KNOWLEDGE, ATTITUDES, AND PRACTICES OF CAREGIVERS TOWARDS MEASLES AND MEASLES VACCINE IN A SELECTED VILLAGE IN VHEMBE DISTRICT, LIMPOPO PROVINCE

BY

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DECLARATION

I, **Happiness Mathenjwa**, hereby declare that I have not previously submitted the proposal titled: "***Knowledge, attitude and practice of Caregivers towards Measles and vaccination at selected districts, Limpopo province, South Africa***" in the University of Venda for any academic qualification at this institution or elsewhere. I confirm that the proposal is entirely my own work, from conception up to completion. I further confirm that all sources referenced or cited within the mini dissertation have been duly acknowledged.



Student name: Ms SH Mathenjwa **Date: 14 January 2025**

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DEDICATION

This study is lovingly dedicated to my cherished grandfather, my aunt, and my son, whose unwavering support and inspiration drive my efforts.

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ACKNOWLEDGMENTS

- First and foremost, I extend my deepest gratitude to my Lord and Savior, Jesus Christ, for His steady providence and the strength granted to see this journey through to its completion.
- I gratefully acknowledge the financial support provided by the National Research Foundation scholarship. Words alone cannot fully convey my appreciation for this invaluable assistance. Thank you for making this journey possible.
- To my supervisor, Prof. L Makhado, a remarkable blend of wisdom, kindness, and brutal honesty qualities few can embody so seamlessly, I owe immense appreciation. Your guidance transformed two years into a lifetime of learning, shaping me from scholarly infancy to maturity. For your steadfast mentorship, I offer infinite gratitude.
- To my three dedicated research assistants, your sacrifices and unwavering support were the pillars upon which this work was built. Without your invaluable contributions, this endeavour would not have been possible.
- To the participants who graciously welcomed us into your homes, thank you for your openness and trust. Your willingness to share your lives and stories, even at the expense of your privacy, is profoundly appreciated and will not be forgotten.
- Finally, to my friends and family, whose numbers are too vast to name individually, you were my unwavering strength. Your support turned what seemed an insurmountable mountain into a molehill. To each of you, my heartfelt thanks for being the foundation upon which I stood.

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LIST OF ACRONYMS AND ABBREVIATIONS

KAP : Knowledge, Attitudes and Practices

MCV (1) : Measles Containing Virus first dose.

MCV (2) : Measles-containing virus second dose.

NICD : National Institute for Communicable Diseases.

SPSS : Statistical Package for the Social Sciences

UNICEF : United Nations Children's Fund.

WHO : World Health Organization.

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ABSTRACT.

Despite the widespread availability of an effective and free measles vaccine, the infection remains a global public health challenge. While barriers to childhood immunization have been extensively studied worldwide, including in South Africa, there is limited information regarding caregivers' specific knowledge, attitudes, and practices (KAP) concerning measles and its vaccination in the South African context. Given the ongoing measles outbreaks in 2022–2024, it is imperative to investigate whether caregivers know their children's vaccination status and the recommended timing for measles immunization. This study aimed to assess the KAP of caregivers toward measles and its vaccine in a selected village in Limpopo Province.

The research was conducted alongside a scoping review to synthesize existing global literature on measles and vaccination and to inform the study's direction. The review incorporated keywords related to the study variables and sourced data from peer-reviewed journals, grey literature, and government reports. Subsequently, the study adopted a quantitative, cross-sectional, non-experimental descriptive design to gather data from caregivers of children aged six months to twelve years residing in the Vhembe District, Limpopo Province. Data were collected using a structured questionnaire designed to measure relevant variables. A simple random sampling method was employed to select 377 eligible respondents. The Statistical Package for the Social Sciences (SPSS, version 29.0) was utilized to analyze the data, presenting findings through tables, frequencies, and percentages, with Pearson correlation analysis used to explore associations.

The scoping review identified themes indicating that caregivers possess adequate knowledge about measles; however, attitudes toward the measles vaccine varied, with the majority reporting positive rather than negative attitudes. Factors influencing caregivers' KAP included vaccine hesitancy, demographic characteristics such as the age and educational status of the caregiver, logistic constraints, the caregiver-physician relationship, and the impact of the COVID-19 pandemic. The quantitative analysis revealed that most caregivers demonstrated low (32.1%) to moderate (66.2%) knowledge levels, while only 6.8% exhibited high knowledge. Attitude scores indicated that most caregivers (89.3%) held positive attitudes toward measles and its vaccine. Practice scores highlighted that the majority (94.2%) demonstrated generally positive practices.

The study found low knowledge could be attributed to limited exposure to measles infections and infrequent discussions with healthcare providers. The study recommends implementing targeted interventions that extend beyond mass community immunization campaigns. These should focus on educating caregivers about identifying measles cases and reinforcing the significance of vaccination, despite the limited exposure to the disease, to sustain community herd immunity.

Keywords: Knowledge, attitude, practice, vaccination, measles

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PREFACE

This mini dissertation is structured in an article format and contains three sections. The first section is a study overview, section two contains two manuscripts (i.e., a scoping review and empirical research article), and section three includes a conclusion, limitation and recommendation.

SECTION 1: OVERVIEW OF STUDY

Section one of this mini-dissertation includes the background and introduction of the study, the problem statement, the study's primary aim and objectives, the study design and research methodology, and concludes with the ethical guidelines adhered to in the duration of the study.

SECTION 2: MANUSCRIPTS.

This section contains two manuscripts, i.e., a scoping review titled Knowledge, attitudes, and Practices of Caregivers Towards Measles and Measles Vaccine: A Comprehensive Scoping Review.

The second manuscript is titled Assessing Caregiver's Prophylaxis Towards Measles and the Measles Vaccine in a Selected Village in Limpopo Province, South Africa.

SECTION 3: CONCLUSION, RECOMMENDATION AND LIMITATIONS OF THE STUDY.

This section presents this study's conclusion, recommendations, and limitations.

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SECTION 1:

OVERVIEW OF THE STUDY

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1. Introduction and background of the study.

Many countries worldwide are experiencing a resurgence of previously eradicated diseases (Zakhour, Tamim, Faytrouni, Khoury, Makki & Charafeddine, 2021). Hotez (2019) draws attention to the rising occurrence of vaccine-preventable diseases and the anti-vaccine movement across Europe and the United States of America. The World Health Organization (WHO, 2023) has also recently reported eight African counties that experienced a significant measles outbreak that affected tens of thousands of children. These outbreaks are compounded by low vaccine coverage in routine immunization programs and delayed vaccination campaigns during the COVID-19 pandemic.

In 2022, the National Institute for Communicable Disease (NICD) (2023) announced a measles outbreak on October 08, after three laboratory-confirmed measles were detected at two healthcare facilities in the Limpopo province. According to NICD (2022), the outbreak spread beyond Limpopo to other parts of the provinces in South Africa. From epidemiological week 40, 2022 (ending 8 October 2022) to week 12 (2023, ending 21 March), 5332 blood samples were collected from outbreak-affected provinces to test for measles. Out of these samples, 864 were confirmed to be measles cases.

The recent interim situation report (09 October 2023) reveals that there has been a noteworthy increase in the number of cases reported from weeks 34-39. From epidemiological week 40, 2022, to week 39, 2023, the NICD tested 7123 serum samples for measles, of which 1214 (17%) were confirmed measles cases. From epidemiological week 40 of 2022 to week 39 of 2023, 1205 laboratory-confirmed cases were reported from eight provinces with declared measles outbreaks: Limpopo (524 cases), Mpumalanga (120 cases), Northwest (222 cases), Gauteng (223 cases), Free State (35 cases), Western Cape (23), KwaZulu-Natal (51) and Northern Cape (7).

In the measles outbreak update of 18 September 2023, issued by the NICD based on laboratory testing data, a total of 1214 confirmed measles cases, of which Limpopo had the highest (524) cases of laboratory-confirmed measles reported between epidemiological week 40, 2022 to week 39, 2023. Most measles cases were reported in the Waterberg, Greater Sekhukhune, and Mopani districts. Waterberg district reported the highest (230) number of measles cases. Mopani district reported 99 cases. Greater Sekhukhune district reported 146 cases. Vhembe district reported 35 cases, and Capricorn district reported 14 cases.

Measles is a contagious virus that impacts the respiratory tract system and can spread throughout the body (WHO,2023). The virus mainly spreads from one person to another through droplets in the air when an infected individual sneezes or coughs (WHO,2023). Measles infection can lead to major outbreaks, resulting in significant morbidity and mortality rates among vulnerable people (WHO,2023). Young and malnourished children, pregnant women, and immunocompromised individuals, including

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those with HIV and cancer or immunosuppressive treatment, are at higher risk of experiencing serious health issues such as ear infection, diarrhoea, blindness, encephalitis, and pneumonia (NICD,2023).

Although there is no specific antiviral treatment (NICD,2023), however, the WHO (2023) recommends coverage of ≥ 95 % with Measles Containing Virus 1 (MCV1) and Measles Containing Virus (MCV2) necessary to ensure and sustain high population immunity against measles and prevent future outbreaks. As a result, the NICD (2023) urged parents to check their children's Road to Health booklet to ensure measles vaccinations are up to date and ensure their children are vaccinated against measles.

Regarding the national immunization coverage of the (MCV1) and (MCV2) the South African National Department of Health (NDOH, 2023) was estimated at 87% and 82%, respectively, in 2021, while in 2022, the respective coverage was 86% and 86%. However, historical vaccination coverage has been low (in 2018, MCV1 coverage averaged 81% and MCV2 75%. In 2017, MCV1 and MCV2 coverage was estimated at 81% and 78%), which has been contributing to the current (2023) resurgence (WHO-UNICEF, 2023).

This information indicates that the national immunization coverage of the measles-containing vaccine (MCV1) and the second dose of the vaccine (MCV2) in South Africa has been low. In 2021, the coverage for MCV1 was estimated at 87%, while MCV2 had a coverage of 82% (WHO, 2023). In 2022, both MCV1 and MCV2 coverage decreased slightly to 86% (WHO, 2023). The percentage of children vaccinated against MCV shows coverage is consistently well below the recommended (95%) coverage. South Africa faces challenges in achieving the optimal measles coverage for herd immunity.

There is a need for continuous efforts to strengthen vaccination programs, improve access to vaccines, and address any barriers that may be contributing to these low coverage rates in South Africa. While many factors influence caregivers' decision to vaccinate their children (sociodemographic characteristics, their trust in the public health system, the parent-physician relationship), the present study focuses on their level of knowledge and their attitudes towards vaccination. This is because parental knowledge and attitudes toward both disease and vaccinations are known to influence vaccine uptake,

Previous studies have indicated that personal level of knowledge and attitude towards a disease influence vaccination behaviour (Gaczkowska, Mertens, Reckendrees, Wortberg & Pott, (2013) while recent studies reveal that Misinterpretations of disease severity, limited knowledge of vaccines, fears of adverse events and concerns over vaccine safety are major contributors to poor vaccination practices (Hussein, Mardia, Amira, Hashim and Abubakar, 2022). Furthermore, recent studies of infectious diseases reveal that refusing vaccinations is becoming a common occurrence among parents globally (Matta, Rayane, Mouallem, Akel, Hallit & Khalife, 2020, Thompson, 2023).

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A study conducted in Saudi Arabia on knowledge of measles recruited 356 parents, and findings revealed that 23.3% perceived measles as slightly contagious and 15.7% of the participants failed to answer any of the measles-related questions correctly (Almansour, lsayahi, Albarakah, & Almana et al., 2021). While another study in the Republic of Cyprus assessed 703 caregivers; according to the study findings, 39% had a relatively low knowledge of measles (Kyprianidou, Tzira, Galanis, & Giannakou, 2021). Additionally, in another similar study by Nasser (2021), in West Asia, parents had inadequate knowledge about the adverse reactions (57.5%) and contraindications of vaccines (61.8%). In Poland, Korzeniowska (2020) assessed the knowledge levels of 537 mothers with children under 18 regarding measles and its vaccine, and the study found that 20 % did not know the answer to the question about symptoms.

More on this, in a study done in Nigeria assessed the knowledge and attitude of 386 mothers towards measles and MMR vaccine, 93.2 % and 65.9% knew what measles and measles are, respectively, but out of these, only 36 % scored high knowledge of measles and measles vaccine (Oluseye, Jimor & Ogunleye, 2021). In another similar conducted in Nigeria, 90.6% of the parents exhibited adequate knowledge of the clinical manifestation and transmission of measles; however, they did not know the complications (Nwangwu, Chike & Ijeoma, 2021). Although the studies reported that all parents knew what measles infection is, some parents classified measles complications as signs and symptoms of early infection. This implies that measles infection is treated at home longer and at a later hospital presentation, which could potentially result in disability.

It is worth noting that most studies reported a positive attitude towards the measles vaccine. However, factors such as concern about the efficacy of the measles vaccine and side effects would result in poor coverage (Oluseye et al., 2021; Nwangwu et al., 2021; Korzeniowska, 2020). A study conducted in Nigeria found that concerned mothers were more likely to delay the measles vaccine (Nwangwu et al., 2021). In Saudi Arabia, a study revealed that some parents intentionally avoid vaccinating their children with measles because they believe side effects could be harmful to their children (Almansour et al., 2021). These studies also noted that mothers with fewer children, especially one child, were associated with a positive attitude and that these mothers are more likely to have a positive attitude to their newborns (Oluseya et al., 2021).

Several studies indicate that many parents in Nigeria choose to use traditional remedies such as palm wine, bitter leaf water, black soap mixtures, and breast milk to treat measles at home rather than seeking medical assistance (Nwangwu et al., 2021; Oluseya et al., 2021; Adefolalo, 2021). A study in Ibadan reported that 91.3% of caregivers employ these methods to manage measles. (Nwangwu et al., 2021). While palm wine offers some benefits due to its vitamin A content, it is important to recognize the harmful effects of these remedies. For example, using black soap mixtures leads to skin dryness, bitter leave exacerbates diarrhoea, and instilling breast milk in the eyes or drinking urine mixtures (human or

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cow) worsens diarrhoea and potentially causes renal failure. These severe reactions have been linked to an increased risk of disabilities. (Nwangwu et al., 2021)

Concerning South Africa, research has been predominantly conducted to identify barriers to achieving optimal measles vaccination rates (Killion, Silverman, Evans, & Coetzee, 2022). The findings suggest that non-adherence to the recommended vaccination schedule, shortages of the recommended vaccine on scheduled days, and extended waiting times at healthcare facilities hinder parents from obtaining the necessary vaccinations. While other studies have explored caregivers' knowledge, attitudes, and practices regarding measles and its vaccine in some areas of sub-Saharan Africa, notably Nigeria, there appears to be a lack of data on this topic in South Africa. This knowledge gap presents a challenge, particularly as measles vaccination coverage remains below optimal levels in the country.

In South Africa in 2023, the Department of Health launched a vaccination drive across the country to respond to the measles outbreak from February 6 to March 31, 2023. However, this initiative was met with reluctance from some parents, who expressed on social media platforms that the government intended to harm their children with the vaccine (ILO News, 2023). This public distrust in authority significantly hinders vaccine acceptance and uptake. In the Vhembe district of Makhado municipality, there were 22 incidences of measles infection during the outbreak; out of these, the majority of cases (19) were from Tshikota village, with 2 cases that required hospitalization. In the school village, a teacher responsible for the health and safety in primary school noticed an increase in measles cases among the learners; two weeks later, two of their learners who presented with symptoms of measles were sent home. The teacher noted that some parents were reluctant to take their children to the clinic. This prompted a measles immunisation campaign to be launched around the area; approximately 1000 children between the ages of 06 months to 12 years old were vaccinated (Chiguvare, ILO News, 2023)

Despite the successful efforts to control the spread of measles in Tshikota village, the high number of cases indicates possible challenges in identifying measles symptoms and understanding its transmission within the community. This situation suggests gaps in fully comprehending how to manage measles at home. Additionally, this highlights gaps regarding the seriousness of measles, its highly contagious nature, and the necessity of isolating infected individuals to prevent further spread. Some community members believe that their child’s illness is not severe enough to stay home, leading to a reluctance to seek medical care. Therefore, this study aimed to assess the caregivers' knowledge attitudes and practices towards measles and the measles vaccine.

1.2 problem statement.

The measles vaccine is accessible for free at government primary health care facilities in South Africa. However, a recent outbreak across provinces highlights immunity gaps in measles vaccine uptake. Children are particularly vulnerable to various infections due to their underdeveloped immune systems.

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Unvaccinated children serve as a potential source of measles transmission, leading to outbreaks in the community. During the 2022-2023 outbreak in Tshikota village, there was a significant surge in measles cases, which prompted a mass vaccination campaign. Despite this campaign, its effectiveness can be limited if caregivers do not participate or follow through with the necessary doses. Caregivers play a paramount role in decision-making regarding their children's health and exhibit a range of knowledge, attitudes, and behaviours that can significantly impact vaccination practices. Therefore, investigating their knowledge, attitudes, and practices towards measles and the measles vaccine can highlight areas where misinformation or lack of information exists. Furthermore, assessing attitudes towards vaccination helps identify any fears, misconceptions, or negative beliefs caregivers might have. This continuous monitoring and assessment ensures that vaccination efforts are not just a one-time success but lead to sustained immunization coverage and preventing future outbreaks.

1.3 significance of the study

The study will assess the severity of measles in the selected village by evaluating parents' knowledge about the disease. This is crucial because what parents know about child vaccination and their attitudes directly influence their behaviour. By assessing caregivers' knowledge of measles and the vaccine, we can identify where misinformation or lack of information exists, allowing health authorities to provide targeted education to address these gaps. Assessing caregivers' attitudes towards vaccination is equally important. This helps to identify any fears, misconceptions, or negative beliefs that might exist. Such attitudes can significantly impact vaccine uptake and must be addressed to ensure the success of vaccination campaigns. Evaluating whether caregivers follow vaccination schedules helps identify practical barriers to vaccinating children. High vaccination coverage in a community is incredibly beneficial. It creates herd immunity, protecting everyone, including those who cannot be vaccinated. This reduces the frequency of outbreaks, easing the strain on healthcare resources and minimizing disruptions to daily life. By ensuring that parents are well-informed and supportive of vaccinations, it is possible to achieve these benefits and maintain a healthier community.

