High Mumps virus IgG seropositivity among women with spontaneous abortion attending health care facilities in Mwanza, Tanzania

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Abstract

Introduction: Mumps virus infection is a public health concern mainly in low- and middle-income countries and has been associated with complications such as spontaneous abortion and post-pubertal orchitis that may result in testicular atrophy and, consequently, infertility. Mumps vaccination is not currently implemented in Tanzania, and the data regarding its magnitude is limited, with no data among women with spontaneous abortions.

Objective: This study aimed to determine seropositivity and factors associated with specific mumps virus IgG antibodies among women with spontaneous abortion in Mwanza, Tanzania.

Methodology: From July to August 2022, a laboratory-based analytical cross-sectional study involving 212 sera collected between 2015 and 2019 from women with spontaneous abortions in Mwanza was conducted. Mumps IgG antibodies were detected by an indirect Enzyme-Linked Immunosorbent Assay. Descriptive data analysis was done using Stata version 15.

Results: The median age of enrolled participants was 27 [IQR: 24-32] years. The overall seroprevalence of mumps virus IgG antibodies was 117/212(55.19%) [95% CI: 48.39-61.80]. Being an urban resident (OR: 3.23, 95% CI 1.83-5.96, P< 0.001) and an increase in the number of household members (OR: 1.18, 95% CI: 1.01-1.38, P=0.040) predicted seropositivity of mumps IgG antibodies among women with spontaneous abortion in Mwanza, Tanzania.

Conclusion: More than half of the women with spontaneous abortion live in the urban settings in the city of Mwanza, Tanzania, and those living in houses with a high number of household members were Mumps virus IgG seropositive. More studies on the causal effect relationship between women with spontaneous abortion and mumps virus are warranted.

Keywords: Mumps virus; Spontaneous abortion, Mwanza, Tanzania

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Background

Mumps virus (MuV), the causative agent of mumps is an enveloped Ribonucleic acid (RNA) virus that belongs to the genus Rubulavirus in the family Paramyxoviridae (Hviid *et al.*, 2008). The virus has a 100-600 nm diameter with 15384 nucleotides. The viral genome is a linear molecule of single-stranded, negative-strand RNA. The genome encodes six structural proteins and two non-structural proteins(Rubin and Carbone, 2003). Mumps are acquired through contact with the body fluids of infected individuals, such as saliva and nasal secretions (Hviid *et al.*, 2008, Rubin *et al.*, 2015).

Before the implementation of the immunization program, Mumps was a severe disease that caused significant morbidity and mortality worldwide(Fields *et al.*, 2019). In the pre-vaccine era, mumps had a high morbidity of approximately 40–726 cases per 100,000 population per year(Su *et al.*, 2020). In the absence of vaccination, mumps viral infections have been circulating endemically with a periodic spike of two to five years, and a peak incidence of the disease has been among children aged five to seven years old in several regions worldwide(Betakova *et al.*, 2013). Risk groups for MuV infection include unvaccinated individuals and ones living in crowded populations, for example, boarding schools, prisons, refugee camps and orphan houses.

Several risk factors have been reported in mumps infection, including age, exposure, compromised immunity, time of the year, travel, and vaccination status(Su *et al.*, 2020). Mumps is prevalent among adolescents and adults; however, the disease mainly affects children aged 5–9. Mumps orchitis develops in 14- 35 % of post-pubertal males with mumps (Manson, 1990) while spontaneous abortion, as well as embryonic and foetal death, increase with MuV infection during pregnancy(Lozo *et al.*, 2012). About 20% of women experience spontaneous before 20 weeks, most occurring within the first 12 weeks of gestation(Lulandala *et al.*, 2017).

By December 2010, 118 out of 193 member states of the World Health Organization (WHO) had included mumps vaccination in their national immunization programs, with the vast majority using the combined measles-mumps-rubella (MMR) vaccine.(Su *et al.*, 2020, Organization, 2012)In countries where large-scale immunization against mumps has been implemented, disease incidence has dropped dramatically (WHO, 2012). Tanzania is among the countries where mumps vaccination has not been implemented in the national immunization program. Only a few studies documented its magnitude in Tanzania, and it has been reported to be 77% among unvaccinated children in Dar es Salaam(Buberwa *et al.*) 15.0% among children in Dar es salaam(Minja, 1998b) and 21.4% among school children in Mwanza(Rakiru *et al.*, 2020).

This study aimed to determine seropositivity and factors associated with mumps virus IgG antibodies among women with spontaneous abortion in Mwanza, Tanzania. The generated information helps provide evidence-based policy recommendations.

Materials and methods

Study Design, duration, population and inclusion criteria

A laboratory-based analytical cross-sectional study was conducted from July to August 2022. The study used achieved sera collected from five hospitals in the city of Mwanza region (Bugando Medical Centre, Sekou Toure, Sengerema DDH, Buzuruga and Butimba Hospital) between 2015 and 2019 from women with spontaneous abortion to determine MuV IgG antibodies. All samples with insufficient volume and incomplete sociodemographic data were excluded.

