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Factors Influencing Vaccines Uptake among Children With and Without Developmental Disabilities

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Abstract
Vaccination is a vital preventive method that has proven its worth worldwide in significantly reducing childhood morbidity and mortality. Since 1924 vaccines have been used to prevent over 100 million cases caused by eight vaccine preventable diseases. Therefore, vaccines are a major force for child survival. The Expanded Programme on Immunisation (EPI) implemented in many countries Cameroon inclusive has led to the reduction of the morbidity and mortality for children below five years.

However, vaccination uptake and coverage rates are still low in Africa. Lower vaccination rates have been reported for children with disabilities as well as among normally developing children. Many parents have rejected vaccination due to worries about vaccines safety, myths and misconceptions as well as political, cultural and religious reasons among others. Autism was once believed to have an association with childhood vaccination. Health care professionals especially nurses have a major role to play in educating parents to ensure that all children are vaccinated according to schedule including those with disabilities. Studies have demonstrated a positive impact of health education on parents' knowledge, practices and attitudes regarding vaccination attendance. Thus, constantly educating parents especially during child well visits and massive sensitisation campaigns within communities could augment the attendance rates for childhood vaccination. This could go a long way to reduce exposure to vaccine preventable diseases and hence, reduce morbidity and mortality rates.

Keywords: Childhood Vaccination Uptake, Parents' Knowledge, Practices, Attitudes, Health Education, Nurses

1. Introduction

Globally, vaccines prevent approximately 2.5 million deaths each year [1]; vaccination is a vital preventive method that has proven its worth worldwide in significantly reducing childhood morbidity and mortality. Even though immunisation has proven to be the most successful public health initiative in reducing the spread of vaccine-preventable diseases (WHO. 2016), vaccination attendance and coverage rates are still low in Africa [2]. Lower vaccination rates for pertussis, measles and rubella have been reported for children with intellectual or physical disabilities [3]. According to Emerson *et al* [4] in the UK children with intellectual disabilities (ID) are more expose to vaccine preventable diseases. It was documented that vaccines' coverage rates for all vaccines were lower for children with intellectual disability when compared to children without intellectual disability [5].

In addition, literature reveals that COVID-19 presents greater risks for individuals with developmental disabilities [6]. Developmental Disabilities (DDs) are disorders which begin in childhood that negatively impact the physical, social communication and/or emotional development of the child. These include disorders such as autism, cerebral palsy, Down syndrome, hearing loss, and Attention Deficit Hyperactivity Disorder (ADHD) among others. Individuals with DDs are disproportionately affected by COVID-19 due to underlying conditions that increase risk of severe illness, difficulty respecting barrier measures such as wearing of face mask, frequent hand washing and physical distancing [7]. Unfortunately, this special group of persons have limited access to vaccination services. Barriers to vaccination uptake may not only endanger the health of this special population, but the health of younger siblings as well as compromise herd immunity.

It is estimated that vaccine-preventable diseases are still responsible for 1.5 million deaths each year among children under age 5 years [8]. Hence, attaining high coverage rates of vaccines is vital to establish 'herd immunity' and prevent disease outbreaks [4]. According to World Health Organisation (WHO) vaccines are essential as they help to save and transform lives; giving children a chance to grow up healthy, attend school and achieve their maximum potential [1, 2]. It is worth noting that when vaccines are combined with other health interventions such as the provision of vitamin A supplementation, de-worming

medication and treated mosquito bed nets, immunisation becomes a major force for child survival [9].

The gradual to wide-scale use of vaccination and immunisation programmes in Europe and later in the rest of the world, made a remarkable contribution to the wellbeing of humans [10]. For instance, in the United States vaccines are said to have prevented 103 million cases of selected infectious diseases including diphtheria and measles. Globally, it is estimated that 80 to 90 percent of children receive the basic package of vaccines from the WHO's Expanded Programme on Immunisation (EPI) [11]. Vaccination programmes in Sub-Saharan Africa face some challenges [12]; these include among others parents' lack of awareness, inadequate knowledge, under utilisation of vaccines, and myth and misconceptions about vaccine safety.

Parents are less likely to attend or complete vaccination schedules if they are poorly informed about immunisation, logistics (time, date, and place of vaccination), and the appropriate series of vaccines to be followed [12]. Most children do not complete their immunisation schedule due to certain factors related to parents, the child's state of health and health system barriers among others [13, 14, 15]. A study conducted by Hassan *et al* [16] revealed poor knowledge and perception of mothers towards supplementary vaccination schedules. However, other studies have demonstrated high level of awareness and perceptions of mothers towards childhood immunisation [17, 18]. Although knowledge maybe insufficient to create demand, inadequate knowledge about the importance of vaccination is a good predictor of non-compliance.

It is particularly essential for children with special needs to be current on their shots as well, as they are more likely to become very sick if they get the infection and may not have the reserve energy to fight the infection compared to their normally developing peers. It has been reiterated that for decades now populations have rejected vaccination due to concerns about vaccine safety, myth and misconceptions as well as political, cultural and religious reasons [19, 20]. At times, vaccines cause concern for parents particularly for children with special needs; parents may see an association between vaccines and the disability, particularly autism. According to WHO and UNICEF out of 116.5 million children below five years in Africa, 12.9 million have not received any vaccine. Also, 6.6 million children have received only one dose out of three required for protection against infectious diseases, thereby exposing them to high risks of morbidity and mortality [1]. This paper presents the importance of childhood vaccination, explain barriers to childhood vaccination uptake and the impact of health education on parental knowledge, attitudes and practices regarding childhood vaccination attendance. It is worth mentioning that in this paper vaccination and immunisation are used interchangeably.