1.4 Aim of the study

- To assess caregivers' knowledge, attitude, and practice towards measles and measles vaccine in a selected village in Vhembe District, Limpopo province.

1.4.1 Objectives of the study

- To assess caregivers' knowledge of measles and measles vaccines.
- To assess the attitude of caregivers towards measles and measles vaccines.
- To assess the practices of caregivers towards measles and measles vaccine
- To assess the relationship between caregivers' knowledge, attitude and practices towards measles and measles vaccine.

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1.5 Research questions.

- What is the caregivers' knowledge level regarding measles and vaccination?
- What is the attitude of caregivers towards measles and measles vaccination?
- What are the practices of caregivers regarding measles and measles vaccination?
- What is the relationship between knowledge, attitude and practice towards measles and the measles vaccine?

1.6 Definition of key terms.

1.6.1 Caregivers: According to Killion et al. (2019), caregivers are mothers or legal guardians who assume the primary responsibility for looking after a child or children under the age of 18 years. This study regards caregivers as an adult family member who assumes the primary responsibility for looking after a child or children between the ages of 6 months and 12 years

1.6.2 Knowledge: "The information and facts an individual possesses about something (Oloyo, 2022). In this study, knowledge refers to the information and facts caregivers possess about measles and the measles vaccine.

1.6.3 Attitude: Plotnik (1996: 540) defines attitude as "any belief or opinion that includes a positive or negative evaluation of some target, and that predisposes us to act in a certain way towards the target". In this study, attitude encompasses the caregiver's beliefs or opinions towards measles vaccination.

1.6.3. Practice: Refers to intentional tasks, actual applications or acts performed by an individual (Oloyo, 2022). In this study, practice refers to the actual behaviours or acts performed by caregivers to manage or treat measles infection.

1.6.4. Measles: Refers to a highly contagious viral disease caused by the measles virus characterised by fever, rash, cough, and other symptoms (WHO, 2023)

1.6.5 Vaccination: Refers to administering vaccines to the body to stimulate the body's immune response and protect against specific infectious diseases. It involves the introduction of a weakened or inactivated virus (WHO, 2023). The study focuses on the measles vaccine administered to children between 6 and 12 months.

1.7 Theoretical framework.

Knowledge-Attitude-Practice (KAP) Model:

The KAP Model is a conceptual framework used to assess and gain insights into individuals' knowledge, attitudes, and practices (Liu et al., 2016). The KAP Model collects data through surveys or questionnaires to measure knowledge, attitudes, and practices separately.

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The study aligns well with the KAB model, as it seeks to assess caregivers' knowledge, attitudes, and vaccination practices related to measles. Caregivers play a paramount role in decision-making regarding their children's health and exhibit a range of knowledge, attitudes, and behaviours that can significantly impact vaccination practices. Caregivers' knowledge regarding measles and vaccination plays a pivotal role as it forms the groundwork for their attitudes and practices concerning vaccination.

With the adoption of the KAB model, the study will comprehensively assess caregivers' knowledge levels, explore the association between knowledge and vaccination practices, and elucidate the impacts on vaccination practices. The model can provide insight into gaps between these three factors, helping identify areas for intervention.

Critical components of the model

1. Knowledge:
   - This component assesses individuals' understanding or awareness of a specific topic.
2. Attitude:
   - This component examines individuals' beliefs, feelings, and evaluations concerning a particular subject, which can influence their behaviour or decision-making.
3. Practice:
   - Also known as behaviour, this component refers to individuals' actual actions or behaviours.

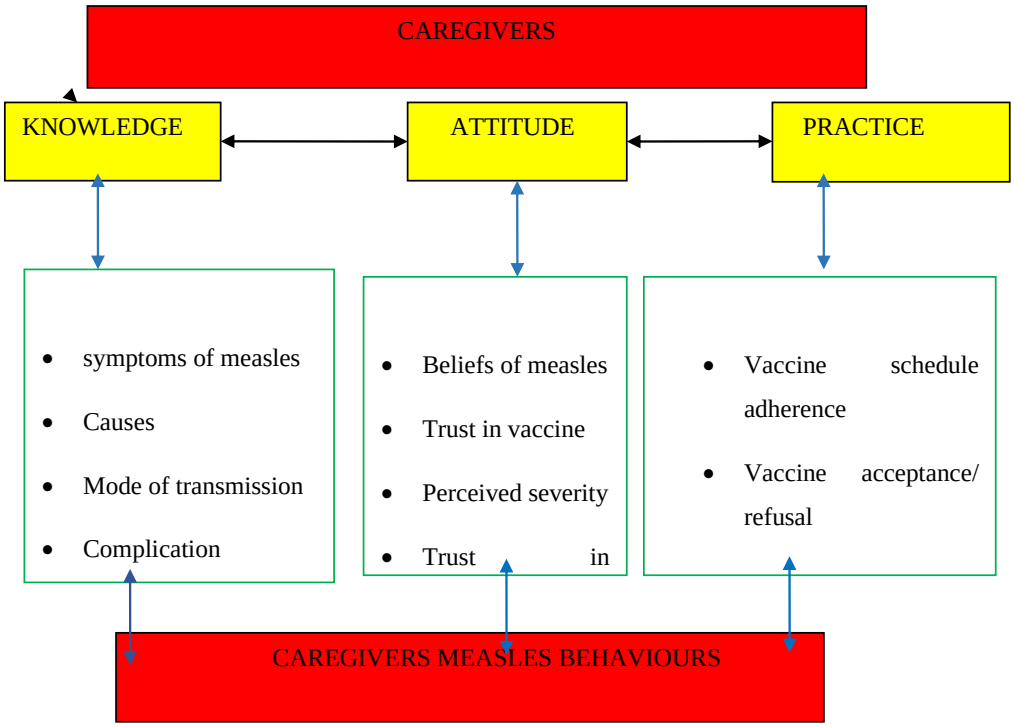


Figure 1: KAP Conceptual framework for this study

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2. RESEARCH METHODOLOGY.

2.1 Research approach.

The proposed study used a quantitative, cross-sectional descriptive design approach to assess the knowledge, attitude, and practices of caregivers responsible for children aged 6 months to 12 years. The study endeavoured to obtain data at a particular instance to evaluate caregivers' comprehension, perspectives, and practices towards measles and measles vaccines in the selected village in the Vhembe District. The selection of a cross-sectional design was motivated by its efficacy in acquiring a substantial volume of data at a singular moment, thereby rendering it cost-effective and administratively manageable (Brink, 2012).

2.2 Study Setting

The research was conducted in Tshikota village, just west of Louis Trichardt in the Vhembe District Municipality of Limpopo province, South Africa. According to the 2022 census data from Statistics South Africa, Tshikota has a population of 4,099 residents. Notably, the village is served by two primary healthcare facilities approximately 8 kilometres apart.

Study population and sampling

2.3. Target population.

The target population for this study were caregivers of children between the ages of 6 months to 12 years who reside in Tshikota village. Regarding exclusion criteria, respondents who did not consent to participate in the study and those who had children above 12 years or below the age of 6 months were excluded.

2.4. sample and sampling.

2.4. 1 Sample size and sample selection procedure:

The sample size was determined by Cochrane's (1977) sample size determination formula for the population size of 4,099.

n = Sample size

z = Critical value of the normal distribution at the required confidence level, 95 % (1, 96)

e = sample error, 0.05

p = Proportion of women in the study, set at 50 % (0.5)

q = (1-p)

Therefore

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$$n = \frac{z^2 \, x \, pq}{e^2}$$

$$= \frac{1.96^2 \; x \; 0{,}5 \; x \; (1-0.5)^2}{0{,}05^2}$$

=377

This study required 377 respondents to ensure a representative sample. This number was based on a 95% confidence level, a 5% margin of error, and an estimated proportion of 50% of women in the study area. Respondents were selected using a simple random sampling technique. To conduct the selection, the researcher prepared 4,099 slips of paper, each representing a household. A cross was marked on 377 of these slips to indicate inclusion in the study. Each eligible household member was asked to draw a paper slip from a closed box randomly. The household was included in the study if the slip had a cross. If not, the researchers skipped to the next household. The process continued until we have successfully included 377 respondents**.**

2.4 Inclusion and exclusion criteria

2.4.1 Inclusion Criteria:

Respondents should be caregivers directly responsible for caring for children aged 6 months to 12 years. Respondents should reside in Tshikota Village to ensure the relevance and applicability of findings to the target population. Respondents should be actively involved in the upbringing and healthcare decision-making for children aged 06 months to 12 years, as they are the focus of the study.

2.4.2 Exclusion Criteria:

Caregivers who are unable or unwilling to provide informed consent or participate in the study

2.5. Measurement instrument

A structured, self-administered questionnaire was developed and used to collect data on variables relevant to the study objectives, drawing upon an extensive literature review. The questionnaire comprised four sections. Section I gathered demographic information about caregivers. Section II assessed respondents' knowledge of measles, including its causes, symptoms, potential complications, and recommended vaccination schedule. This knowledge assessment included three domains. Domain 1 contained 10 questions, with 1 point awarded per correct answer, for a maximum score of 10 points. Domain 2 had 11 multiple-choice questions and scored 1 point per correct answer, reaching a maximum of 11 points. Domain 3 included one multiple-choice question with two correct responses, with each correct response earning 1 point for a maximum of 2 points. The total knowledge score was 22 points. Knowledge levels were calculated as a percentage, dividing the respondent’s score by the total possible score and multiplying by 100. Using Bloom's cutoff, knowledge was classified as High (80–100%, 18–22 points), Moderate (60–79%, 13–17 points), or Low (0–59%, 0–12 points). Section III measured

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attitudes towards measles and vaccination using ten Likert-scale statements. Respondents rated each statement from 1 (strongly agree) to 4 (strongly disagree), yielding a maximum possible score of 10 points. Attitudes were classified as Positive (50–100%, 5–10 points) or Negative (0–49%, 0–4 points) according to Bloom's criteria. Section IV assessed caregivers' practices in managing and preventing measles in children. This section included eleven statements rated on a five-point Likert scale (1 = Always to 5 = Rarely). The maximum practice score was 11 points, with levels categorized as Good (80–100%, 9–11 points), Moderate (60–79%, 7–8 points), and Poor (0–59%, 0–6 points).

2.6 Pre-test.

To ensure adequate data collection, the researcher pre-tested the questionnaire. The pre-test aimed to gather feedback, identify irrelevant information, and adjust the data collection strategy or refine questions to align with the study's objectives. The pre-test was conducted in the study area with a sample of caregivers representing 10% of the target population, allowing the researcher to evaluate the tool's effectiveness and estimate the time needed for data collection. Insights from the pre-test informed improvements to the data collection process for the main study. Respondents from the pre-test were excluded from the primary study sample, and their data were not included in the final analysis.

2.7 Validity and reliability.

The researcher developed the instrument's content through a comprehensive literature review and then submitted it to supervisors, who are professional nurses, for content and face validity assessment. They evaluated the instrument's relevance, clarity, and alignment with the study objectives. Based on their feedback, the instrument was revised accordingly.

2.7 2. Reliability

The reliability of the study instrument was confirmed through two approaches. First, a standardized data collection procedure was implemented, and clarifications were provided by two Tshivenda-speaking research assistants to respondents to ensure accurate interpretation of questions. Test-retest reliability was assessed by re-administering the questionnaire to the same sample on two occasions. Additionally, internal consistency was evaluated using Cronbach's alpha, yielding a value of $\alpha = [0.91]$, indicating the instrument's reliability

2.8 Plan for data collection.

Data was collected in Tshikota village after obtaining permission from the tribal authorities. Upon visiting each household, the researcher and research assistant introduced themselves and inquired whether the household had a child aged between 6 months and 12 years. If so, they explained the background of the study, aim and objectives. Households that agreed to participate were asked to select a paper from a closed box containing 4,099 small paper slips, of which 3,722 were unmarked, and 377 were marked with a cross to represent the required sample size. An eligible respondent from each

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household picked a paper, and if it was marked with a cross and the household had a child within the specified age range, they were included in the study. This process continued until the desired sample size was reached. The research assistant helped respondents who were not proficient in English or had difficulty writing to complete the questionnaire.

2.9 Data analysis.

The questionnaires were all checked for completeness, readability, correctness, and consistency. Statistical analysis was done using the SPSS version 29.0 (IBM SPSS Statistics, 2023). Data was entered, cleaned and checked before analysis into Microsoft Excel software. Of the 377 questionnaires sent out, 69 were incomplete and excluded from the analysis. Complete questionnaires were coded and entered into SPSS for analysis. The variables were summarized descriptively in tables, frequencies, and percentages. Pearson correlation analysis assessed the association between total knowledge, attitude, and practice score.

2.10 Data Management.

The researcher implemented measures to ensure the data collected is securely maintained. The researcher took precautions to prevent loss or unauthorized access to the data. To ensure the security of the physical copies of the questionnaires, the researcher has kept them in a secure and locked location in the supervisor's office. This will ensure that the questionnaires are stored safely and can only be accessed by authorized individuals. The researcher intends to store the collected data for a minimum of five years as evidence in case there are any future inquiries or requests for information related to the research

3 Ethical considerations

3.1. Ethical approval

Before initiating data collection, ethical approval was obtained from the University of Venda Human and Clinical Trial Research Ethics Committee (FHS/24/PH/17/0708). Verbal informed consent was obtained from all responding caregivers, ensuring their rights, privacy, and confidentiality were protected throughout the study. Respondents were informed about the voluntary nature of their participation and their ability to withdraw from the study without consequences. Important ethical principles that were followed and upheld during the study are described below:

3.1.1 Voluntary participation

Voluntary participation is an ethical principle that asserts that research participation must be upon the participants, and no one should be forced to participate, no matter the circumstances (Babbie & Mouton, 2009). Respondents were fully informed about the nature and purpose of the study and the advantages and disadvantages of taking part before they agreed to participate. This was done to enable the respondent to engage knowingly and willingly.

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3.1.2. Informed consent

Terre Blanche, Durrheim and Painter (2006) assert that obtaining the necessary permission from the respondents is crucial after they are thoroughly and truthfully informed about the purpose of the study and investigation. This implies that the researcher has no right to impose questions on the respondents without their willingness and clear understanding of what they are doing and what they need to expect and not expect. With this awareness, the researcher explained the study's background and the aims and objectives to those willing to participate in the study; the researchers requested their confirmatory verbal consent before responding to the questionnaire.

3.1.3 Respect for a person (dignity and autonomy)

According to the South African Health Research guidelines (2024), researchers must uphold respondents' rights to decide on their study participation, prioritizing their dignity, privacy, confidentiality, well-being, and safety. Throughout the study, all respondents were treated respectfully, acknowledging their intrinsic value as individuals regardless of their circumstances. Participation was entirely voluntary, with respondents having the option to withdraw at any stage. To ensure confidentiality, revealing information about the participants was not shared with others outside the research team. The data collected is secured in a locked cabinet in the supervisor's office, limiting unauthorized access.

3.1.4 Avoidance of harm.

The Human Research Ethics Committee, HREC, 2021 asserts that harm includes injuring the safety and welfare of the participants. This includes physical, psychological or social. The study never injured the caregivers being studied, regardless of whether they volunteered for the study or not. The researcher was cognizant of the potential for respondents to experience either physical or psychological harm during the study. Data collection took place within the respondent's households, and the researcher implemented all necessary measures to prevent emotional harm by maintaining a calm tone of voice and minimising psychological distress throughout the study.

3.5 The risk-benefit ratio.

The researcher and reviewers assessed the balance between the benefits and risks in this study. As Burns and Grove (2005) asserted, it is not solely the researcher's duty to ensure that the benefits outweigh the risks. The researcher is cognizant of the risk of undertaking research, although there were no risks for the respondents. However, the researcher prioritized ensuring the respondent's benefit exceeded potential risks.

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SECTION 2:

MANUSCRIPTS/ARTICLES

This section comprised two manuscripts: a scoping review and a research article. The scoping review has been submitted to the MDPI disease Journal, which is currently **under review**. At the same time, the research article has been submitted to the Public Health Challenges journal and is also under review. The submission process duly adhered to the journal guidelines provided by both journals, and the website links have been attached hereunder.

MANUSCRIPT 1: KNOWLEDGE, ATTITUDES, AND PRACTICES OF CAREGIVERS TOWARDS MEASLES AND MEASLES VACCINE: A COMPREHENSIVE SCOPING REVIEW.

Journal author guidelines were submitted to the **MDPI disease journal**. The following instructions are for authors for manuscript preparation: https://www.mdpi.com/journal/diseases/about.

MANUSCRIPT 2: MEASLES PROPHYLAXIS: ASSESSING CAREGIVERS' KNOWLEDGE, ATTITUDE AND PRACTICES IN A SELECTED VILLAGE IN VHEMBE DISTRICT, LIMPOPO PROVINCE, SOUTH AFRICA.

Submitted to **Public Health Challenges Journal** following the instructions for authors for manuscript preparation herein contained: Public Health Challenges - Wiley Online Library

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2.1 Manuscript 1: Scoping Review Summitted to MDPI Disease Journal (Under Review)

KNOWLEDGE, ATTITUDES, AND PRACTICES OF CARE-GIVERS TOWARDS MEASLES AND MEASLES VACCINE: A COMPREHENSIVE SCOPING REVIEW.

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Abstract

Introduction: Despite a measles vaccine, measles outbreaks persist globally. Recent global measles outbreaks from 2019 to 2023 raise concerns and require a detailed investigation into the contributing factors. The primary objective of this review is to describe caregivers' knowledge, attitudes, and practices towards measles and measles vaccination.

Methods: A comprehensive search was conducted using Medline, Google Scholar, and EBSCO host to identify relevant literature published in English since 2019. The search employed a key strategy targeting caregivers' knowledge, attitudes, and practices towards measles, factors affecting it, recommendations, and interventions.

Results: Findings indicate that parents generally possess adequate knowledge about measles. Attitudes towards measles and vaccination varied, with some studies reporting positive perspectives and others noting negative attitudes towards the measles vaccine. Furthermore, studies revealed several themes influencing caregivers' knowledge, attitudes, and practices, including vaccine hesitancy, caregiver characteristics such as age and educational level, financial constraints, the caregiver-physician relationship, and the impact of the COVID-19 pandemic.