Data and sample collection
Samples (-80^{o}C storage) were obtained from the CUHAS Microbiology laboratory. Sociodemographic information (study number, age, residency, location, marital status, level of education, occupation, etc.) and clinical data (history of fever, headache, etc.) were extracted from the existing database.

Specimen analysis
Sera were analysed for mumps virus antibodies using Indirect ELISA test kits per the manufacturer's instructions (Vircell, S.L. Parque Technologico de la Salud, Avicena 8, Granada, Spain). The test kit has a sensitivity of 98% and a specificity of 95%.

Data management and analysis
Laboratory results were recorded in the laboratory logbook and then sorted and transferred into a Microsoft Excel sheet for cleaning and coding. Descriptive data analysis was done using statistical software for data analysis (Stata Corp, Texas-USA, version 15). Proportions were used to summarize categorical variables, including sex, employment, residence, and marital status, while the median (IQR) was used for continuous variables, including age and number of households. Univariable and multivariable logistic regression were used to show factors associated with mumps antibodies, whereby factors with P value <0.2 on univariable analysis were subjected to multivariable analysis. Odds ratio and 95% confidence intervals were determined, and variables with a P-value of <0.05 were considered statistically significant.

Ethical considerations
Ethical clearance was sought from the CUHAS/BMC research ethics and review committee (CREC) with the ethical clearance number CREC/2336/2022. Confidentiality information was maintained throughout the study.

Results
Sociodemographic and clinical characteristics
A total of 212 archived samples collected from women with spontaneous abortion in Mwanza were analysed in this study with a median age of 27 [IQR: 24-32] years. More than half of the participants, 120/212 (56.6%), resided in the urban areas of the city of Mwanza. Most of the participants, 201/212 (94.81%), attained formal education ranging from primary to tertiary education. Moreover, over three-quarters of 176/212 (83.02%) participants were married. The median number of household members for the enrolled participants in this study was 4 [IQR: 3-6] members. 87/212 (41.04%) reported fever, and about one-third, 70/212 (33.02%) reported experiencing headache during pregnancy.

Table 1: Socio-demographic and clinical characteristics of enrolled participants

Variables/Characteristics		Frequency(n)	Percentage (%)
Median (IQR) age in years		27[24-32]	
Residence	Rural	92	43.4
	Urban	120	56.4
Education	No education	11	5.19
	Primary	124	58.49
	Secondary	58	27.36
	Tertiary	19	8.96
Median [IQR] Household members		4 [3-6]	
Occupation	Housewife	72	33.96
	Peasant	31	14.62
	Self employed	18	8.49
	Business	65	30.66
	Employed	26	12.26
Marital status	Married	176	83.02
	Single	34	16.04
	Widow	27	0.94
Fever	No	125	58.96
	Yes	87	41.04
Headache	No	142	66.97
	Yes	70	33.03

Laboratory results

Of 212 participants, 117/212(55.19%) [95% CI: 48.39-61.80] were seropositive for IgG MuV antibodies.

Factors associated with Mumps IgG antibodies seropositivity among women with spontaneous abortion in Mwanza, Tanzania

By univariable logistic regression analysis, an increase in household members (OR: 1.21, 95% CI: 1.06-1.37, P=0.005) was significantly associated with Mumps IgG seropositivity. Being an urban resident (OR: 3.23, 95% CI 1.83-5.96, P= 0.000), being self-employed (OR: 11.07, 95% CL: 2.16-56.76, P=0.04) and being a businesswoman (OR: 2.71, 95% CL: 1.12-6.52, P=0.026) were significantly associated with Mumps IgG seropositivity. By multivariable logistic regression analysis being urban residents (OR: 3.64, 95% CI: 2.01-6.62, P= 0.000) and increase in the number of household members (OR: 1.21, 95% CI: 1.01-1.38, P=0.011) independently predicted Mumps IgG seropositivity among women with spontaneous abortion **(Table 2).**

Table 2: ***Univariate and multivariate logistic regression analysis on the factors associated with Mumps virus IgG antibodies seropositivity***

Characteristics		Mumps IgG antibodies		Univariable logistic analysis		Multivariable logistic analysis	
		Negative n	Positive n (%)	cOR[95%CI]	P value	aOR[95%CI]	P value
Age				1.04[1.00-1.09]	0.071	1.01 [0.96-1.06]	0.667
N/ household				1.21[1.06-1.37]	0.005	1.21 [1.01-1.38]	0.011
Residence	Urban	39 (32.5%)	81 (67.5%)	3.23[1.83-5.96]	0.000	3.64 [2.01-6.62]	0.000
	Rural	56 (60.87%)	36 (39.13%)	1			
Marital status	Married	78 (44.32%)	98 (55.68%)	0.99[0.47-2.078]	0.983		
	Single	15(44.12	19(55.88%)	1			
	Widow	2(100%)	0 (100%)	1			
Education	None	6(54.55%)	5 (45.45%)	0.75[0.17-3.33]	0.705		
	Primary	48(38.71%)	76 (61.29%)	1.43[0.54-3.76]	0.474		
	Secondary	32 (55.17 %)	26 (44.83%)	0.73[0.26-2.07]	0.555		
	Tertiary	9 (47.37%)	10(52.63%)	1			
Occupation	H/wife	40 (55.56%)	32 (44.44%)	1.11[0.47-2.59]	0.814	0.91 [0.73-1.12]	P=0.364
	Employed	13 (50%)	13 (50%)	1.38[0.49-3.95]	0.543		
	S/employ	2 (11.11%)	16 (88.89%)	11.07[2.16-56.76]	0.004		
	Business	22 (33.85%)	43 (66.15%)	2.71[1.12-6.52]	0.026		
	Peasant	18 (58.06%)	13(41.94%)	1			
Fever	Yes	38 (43.68%)	49(56.32%)	1.08[0.62-1.87]	0.782		
	No	57 (45.6%)	68(54.4%)	1			
Headache	Yes	32 (45.71%)	38 (54.29%)	0.85[0.49-1.47]	0.556		
	No	63 (44.37%)	79 (55.63%)	1			

