, complications of worm infestations are the leading cause of death amongst lower primary school going children especially those coming from rural areas [9]. Prevalence rate is as high as (20-30 %), and even higher in rural areas (40 – 50 %). Worm infestations in lower primary school going children is still a significant factor of public health concern in both developed and developing countries and it is one of the top five medical conditions that contribute to early deaths of young children in most communities [10]. However, the impact of the disease is felt more severely in developing countries. Unlike other more prevalent causes of worm infestations, medical interventions may be ineffective due to late presentation of cases. The problem is confounded by the continued mystery of etiology and the unpredictable nature of the disease.

However, there have been no such health facility-based studies looking at worm infestations in Kasama District, Northern Province of Zambia conducted on lower primary school going children. Therefore, this study was a pioneer to the many other related surveys that will be conducted later on the topic in selected schools of Kasama District and Northern Province as a whole. Consequently, the aim of this study was to examine those unknown factors which could be attributable to the higher prevalence of worm infestation and associated risk factors among rural and urban lower primary school going children in Kasama District in Northern Province of Zambia [11]. Most factors became known after secondary data analysis was done on medical records of 6 health facilities (3 rural and 3 urban health facilities) that attended lower primary school going children who were treated for worm infestation. Thus, the overall purpose of this paper was to highlight the factors associated with worm infestations and suggest measures which could be used to address them within the local context. The study also helped to determine the prevalence of worm infestation in Kasama district of Northern Province in Zambia.

Data entry and analysis was done with the help of Epi Data version 3.1 and Statistical Package for Social Sciences (SPSS) version 19.0. All the baseline features of the study population were summarized by use of tables as well as frequencies of categorical variables [12].

Logistic regression was used in determining those factors that were independently related to worm infestations. 95% confidence interval (CI) was used with a 5% level of statistical significance set as a cutoff point.

According to WHO guidelines, the formula below was used to calculate the prevalence of infection:

i.e., Prevalence = (Number of subjects testing positive × 100) / Number of subjects investigated.

As for socioeconomic status of the children, the interface between social as well as economic conducts of a collection of people was applied.

A financial scale was used in this study as shown in Table 1 below to do an estimate of the socio-economic status of school children (participants).

Table 1. Financial Scale Estimating Socio-economic Status

Socio-economic status	US Dollar/person/day	Zambian kwacha/person/day
Low income	1	22
Medium income	2	44
High income	3	66

Table 1 shows how descriptions of low, medium, and high socio-economic status were based on the currencies in order to categorize participants.

And residency was used to mean the place of stay of the lower primary school going child at the time of this study, while urban and rural schools/health facilities were taken as those facilities located within a 5kilometer radius from Central Business District-CBD, whereas a rural school/health facility was defined as a school/health facility whose locality was outside that defined as urban.

The prevalence of worm infestation and associated risk factors with respect to residency is important in preventing disease burden, especially in rural areas. The outcome of this study will also bridge the current scientific knowledge gap and contribute to a paradigm shift in the prevention and management of worm infestation from the public health perspective. In addition, it will contribute to the debate on providing socio-economic assistance to vulnerable groups such as lower primary school going children especially those in resource-limited areas as well as provide adequate scientific evidence needed by policymakers for robust decision making and contribute to the improvement of healthcare in both settings for the maximum benefit of public health field.

A good number of scholars have researched on various factors contributing to increased worm infestation with respect to distribution in communities. Factors such as age and sex of children, socio-economic status of the children, residency (urban or rural) of children and number of hospital visits of the children due to worm infestation have been documented in various literature as risk factors. Nonetheless, there were no research done to determine the prevalence and show scientific association between distribution of worm infestation and associated risk factors in Kasama District, Northern Province of Zambia with respect to residency.

There has been little or no documentation on health facility-based surveys conducted on lower primary school going children in both the urban and rural areas on worm infestations in Northern Province of Zambia. However, worm infestations continue to account for most of the morbidity and mortality in lower primary school going children [13]. This study began with a recorded prevalence rate of 20% worm infestations and would like to contribute to the improvement of strategies and policies that are designed for Zambia to prevent worm infestations.

According to this study, one of the factors independently associated with worm infestations is the employment status of their fathers/mothers. Children whose fathers/mothers are employed are less likely to be infected compared with children of unemployed fathers/mothers [14]. Also, other studies show that the better the economic status, the lower the infestations as unemployment and low income corresponds to a high risk for infection in these children [15].