Conclusion: Notable gaps were identified, particularly in their understanding of the causes, severity, and complications of the disease. Caregivers' concerns about vaccine safety and potential side effects persisted. In terms of practices, most studies reported adherence to vaccination schedules and effective management of vaccine side effects. This review recommends that continuous education on measles would be significantly more effective than relying solely on vaccine schedules, supplementary immunization campaigns, and home management strategies.

Keywords: Knowledge; Attitude; Practice; Measles; Measles vaccine; Caregivers.

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1 Introduction

According to the World Health Organization, all WHO regions have had one or more significant measles outbreaks, claiming thousands of lives in 2019 [1]. Global trends in measles outbreaks also show that even wealthy countries, including the United States (704 cases (94 %) and the United Kingdom (141 confirmed cases, 60%), have had resurgent transmission of the measles virus in 2019 [2].This observation was despite their achievement of adequate levels for measles elimination between 2016 and 2017. The global mortality rate due to measles has increased by almost 50% since 2016, resulting in an estimated 207,500 deaths in 2019 [1]. Measles-containing vaccine 1 (MCV1) coverage in Africa and the Eastern Mediterranean was assessed to be below 60%, failing to meet the World Health Organization's target for measles elimination [3]

Measles is highly infectious and a primary cause of vaccine-preventable mortality in children, particularly in Sub-Saharan Africa [4] . The clinical symptoms of measles are high temperature, flu-like symptoms such as cough, sore throat, nasal congestion, conjunctivitis, white patches within the mouth and on the inner cheeks may appear, followed by a fine rash on the face that spreads to the rest of the body within three days and generally lasts for 5-7 days [5]. Measles infection can lead to severe complications such as diarrhoea, dehydration, pneumonia, brain infection, blindness, vomiting and death [5] .

Although there is no specific anti-viral treatment for measles, the measles vaccine is the safest and most effective way of protecting children from potentially fatal diseases [1]. The measles vaccine was developed in 1963; before that, measles was responsible for more than two million deaths annually [6] However, the global dissemination of the measles vaccine has achieved a 75 % decline in reported measles incidence [2]. This view was supported by researchers such as Killion and colleagues, who hold that vaccines for just four diseases, i.e., diphtheria, tetanus, pertussis, and measles, prevent two million to three million mortalities annually [7]

Despite the availability of a safe and effective measles vaccine, the persistence of measles outbreaks necessitates a holistic review of the underlying causes. Although there might be myriads of causes of the measles disease outbreak, this review focuses on caregivers' knowledge, attitudes, and practices because they play a crucial role in shaping the practices of caregivers. Their decisions are pivotal in enhancing vaccination rates and compliance. Consequently, good practice leads to the complete vaccination of their children, effectively preventing measles infections.

This scoping review explored existing literature on caregivers' knowledge, attitudes, and practices (KAP) regarding measles and its vaccination. It seeks to identify the key factors influencing caregivers' behaviours towards measles vaccine uptake. Furthermore, the review explored the evidence-based strategies implemented to address these influencing factors.

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2. Materials and Methods

2.1 Methodical framework.

The study employed a scoping review to map evidence from various sources and identify knowledge gaps about the variables under review. The Arksey and O'Malley's [8] methodological framework for scoping reviews involving (i) identifying the research question, (ii) identifying relevant studies, (iii) study selection, (iv) charting the data, and (v) collating, summarizing, and reporting results were used to guide this review.

2.1.1 Identifying the research question.

The research questions for the current review were guided by the PCC (Population participant/ concept/context) [9].

Population - in this review, parents, mothers, fathers, or any adult responsible for caring for a child or children eligible for measles and measles vaccine.

Concepts – the review focused on the knowledge, attitude, and practice of caregivers on measles and measles vaccine

Context – studies conducted worldwide provided they reported on the knowledge attitude and practices, factors influencing caregivers' knowledge, attitude and practices and interventions/ strategies aimed at addressing caregivers knowledge, attitude and practices towards measles and measles vaccine.

The research questions pursued in this scoping review were:

- What is known from existing literature about caregivers' knowledge, attitude, and practice towards measles and measles vaccine?
- What factors affect caregivers' knowledge, attitude, and practices regarding measles and measles vaccine?
- what strategies are for improving measles knowledge, attitude, and vaccination practices?

2.1.2 Identifying relevant studies

This scoping review included primary studies, reviews, and non-empirical evidence that addressed the research question. Systematic searches of relevant articles were performed using electronic library databases: Google Scholar, EBSCOhost, Med-line, and the World Health Organization (WHO) library. Identification of studies was accomplished by searching published literature in the English language between 2019 and 2023. This timeline was motivated by the increase in measles cases globally from 2019 to 2023. The researcher sought to explore the aetiology behind this re-emergence, even in countries where elimination was declared. The search terms included were 'Knowledge,' Attitude,'

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Practice,' and 'Measles.' Boolean terms such as 'OR' and 'AND' were used to separate search keywords.

2.1.3 Study selection.

Studies eligible for inclusion were articles that reported information regarding caregivers' knowledge, attitudes, and practices towards measles and the measles vaccine. Furthermore, studies that reported data on factors influencing the study variables and interventions to address any identified issues were also included. Articles published in peer-reviewed journals and grey literature, regardless of study design and country of origin, and articles reported on measles and measles vaccination programs were eligible for inclusion. However, studies that reported on measles but did not focus on children were excluded from the study. The initial search yielded a total of 15387 relevant studies. After removing duplicate studies and screening the titles and abstracts, 70 studies met the criteria for inclusion. Subsequently, 15 studies were excluded because they focused on nurses and adolescents. This reduced the number of articles eligible for a thorough full-article examination to 55. During the full-article screening, 23 more studies were excluded as they reported on childhood immunization but did not provide information specifically related to the study variables. Ultimately, 32 articles were selected for data extraction. The study adhered to the Preferred Report Items for Systematic and Meta-Analysis (PRISMA) flow chart for the systematic screening and selection of studies [10].

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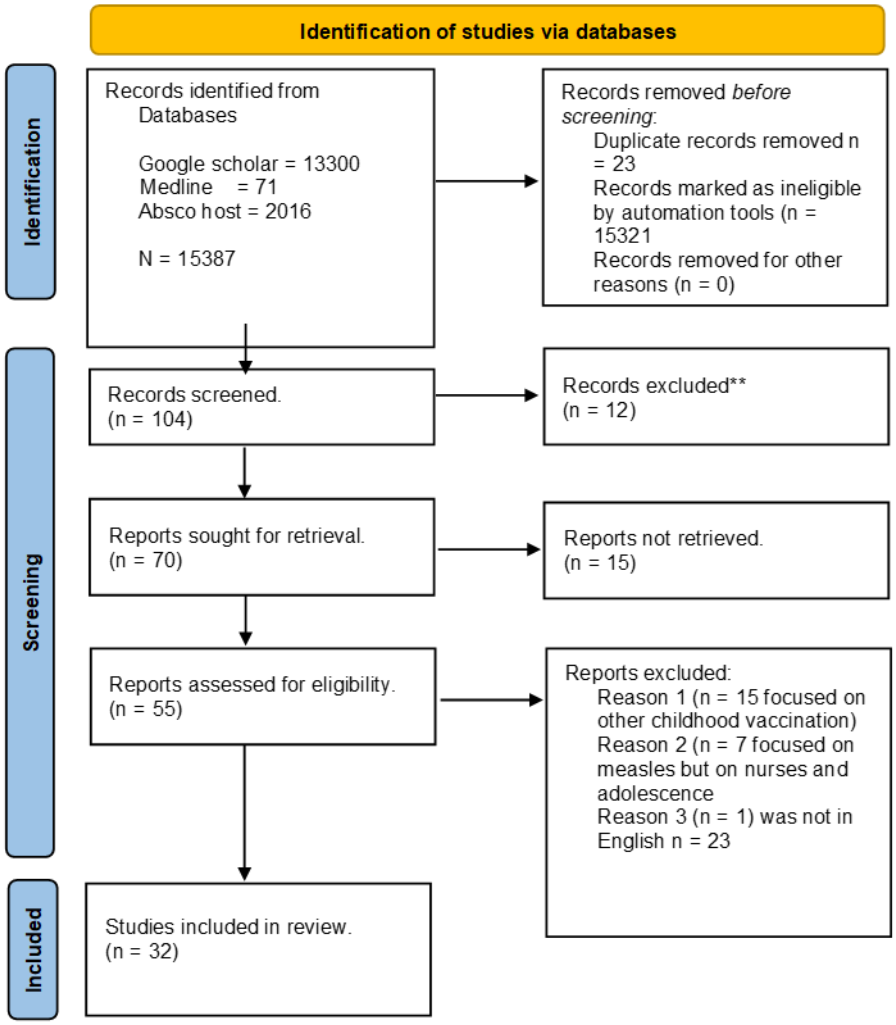


Figure 2: PRISMA framework for study selection.

2.1.4 Quality Appraisal

In this scoping review, the quality of the data was evaluated using the Critical Appraisal Skills Program (CASP) [11] research checklist, which enabled the researcher to assess the credibility of the published literature. The evaluation focused on whether the studies clearly articulated their research objectives, appropriately described their methodology and research design, addressed ethical considerations, conducted thorough data analysis, and presented meaningful conclusions. The primary researcher reviewed the articles and then independently assessed them with two additional researchers. Each researcher conducted an individual evaluation before collectively discussing their findings. Specific CASP checklists designed for cross-sectional, case-control, cohort, systematic review, and randomized controlled trial studies were consulted to assess the methodological quality. The checklists contained 1 - 12 items, each receiving a score of one point. Based on these scores, the studies were categorized into three quality groups: high, moderate, and poor. Articles scoring 10 points or higher were classified as high quality, those scoring between 6 and 9 were categorized as moderate quality, and scores of 5 or

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below indicated poor quality. In cases where the researchers' assessments differed, discussions were held to reach a consensus. Ultimately, all the articles reviewed were rated with 10 points or higher, thus deemed high quality.

Table 1 Critical appraisal of selected studies: Critical appraisal of included studies

Author, year	Study design	CASP Score	%
Almansour (2021).	Cross-sectional design	09/10	90
Okafor (2020).	Cross section design	09/10	90
Oloya (2022).	Descriptive cross-sectional design	10/12	83
Shoaib (2020).	Cross-sectional study	10/12	83
Adefolalu et al. (2019)	Cross-sectional descriptive design	10/11	90
Almansour et al.2021	Cross-sectional	11/11	100
Almutairi et al. (2021).	Cross-sectional descriptive design	11/11	100
Bangura et al. (2020)	Cross sectional	08/10	80
Bozzola et al. (2020)	Descriptive design	11/11	100
Briedger et al. (2017).	Cohort	10/12	90
Aborode et al. (2021).	Descriptive	10/11	90
Hailu et al. (2022).	Cross-sectional study	10/11	90
Galadima et al. (2021).	Systematic review	9/10	90
Hussein et al. (2022).	Cross-sectional study	10/11	90
Kibreab et al. (2020).	Descriptive design	11/11	100
Killion et al. (2022).	Cross-sectional	11/11	100
Korzeniowska et al. (2020)	Cross sectional	10/11	90
Kostandova et al. (2020).	Descriptive design	11/11	100
Kuddus et al. (2023).	Descriptive design	11/11	100
Kyprianidou et al. (2021)	Cross-sectional	11/11	100
Lewandowska et al. (2020)	Population survey	11/11	100
Membrate et al. (2023).	Case-control study	11/11	100
Nasser et al. (2021).	Case-control study	10/11	90
Nassar et al. (2023).	Cross-sectional	10/11	90
Novilla et al. (2023).	Systematic review	10/10	100
Ngwangwu et al. (2021)	Cross-sectional	11/11	100
Oloya (2022).	Cross-sectional	11/11	100
Ori et al. (2021).	Randomized control trial	10/11	90
Uchendu et al. (2019).	Cross-sectional	11/11	100
Yousif et al. (2022).	Descriptive study	11/11	100
Thompson et al. (2023).	Descriptive design	11/11	100
Wilder-Smith et al. (2023).	Systematic review	10/10	100

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2.1.5 Charting the data.

The charted data was entered into a ‘data charting form.’ Data was extracted under these headings: author and year of study, study title, research aims, study setting (country), study design, sample size and data collection and study findings. Refer to Table 2

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Table 2 Data charting

	Study title	Research aims	Study setting	Study design	Sample size and data collection	Findings.
1. Aborode, et al., 2021	Measles outbreak amidst COVID-19 pandemic in Africa: grappling with looming crises.	To discuss the impact of the COVID-19 pandemic on the prevention and management of measles in Africa.	Africa	Document analysis	8 articles	The COVID-19 pandemic has worsened the implementation of mass measles vaccination, hence increasing the population of unimmunized children susceptible to measles, resulting in a double burden and gross fatality rate.
2. Adefolalu et al., 2019	Maternal knowledge, attitude, and compliance regarding immunization of under-five children in primary health care centres in Ikorodu local government area	To assess mothers' knowledge, attitude, and compliance regarding immunization of under-five children in Ikorodu Local Government Area, Lagos State.	Nigeria	A cross-sectional descriptive	250 mothers of under-five children	One hundred and ninety-three (90.6%) expressed above-average knowledge about measles and the measles vaccine. All the respondents had a positive attitude to the measles vaccine. Forty-seven (22.1%) respondents delayed having their child get a measles shot.
3. Elena Bozzola et al., 2020	Global Measles Epidemic Risk: Current Perspectives on the Growing Need for Implementing Digital Communication Strategies, Risk Management and Healthcare Policy.	To describe the measles prevention strategies	unspecified	Document review	56 articles	If the global community is successful in providing effective communication for measles immunization and allows the public to understand the key facts of immunization strategies, measles elimination will be easier to achieve.
4. Hussain et.al, 2022	Knowledge and Practice of Parents Towards Measles, Mumps and Rubella Vaccination	to determine the parents' knowledge and practice regarding MMR vaccination and examine its associations.	Malaysia	Cross-sectional study	202 parents, modified self-administered questionnaire developed by	53.5% of parents had low knowledge of MMR vaccination, 35.1% had

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					Awadh et al.	moderate knowledge and 11.4% had high knowledge of MMR vaccination. Meanwhile, 54.5% had good practice of MMR vaccination and 45.4% reported they had not practised immunising their children with the MMR vaccine
5. Ige et al, 2019	Knowledge and home treatment of measles infection by caregivers of children under five in a low-income urban community, Nigeria.	assessed the knowledge and home treatment of measles by caregivers of children under 5 years.	Nigeria	A descriptive cross-sectional study	509 caregivers of children aged 6 months to 5 years	More than half had good knowledge of the cause (59.7%) and main symptoms and signs (52.8%) of measles. The majority (91.3%) of caregivers whose children had measles gave home treatment,
6. Kuddus et al, 2023	Analysis of the different intervention scenarios for programmatic measles control in Bangladesh: A modelling study.	explore the dynamics of measles in Bangladesh	Bangladesh	Mathematical modelling framework	Document analysis	strategies that focus on a single intervention do not dramatically affect the decline in measles incidence cases; instead, those that combine two or more interventions simultaneously are the most effective in decreasing the burden of measles incidence and mortality.
7. Hailu et al., 2023	Measles outbreak investigation in Kasoshekumer kebele, Sinana district, South-Eastern Oromia, Ethiopia: A case-control study	To identify the determinants of the measles vaccine dropout rate in Afar regional state which is one of the pastoralist communities in Ethiopia.	Ethiopia	A case-control study	109 study participants,	Poor knowledge of the parents on vaccination and the less effort taken to deliver a good attitude toward vaccination is resulting in measles outbreak
8. Novilla et al., 2023	Why Parents Say No to Having Their Children Vaccinated against	To determine major themes regarding parental reasons for MMR vaccine hesitancy,	Switzerland	Systematic review	115 articles	Social factors, such as income and education, exerted a bidirectional

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	Measles: A Systematic Review of the Social Determinants of Parental Perceptions on MMR Vaccine Hesitancy	the social context of MMR vaccine hesitancy, and Trustworthy vaccine information sources				influence, which facilitated or hindered vaccine compliance Fear of autism was the most cited reason for MMR hesitancy
9. Wilder-Smith et al., 2020	Resurgence of measles in Europe: A systematic review on parental attitudes and beliefs of measles vaccine	Assess parental attitudes and beliefs toward MMR uptake, to develop strategies and policy recommendations to effectively improve MMR vaccine uptake accordingly to identify areas for further research	Europe	Systematic review	20 articles	The poor practice was due to concerns about vaccine safety, effectiveness, perception of measles risk and burden, mistrust in experts, and accessibility.
10. Almansour et al., 2021	Parents' awareness and attitude towards MMR and measles vaccine in Saudi Arabia	To assess the knowledge, opinion, and attitudes toward the MMR vaccine among parents at the medical centre of Al-Imam Mohammed Ibn Saud Islamic University in Riyadh, Saudi Arabia	Saudi Arabia	Cross-sectional study	356 parents	Most children were up to date on vaccines (n = 312, 87.6%) and received the Measles or MMR vaccine (n = 282, 79.2%).
11. Thompson et al., 2023	Mitigating Vaccine Hesitancy and Building Trust to Prevent Future Measles Outbreaks in England	To describe measles incidence and MMR coverage over the last decade	England	secondary data analysis	Official administrative data on measles and MMR coverage incidence in England from 2012 to 2021.	Over the last decade, MMR uptake has fallen across all regions with no area currently reaching the WHO target of 95% coverage of both doses of MMR necessary for herd immunity. Factors associated with MMR coverage overlap with the 3C (convenience, complacency and confidence) model of vaccine hesitancy. The COVID-19 pandemic has reinforced pre-existing vaccine hesitancy.