Discussion

In efforts to control viral diseases, it is important to understand the magnitude and epidemiology of infectious agents. Here, we report MuV IgG seropositivity among women with spontaneous abortion in Mwanza, Tanzania. More than half of the women in this study were found to be MuV IgG seropositive which is low compared to the previous reports from Tanzania among unvaccinated children and from other studies in Colombia(epidemic period), USA (adult population), Turkey (unvaccinated adolescents) and Brazil (school-aged children) (Santacruz-Sanmartín *et al.*, 2015, Lebo *et al.*, 2015, Kanbur *et al.*, 2003, Buberwa *et al.*). The possible explanations for these variations could be due to differences in the study population, seasonality, and geographical and climatic conditions. Compared to previous studies in Africa(Rakiru et al., 2018, Minja, 1998a, Doshi et al., 2017), the prevalence reported in the current study is high. The observed difference could be explained by the current research involving adults compared to previous studies focusing on children. As in many other infections, the risk of virus exposure increases as the age increases.

Among the factors assessed in the current study, residing in urban was significantly associated with MuV IgG seropositivity, which is inconsistent with a previous report in Mwanza, Tanzania, among children(Rakiru *et al.*, 2018). This could be explained by the high rate of interactions in urban settings compared to rural settings, which might increase the risk of transmission. Furthermore, this can be partly explained by the high number of participants from urban areas in the current study compared to a previous report.

Moreover, in the current study, MuV IgG seropositivity was significantly associated with an increase in the number of household members, which is in agreement with previous reports in the Democratic Republic of Congo (DRC), Spain and Turkey among unvaccinated children(Doshi *et al.*, 2017, Arroyo *et al.*, 1986, Gurgoze *et al.*, 2006). This could be explained by the fact that as the number of household members increases, the risk of transmission also increases due to overcrowding, which facilitates the transmission of the viruses. However, these findings are different from previous reports in Mwanza and Dar es Salaam (Rakiru *et al.*, 2018, Buberwa *et al.*).

Furthermore, in the current study, we observed more than half of the participants who were seropositive to MuV IgG antibodies had neither a history of fever nor headache, similar to the study done in Mwanza among school-aged children(Rakiru *et al.*, 2018). This can be explained by the fact that mumps is asymptomatic in 20-30% of individuals(FOY *et al.*, 1971).

Limitations of the study

The high seropositivity of Mumps IgG antibodies observed among women with spontaneous abortion is not an indication of active mumps infection. Further studies in the Mwanza region are warranted to establish active infection and causal effect relationships.

Conclusion

This study observed that the seropositivity of MuV IgG antibodies among women with spontaneous abortion in the Mwanza region is high and is predicted by residing in urban areas and an increase in the number of household members. This calls for more prospective studies in the study area and other regions across the country to provide more epidemiological data that might be useful in devising control measures, including introducing the Mumps vaccine in the national Immunization programmes.

Declaration

Ethical approval

Ethical clearance for conducting this study was sought from the CUHAS/BMC research ethics and review committee (CREC), with ethical clearance number CREC/2336/2022. Confidentiality was maintained throughout the study.

Consent for publication: Not applicable

Availability of data and material: All data generated/ analysed during this study are included in this manuscript

Competing interests: The authors declare that they have no competing interests

Funding: None

Authors contributions

HN and MMM participated in designing the study. EGK, HN, EC, FM, PS, and BM participated in data/sample curation. EGK, HN, EC, FM, PS, and BM participated in laboratory analysis of samples. MMM and SEM analysed data, and DK, MM, and AEC participated in data interpretation. MMM and EGK wrote the first draft of the manuscript. SEM, MM and MM did the critical review of the manuscript. All authors approved the last version of the manuscript

Acknowledgement

The authors acknowledge the support provided by the Department of Microbiology and Immunology in retrieving data and samples and analysing them in the laboratory.

List of Abbreviation

BMC	Bugando Medical Centre
CUHAS	Catholic University of Health and Allied Sciences
ELISA	Enzyme-Linked Immunosorbent Assay
IgG	Immunoglobulin G
IgM	Immunoglobulin M
MMR	Measles-Mumps-Rubella
RNA	Ribonucleic Acid
RT-PCR	Reverse Transcriptase Polymerase Chain Reaction
WHO	World Health Organization

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