Compared with children who have no history of worm infestation, those with a history of infestation are more likely to be infected again. Most studies available show that urban slums have children that are more likely to be infected and re-infected constantly for the rest of their lives due to the poor environments. This study therefore made a comparison of both urban and rural schools and areas of residency [16].

The main objective of this study was to establish the association between socio-economic status (age, occupation of guardians/parents and age, sex and grade of lower primary school going children) and associated worm infestations with respect to residency in both urban and rural areas of Northern Province, Zambia. The other objective was to identify the risk factors attributable to worm infestation in both urban and rural areas of Northern province, Zambia. The last objective was to determine the prevalence of worm infestation in both rural and urban lower primary school going children of Northern Province in Zambia.

Materials and Methods

Research Design and Study Population

A retrospective structured study was conducted which was quantitative and comparative in nature. This was at 6 health facilities located near 6 respective lower primary schools within Kasama, Northern Province of Zambia. Medical records from January 2018 to January 2020 were analysed. The study sample was determined by using the single proportion population formula. Because the overall prevalence rate (p) of the worm infestations is not currently known in the study area: p was taken as 20%. And for the purpose of calculation, a 95% confidence interval (z) and a 5% margin of error (d) was used. Final sample size was expected to be 120 eligible children.

Information about socio-demographics of children in addition to the likely associated risk factors of worm infestations was collected using secondary data from patients' records in 6 health facilities. These were recorded and analysed for each child that was considered for the study. And to establish associations, Pearson's Chi-square was used.

Ethical Considerations

In compliance with the ethical guidelines of the Copperbelt University – School of Medicine, and the National Ethics Review Board, the researcher clearly stated the purpose of the research, duration, methods used and data collection instruments which were approved. Review of Medical reports were done in record time in order to save time for other health facility services.

Sample Size Determination

Systematic sampling in which all the children treated for worm infestation at the health facilities was used in the study. A list arranged in sequential order (by date of their presentation at the health facility) showing the children's health facility visitation for worm infestation treatment was made.

This formula ($N = Z^2 Q P / D^2$) was used in this study in order to calculate a desired sample population while systematic sampling of every third child within the inclusion criteria were used to select the final representative sample.

Sample Size Calculation

n = desired sample size for children that were treated for worm infestation at the health facilities in Kasama, Northern Province of Zambia representing the 6 respective schools.

Z = Standard normal deviation at 95% confidence level = 1.98.

P = Prevalence of worm infestation in Zambia at 20%, therefore, P = 0.2.

Q = 1-P = 0.8.

D = Degree of precision or acceptable error of margin (5% or 0.05 for this study).

Therefore, **n =** 120, giving working sample of 138 lower primary school going children.

A sampling frame of 360 lower primary going children that were treated for worm infestations at the various 6 health facilities was used. A systematic sampling approach was then applied to this sampling frame by selecting every third participant to arrive at a total of **(n = 120)** participant as a representative sample in this study.

Data Collection

Data was collected using a check list from registers (Outpatient, Inpatient, Referral forms),

at 6 health facilities. These were needed for analysis**.** Table 2 shows how data was operationalized on Statistical Codes for age and economy of parents.

Table 2. Operationalization of Data

Children's variables	Statistical Codes		
	1	2	3
Mother's age (yrs.)	≤ 19 Teenager	20 – 30\ Ideal age	≥ 31 Old age
Father's age (yrs.)	≤ 19 Teenager	20 – 30 Ideal age	≥ 31 Old age
Economy of Parents (ZMW/day/person)	< K500 Low income	K1,000 – K3,000 Medium income	K3, 500 ≤ High income

Results

Table 3 shows that residency, and sex of child were strongly associated with worm infestation (CI 95%, df = 1, p < P), while age of child was only moderately associated (CI 95%, df = 2, p < P), with grade of child having lowest association (CI 95%, df = 3, p < P), but all of them were statistically significant at 95 % confidence level (0.000 < 0.05).

Table 3: Demographics of Children and Associated Risk Factors

	Residency	Age of child	Sex of child	Grade of child
Chi-Square	34.931[a]	51.752[b]	76.119[a]	217.208[c]
df	1	2	1	3
Asymp. Sig.	.001	.012	.001	.013

Table 4 shows that the age of female parents/ guardians was strongly associated with worm infestation (CI 95%, df = 1, p < P), while the age of male parents/ guardians was moderately associated (CI 95%, df = 2, p < P), with occupation of parents/ guardians having lowest association (CI 95%, df = 3, p < P), but all of them were statistically significant at 95 % confidence level (0.000 < 0.05.