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12. Ori et al., 2021	Descriptive epidemiology of measles cases in Bauchi State, 2013–2018	To describe the trend and burden of measles in Bauchi State, Nigeria.	Nigeria	Secondary data analysis.	Data was collected from the Integrated Disease Surveillance and Response System (IDSR 002, weekly data) in Excel format from the Bauchi State Ministry of Health's Epidemiology Unit.	The measles cases variation index per quarter was highest in quarter 1 (198.86), followed by quarter 2 (62.21) and least in quarter 4 (10.37) of every year. Only 889 (18%) of the measles cases received at least one dose of measles vaccine, 2701 (54.7%) had no history of measles vaccination, while 1346 (27.3%) had unknown vaccination status. The fatality of measles in Bauchi State was significantly associated with being under 5 years (AOR = 5.58; 95%CI: 2.19–14.22) and not having at least a dose of MCV (OR = 7.14; 95%CI: 3.70–14.29).
13. Nwangwu et al., 2021	Cross-sectional Survey on Parental Perception and Attitude on Measles Vaccine: Low Hospital Measles Case Presentation in Rural Area in Enugu Nigeria	To assess the parental knowledge of measles, attitude to measles vaccine and practice of case notification in a rural area in Enugu, Nigeria	Nigeria	Descriptive cross-sectional study	213 participants, the Parental Attitude on Childhood Vaccine (PACV) questions were adopted and used to assess the attitude of parents to the measles	One hundred and ninety-three (90.6%) expressed above-average knowledge about measles and the measles vaccine. All the respondents had a positive attitude to the measles vaccine. Forty-seven of the respondents delayed having their child get a measles shot while
14. Uchendu et al, 2019	Knowledge and home treatment of measles infection by caregivers of children under five in a low-income urban community, Nigeria	Assessed the knowledge and home treatment of measles by caregivers of children under 5 years.	Nigeria	A descriptive cross-sectional study	509 caregivers of children aged 6 months to 5 years.	More than half had good knowledge of the cause (59.7%) and main symptoms and signs (52.8%) of measles. There was a significant association between caregivers' educational status, age, tribe and marital status and their knowledge of measles. Caregivers

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						who were 35 years and older compared to those younger than 35 years had lower odds of having good knowledge of measles, respectively
15. Korzeniowska et al., 2023	The knowledge of mothers in Poland on measles and its prevention - a survey study	The study aims to assess the knowledge of mothers having children under 18 years old about measles and MMR vaccination	Poland	Cross-sectional	537 participants	The average test result was 10.33 out of 17 points. The questions with the highest number of correct answers concerned the obligation, the method of vaccine administration, the aetiology of the disease and the method of infection. The problematic questions were the symptoms of measles, complications or ways to prevent the disease. 8.6% of respondents said that they did not vaccinate their child according to the vaccination calendar, giving real contraindications and unreasonable reasons
16. Oloyo, 2022	knowledge, attitude, and practices of mothers/caregivers towards immunization of children under 5 years of age in Awach Health Centre iv, Gulu district	To assess the knowledge, attitudes, and practices of mothers/caregivers towards immunization of children under five years in Awach Health Centre IV Gulu district	Uganda	Cross-sectional design	116 participants, structured interview	The results showed that most of the participants (73.3%) had insufficient knowledge of immunization. Most of the mothers/caregivers (53.4%) had an unfavourable attitude toward immunization. Moreover, most participants (77.6%) had poor practices towards immunization. Mothers/caregivers who attained a secondary or higher level of education were 4.28 times more likely to have sufficient knowledge

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						about immunization than housewives, male children were 3.67 times more likely to have favourable attitudes and married mothers were 4.28 times.
17. Almutairi, 202**1**	Assessment of Mothers' Knowledge, Attitudes, and Practices Regarding Childhood Vaccination during the First Five Years of Life in Saudi Arabia	To assess the knowledge, attitudes, and practices of mothers regarding childhood vaccination during the first five years of children's lives in Saudi Arabia. Method	Saudi Arabia	Cross sectional	262 mothers completed a self-administered questionnaire	Most of the participants were aged 25–31 years (57%), 61% held a bachelor's degree, and 60.3% had children aged 2–5 years. The knowledge score was 86%, 2492 out of a total score of 2893; the attitude score was 89.1%, 973 out of a total score of 1052; the practice score was 80.5%, 1059 out of a total score of 1315.
18. Hailu, 2022.	Determinants of measles vaccination dropout among 12 – 23 months aged children in pastoralist community of Afar, Ethiopia.	To identify the determinants of the measles vaccine dropout rate in Afar regional state, one of Ethiopia's pastoralist communities.	Ethiopia	case-control study design	487 participants, structured questionnaire	A mother who had antenatal care visits, being in the birth order of 1 – 3, long waiting times > 60 household visits by a health worker, pregnant women not participating with the women development army and poor maternal knowledge on vaccination were significant determinants with measles vaccination dropout rate
19**.** Lewandowska et al., 2020	Opinions and Knowledge of Parents Regarding Preventive Vaccinations of Children and Causes of Reluctance toward Preventive Vaccinations	To assess parents' knowledge, attitudes, and beliefs about vaccines	Poland	Diagnostic survey	2300 people	71% (95% CI: 69–73) responded favourably, declaring the need to perform them, 18% (95% CI: 13–23) responded indifferently, and 11% (95% CI: 8–18) were against vaccinations. As many as 91% (95% CI: 88–92) of the respondents believed that vaccinations

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						significantly impact the child's health, including as many as 35% (95% CI: 23–37) who believed it is not a positive impact. claiming that vaccinations should be voluntary, and 3% of women and 8% of men have no opinion
20. Galadima et al., 2021	Factors influencing childhood immunisation uptake in Africa: a systematic review	To collate evidence on the factors that influence childhood immunisation uptake in Africa, as well as to provide evidence for future researchers in developing, implementing and evaluating interventions among African populations which will improve childhood immunisation uptake.	Africa	Systematic review	51 Articles	Out of 18,708 recorded citations retrieved, 10,396 titles were filtered, and 324 titles remained. These 324 abstracts were screened leading to 51 included studies. Statistically significant factors found to influence childhood immunisation uptake were classified into modifiable and non-modifiable factors and were further categorised into different groups based on relevance. The modifiable factors include obstetric factors, maternal knowledge, maternal attitude, self-efficacy and maternal outcome expectation, whereas non-modifiable factors were sociodemographic factors of parent and child, logistic and administration factors.
21. Kibreab, 2020	Impact of mother's education on full immunization of children aged 12–23 months in Eritrea: Population and health survey 2010 data analysis	To assess the impact of maternal education on full immunization of children aged 12–23 months	Eritrea, Africa	Secondary data analysis	1323 mothers of children aged 12–23 months. Data on immunization coverage came from vaccination cards and from mothers'	In unadjusted analyses, children of mothers with primary (OR = 2.75, 95% CI 1.74–4.37), and middle or above (OR = 3.16, 95% CI 2.09–4.78) education were more likely to be fully immunised. However, after adjusting for wealth, region, ANC

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					or caretakers' verbal reports	visit, and vaccination card ownership, only the effect for primary education remained significant (OR = 2.34, 95% CI 1.30–4.21).
22. Killion et al., 2023	Vaccination coverage at seven months of age in Limpopo Province, South Africa:	investigate factors associated with vaccination coverage in Mopani District, Limpopo Province, South Africa	South Africa	A cross-sectional survey	317 caregivers, Chart review	Caregivers reported positive attitudes towards vaccination, based on a seven-question survey of vaccination attitudes. Although coverage was high for most recommended vaccines, it was low for pneumococcal conjugate vaccine (PCV), with just 36% of children having received it by age seven months
23. Aldakhil et al., 2020	Vaccine hesitancy towards childhood immunizations as a predictor of mothers' intention to vaccinate their children against COVID-19 in Saudi Arabia	To measure the prevalence and related factors of vaccine hesitancy towards childhood immunization during the era of COVID-19 along with the prevalence of mothers' intention to vaccinate their children the future of COVID-19 and its association with childhood vaccine hesitancy	South Africa	Cross-sectional	270, Data were collected using a SAGE Group standardized questionnaire.	Vaccine hesitancy was found to be a significant predictor of mothers' intentions. Mothers' education level was significantly associated with being hesitant towards childhood immunization as well as the intention to accept the future COVID-19 vaccine ($p < 0.05$). Main reason that was highly significantly associated with being hesitant is the concerns about the side effect (50%)
24. Novilla et al., 2023	Why Parents Say No to Having Their Children Vaccinated against Measles: A Systematic Review of the Social Determinants of Parental	To determined major themes regarding parental reasons for MMR vaccine hesitancy, social context of MMR vaccine hesitancy, and trustworthy vaccine information sources	United states of America	Systematic review	115 articles;	Fear of autism was the most cited reason for MMR hesitancy. Vaccine hesitancy to MMR and other childhood vaccines clustered in middle- to high-income areas among mothers with a college-level education or higher who

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	Perceptions on MMR Vaccine Hesitancy					preferred internet/social media narratives over physician-based vaccine information. They had a low parental trust, low perceived disease susceptibility, and were sceptical of vaccine safety and benefits. Combating MMR vaccine misinformation and hesitancy requires intersectoral and multifaceted approaches at various socio-ecological levels to address the social drivers of vaccine behaviour.
25. Kostandova et al., 2022	Impact of disruptions to routine vaccination programs, quantifying burden of measles, and mapping targeted supplementary immunization activities.	To estimate the expected burden of national and local measles outbreaks in Zambia with the current COVID-19 pandemic as a framework to inform disruptions to routine vaccination.	Zambia	Secondary data analysis	District-specific routine MCV1 vaccination coverage from 2013 to 2018	Interruptions to routine MCV1 services resulted in a projected increased case burden after disruptions.
26. Sahoo et al., 2023	Decision-making in childhood vaccination: vaccine hesitancy among caregivers of under-5 children from a tertiary care institution in Eastern India	This study analysed vaccine hesitancy and belief towards vaccination among caregivers of children aged below 5 years.	India	Cross-sectional study	196 caregivers, Vaccine Hesitancy Scale	Vaccine hesitancy was observed in 9.18% of the participants. Only the age of the child was significantly associated with vaccine hesitancy. Nearly half (48.5%) of the participants were concerned about the serious adverse effects of vaccines, and a third (30.6%) agreed that newer vaccines are associated with higher risks than the older ones. Caregivers felt that vaccines are no longer required for uncommon diseases.

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27. Shoaib et al., 2020	Frequency of Complications of Measles Patients Admitted in Paediatric Ward Ayub Teaching Hospital (ATH) Abbottabad	To assess the complications of measles in the Pediatric ward of Ayub Teaching Hospital (ATH)Abbottabad	Pakistan	Cross-sectional	Patients admitted with measles in the paediatric ward	Vaccinated children, as predicted, were less affected than non-vaccinated children because of their vulnerable immune system. Children who received vitamin A supplementation had a less severe form of the disease as compared to those children who were deprived of vitamin A supplementation during or before the infection. In this area, the measles vaccination rate was way below satisfactory. Children who were brought in a later stage of the disease had distinctly severe symptoms than those who were hospitalized in proper time. Measles infection is highly contagious and the patient must be isolated.
28. Briedger et al., 2017	Knowledge, attitudes and opinions towards measles and the MMR vaccine across two NSW cohorts	to investigate the knowledge and opinions on measles and MMR vaccine in NSW Central and Nort Coast regions.	Australia	Purpose design survey	Parents (n=201) of children <12 years.	Eight per cent of respondents reported not immunising their child with MMR vaccine. Most respondents recognised that measles is a highly contagious disease. Non-immunised were found to be older, had a lower perceived severity of measles, were less likely to agree with the efficacy and safety of the vaccine, and were more likely to have encountered someone who had suffered side-effects of the vaccine

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29. Bangura et al., 2020	Barriers to childhood immunization in sub-Saharan Africa: A systematic review	Barriers to childhood immunization in sub-Saharan Africa: A systematic review	Sub–Saharan Africa	Systematic review	48 studies	8 studies examined all – parental/caretakers, health systems and providers' barriers. 21 studies examined parental/caretakers and health system barriers. 18 studies only looked at parental/caretaker barriers. and one study examined parental and provider barriers. Several Sub-Saharan countries were reported to have low childhood immunization coverage with variations across the region. Nigeria reported the lowest with 12·7% in 2013, and Ethiopia highest with 88% in 2013.

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2.1.6. Collating, summarizing, and reporting the results.

Thematic content analysis was used to analyse the narrative account of the data extracted from the included studies. Data was extracted around the following outcomes: knowledge of measles and measles vaccine, attitude towards measles vaccine and practices towards measles and measles vaccine, factors affecting the variables, and recommendations for mitigating these factors.

3. Results

3.1 Knowledge of caregivers on measles and measles vaccine.

A study by Nwangwu et al. [12], conducted with 213 participants in Nigeria, found that a substantial majority (90.6%) of the parents had above-average knowledge regarding measles and the measles vaccine. In alignment with two other studies conducted in Nigeria, one was conducted in Ikorodu involving 250 mothers; findings demonstrated that 65 % correctly identified measles as vaccine-preventable; however, 14 % misidentified measles vaccine as administered at birth [13]. In a different region in Nigeria, Ibadan state, a study by Uchendu et al., [14] sampled 509 respondents, the majority were aware of measles infection. At the same time, 59.7% demonstrated good knowledge of the causes of measles, with 79.8% exhibiting sufficient knowledge of the measles case definition and 36.3% of caregivers correctly identified a microorganism as the cause of the measles disease.

A national study in Saudi Arabia in Jordan by Nasser et al. [15], involving 1477 participants, found that all respondents were aware of immunization and its importance. Additionally, 75.6% believed that vaccination could control measles. Another study conducted in Saudi Arabia by Alsayahi, Albarakah, et al. [16] used three questions to assess 356 parents' knowledge about measles in Riyadh; approximately 47.% (n = 168) of the respondents perceived measles as highly contagious, while 23.3% (n = 83) perceived it as slightly infectious. Additionally, 50.8% (n = 181) considered measles highly dangerous, whereas 29.2% (n = 104) perceived it as somewhat risky. The study also revealed that 15.7% (n = 56) of the participants did not answer any of the questions correctly, while 30.6% (n = 109) answered all three questions correctly.

A study conducted in Poland by Korzeniowska et al. [17] assessed the knowledge levels of 537 mothers with children under 18 regarding measles and the measles vaccine. The findings revealed moderate average test performance, with 60.76% correct responses. Most participants (82.5%) correctly identified the viral aetiology of measles, 5.4% attributed it to a bacterium, and 11.2% expressed uncertainty. Furthermore, a significant proportion (90.3%) understood how measles is contracted. However, a notable percentage (22%) lacked knowledge about measles symptoms, and 43.8% accurately recognized that salivary gland enlargement was not a symptom of measles.

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3.2 Attitudes of caregivers towards measles and measles vaccine.

A study conducted in Lagos, Nigeria, by Kanma-Okafor et al., [13] assessed maternal knowledge, attitude, and compliance regarding immunization of under-five children, 250 mothers were recruited to form part of the study. Findings revealed that all (100%) mothers had a positive attitude towards childhood vaccination. The same study found a positive association between a positive attitude and a higher percentage of fully vaccinated children. In Saudi Arabia, a study by Almutairi et al.[18] assessed the knowledge, attitudes, and practices regarding childhood vaccination during the first five years of life. The study sampled 262 mothers and found that 98.5% expressed positive attitudes toward vaccination, and 98.5 % ensured their children received complete immunization. Nassar et al. [15] conducted a study to identify the determinants of parents' knowledge, attitude, and practice toward childhood vaccination in Jordan. The sample included 1477 parents, and data revealed that 92 % exhibited positive attitudes towards vaccination, and 93.2% believed that childhood vaccines are essential; however, 83 % had a negative attitude towards vaccine safety.

In India, Sahoo et al. [19] assessed 196 caregivers' attitudes toward childhood vaccines; the study concluded that participants believed their children did not require vaccines for no longer prevalent diseases. Similarly, In Poland, Korzeniowska et al. [17] found that parents who did not vaccinate their children believed that the measles vaccine was unnecessary, ineffective, and harmful to children's health. On the contrary, Oloyo [20] surveyed 161 mothers in Uganda, Awach Health Centre IV, Gulu District; the study utilized both bivariate and multivariate analyses to explore the relationship between socio-demographic factors and parents' attitudes toward childhood immunization. The findings indicated a significant association ($p < 0.05$) between caregivers' sociodemographic characteristics and their attitudes toward vaccination. Notably, a majority (66.4%) of participants strongly disagreed with the statement that infants contract the diseases for which they are vaccinated. However, a substantial proportion (84.5%) expressed the belief that vaccine side effects could be fatal and 80.1% perceived vaccination as more critical for boys than for girls.

3.3. Practice of caregivers towards Measles vaccine.

Almutairi et al. [18] study of 262 Saudi mothers found that 98.5 % followed the recommended vaccine and the mandatory schedule duly. Furthermore, a substantial amount (93.5 %) reported adherence to the compulsory vaccination programs, and 88.3 % applied a cold press to reduce swelling and give painkillers to relieve pain to deal with the side effects of vaccines. Similarly, Nasser et al. [15] study conducted among Jordan parents found that 92.8 followed the obligatory vaccine programs while 86.4% completed the vaccination program. Findings also revealed that parents utilize antipyretics to manage vaccine-induced fever. Conversely, a poor practice score (35.5%) was for searching for other available vaccines than those in the National Immunization Program.

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For the study conducted in Uganda by Oloya [20] , practice items were assessed to determine whether the child/ children under five were up to date with the immunization schedule and if the child had missed any vaccine. The results found no significant association between sociodemographic characteristics and participants' practice; in the study, 87,9% were up to date, 12.1% were not, and 89.7 had not missed any vaccines.

The study conducted in Nigeria by Nwangwu et al. [12] reported that 90.6% of participants had adequate knowledge of measles symptoms, transmission, and prevention and demonstrated poor understanding of its complications. Ironically, the study reported that few measles cases were treated in hospitals despite positive attitudes toward the measles vaccine; significant concerns were noted among parents with more than two children, and the study noted delays in vaccination, doubts about vaccine efficacy, and fears of side effects. Similarly, in a different district in Nigeria, Kanma-Okafor et al. [21] sampled 509 mothers, and findings demonstrated that 277 of their children contracted measles, with 253 (91.3%) receiving home treatment. Only 24 (8.7%) sought treatment from health facilities. The study noted that 81.8% of mothers used palm oil, 77.5% administered palm wine, 75.1% gave antibiotics, 91.3% delayed seeking appropriate medical care, and only 8.7% pursued professional medical assistance.

3.4 Factors Affecting Caregivers' Knowledge, practices, and Attitudes Regarding Measles and measles Vaccine.

a. Caregiver's educational status and age.

Wilder-Smith et al. [22] conducted a systematic review of parental attitudes and beliefs regarding the measles vaccine; the review included seven countries within the WHO European region, and findings revealed that parents with higher levels of education have a higher frequency of refusing the measles vaccine. The same review further found that younger parents were more supportive of MMR vaccination than older parents. In addition, there was a statistically significant association between the ages of parents and physicians; younger parents were less likely to vaccinate their children if their physicians were older. In comparison, older parents were more likely to vaccinate their children if their physicians were also older. A study conducted in Poland, Podkarpackie, by Lewandowska et al. [23] found that educated parents perceived vaccinations as less safe than those with lower levels of education ($p = 0.03$). A systematic review of factors influencing childhood immunization uptake in Africa by Galadima et al. [24] found that mothers over 19 were ten times more likely to have their children fully vaccinated than mothers under 19 years of age. The same review found that mothers with at least a primary or secondary school education were eight times more likely to have their children fully vaccinated compared to mothers with no formal education. Furthermore, in Eritrea, Kibreab et al. [25] assessed the impact of maternal education on the full immunization of children aged 12–23 months. A bivariate analysis of the study found a significant association between maternal education and immunization; children of mothers with a primary level of education were 2.8 times more likely to be

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fully vaccinated, and children of mothers with middle or above levels of education were 3.2 times more likely to be fully vaccinated, compared to children of mothers with no education. In contrast, a study by Oloyo [20] in Uganda found that mothers or caregivers who attended primary and secondary school were less likely to have a favourable attitude towards immunization than parents who attended higher education.

b. Caregiver-physician relationship.

In Australia, Kyprianidou et al. [26] conducted a cross-sectional study to assess mothers' knowledge regarding children's vaccinations in Cyprus. The study reported that more than half of the participants (57%) had delayed their child/children's vaccination, with their paediatrician's suggestion being the main reason. In a study by Matta et al. [27] in Lebanon on parents' knowledge, attitude, and practice towards children's vaccination, a multivariable analysis found that better patient-physician communication was significantly associated with higher knowledge, better attitude, and practice. Moreover, better knowledge was significantly associated with better attitude, whereas better knowledge and attitude were significantly associated with better practice. A study conducted in South Africa by Killion et al. [7] investigated factors related to vaccination coverage in Mopani District, Limpopo Province; the study found that children were more likely to be up to date with vaccinations if a community health worker had recently visited their home. The systematic review by Wilder-Smith et al. [22] in European countries revealed that parents who were outright rejectors of vaccines believed that healthcare professionals avoid discussing the associated risks of vaccines. A study by Bozzola et al. [28] added that false information online and conflicting advice from health providers can confuse parents and lead to vaccine hesitancy.

c. Financial barriers on measles vaccine uptake: Implications for caregivers

The measles vaccine costs did not directly affect the mother's practice, in that the measles vaccine is provided freely by the government in primary health care facilities in most of the reviewed studies. However, Killion et al. [7] and Oloyo [20] studies demonstrated that lack of measles vaccine on the day of uptake, long distance to clinic, limited operational hours, and extended waiting times presented a challenge for caregivers. The study by Korzeniowska et al. [17], conducted in Poland, found that the high cost of combined and recommended vaccines posed a significant financial barrier for mothers, making it challenging to vaccinate their children. This finding was congruent with Lewandowska et al. [23], also conducted in Poland, where financial constraint was pronounced regarding the cost of the measles vaccine.

d. Vaccine Hesitancy.

Aldakhil et al.'s [29] study conducted in Saudi Arabia on vaccine hesitancy towards childhood immunizations found a 24.31% vaccine hesitancy among parents regarding childhood immunization.

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Key factors contributing to this hesitancy towards the measles vaccine included concerns about autism and vaccine safety. The research further found a higher likelihood of vaccine hesitancy among mothers with one or two children. This finding was attributed to their limited experience with childhood vaccinations, which may have increased their doubts compared to mothers with more than two children. A report by the WHO [30] found that social media plays a pivotal role in misinformation and that the media breeds increased negative attitudes toward vaccines. The report went on to explain that since younger parents seek information from online sources, they are more likely to fall prey to scientifically unconfirmed information that emphasizes adverse effects and scare tactics promoted by anti-vaccination campaigners.

These findings align with a systematic review by Novilla et al. [31] which examined studies conducted in the United States to explore parental reasons for refusing to vaccinate their children with the measles, mumps, and rubella (MMR) vaccine. The review analysed 115 studies, and findings highlighted the fear of autism as the most frequently cited cause of vaccine hesitancy, accounting for 43% of studies. A correlation between maternal education level and vaccine hesitancy was observed in 50% of the included articles, with college-educated mothers exhibiting higher levels of hesitancy. Additionally, 7 out of 28 studies linked younger parental age to increased vaccine hesitancy.

e. Covid-19 disruption.

This current review found that the COVID-19 pandemic significantly disrupted large-scale vaccination campaigns, widening immunization gaps and increasing the risk of measles outbreaks [1, 32]. Research by Kostandova et al. [33] in Zambia demonstrated a direct correlation between the duration of vaccination program disruptions and the subsequent increase in measles cases. The study indicated that prolonged interruptions of six months or more led to substantial surges in confirmed measles cases while observing disruptions that lasted for only one month; there were no significant differences in measles cases during that interruption period. A systematic review by Aborode et al. [34] underscored the pandemic's devastating impact on measles prevention and management in Africa; the study estimated that 80 million children across 68 countries are at heightened risk of vaccine-preventable diseases because of the disruption during the implementation of COVID-19 control measures.

2.1.3.5. Strategies for improving measles knowledge, attitude, and vaccination practices: recommendations from research.

This review found that health education and promotion are crucial initiatives for enhancing caregiver knowledge of measles; studies stressed the importance of disseminating accurate information at antenatal, immunization, and postnatal clinics[15, 23, 29] Other studies recognized the critical role of community health workers in enhancing vaccination uptake, noting that home visits conducted in local languages proved effective in educating caregivers about measles [2, 7]. Furthermore, inclusive

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community engagement involving local leaders was recommended for addressing vaccine hesitancy and dispelling myths [34]. A multifaceted approach was recommended in encountering misinformation effectively [2, 7, 34]. Ensuring adequate vaccine supplies at clinics and promoting parental adherence to the recommended measles vaccine schedule were key strategies for reaching sufficient levels of measles vaccination coverage [7].

4. Discussion.

This scoping review had three objectives, which were to explore caregivers' knowledge, attitudes, and practices towards measles and the measles vaccine and describe factors affecting caregivers' knowledge, attitude, and practices regarding measles and measles vaccine, thirdly, to describe the strategies for improving measles knowledge, attitude, and vaccination practices.

The findings revealed adequate knowledge regarding measles and its vaccination, as evidenced by studies conducted in Nigeria and Saudi Arabia [14, 15, 21] where a significant majority of parents demonstrated an above-average understanding of the measles case definition. However, persistent misconceptions, such as the belief that measles vaccines are administered at birth, alongside knowledge gaps in critical areas, such as the aetiology of measles and its severity, emphasize the need for healthcare providers to offer comprehensive education during consultations. Specifically, there is a need for healthcare providers to properly explain to parents the vaccine they are administering, the diseases it prevents, and the consequences of the missing vaccine. This ensures that parents are adequately informed about the vaccines their children have received and the timing of each vaccination [30].

The reviewed studies showed a positive attitude towards measles and the measles vaccine, particularly among caregivers in Lagos, Nigeria [14], and Saudi Arabia [16, 18]. Interestingly, in the study conducted in Nigeria, although caregivers reported high knowledge and positive attitudes, they preferred home treatments over seeking professional healthcare services. This could point to gaps in understanding the disease's seriousness and complications and infectious diseases. However, a thorough investigation is needed to provide accurate underlying factors influencing this preference. Two studies, one conducted in India [19] and another in Poland [23], also revealed low perceived severity regarding measles infection and believed that measles vaccines are unnecessary, seeing as now measles are uncommon and, therefore, did not consider vaccination essential. This finding aligns with earlier research suggesting that the low visibility of measles cases contributes to community complacency [2, 35]. In Uganda, [20] a positive attitude toward vaccination was observed; however, misconceptions about vaccine side effects remained prevalent. This highlights the importance of healthcare providers educating caregivers on the safety and efficacy of vaccines and providing guidance on the proper management of vaccine side effects [30, 36]. In the studies conducted in Saudi Arabia [16, 18] and Uganda [20], mothers demonstrated adherence to recommended vaccination schedules, complied with mandatory vaccination programs and effectively managed vaccine side effects. Findings from studies

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conducted in Nigeria [14, 21] reveal notable gaps in caregiver practices. Despite participants having adequate knowledge of measles, they prefer home-based management; this contributes to delayed medical attention, as caregivers tend to seek professional care only when symptoms worsen. Consequently, this delay in seeking timely medical intervention worsen the spread of measles within communities, and this could be a significant factor in the persistence of measles, as the absence of herd immunity allows for the continued transmission of the virus, making it challenging to control and contain outbreaks in the area.

The second objective of this review was to examine the factors influencing caregivers' knowledge, attitudes, and practices regarding measles and the measles vaccine. The findings suggest that caregivers' educational level and age significantly shape their knowledge, attitudes, and practices. Paradoxically, while higher educational status correlated with increased vaccine refusal in some studies [17, 23, 29] in other regions, it was linked to higher vaccination rates [23, 26]. This can be explained by the fact that educated caregivers have greater access to a wide range of information, including misinformation. Considering the rise of social media and online platforms, those with higher education levels are more likely to encounter anti-vaccine movements and unscientific information.

According to the findings of this review, younger parents showed greater support for the measles vaccine [22, 35]. This trend may be attributed to the fact that younger parents, who grew up after the controversy surrounding Wakefield's [17] study on the measles vaccine, they are less affected by the misinformation that influences older parents. Furthermore, studies within this review indicated that positive caregiver-physician relationships substantially impacted vaccination decisions [17, 37]. In contrast, misinformation and contradictory medical advice were key factors contributing to vaccine hesitancy [29]. Financial barriers, such as logistical challenges and the cost of combined vaccines, discouraged some caregivers from vaccinating their children [7, 19, 25, 26]. The COVID-19 pandemic disrupted vaccination services and increased the risk of measles outbreaks despite control measures that inadvertently reduced measles spread [32].

Interventions found in this review suggest a need for a multifaceted approach to effectively controlling the health burden of measles. Firstly, intensifying educational interventions to improve parental knowledge is crucial [20]. Simultaneously, adopting digital communication strategies via social media and internet platforms can effectively promote immunization among educated parents and address vaccine hesitancy [28]. Community and home-based interventions, such as home visits by community health workers, were recommended to ensure parents have adequate knowledge about measles severity and complications [2, 7]. Government support effectively addressed vaccine stock-outs [7, 15, 21]. Additionally, awareness campaigns were observed to be necessary to underscore the significance of immunization and educate communities about the seriousness of measles [30].

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5. CONCLUSION.

The caregivers' knowledge regarding measles was generally adequate; however, notable gaps were identified, particularly in their understanding of the disease's causes, severity, and complications. While caregivers exhibited a positive attitude towards the measles vaccine, concerns around vaccine safety and potential side effects persisted. The review revealed a combination of good and poor practices, with most studies reporting adherence to vaccination schedules and effective management of vaccine side effects. Several factors influencing caregivers' practices were identified, including the educational level and age of the caregivers, the impact of the COVID-19 pandemic, and logistical barriers such as vaccine stockouts and the distance to healthcare facilities, which hindered timely vaccination. This review suggests that a comprehensive approach combining measles vaccination with appropriate health education would be far more effective than relying solely on the vaccine schedule, supplementary vaccine or home-based treatment.

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2.2 MANUSCRIPT 2: EMPIRICAL STUDY SUBMITTED TO PUBLIC HEALTH CHALLENGES JOURNAL (UNDER REVIEW)

MEASLES PROPHYLAXIS: ASSESSING CAREGIVERS' KNOWLEDGE, ATTITUDE AND PRACTICES IN A SELECTED VILLAGE IN VHEMBE DISTRICT, LIMPOPO PROVINCE, SOUTH AFRICA.

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Data availability statement.

Data supporting the study's findings will be made available from the corresponding author upon reasonable request.

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Conflict of interest disclosure.

The authors declare no conflict of interest. The funders had no role in the conception and execution of this manuscript or in the decision to publish the results thereof.

Ethics statement

The University of Venda Human and Clinical Trial Research Ethics Committee granted ethical approval. Ethical clearance no: FHS/24/PH/17/07/08.

Patient consent statement.

All subjects provided verbal informed consent to participate in the study.

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MEASLES PROPHYLAXIS: ASSESSING CAREGIVERS KNOWLEDGE, ATTITUDE AND PRACTICES IN A SELECTED VILLAGE IN VHEMBE DISTRICT, LIMPOPO PROVINCE, SOUTH AFRICA.

ABSTRACT

Introduction: Despite ongoing measles control efforts, cases persist worldwide, with South Africa experiencing a concerning resurgence in recent years. In 2023 alone, over 2,000 cases were reported across all provinces, with outbreaks occurring in eight out of nine provinces. These heightened case numbers highlight critical gaps in measles prophylactic guidelines. The present study assessed caregivers' knowledge, attitude, and practice regarding measles and the measles vaccine.

Methods This study employed a quantitative, cross-sectional descriptive design to assess the knowledge, attitudes, and practices of caregivers with children between children aged 6 months to 12 years in a selected village within the Vhembe District, Limpopo Province. A simple random sampling technique was used to select 377 caregivers. A self-constructed questionnaire was developed and used for data collection. Responses were cleaned and coded on Excel software and imported into SPSS version 30.0 software for analysis.

Results: The results indicated that most caregivers have low (99; 32.1%) and average knowledge (188; 61.0%). Only a tiny fraction (21; 6.8%) of the caregivers demonstrated high knowledge. The total attitude score results suggested that most caregivers have positive attitudes, with nearly 90% of respondents displaying positive attitudes. For total practices, the score suggests that almost all respondents have a somewhat positive level of practice (290; 92,2%), with very few displaying a poor practice level (17; 5.5%).

Conclusion and recommendation: The findings of this study revealed inadequate knowledge and practices despite participants demonstrating a positive attitude. It is recommended that measles control measures should incorporate continuous educational initiatives aimed at enhancing caregivers' recognition of symptoms and understanding of causative factors and transmission routes.

Keywords: Knowledge; attitude; practice; measles; measles vaccine; caregivers

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1 Background and Introduction.

Measles, a preventable yet highly contagious viral disease, has seen a troubling resurgence worldwide, raising significant public health concerns. In 2022, an estimated 9 million children were infected globally, according to the Centre for Disease control and prevention, (2024).This trend worsened in 2023, with World Health Organization (2024) reporting a 79% increase in cases, marking a rapid upward trajectory. The United States documented 53 cases by 2024, while Europe and Asia recorded 58,000 infections in 2023. Major outbreaks in countries such as Austria, the Philippines, Romania, and the United Kingdom have emphasized the urgent need for strengthened immunization efforts worldwide (World Health Organization, 2024).

Measles poses severe health risks, particularly for unvaccinated individuals, as it can lead to complications like pneumonia, encephalitis, and even death (Oluseye et al., 2021). Symptoms typically begin with fever, cough, runny nose, and conjunctivitis, followed by a rash that appears within 7 to 21 days after exposure (Korzeniowska et al., 2020). Measles spreads easily through direct contact or airborne transmission, and the virus can remain infectious in the air and on surfaces for up to two hours after an infected person has left the area (Nwangwu et al., 2021).

In recent years, South Africa has also witnessed a resurgence of measles. Sporadic cases in 2022 escalated into an outbreak in Limpopo province by October 2022. By March 2023, cases had spread to all provinces, with eight of nine provinces reporting outbreaks. The National Institute for Communicable Diseases (NICD, 2023) documented 1,338 cases from October 2022 to December 2023, with Limpopo experiencing the highest case count (533), followed by Gauteng (265), Northwest (226), and Western Cape (56). As of 2024, the National Institute for communicable diseases (2024) confirmed continued measles transmission with 158 laboratory-confirmed measles cases in South Africa.

Despite the availability of safe and effective vaccines, measles outbreaks continue to pose significant public health challenges globally and within South Africa. Research on childhood vaccination in South Africa has identified several impediments to achieving optimal immunization rates, with issues such as non-adherence to vaccination schedules, vaccine shortages, and long wait times at health facilities as primary obstacles (Centre for Disease control and prevention, 2023; Killion et al., 2023; World Health Organization, 2020). The COVID-19 pandemic has compounded these issues, disrupting immunization programs worldwide and intensifying pre-existing barriers to vaccination (WHO, 2020).

Although some studies have examined caregivers' knowledge, attitudes, and practices regarding measles vaccinations. For instance, a recent study in Saudi Arabia indicated that some parents hold concerns that the vaccine may cause severe adverse effects in children, fostering negative attitudes toward immunization (Almansour, 2023). Additionally, some studies reveal that caregivers question the necessity of the measles vaccine (Lewandowska et al., 2020). Similar patterns of hesitancy and

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misconceptions regarding the measles, mumps, and rubella (MMR) vaccine have been observed across various countries (Korzeniowska et al., 2020; Thompson et al., 2023).

Several studies have explored caregivers' knowledge, attitudes, and practices related to measles vaccination in sub-Saharan Africa, including Nigeria (Nwangwu et al., 2021; Oluseye et al., 2021; Uchendu et al., 2019). There remains a notable gap in the literature specific to the South African context. This deficit is particularly concerning given that measles vaccination coverage in South Africa continues to fall short of optimal levels, with coverage in Measles Vaccine 1 (MCV1), 80% and MCV2 at 84% (UNICEF, 2024). Furthermore, in KwaZulu-Natal Province, certain parents have expressed distrust, citing fears that the vaccine could harm their children (Zondi, 2023). In 2023 in Limpopo Province, schoolteachers reported increased measles cases among learners and observed that some parents were reluctant to seek medical care for their children. This outbreak prompted a localized vaccination campaign that reached approximately 1,000 children aged 6 months to 12 years (Chiguvare, 2023).