Table 4. Demographics of Parents/Guardians and Associated Risk Factors

	Age of Male parents/guardians	Age of Female parents/guardians	Occupation of parents/ guardians
Chi-Square	89.832[a]	86.257[b]	415.129[c]
df	2	1	3
Asymp. Sig.	.001	.012	.013

Figure 1 shows that Roundworms where more prevalent (42.5%), followed by Whipworms at (24.2%), the Hookworms at (19.2%) and lastly Tapeworms at (9.1%). Other types of worms only contributed 5%. In addition, the study also showed that 70.8% of worm infestation was diagnosed in children from rural areas while only 29.2% were from urban areas.

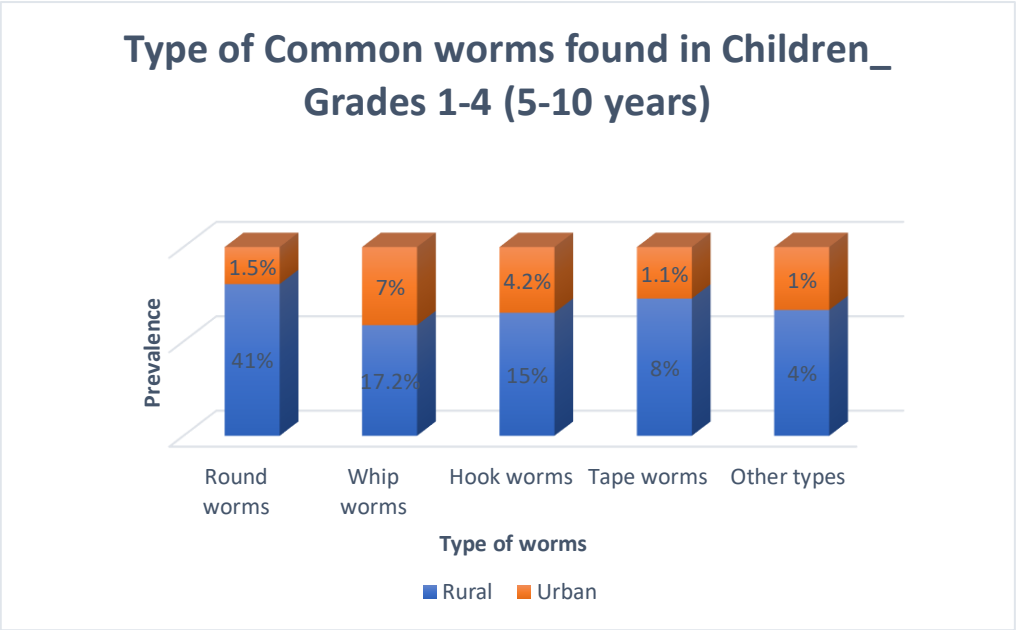

Figure 1. Prevalence of Worm infestations

Cross – Tabulations of Residency and other Risk Factors:

Figure 2 shows that for the age of 5-10 years of lower primary school going children under study, 60.8% of them were from rural areas, while 39.2 % are from urban areas.