Despite these efforts implemented to control measles infection, measles cases persist. The high case numbers reveal potential gaps in recognizing measles symptoms, understanding its transmission, and adhering to isolation regulations. This situation suggests a need to study local knowledge and practices around measles to identify specific knowledge gaps and develop targeted educational interventions to control measles community transmission.

2 Purpose of the study

This study assessed caregivers' knowledge, attitudes, and practices toward measles and the measles vaccine in a selected village within the Vhembe District of Limpopo Province.

3 Material and Methods

This study employed a quantitative, cross-sectional descriptive design to assess caregivers' knowledge, attitudes, and practices with children aged 6 months to 12 years in a selected village within the Vhembe District, Limpopo Province. A simple random sampling technique was used to select 377 caregivers, with data collected using a structured questionnaire developed from an extensive literature review. The research was conducted in Tshikota village, just west of Louis Trichardt, in the Vhembe District Municipality, Limpopo Province, South Africa. According to the 2022 census data from Statistics South Africa, Tshikota has a population of 4,099 residents and is served by two primary healthcare facilities approximately 8 kilometres apart.

The study targeted caregivers of children between 6 months and 12 years residing in Tshikota village. A sample size of 377 respondents was determined using Cochrane's (1977) formula based on the total population of 4,099, a 95% confidence level, a 5% margin of error, and an estimated proportion of 50%

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females in the study area. Caregivers were selected through a simple random sampling technique involving the preparation of 4,099 slips, each representing a household. The selection process included visiting a household, where the researcher and two research assistants introduced themselves and inquired if the household had a child aged between 6 months and 12 years. Consenting individuals were requested to draw one slip from a closed box containing the slips. If the selected slip had a cross and the individual met the study criteria, they were included. This procedure continued until the required sample of 377 participants was achieved. The inclusion criteria required a caregiver to be an adult actively involved in healthcare decisions for a child or children aged 6 months to 12 years. Exclusion criteria included caregivers unwilling or unable to provide informed consent.

A structured, self-administered questionnaire was developed based on extensive literature to gather data on relevant study variables. The questionnaire was divided into four sections: Section I: collected demographic information about respondents. Section II assessed caregivers' knowledge of measles, including its causes, symptoms, complications, and vaccination schedule. Knowledge was evaluated across three domains. The first contained ten questions, with 1 point per correct response (maximum score= 10 points). Domain 2 included one multiple-choice question with 1 point per correct response (maximum score was 11 points), and the third domain was one multiple-choice question with two correct responses, with each correct response worth 1 point (maximum score was 2 points). The total knowledge score was a maximum of 22 points, with knowledge levels calculated as a percentage of the total score. Using Bloom's cutoffs, knowledge was classified as High (80–100%, 18–22 points), Moderate (60–79%, 13–17 points), or Low (0–59%, 0–12 points).

Section III: Measured attitudes towards measles vaccination using ten Likert-scale items. Each item was rated from 1 (strongly agree) to 4 (strongly disagree), with a maximum score of 10 points. Attitudes were categorized as positive (50–100%, 5–10 points) or Negative (0–49%, 0–4 points) according to Bloom's criteria. Section IV assessed caregivers' practices in managing and preventing measles. This section included eleven Likert-scale items, rated from 1 (Always) to 5 (Rarely). The maximum practice score was 11 points, with practice levels classified as Good (80–100%, 9–11 points), Moderate (60–79%, 7–8 points), and Poor (0–59%, 0–6 points).

Data was analyzed using SPSS version 30.0 (IBM SPSS Statistics, 2024). Data was entered, cleaned and checked before analysis into Microsoft Excel software. Responses were coded and entered into SPSS for analysis. The variables were summarized descriptively using tables, frequencies and percentages. Pearson correlation analysis assessed the relationships between total knowledge, attitude, and practice scores.

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4 Results.

This chapter presents the statistically analysed data from the study and the interpretation of the information obtained. The recommended sample size for the study was 377. However, 69 questionnaires were excluded from the analysis as they were incomplete, which resulted in 308 questionnaires being included for analysis. The data was analysed, and the results of caregivers' knowledge, attitude, and practices towards measles and the measles vaccine are presented in tables, frequencies, and percentages. These also included the results of the sociodemographic characteristics of the caregivers.

Table 3 Socio-demographic characteristics of caregivers.

Demographic Characteristics			
Item	**Attributes**	**N**	**%**
Age	14 - 19	15	4,9%
	20 - 39	149	48,4%
	40 - 49	73	23,7%
	50 - 80	71	23,1%
Gender	Male	62	20,1%
	Female	246	79,8%
Education level	No formal education	71	23,1%
	Primary education	36	11,7%
	Secondary education	155	50,3%
	Tertiary education	46	14,9%
Employment status	Employed	73	23,7%
	Unemployed	235	76,3%
Relationship to the child	Mother	195	63,3%
	Father	51	16,6%
	Grandparents	62	20,1%
Language	Venda	236	76,6%
	Tsonga	64	20,8%
	Zulu	4	1,3%
	Sotho	2	0,6%
	Xhosa	1	0,3%
	Pedi	1	0,3%

The sociodemographic analysis revealed that nearly half of the caregivers were predominantly between the 20–39 age group (48.4%). Most caregivers were females (79.8%), with males representing a smaller portion (20.1%). In terms of education, most caregivers have completed secondary education (50.3%), while a notable percentage have no formal education (23.1%); fewer have attained primary (11.7%) or tertiary education (14.9%). Employment status data indicated that a significant proportion of caregivers are unemployed (76.3%), with only 23.7% reporting employment. The primary caregivers were mothers (63.3%), followed by fathers (16.6%) and grandparents (20.1%). Language demographics showed that Venda is the dominant language among caregivers (76.6%), with Tsonga as the next most common (20.8%).

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Table 4 Caregivers' experiences and access to measles-related information and services .

	Attributes	N	%
Have you or anyone in your care ever contracted measles?	Yes	63	20,4%
	No	245	79,5%
Are any barriers preventing you from accessing the measles vaccine at your clinic for the children under your care?	Distance to the clinic	113	36,7%
	Vaccine shortage	108	35,1%
	Long waiting time	82	26,6%
	Other	5	1,6%
What sources of information do you rely on when seeking information about measles and measles vaccines?	Healthcare providers	62	20,1%
	Family members and friends	80	26,0%
	Radio and television	140	45,5%
	Social media	26	8,4%

Table 4 shows the results of caregivers' experience with measles and the measles vaccine. Approximately 20 % of caregivers reported that they or someone in their care has contracted measles. When it comes to barriers to accessing the measles vaccine, distance to the clinic was the most reported obstacle (36.7%), followed by vaccine shortages (35.1%) and long waiting times (26.6%), with a small percentage (1.6%) citing other unspecified barriers. Regarding information sources, nearly half of the caregivers (45.5%) rely on radio and television for information about measles and its vaccine. Family members and friends served as a source for 26.0% of respondents, followed by healthcare providers (20.1%) and social media (8.4%).

Table 5 Caregivers ' knowledge of signs and symptoms of measles infection.

Knowledge of the signs and symptoms of measles infection			
	Attributes	**N**	**%**
High fever	Yes	258	83,8%
Vomiting	Yes	105	34,1%
Death	Yes	92	29,9%
Conjunctivitis (Red, watery eyes)	Yes	87	28,2%
Stiff neck and back	Yes	60	19,5%
Dry cough	Yes	55	17,9%
Brain inflammation	Yes	39	12,7%
Blindness	Yes	36	11,7%
Small white spot inside the mouth	Yes	27	8,8%
Deafness	Yes	19	6,2%

The data on caregivers' knowledge of the signs and symptoms of measles revealed that most caregivers (83.8%) recognized high fever as one of the primary symptoms of measles infection. About 34 % of caregivers identified vomiting as a symptom, while 29.9% identified measles as leading to death. Fewer caregivers recognized conjunctivitis (28.2%), stiff neck and back (19.5%), or dry cough (17.9%) as

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related symptoms. Knowledge of severe complications such as brain inflammation (12.7%), blindness (11.7%), small white spots inside the mouth (8.8%), and deafness (6.2%) was observed as very low.

Table 6: knowledge of caregivers on children's age for measles vaccination.

age that aligns with the recommended age for administering the measles vaccine (1) and measles vaccine (2) to children in South Africa			
Item	**Attributes**	**N**	**%**
At birth	Incorrect	63	20,5%
6 weeks.	Incorrect	30	9,7%
10 weeks.	Incorrect	2	0,6%
14 weeks	Incorrect	2	0,6%
6 months	Correct	72	23,4%
9 months	Incorrect	10	3,2%
12 months	Correct	52	16,9%
Don't know		155	50,3%

This study showed that most respondents (50.3%, n=155) reported not knowing the correct ages for measles vaccine administration. Among those who provided specific ages, 23.4% (n=72) correctly identified 6 months as a recommended age, while 16.9% (n=52) correctly identified 12 months. Incorrect responses included at birth (20.5%, n=63), 6 weeks (9.7%, n=30), 10 weeks (0.6%, n=2), 14 weeks (0.6%, n=2), and 9 months (3.2%, n=10).

Table 7: Shows the caregivers' knowledge of the cause of measles.

Knowledge of the causes of measles infection, transmission and complications		
	Response	
Item	**Incorrect N (%)**	**Correct N (%)**
Vitamin A deficiency	163(52,9%)	145(47,1%)
It is caused by the virus Rubeola	224(72,7%)	84(27,3%)
The virus lives in the nose or throat of an infected person.	219(71,1%)	89(28,9%)
The virus spreads through the mucus or saliva of the infected person	226(73,4%)	82(26,6%)
The infected droplets spread into the air through sneezing and coughing and may fall on surfaces.	230(74,7%)	78(25,3%)
The measles virus spreads swiftly through the coughs and sneezes of those who are ill	215(69,8%)	93(30,2%)
Measles can lead to serious complications such as brain damage.	195(63,3%)	113(36,7%)

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Table 8: Caregiver's attitude towards measles and the measles vaccine.

Attitudes		
	Attitude	
Items	**Negative N (%)**	**Positive N (%)**
The measles vaccine is safe for children.	12(3,9%)	296(96,1%)
The measles vaccine harms children's health.	63(20,5%)	245(79,5%)
The measles vaccine is an effective way to prevent the spread of the disease	67(21,8%)	241(78,2%)
All eligible children need to receive the measles vaccine	45(14,6%)	263(85,4%)
Measles disease is not a threat to a child's health	91(29,5%)	217(70,5%)
I trust the government to provide accurate information about measles and the measles vaccine.	44(14,3%)	264(85,7%)
Measles vaccination campaigns are necessary to create awareness and increase vaccination rates.	56(18,2%)	252(81,8%)
measles is a highly contagious disease, and any interaction poses the risk of infection	8(2,6%)	300(97,4%)
Measles is not a severe illness and does not require vaccination.	79(25,6%)	229(74,4%)
Measles vaccine can cause severe side effects	166(53,9%)	142(46,1%)

Results of the study indicated that most (96.1%, n=296) of the respondents believed the measles vaccine was safe for children. Most respondents (79.5%, n=245) disagreed that the measles vaccine harms children's health, though 20.5% (n=63) view it as potentially harmful. Regarding the vaccine's effectiveness, 78.2% (n=241) considered it an effective way to prevent measles spread. The majority (85.4%, n=263) agreed that all eligible children should receive the measles vaccine. In the present study, 70.5% (n=217) of the majority considered measles a threat to child health.

Table 9: Practices of caregivers towards measles and measles vaccine.

Practice					
	Always	**Often**	**Sometimes**	**Never**	**Rarely**
	N (%)	N (%)	N (%)	N (%)	N (%)
I ensure that the children under my care receive the recommended measles vaccine on time	178(57,8%)	59(19,2%)	61(19,8%)	4(1,3%)	6(1,9%)
I give plenty of fluids.	110(35,7%)	92(29,9%)	98(31,8%)	3(1,0%)	5(1,6%)
I practice good hygiene (e.g., handwashing)	139(45,1%)	60(19,5%)	95(30,8%)	11(3,6%)	3(1,0%)
I am aware of when my child is supposed to receive the measles vaccine	10(3,2%)	46(14,9%)	141(45,8%)	52(16,9%)	59(19,2%)
I give my child nutritious food	77(25,0%)	93(30,2%)	119(38,6%)	17(5,5%)	2(0,6%)
I have discussed measles infection and measles vaccine with a health care provider.	38(12,3%)	44(14,3%)	94(30,5%)	113(36,7%)	19(6,2%)
I have discussed the importance of measles vaccination with other caregivers.	19(6,2%)	113(36,7%)	94(30,5%)	44(14,3%)	38(12,3%)
I actively seek information about measles and the measles vaccine from the internet	29(9,4%)	30(9,7%)	66(21,4%)	135(43,8%)	48(15,6%)
I keep my child isolated from other children if I suspect they have measles.	60(19,5%)	64(20,8%)	123(39,9%)	39(12,7%)	22(7,1%)
I give fever-reducing medication.	73(23,7%)	81(26,3%)	119(38,6%)	19(6,2%)	16(5,2%)
I ensure my child gets enough rest	160(51,9%)	75(24,4%)	51(16,6%)	15(4,9%)	7(2,3%)

Regarding practices, most caregivers (57.8%) ensured that their children received the measles vaccine on time, with 19.2% often doing so. However, a minority (3.2%) are not consistently aware of when

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children are due for the vaccine. Practices such as providing fluids, nutritious food, and adequate rest were widely observed, with 35.7% of caregivers always giving fluids, 25% always providing nutritious food, and 51.9% always ensuring that children get enough rest.

Table 10: Total Knowledge, Attitude and Practice scores

		Frequency (Percent)
Total knowledge score	Low Knowledge	188 (61,0)
	Average Knowledge	99 (32,1)
	High Knowledge	21 (6,8)
Attitude	Negative Attitude	33 (10,7)
	Positive Attitude	275 (89,3)
Total Practice Score	Somewhat Positive Practice	290 (94.5)
	Negative Practice	17 (5,5)

These results indicate that most caregivers have low (188; 61.0%) or average knowledge (99; 32.1%) according to the knowledge assessment used in this study. Only a small fraction (21; 6.8 %) of the caregivers demonstrated high knowledge. The total attitude score suggests that most caregivers have positive attitudes, with approximately 90% of respondents showing positive attitudes. The total practice score suggests that almost all respondents have a somewhat positive level of practice (290; 92,2%), with very few displaying a negative practice level (17; 5.5%).

Correlation analysis.

A Pearson correlation analysis was conducted to examine the relationships between total knowledge score, total attitude score, and total practice score among caregivers. The results of the correlation analysis, including confidence intervals, are detailed and summarized in Tables 11 and 12.

Table 11 Correlation coefficients.

Variable	Total knowledge score	Total attitude score	Total practice score
Total knowledge score		-0.209**	-0.240**
		(<0.001)	(<0.001)
Total attitude score	-0.209**		-0.050
	(<0.001)		(0.384)
Total practice score	-0.240**	-0.050	
	(<0.001)	(0.384)	

Note: Correlation is significant at the 0.01 level (2-tailed).

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For this study, the correlation between total attitude and practice scores was not statistically significant (r=−0.050, p=0.384) with a 95% confidence interval ranging from (−0.161 to 0.062).

Table 12 Confidence interval for the correlations.

Correlation	r	p-value	95% CI Lower Bound	95% CI Upper Bound
Knowledge score - attitude score	-0.209	<0.001	-0.314	-0.100
Knowledge Score - practice Score	-0.240	<0.001	-0.343	-0.132
Attitude Score - practice Score	-0.050	0.384	-0.161	0.062

Note: Confidence intervals are based on Fisher's r-to-z transformation.

5 Discussion.

The study's main objective was to assess caregivers' KAP levels, and a secondary objective was to assess the relationship between knowledge, attitudes and caregivers' practices. The study found that 20.4% of caregivers had prior exposure to measles infection. This is similar to findings in Korzeniowska et al. (2020), where quite a small fraction (13.2%; 71 out of 536) reported previous experience with measles. Critical barriers to vaccine uptake included the considerable distance to healthcare facilities (36.7%), a finding consistent with the results of Bangura et al. (2023) systematic review where healthcare systems include long distances to clinics as factors preventing vaccine-related services to beneficiaries. Additionally, frequent vaccine stockouts (35.1%) emerged as another barrier, mirroring findings reported by Killion et al. (2023) in a survey conducted in a different district in Limpopo Province.

Caregivers obtained information regarding measles and vaccination from media and healthcare providers, with 45.5% of caregivers depending on these media outlets for information. Comparable findings were reported in Almansour's (2023) study in Saudi Arabia, where the child's doctor was the predominant source of information on the measles vaccine (69.7%), followed by social media content.

Significant gaps were identified in caregivers' knowledge of measles, particularly regarding recognising its early symptoms. While the majority (83.3%) correctly identified high fever as a common symptom, awareness of other critical signs was markedly lower. Only 17.9% associated measles with a dry cough, 34.1% recognized vomiting, and 28.2% identified conjunctivitis, all of which are clinical features of measles complications. This lack of awareness often results in children remaining at home longer as the infection progresses before caregivers seek medical assistance. These findings differ from those of Korzeniowska et al. (2020), where most participants demonstrated an understanding of measles as a viral disease, correctly identifying its cause and its transmission through contact with infected secretions. In contrast, the limited awareness observed in the present study could delay the timely recognition and management of measles, increasing the risk of complications and postponing necessary medical interventions. Furthermore, the inadequate understanding of severe measles complications

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perpetuates the misconception that measles is a mild illness, further hindering access to critical healthcare services. The findings of this study align with those of Oluseye et al. (2021), who observed similar patterns in Nigeria, where caregivers demonstrated limited awareness of severe complications and often misinterpreted complications as the initial onset of the infection. These results highlight the importance of implementing targeted educational interventions to enhance caregivers' understanding of measles symptoms and complications, facilitating timely access to healthcare and reducing the likelihood of adverse outcomes.