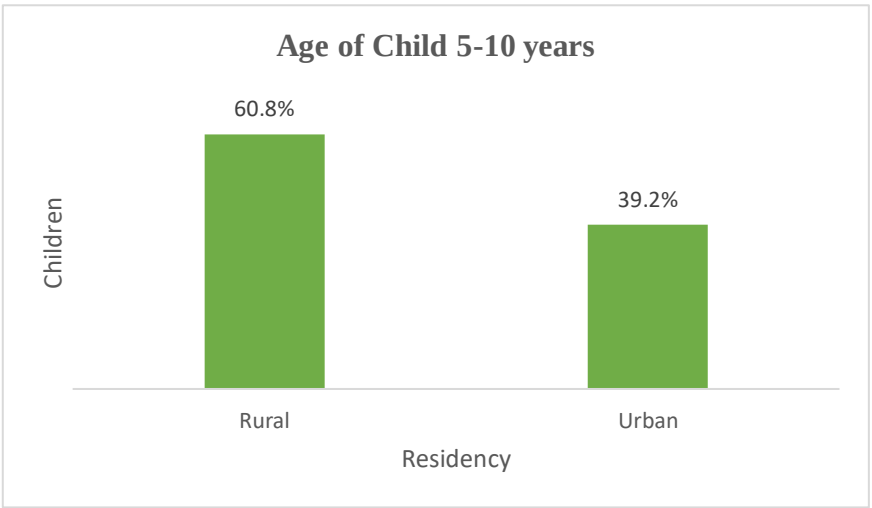

Figure 2. Residency & Age of Child 5-10 years

Figure 3 shows that 60 % of the lower primary school going children were females while 40 % were males. As for those in urban areas, 69.2 % were males and females from urban areas while 30.8 % were males from rural areas.

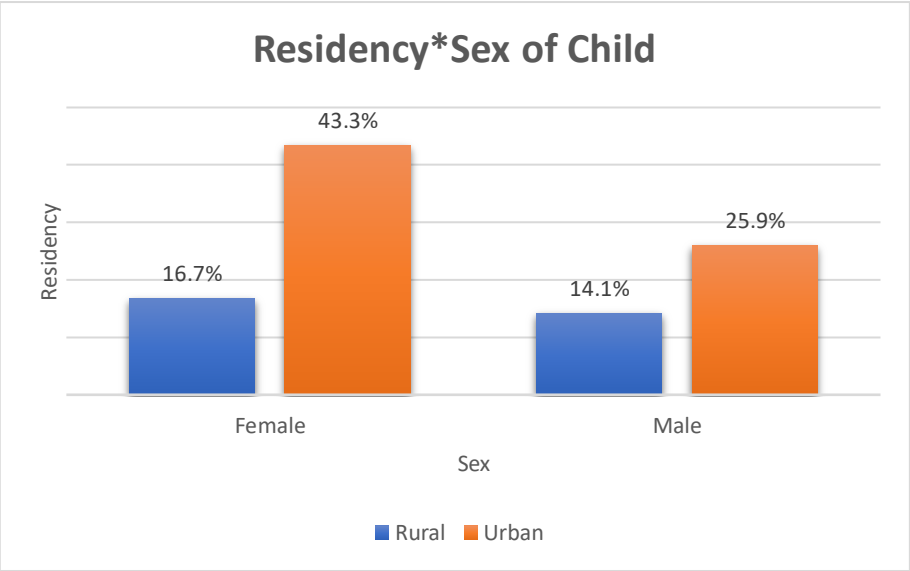

Figure 3. Residency & Sex of Child

Figure 4 shows that 76.6 % of the lower primary school going children in grades 1- 2 come from rural areas while 23.4 % in the same grades come from urban areas. As for those in grades 3 – 4, the majority (67.4 %) come from urban areas while the rest (32.6 %) come from rural areas.

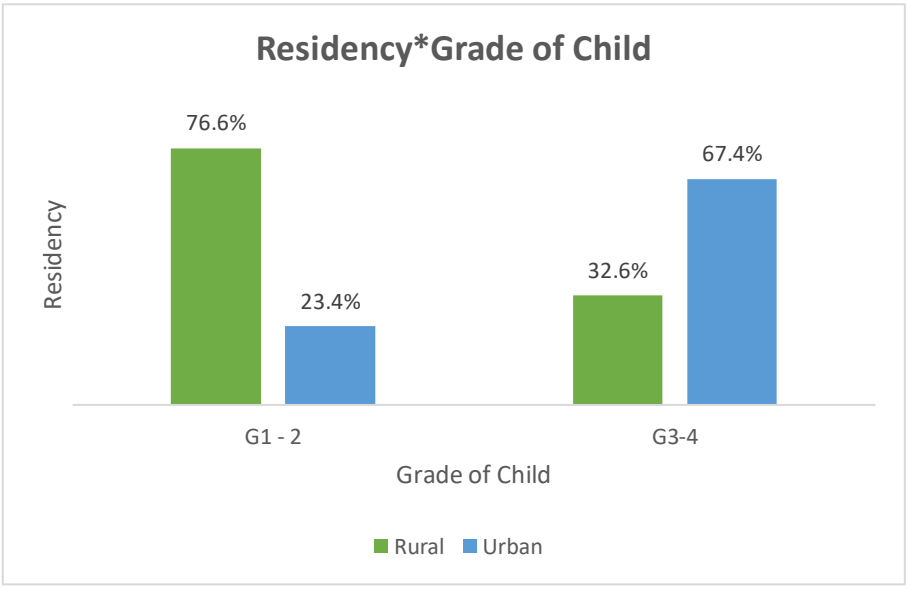

Figure 4. Residency & Grade of Child

Figure 5 shows that of those male parents/ guardians that were less than 30years, 82.4% of them were from rural areas while only 17.6% were from urban areas. As for those aged 30 years and above, 67.4% were from urban areas while only 32.6% were from rural areas.