The limited understanding of onset symptoms and potential complications in this study could be attributed to caregivers' lack of direct experience with measles cases, as the findings indicated that only 20% have prior experience with measles. These gaps likely inhibit the transfer of essential knowledge regarding the disease's severity and implications. Furthermore, the study found inadequate knowledge regarding the appropriate timing for measles vaccinations. Only 23% and 16.9% of caregivers correctly identified the recommended ages for the first and second doses. Oluseye et al. (2021) also noted similar patterns, revealing that about half of caregivers were aware of the recommended age for the first dose, with even fewer knowledgeable about the second dose. Accurate knowledge of vaccination schedules is crucial for effective measles prevention, and the findings indicate a significant shortfall in this regard. Caregivers who are uninformed may inadvertently miss critical vaccination schedules, thereby increasing the likelihood of measles outbreaks.

The total assessment of knowledge scores revealed that most caregivers had low to average knowledge about measles, with only a small proportion demonstrating a high level of understanding. This finding is consistent with other studies showing limited awareness among caregivers regarding measles symptoms, risks, and preventive measures (Korzeniowska et al., 2020; Oluseye et al., 2021). In contrast, a study by Nwangwu et al. (2021) in another region of Nigeria reported significantly higher awareness of measles and its vaccine. This higher awareness may be attributed to Nigeria’s implementation of house-to-house vaccination strategies, which have effectively enhanced measles education. Furthermore, the high mortality and severe complications caused by measles in many parts of Nigeria likely contribute to increased public awareness.

In South Africa, measles outbreaks typically follow a cyclical pattern, occurring approximately every six years and separated by periods of low transmission during which the country achieves its disease control targets (Yousif et al., 2022). These inter-epidemic periods often contribute to a decline in public awareness about measles, reducing the prioritization of vaccination among caregivers. This decline in vaccination coverage creates immunity gaps within communities, increasing vulnerability to outbreaks when conditions facilitate the spread of the virus.

Nevertheless, South Africa benefits from reliable population data to monitor measles immunization coverage, enabling health authorities to identify regions with low vaccination rates. (NICD, UNICEF,

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WHO). This data proves instrumental in implementing targeted vaccination campaigns to address immunity gaps and reduce the risk of future outbreaks. However, the cyclical nature of measles outbreaks reveals a problematic trend. Outbreaks often prompt mass vaccination campaigns that temporarily boost immunization coverage. Nevertheless, as the perceived threat diminishes during periods of low transmission, complacency sets in, leading to a gradual decline in vaccine uptake. Over time, this decline results in inadequate immunization coverage levels, perpetuating the risk of future outbreaks and compromising long-term measles control efforts.

Caregivers demonstrated positive attitudes toward measles vaccination, with the majority recognizing the harmful impact of measles on children and its high contagiousness despite some concerns about severe side effects. Most caregivers expressed strong agreement regarding the safety and effectiveness of the vaccine in preventing transmission. These findings align with studies conducted by Almansour (2023) in Saudi Arabia, Nwangwu et al. (2021) and Oluseye et al. (2021) in Nigeria, and Oloya (2023) in Ghana. This suggests that while caregivers' limited knowledge of measles may not reduce their confidence in the vaccine’s effectiveness, it likely influences their perception of the disease's severity and seriousness. It is also possible that the lack of widespread awareness about measles contributes to this lower perception of its severity among caregivers.

The study revealed that caregivers exhibited somewhat positive practices regarding measles vaccination and infection management. Although the majority ensured their children were vaccinated against measles, certain aspects of home-based care required improvement, particularly in maintaining hydration and managing fever effectively. Furthermore, interactions between caregivers and healthcare professionals regarding measles and vaccination were infrequent, highlighting an area for enhanced communication. These findings are congruent with a study by Nwangwu et al. (2021) in Nigeria, where most (92.5%) of caregivers vaccinated their children against measles. However, the majority (92%) reported having encountered a child with measles-like symptoms. The findings of this study were also consistent with findings from a study conducted in Ghana, where most parents reported being up to date with their immunizations (Oloya, 2023). In contrast, a study in Ibadan, Nigeria, found that 91.3% of caregivers managed measles at home, while only a few sought care from health facilities. The preference for home-based care over seeking professional medical assistance needs further investigation as reliance on home treatment poses challenges for accurate measles case identification and reporting, potentially hindering targeted immunization efforts.

A contrary study conducted in Poland by Korzeniowska et al. (2020) reported a significant proportion of women failing to adhere to the compulsory measles vaccination. The main reason cited was that the vaccine was unnecessary because the disease was no longer prevalent. These findings suggest that while caregivers demonstrate positive practices in certain aspects, significant gaps in vaccination uptake and case management still require attention through further research.

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The findings of this study highlight important implications regarding the relationship between knowledge, attitudes, and practices related to measles and measles vaccination among caregivers. The observed negative correlations between knowledge and attitude and practice scores suggest a complex dynamic where higher levels of knowledge do not necessarily translate into positive attitudes or effective practices. This raises concerns about potential gaps in how caregivers understand and apply their knowledge in real-world settings. The lack of a significant correlation between attitudes and practices indicates that positive attitudes towards measles and vaccination may not directly lead to changes in caregiving behaviours. This dissociation could point to the need for more comprehensive educational interventions that enhance knowledge and engage caregivers in understanding the practical applications of that knowledge.

Research in this field frequently examines associations through demographic factors (Killion et al., 2023; Oluseye et al., 2021; Uchendu et al., 2019). For instance, evidence consistently suggests that older mothers exhibit greater knowledge regarding childhood immunization. Moreover, significant relationships have been identified between caregivers' knowledge levels and their attitudes and practices toward vaccinating their children. A study by Matta et al. (2020) revealed that effective patient-physician communication is strongly associated with higher knowledge, more favourable attitudes, and improved vaccination practices. The same study further demonstrated that higher levels of knowledge positively correlate with positive attitudes, while a combination of better knowledge and attitudes is closely linked to improved vaccination practices. Future research may prioritize exploring the associations between caregivers' sociodemographic characteristics and their knowledge, attitudes, and practices to provide a more comprehensive understanding of these relationships. This approach would accurately describe the factors influencing immunization behaviours and help design effective caregivers for measles prophylaxis in the study area.

6 Conclusion.

This study has highlighted significant knowledge gaps, positive attitudes, and positive practices among caregivers regarding measles and the measles vaccine. While caregivers generally hold a positive view of vaccination, their limited understanding of critical aspects such as measles symptoms, vaccination timing, and transmission methods calls for attention. It is not inherently problematic that caregivers cannot identify all symptoms of measles, as diagnosing the disease is the responsibility of healthcare professionals. However, the concerning finding is that many caregivers could not name even the basic symptoms of measles, excluding complications. This is particularly worrisome in South Africa, where measles outbreaks are sporadic, and caregivers are less likely to encounter the disease firsthand. This infrequent exposure leads to a false sense of security, as caregivers may fail to recognize the importance of routine immunization for diseases they rarely see. The perception that immunization efforts might appear unnecessary for diseases no longer present, as observed in high-income countries, is likely to

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emerge in this context as well. Therefore, discussions between caregivers and healthcare providers should focus on educating parents about infectious diseases, vaccine safety, and the concept of herd immunity. This education must be delivered in a language that resonates with the community, ensuring that caregivers are fully informed and motivated to protect their children from measles.

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SECTION 1:

CONCLUSION, RECOMMENDATION, STRENGTH AND LIMITATION

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3.1 Introduction.

This mini-dissertation aimed to assess caregivers' knowledge, attitude, and practice towards measles and measles vaccines in Tshikota Village in the Vhembe District, Limpopo Province. To achieve this objective, primary research was conducted alongside a scoping review to synthesize information and facilitate the exploration of this phenomenon from global and local perspectives. This section delineates the conclusions drawn from the scoping review and the primary research manuscript.

3.2 Conclusions

3.2.1 Manuscripts/Article Conclusions

- **CONCLUSION FROM MANUSCRIPT 1: KNOWLEDGE, ATTITUDES, AND PRACTICES OF CAREGIVERS TOWARDS MEASLES AND MEASLES VACCINE: A COMPREHENSIVE SCOPING REVIEW.**

From the scoping review, caregivers' knowledge regarding measles was generally adequate; however, notable gaps were identified in their understanding of the disease's causes, severity, complications, and virology. While caregivers exhibited positive attitudes towards the measles vaccine, concerns surrounding its safety and potential side effects persisted. The review revealed a combination of good and poor practices, with most studies reporting adherence to vaccination schedules and effective management of vaccine side effects. Several factors influencing caregivers' practices were identified, including the educational level and age of the caregivers, the impact of the COVID-19 pandemic, and logistical barriers such as vaccine stockouts and the distance to healthcare facilities, which hindered timely vaccination.

- **CONCLUSION FROM MANUSCRIPT 2. MEASLES PROPHYLAXIS: ASSESSING CAREGIVERS KNOWLEDGE, ATTITUDE AND PRACTICES IN A SELECTED VILLAGE IN LIMPOPO PROVINCE, SOUTH AFRICA.**

Conclusion 2 is from primary research conducted among caregivers in Tshikota village; the findings highlighted significant knowledge gaps, positive attitudes, and positive practices regarding measles and the measles vaccine. While caregivers generally held a positive view of vaccination, their limited understanding of critical aspects such as measles symptoms, vaccination timing, and transmission methods called for attention. It is not inherently problematic that caregivers cannot identify all symptoms of measles, as diagnosing the disease is the responsibility of healthcare professionals. However, the concerning finding is that many caregivers could not name even the basic symptoms of measles, excluding complications. This is particularly problematic in South Africa, where measles outbreaks are sporadic, and caregivers are less likely to encounter the disease firsthand. This infrequent exposure leads to a false sense of security, as caregivers may fail to recognize the importance of routine immunization for diseases they rarely see. The perception that immunization efforts might appear unnecessary for diseases no longer present, as observed in high-income countries, is likely to emerge

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in this context as well. Therefore, discussions between caregivers and healthcare providers should focus on educating parents about infectious diseases, vaccine safety, and herd immunity. This education must be delivered in a language that resonates with the community, ensuring that caregivers are fully informed and motivated to protect their children from measles.

3.2.2 Overall conclusion.

This mini-dissertation concludes that caregivers' knowledge, attitudes and practices regarding measles and the measles vaccine were complex. Caregivers demonstrated satisfactory baseline knowledge and positive attitudes toward vaccination; critical gaps persisted in their understanding of key aspects such as measles' causation, severity, transmission, and complications. The findings of the reviewed studies revealed diverse barriers to adequate vaccine uptake. In European countries, vaccine hesitancy, misinformation, anti-vaccination movements, distrust in government authorities, and the perception of low disease severity attributable to the reduced visibility of measles were particularly prominent. In contrast, studies conducted in African contexts identified logistical challenges, including vaccine shortages, long distances to healthcare facilities, healthcare staff shortages, and the exacerbating effects of the COVID-19 pandemic on routine childhood immunization. Notably, the pandemic highlighted pre-existing gaps, with measles vaccination coverage falling below optimal levels intercontinental. This is paradoxical, as the decline in visible measles outbreaks due to effective control measures appears to have contributed to diminished global public knowledge of the disease.

Parental attitudes vary across countries. For instance, in Poland, the United Kingdom, and India, a low perceived severity of measles often resulted in perceptions of vaccination as unnecessary. However, in the present study, caregivers exhibited positive attitudes toward towards the necessity despite limited disease knowledge. As a result, it was noted that measles rarely occurs is now perceived as a non-threatening disease that does not require a vaccine. Regarding practices, it was noted that caregivers adhered to recommended immunization schedules; however, logistical barriers, often beyond the caregivers' control, significantly impeded vaccine uptake. A preference for home-based treatment over hospital care was observed in regions like Nigeria. While this preference seemed pragmatic to caregivers, educational interventions are necessary to demonstrate the limitations of home care, particularly its inability to mitigate disease transmission. These efforts should incorporate discussions on community herd immunity and disease eradication, presenting caregivers with clear, evidence-based information on infectious diseases and explaining their historical decline due to vaccination and the potential consequences of inadequate vaccine uptake. This ensures continued measles knowledge within local communities.

Additionally, international travel emerged as a significant contributor to measles transmission, as evidenced by studies in the United States and the United Kingdom. This underscores the importance of implementing rigorous measures to assess travellers’ vaccination statuses to curb intercontinental disease spread. Sociodemographic factors, including age, education, and employment status of

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caregivers and physician-parent relationships, further shaped vaccine-related attitudes and practices. For example, in high-income countries, younger, educated parents exhibited greater vaccine hesitancy than their counterparts in low-income countries, where higher education correlated with better vaccine adherence. The physician–caregiver relationship was associated with better attitudes and practices.

This study concludes that caregivers have moderate knowledge of measles; a critical gap remains in their understanding of disease severity due to low visibility. Attitudes toward vaccination are largely positive, and key concerns include vaccine side effects and the need for transparent communication. Practices related to vaccine uptake are influenced by systemic healthcare barriers rather than caregiver actions alone. Addressing these issues holistically through targeted education and systemic improvements is essential to ensure sustained progress in measles prevention and control.

3.5 Recommendations of the study.

Based on the findings of this study, several recommendations have been identified to address the gaps. First, targeted education campaigns must enhance caregivers' understanding of measles symptoms, vaccination timing, and transmission methods. These campaigns should emphasize the importance of routine immunization, even when measles outbreaks are infrequent. Additionally, healthcare providers must consult more frequently with caregivers, discussing the significance of vaccination, non-vaccination risks, and herd immunity. Educating caregivers on the basic symptoms of measles will enable them to identify potential cases early and seek appropriate medical intervention. Considering the sporadic nature of measles outbreaks in South Africa, localized awareness programs are essential to increase visibility and understanding of the disease. These programs should emphasize the severity of measles, even when rarely seen, and highlight its potential health risks. Education materials must include visual aids, infographics, and interactive elements to overcome comprehension barriers. These materials should be culturally sensitive, clear, and accessible, ensuring caregivers understand the importance of immunization. Regular mobile vaccination campaigns should be established to mitigate the challenges posed by long distances to healthcare facilities. These initiatives should not be limited to critical periods, such as measles outbreaks, but should aim to provide consistent access and comprehensive coverage in remote and underserved areas.

3.1.6 Strengths and Limitations of the Study.

The respondents for this study were selected using random sampling, and the sample size was sufficiently large to allow generalization within the study area. However, a notable limitation of the study was that information on whether caregivers ensured that children under their care received the recommended vaccines relied on recall, particularly from grandparents, who might not have accurate knowledge. Consequently, the reported practice scores could have been either overestimated or underestimated. This issue was further compounded by the fact that road-to-health booklets were not consulted in some instances, and parents might have claimed adherence to vaccination schedules due to social desirability bias. Moreover, data collection relied on respondents' self-completion of the

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questionnaire, which impacted both the response rate and data accuracy. This was evidenced by excluding 69 incomplete questionnaires from the final analysis.

3.7 Summary of the mini-dissertation.

This mini-dissertation focused on caregivers' knowledge, attitudes and practice towards measles and the measles vaccine. Key findings revealed that caregivers generally demonstrated adequate knowledge of measles, but significant gaps were found in their understanding of the disease's causes, severity, complications, and virology. Contrary to other studies' general findings, manuscript two found low knowledge of measles clinical manifestation, positive attitudes and somewhat good practices. The study emphasizes the need for targeted education campaigns to address these knowledge gaps, particularly by enhancing caregivers' understanding of measles symptoms, vaccination timing, and transmission methods. It emphasises the probable effect of knowledge deficiencies on adopting necessary preventive measures. Based on the findings, we recommended culturally sensitive and accessible materials, such as visual aids and infographics, to overcome comprehension barriers and emphasize the importance of education on herd immunity for infectious, uncommon diseases. The sample selection procedure and sample size rendered the strength worthy of being generalized to the population. At the same time, data for measles full vaccination cannot be confirmed due to social desirability bias from the respondents.

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ANNEXURES

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Annexure 1: Ethical clearance certificate.

RESEARCH AND INNOVATION
OFFICE OF THE DIRECTOR

NAME OF RESEARCHER/INVESTIGATOR:
Ms H Mathenjwa

STUDENT NO:
16004416

PROJECT TITLE: **Knowledge, attitude and practice of caregivers towards measles and measles vaccine in a selected village in Vhembe district, South Africa.**

ETHICAL CLEARANCE NO: **FHS/24/PH/17/0708**

SUPERVISORS/ CO-RESEARCHERS/ CO-INVESTIGATORS

NAME	INSTITUTION & DEPARTMENT	ROLE
Prof L Makhado	UNIVEN, PUBLIC HEALTH	Supervisor
Dr S Olofinbiyi	UNIVEN, PUBLIC HEALTH	Co-Supervisor
Ms H Mathenjwa	UNIVEN, PUBLIC HEALTH	Investigator – Student

Type: **Masters Research**
Risk: ***Minimal risk to humans, animals, or environment*** **(Category 2)**
Approval Period: **August 2024 – August 2025**

The Human and Clinical Trials Research Ethics Committee (HCTREC) hereby approves your project as indicated above.

General Conditions
While this ethics approval is subject to all declarations, undertakings and agreements incorporated and signed in the application form, please note the following:

- The project leader (principal investigator) must agree to file the unexpected format to the REC:
  - Annually (or as otherwise requested) on the progress of the project, and upon completion of the project.
  - Within 48hrs in case of any adverse event (or any matter that may affect the rights, safety or well-being of research participants and clinical principles) during the course of the project.
  - Annually a number of projects may be randomly selected for an external audit.
- The approved application is strictly to the protocol as stipulated in the application form. Should any changes to the protocol be deemed necessary during the course of the project, the project leader must apply for approval of these changes at the REC. Should there be deviation from the project protocol without the necessary approval of such changes, the ethics approval is withdrawn, and automatically terminated.
- The date of approval indicates the first date that the project may be started. Should the project have to continue after the expiry date, a new application must be made to the REC and new approval received before or on the expiry date.
- In the interest of ethical responsibility, the REC retains the right to:
  - Request access to any information or data at any time during the course or after completion of the project.
  - To ask further questions; Seek additional information; Require further modification or monitor the conduct of your research or the informed consent process.
  - Withdraw or postpone approval if:
  - Any unethical principles or practices of the project are revealed or suspected.
  - It becomes apparent that any relevant information was withheld from the REC or that information has been false or misrepresented.
  - The required annual report and reporting of adverse events was not done timely and accurately.
  - New institutional rules, national legislation or international conventions deem it necessary.