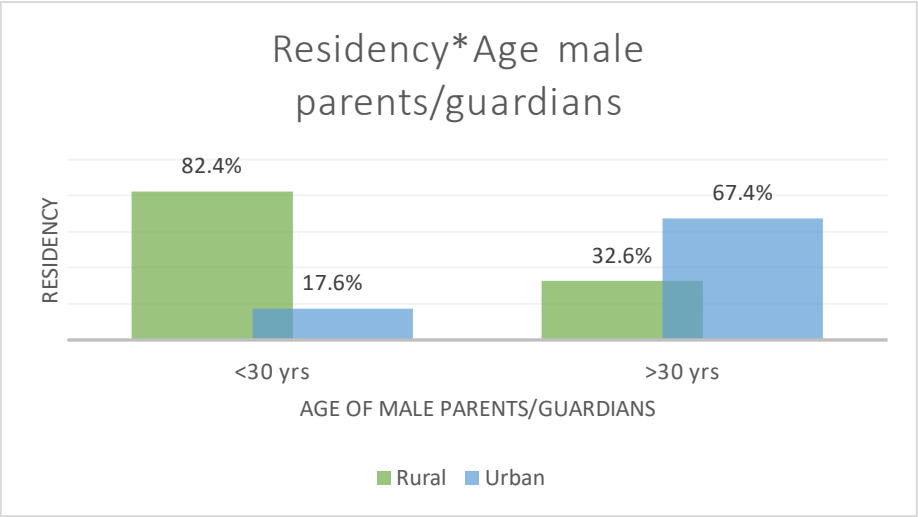

Figure 5. Residency & Age of Male Parents/Guardians

Figure 6 shows that 82.0 % of female parents/guardians less than 30 years were in rural areas, while only 18 % were from urban areas. However, 74.2 % of those over 30 years come from rural areas as compared to 25.8 % who were from urban areas.

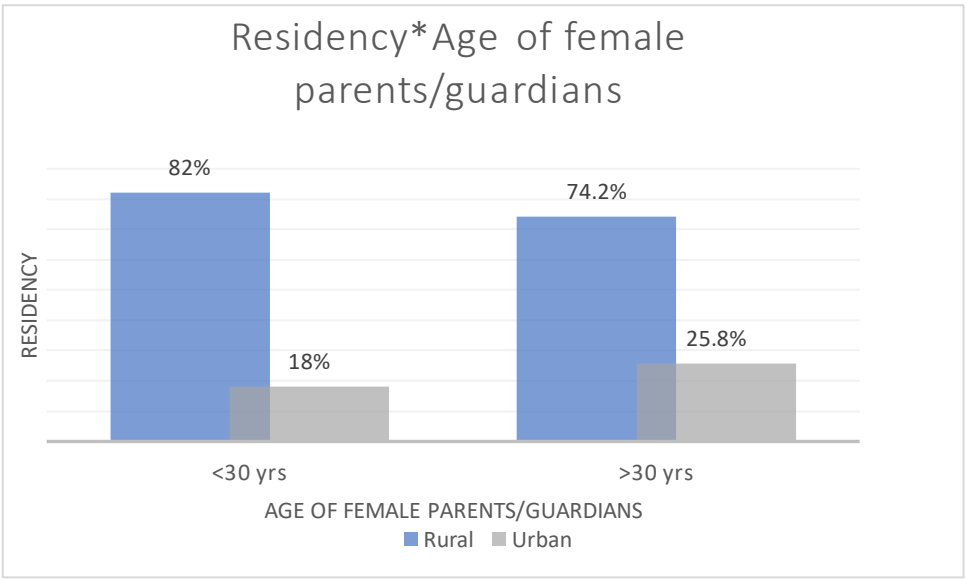

Figure 6. Residence & Age of Female Parents/Guardians

Figure 7 shows that out of the 120 Guardians/Parents, 99 (82.7%) were in the informal employment, and only 21 (17.5%) Guardians/Parents were in the formal employment. And of those from informal employment, 57.5%. were from rural areas and only 25% were from urban areas. As for those in formal employment (11.7%) were from urban areas, whereas only 5.8% were from rural areas. Finally, the occupation of those guardians/parents in both rural and urban areas had insignificant association with regards the worm infestation.