ISSUED BY:
UNIVERSITY OF VENDA, RESEARCH ETHICS COMMITTEE
Date Considered: August 2024

Name of the HCTREC Chairperson of the Committee: Prof NS Mashau

Signature:

UNIVERS OF VEND
OFFICE OF THE DIRECTOR
RESEARCH AND INNOVATION
2024 -08- 07
Private Bag X5050
Thohoyandou 0950

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Annexure 2: Letter to conduct research in the university.

University of Venda

Private Bag X5050

Thohoyandou

0950

Dear Sir/Madam,

Subject: Request for Permission to Conduct a Research Study

I trust this email finds you in good health. I, Mathenjwa Happiness (Student ID: 16004416), am writing to request permission to conduct my research study titled "Knowledge, Attitude, and Practice of Caregivers towards Measles and Measles Vaccine in Selected Districts in Limpopo Province, South Africa". I am currently enrolled in the master's program in Public Health within the Faculty of Health Sciences.

The primary objective of this study is to assess the knowledge, attitudes, and practice of caregivers towards measles and measles vaccine within the selected districts of Limpopo Province, South Africa. It aims to contribute to the existing literature on this subject and potentially inform interventions to improve measles vaccination coverage in the area.

I want to assure you that all necessary ethical protocols will be rigorously followed to ensure the safety and well-being of both the researcher and study participants. Any personal and sensitive information collected during the study will be treated with the utmost confidentiality and used solely for research purposes.

I kindly request your favourable consideration of this request. Your support in granting permission for this research would be greatly appreciated. Should you have any concerns or require additional information, please do not hesitate to contact me at smathenjwa789@gmail.com

Thank you for your attention to this matter.

Yours sincerely,

_____

Mathenjwa Happiness

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Annexure 2: Information sheet.

Title of the Research Study: **Knowledge, Attitude and Practice of Caregivers towards Measles and Measles Vaccine in a Selected District in Limpopo Province, South Africa.**

Principal Researcher: Mathenjwa Happiness Sizakele, master's in public health student.

Supervisor: Prof Makhado L

Brief Introduction and Purpose of the Study:

I, Mathenjwa Happiness, a student pursuing a Master of Public Health at the University of Venda, am embarking on research titled above. I would ask you to participate in the study. You are not forced to participate in the study. You can ask anyone you feel comfortable with regarding this research. If you encounter any unusual words or words you do not understand, please ask me to explain them before proceeding.

Purpose of the study: The study aims to explore the knowledge of measles among caregivers in selected districts of the Limpopo province.

Outline the procedure: The study will utilize a quantitative approach, specifically a cross-sectional descriptive design. Simple random sampling will be employed to select respondents from three chosen districts in Limpopo province willing to participate. The target population will consist of all caregivers with children aged between zero and five years. The sample size will be 377, determined through the use of the RaoSoft software calculator based on the population of Limpopo province. Face-to-face interviews will be conducted to collect the data.

Time of intervention- The completion of the questionnaire is estimated to take around 15 to 30 minutes. However, the duration may vary depending on the participant's pace and comprehension while answering the questions.

Participation selection- You are being invited to participate because the researcher believes that your expertise and knowledge regarding measles can greatly contribute to our understanding of how individuals perceive and approach measles and its vaccination. Your participation will be highly valued in gaining insights and enriching the study.

Voluntary participation and withdrawal- Participation in the study is entirely voluntary. You are under no obligation to take part, and if you decide not to participate, there will be no negative consequences. Should you, at any point, choose to withdraw from the research, your decision will be respected, and no repercussions will arise as a result.

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Procedure- During the face-to-face interview, respondents will be asked to complete a questionnaire. If a participant is not comfortable answering a particular question, they have the option to either skip to the next question or choose not to answer at all. It is essential to emphasize that any information shared by respondents will be treated as confidential. Only the researcher, as well as supervisors (Prof Makhado L), will have access to the data provided. Furthermore, if any changes are necessary during the course of the study, the researcher will inform the participant and obtain their permission before implementing any modifications.

Risks and discomforts to the participants- There might be some personal questions that require your truthful response during the interview. If you feel uneasy about sharing certain information, you have the option to refrain from answering or participating in the interview.

Benefits- Benefits of participating in this study include gaining valuable insights and knowledge about measles for the researcher, participants, and the community.

Remuneration- Respondents will not receive any monetary compensation for their involvement in the study.

Cost of the study- There will be no cost associated with participating or completing the questionnaire.

Confidentiality- the confidentiality of the answered questionnaire will be strictly maintained, with only the research team having access to the information provided. No personal identifying information will be attached to the respondent's data.

Research-related injury- any research-related injuries will not result in compensation for the participants, and the results of the study will not be attributed to any participant by name. Respondents will be informed of the researcher's findings before they are made public.

Persons to contact in case of any problem: My supervisors Prof L. Makhado on Lufuno.Makhado@univen.ac.za

Kindly contact the researcher on 0792606696 or University Research Ethics Committee Secretary on 0159629058/ Vanecia.Khoza@univen.ac.za.

For complaints, they can be reported to the University Research Ethics Committee Secretariat on 015 962 9058 / Vanecia.Khoza@univen.ac.za or Whistle blowing Ethics Hotline Tollfree Telephone number: 0800212755 Email.univenhotline@tipoffs.com

General- All respondents will be given the assurance that their involvement is completely optional. The total number of respondents will be shared openly. The researcher will provide each participant with a duplicate of an information letter. The letter and consent forms will be written in Tsonga, Tshivenda, and Pedi to ensure easy comprehension.

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Annexure 3: Consent form.

Statement of Agreement to Participate in the Research Study:

I hereby acknowledge that I have been duly informed by the researcher (Mathenjwa Happiness) about the nature, methodology, potential benefits, and associated risks involved in this study. This research has obtained ethics clearance under the designated Research Ethics Clearance Number:

I have thoroughly reviewed and comprehended the written information provided regarding this study. I am fully aware that the results of this study, including personally identifiable details such as gender, age, date of birth, and initials, will be processed anonymously for the purpose of generating a comprehensive study report.

Considering the requirements of research, I consent to the electronic processing of the data collected during this study in a computerized system under the supervision of the researcher. I understand that I reserve the right to withdraw my consent and discontinue my participation in the study at any time, without any negative consequences.

I affirm that I have had ample opportunity to seek clarification and have all my questions addressed. Consequently, I am prepared to participate in this study. I acknowledge that any significant new findings emerging throughout the course of this research, which directly relate to my participation, will be made available to me in a timely manner.

Full Name of Participant Date Time Signature

I, **Mathenjwa Happiness** herewith confirm that the above participant has been fully Informed about the nature, conduct and risks of the above study.

Full Name of Researcher: **Happiness Sizakele** Date Time Signature

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Annexure 4 Confirmation email of submission to MDPI disease journal



41% 09:05

[Diseases] Manuscript ID: diseases-3356395 - Submission Received Inbox

Editorial Office 7 days ago
to me, Lufuno

Dear Ms. Mathenjwa,

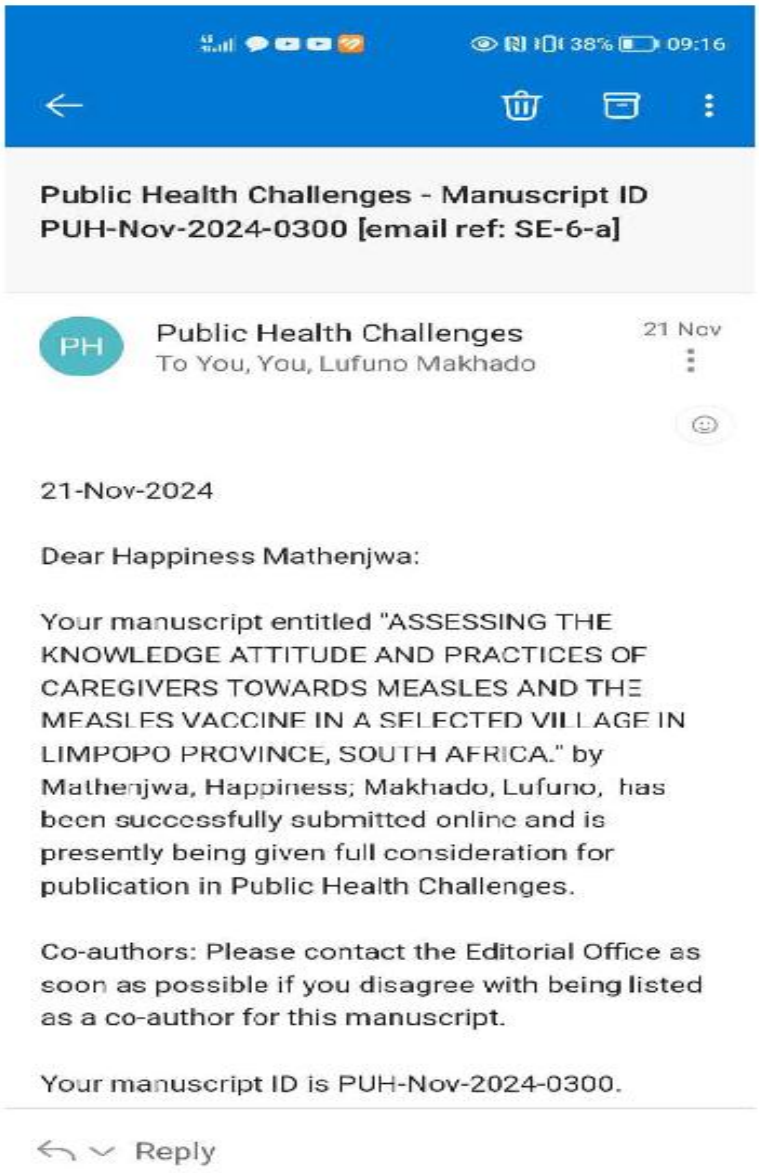
Thank you very much for uploading the following manuscript to the MDPI
submission system. One of our editors will be in touch with you soon.

Journal name: Diseases
Manuscript ID: diseases-3356395
Type of manuscript: Review
Title: KNOWLEDGE, ATTITUDES, AND PRACTICES OF CAREGIVERS TOWARDS MEASLES AND MEASLES VACCINE: A COMPREHENSIVE SCOPING REVIEW.
Authors: Happiness Mathenjwa *, Lufuno Makhado
Received: 21 Nov 2024
E-mails: smathenjwa789@gmail.com, lufuno.makhado@univen.ac.za
Infectious Disease
https://www.mdpi.com/journal/diseases/sections/infectious_disease

We encourage you to provide an Author Biography on this publication's
webpage. Please click the following link to find the corresponding
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Annexure 5: Confirmation email of submission to Public Health Challenges journal



38% 09:16

Public Health Challenges - Manuscript ID PUH-Nov-2024-0300 [email ref: SE-6-a]

PH Public Health Challenges
To You, You, Lufuno Makhado
21 Nov

21-Nov-2024

Dear Happiness Mathenjwa:

Your manuscript entitled "ASSESSING THE KNOWLEDGE ATTITUDE AND PRACTICES OF CAREGIVERS TOWARDS MEASLES AND THE MEASLES VACCINE IN A SELECTED VILLAGE IN LIMPOPO PROVINCE, SOUTH AFRICA." by Mathenjwa, Happiness; Makhado, Lufuno, has been successfully submitted online and is presently being given full consideration for publication in Public Health Challenges.

Co-authors: Please contact the Editorial Office as soon as possible if you disagree with being listed as a co-author for this manuscript.

Your manuscript ID is PUH-Nov-2024-0300.

Reply

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Annexure 6: Data collection tool- structured questionnaire

This survey is an integral part of a research project that seeks to evaluate caregivers' knowledge, attitudes, and practices towards measles and the measles vaccine. The main objective of this research is to develop a program focused on raising measles and vaccine awareness. We sincerely appreciate your decision to participate in this study. Please review the instructions provided below.

INSTRUCTIONS.

- Kindly ensure you have all the required sections and pages: Section 1, Section 2, Section 3 , Section 4, Section 5 and Section 6 and a total of 4 pages.
- It is important to answer all the questions honestly and carefully follow the given instructions for each question.
- To mark your answer, please place a cross (X) inside the designated boxes.
- Please do not omit any questions unless it is necessary.

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STUDY TITLE: KNOWLEDGE ATTITUDE AND PRACTICE OF CAREGIVERS TOWARDS MEASLES AND MEASLES VACCINE IN A SELECTED VILLAGE IN VHEMBE DISTRICT, LIMPOPO PROVINCE, SOUTH AFRICA

SECTION 1.

1. Demographic Information

1. Age:

1. 14 – 19 ☐

2. 20 – 39 ☐

3. 40 – 49 ☐

4 50 and above ☐

2. Gender:

1. Male ☐

2. Female ☐

3. Educational Background:

1. No formal education ☐
2. Primary education ☐
3. Secondary education ☐
4. Tertiary education ☐

5. Occupation:

1. Employed ☐
2. Unemployed ☐

5. Relationship to the child/children:

1. Mother ☐
2. Father ☐
3. Grandparent ☐
4. Other (please specify): ----------

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6. Ethnic group

1. Venda :
2. Tsonga :
3. Zulu
4. Sotho
5. Xhosa
6. Pedi

SECTION 2: EXPERIENCE OF MEASLES AND MEASLES VACCINE

Question 1: Have you or anyone in your care ever contracted measles? (Yes/No).

1	Yes
2	No

Question 2: Are there any barriers that prevent you from accessing the measles vaccine at your clinic for the children under your care? If so, please select from the options provided below.

1. Distance to the clinic	
2. Vaccine shortage	
3. Long waiting time	
4. Other , specify	

Question 3: What sources of information do you rely on when seeking information about measles and measles vaccines?

1. Health care providers	
2. Family members and friends	
3. Radio and television	
4. Social media platforms	

SECTION 3: KNOWLEDGE ABOUT MEASLES AND MEASLES VACCINE

Question 4 Please assess your knowledge of the cause of measles infection by indicating your level of agreement with the following statements. Circle one number to indicate your agreement or disagreement with each statement:

1. Strongly agree.
2. Agree
3. Don't know.
4. Disagree
5. Strongly disagree

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a. Vitamin A deficiency	1	2	3	4	5
b. 1It is caused by the virus Rubeola	1	2	3	4	5
c. The virus lives in the nose or throat of an infected person.	1	2	3	4	5
d. The virus spreads through the mucus or saliva of the infected person.	1	2	3	4	5
e. The infected droplets spread into the air through sneezing and coughing and may fall on surfaces;	1	2	3	4	5
f. The measles virus spreads swiftly through the coughs and sneezes of those who are ill	1	2	3	4	5
g. Measles can lead to serious complications such as brain damage.	1	2	3	4	5

Question 5. Please review the list of potential signs and symptoms of measles provided below and indicate whether each item is a sign or symptom of measles by checking the corresponding box:

a. High fever	
b. Dry cough	
c. Conjunctivitis (red watery eyes)	
d. Deafness	
e. Brain inflammation	
f. Death	
g. Blindness	
h. Small white spot inside the mouth	
i. Stiff neck and back	
j. Vomiting	

Question 6: Please select the age that aligns with the recommended age for administering the measles vaccine (1) and measles vaccine (2) to children in South Africa.

a. **At birth**	
b. **6 weeks.**	
c. **10 weeks.**	
d. **14 weeks**	
e. **6 months**	
f. **9 months**	
g. **12 months**	
h. **Don't know**	

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SECTION 3: ATTITUDES TOWARDS MEASLES AND VACCINATION.

Question 7: Please rate your attitude towards the statement below using a scale of 1 – 4. Indicate the level of agreement or disagreement for each of the following statements by selecting the appropriate number that reflect your attitude towards it.

1. strongly agree.
2 . agree
3. disagree
4. strongly disagree

a. The measles vaccine is safe for children	1	2	3	4
b. The measles vaccine harm child's health	1	2	3	4
c. The measles vaccine is an effective way to prevent the spread of the disease.	1	2	3	4
d. It is important for all eligible children to receive the measles vaccine	1	2	3	4
e. Measles disease is not a threat to a child's health	1	2	3	4
f. I trust the government to provide accurate information about measles and the measles vaccine	1	2	3	4
g. Measles vaccination campaigns are necessary to create awareness and increase vaccination rates.	1	2	3	4
h. measles is a highly contagious disease, and any interaction poses the risk of infection.	1	2	3	4
i. Measles is not a serious illness and does not require vaccination	1	2	3	4
j. Measles vaccine can cause severe side effects	1	2	3	4

SECTION 3: PRACTICE ON MEASLES INFECTION.

Question 8. What methods do you use to manage your child's symptoms of measles at home? Please respond to the statements below using a scale of 1 to 5.

1 . Always
2 . Often.
3 . sometimes.
4 . never.
5 . Rarely.

a. I ensure that the children under my care receive the recommended measles vaccine on time	1	2	3	4	5
b. I give plenty of fluids	1	2	3	4	5
c. I Practice good hygiene (e.g., handwashing)	1	2	3	4	5

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d. I am unaware of when my child is supposed to receive the measles vaccine.	1	2	3	4	5
e. I give my child nutritious food	1	2	3	4	5
f. I have discussed measles infection and measles vaccine with a health care provider.	1	2	3	4	5
g. I have discussed the importance of measles vaccination with other caregivers.	1	2	3	4	5
h. I actively seek information about measles and the measles vaccine from the internet	1	2	3	4	5
i. I keep my child isolated from other children if I suspect they have measles	1	2	3	4	5
j. I give fever-reducing medication	1	2	3	4	5
k. I ensure my child gets enough rest	1	2	3	4	5

Do you have any suggestions for improving vaccination practices in your community?

- Yes (please specify): _____
- No

Thank you for participating in this survey. Your responses will contribute valuable insights for our research study.

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ANNEXURE 8: TURNITIN REPORT

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ANNEXURE 9: LANGUAGE EDITING CERTIFICATION

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