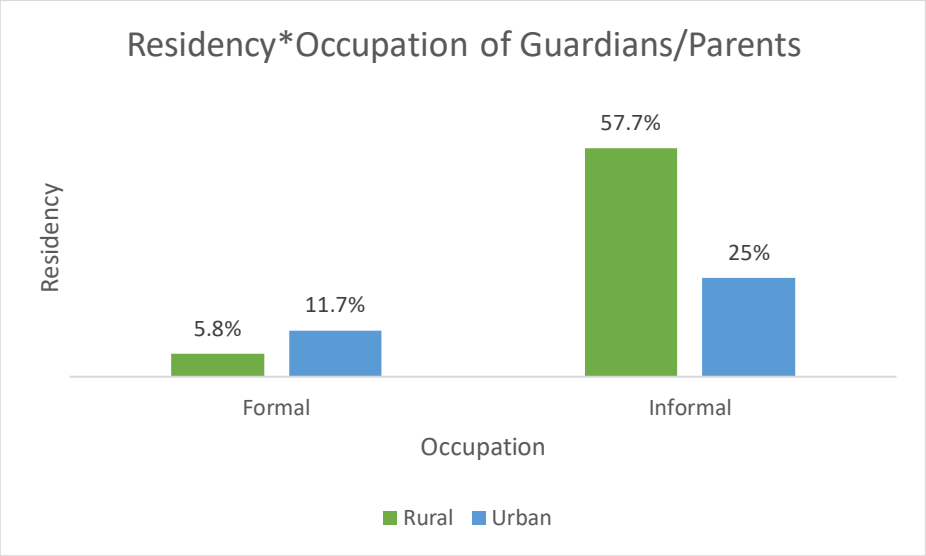

Figure 7. Residency & Occupation of Guardians/Parents

Objective 1: To establish the association between socio-economic status (age and occupation of guardians/parents) and associated worm infestations with respect to residency in both urban and rural areas of Northern Province, Zambia.

Hypothesis 1: The study rejects the Null Hypothesis (H0) that "none" of the socio-demographic risk factors (age and occupation of guardians/parents) are associated with worm infestation with respect to 'residency' and accepts the Alternate Hypothesis (H1) that at "least one" of the socio-demographic risk factors (age and occupation of guardians/parents) is associated with worm infestation with respect to 'residency', because the results were statistically significant at 95 % confidence level.

Results 1

Analysis 1: Age of female parents/ guardians was strongly associated with worm infestation (CI 95%, df = 1, p < P), while age of male parents/ guardians was moderately associated (CI 95%, df = 2, p < P), with occupation of parents/ guardians having lowest association (CI 95%, df = 3, p < P), but all of them were statistically significant at 95 % confidence level (0.000 < 0.05.

Analysis 2: The study showed that 82.0 % of female parents/guardians less than 30 years were in rural areas, while only 18 % were from urban areas. However, 74.2 % of those over 30 years come from rural areas as compared to 25.8 % who were from urban areas. Out of the 120 Guardians/Parents, 99 (82.7%) were in informal employment, and only 21 (17.5%) Guardians/Parents were in formal employment. And of those from informal employment, 57.5%. were from rural areas and only 25% were from urban areas. As for those in formal employment (11.7%) were from urban areas, whereas only 5.8% were from rural areas. Finally, the education levels of those guardians/parents in both rural and urban areas had insignificant association with regards the worm infestation of their children.

Objective 2: To identify the risk factors attributable to worm infestation in both urban and rural areas of Northern province, Zambia.

Hypothesis 2: The study rejects the Null Hypothesis (H0) that "none" of the risk factors (age of child and grade of child) are associated with worm infection with respect to areas of residency and accepts the Alternate Hypothesis (H1) that at "least one" of the risk factors (age of child and grade of child) is associated with worm infestation with respect to areas of residency, because the results are statistically significant at 95 % confidence level.

Results 2

Analysis 3: Residency, and sex of child were strongly associated with worm infestation (CI 95%, df = 1, p < P), while age of child and residency were moderately associated (CI 95%, df = 2, p < P), with grade of child having lowest association (CI 95%, df = 3, p < P), but all of them were statistically significant at 95 % confidence level (0.000 < 0.05).

Analysis 4: The study showed that for the age of 5-10 years of lower primary school going children under study, 60.8% of them were from rural areas, while 39.2 % are from urban areas.

Analysis 5: 60 % of the lower primary school going children were females while 40 % were males. As for those in urban areas, 69.2 % were males and females from urban areas while 30.8 % were males and females from rural areas.

Analysis 6: 76.6 % of the lower primary school going children in grades 1- 2 come from rural areas while 23.4 % in the same grades come from urban areas. As for those in grades 3 – 4, the majority (67.4 %) come from urban areas while the rest (32.6 %) come from rural areas.

Objective 3: To determine the prevalence of worm infestation in both rural and urban lower primary school going children of Northern Province in Zambia.

Analysis 7: The study shows that Roundworms were more prevalent (42.5%), followed by Whipworms at (24.2%), the Hookworms at (19.2%) and lastly Tapeworms at (9.1%). Other types of worms only contributed 5%. In addition, the study also showed that 70.8% of worm infestation was diagnosed in children from rural areas while only 29.2% were from urban areas.

Discussion

This study demonstrated that all the carefully chosen factors had significant statistical Residency, and sex of child were strongly associated with worm infestation (CI 95%, df = 1, p < P), while age of child and residency was only moderately associated (CI 95%, df = 2, p < P), with grade of child having lowest association (CI 95%, df = 3, p < P), but all of them were statistically significant at 95 % confidence level (0.000 < 0.05). Age of female parents/ guardians was strongly associated with worm infestation (CI 95%, df = 1, p < P), while age of male parents/ guardians was moderately associated (CI 95%, df = 2, p < P), with occupation of parents/ guardians having lowest association (CI 95%, df = 3, p < P), but all of them were statistically significant at 95 % confidence level (0.000 < 0.05).

Urban lower primary school going children were found to have better health-seeking behavior and had at least 3 visits, unlike those from rural lower primary school going children who only attended maximum of 2 visits. It was also noted that urban children had early health facility visitations compared to those from rural areas that visited the facilities late when infected.

Having higher education in rural was found to be protective against worm infestation when compared to urban children. This may be due to good health seeking behavior seen among educated rural parents [17].

However, the rampant use of traditional remedies in treating worn infestation by most parents from rural areas was a clear indication of the huge knowledge gap about the disease. This could have been the major contributor to the various adverse infection outcomes among rural lower primary school going children in Northern Province of Zambia [18].

Therefore, more robust public health interventions such as public health practitioners spending most of their time at community level preventing and treating worm infestation at primary level to lower primary school children would provide a paradigm solution that could reduce complications resulting from worm infestation [19]. Consequently, coming up with community interventions of public health importance tarred to lower primary school going children such as community awareness and mass deworming would help increase on knowledge about worm infestation so that they position

themselves on how to prevent all forms of worm infestation [20].

Conclusion

This retrospective study found that 76.6 % of the lower primary school going children in grades 1- 2 come from rural areas while 23.4 % in the same grades come from urban areas. As for those in grades 3 – 4, the majority (67.4 %) come from urban areas while the rest (32.6 %) come from rural areas. The study also showed that 81.7 % of lower primary school going children from rural areas visited the health facilities more that those coming from urban areas who only visited the health facilities by 18.3 %. This could be attributed to the fact that most children in rural schools have poor environments that make them more susceptible to worm infestations. In addition, the study showed that 84.4 % of male parents/guardians in rural areas were less than 30 years, while only 32.6 % of them were over 30 years. As for urban areas, 67.4 % were above 30 years and only 17.6 % were below 30 years. As for prevalence, the study shows that Roundworms were more prevalent (42.5%), followed by Whipworms at (24.2%), the Hookworms at (19.2%) and Tapeworms at (9.1%). Other types of worms only contributed 5%. In addition, the study showed that 70.8% of worm infestation was diagnosed in children from rural areas while only 29.2% were from urban areas. Therefore, the study made recommendations on the country's policies towards mass deworming programs and basic hygiene in lower primary school going children which were availed to government after completing the study.

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Conflict of Interest

The was no conflict of interest that was directly or indirectly associated with the researcher conducting this study.

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