2. Importance of Childhood Vaccination

Globally, vaccination is said to have a huge impact on improving child health. An estimated 80–90 percent of children in the world receive the basic package of vaccines from the World Health Organisation's (WHO) Expanded Program on Immunisation (EPI) [21]. Vaccination and immunisation programmes have been used worldwide to prevent approximately 2.5 million deaths annually [1]. Since 1924 vaccines have been used to prevent over 100 million cases caused by eight vaccine preventable diseases [22]. For instance, since 1924 in the United States, vaccines have been used to prevent 103 million cases of selected infectious diseases, including forty million cases of diphtheria, and thirty-five million cases of measles since 1963. Therefore, vaccines are a major force for child survival [9] transforming lives giving children a chance to grow up healthy, go to school and improve their life prospects [1]. The Expanded Programme on Immunisation (EPI) implemented in Cameroon in 1981 led to the reduction of the morbidity and mortality for children below five years [19].

When a child is given vaccines as expected (i.e. in their required doses, routes and planned schedules), the body's immune response is activated, leading to either the production of antibodies to the said infection or it brings about other processes that develops immunity [23]. This prepares the child's immune system to fight the infection, whenever he/she is exposed to the organism causing the disease or infection. Generally, the child develops an immunity which helps to prevent him/her from having the infection, or helps to reduce disease severity if the child ever gets the infection. It is important to note that preventing childhood infectious diseases is much easier and more cost-effective than to treat them, and this can only be done by vaccinating each child according to schedule.

Through vaccination children have been protected from deadly infectious diseases such as measles, tetanus and diphtheria among others. Proper vaccination and immunisation can also prevent the spread of these diseases from one child to another. This is because children who are vaccinated and fully immunised cannot harbor and transmit infectious diseases to other children, thus protecting their peers by reducing their exposure to infectious diseases. This goes a long way to reduce the burden of childhood diseases. Also, vaccination has almost eradicated diseases such as polio and smallpox [23]. The use of vaccines in the UK has eradicated and made rare diseases like smallpox, polio and tetanus that used to kill or disable many children, while other infections such as measles and whooping cough have been reduced by up to 99.9%.

According to Centers for Disease Control and Prevention (CDC), vaccines are very effective in preventing childhood infections at 90%-100% [23]. It is worth mentioning that even when vaccination has not given a child 100% immunity, if he/she is exposed to an infectious disease the symptoms will usually be milder compared to if the child had not been vaccinated or immunised at all. Hence, vaccination is able to protect every child against ill health as well as reducing the severity of infections. Every year vaccination prevents up to three million deaths globally [24] thus, the effectiveness of vaccines cannot be over emphasised. Therefore, it is important to continuously evaluate and seek ways of reducing barriers to vaccination uptake. This will go a long way to enhance childhood vaccination attendance, prevent the spread of infectious diseases and keep our children (including children with disabilities) healthy and safe.

3. Barriers to Childhood Vaccination Uptake

For decades now many parents have rejected vaccination due to worries about the safety of vaccines, myths and misconceptions as well as political, cultural and religious reasons [19, 20]. In addition, the lack of accurate information, inaccessible vaccination services, parents' educational level, age, income, marital status, and the child's state of health

among others may influence vaccination uptake [20]. The most frequently and consistently reported barrier to childhood vaccination is parents not being knowledgeable on immunisation. Parents' perceptions also influence their decision regarding childhood vaccination attendance [25]. Inadequate parental knowledge on and/or lack of access to adequate information about childhood immunisation could be a significant contributor to the high burden of unimmunised children in Sub-Saharan Africa [26].

Studies have demonstrated that parents with a lower educational level or lower monthly income have lower overall knowledge about immunisation compared to those who had better education and higher monthly income [25, 26, 27, 28]. In a recent study conducted by Sinuraya *et al* [29] aimed at investigating parents' knowledge, attitude and practice on childhood immunisation during the COVID-19 pandemic it was found that participants with a tertiary level of schooling were more knowledgeable than those with senior high school education. The study also revealed that employed participants had better scores in knowledge and practice, compared to unemployed participants.

It is worth noting that parents with little or no knowledge on vaccination may not complete the required vaccine series for their children. It has been stated that delay on vaccine birth doses is associated with lack of maternal education [25]. In addition, misconceptions about childhood immunisation were recorded as the main hindrance to effective utilisation of immunisation services [30]. Some parents believe that the immunity induced by vaccines is less effective than that of the natural disease, hence, they prefer to endure the symptoms of diseases than the side effects of vaccination. Others believe in the efficacy of traditional medicines as an alternative to immunisation and concomitant treatment by traditional healers.

Barriers related to Healthcare Systems are irregular supplies and distribution of vaccines; limited human resource and infrastructures, non-disability friendly environment and long distances between the health facilities and parents' homes [31]. Persons with disabilities are said to be less likely to receive a COVID-19 vaccine compared to their non-disabled peers. This is partly due to inaccessible healthcare systems [7], meanwhile infection with SARS CoV-2 (COVID-19) poses a serious risk for individuals with Intellectual and/or Developmental Disabilities (DDs). In the UK children with intellectual disabilities are at increased risk of vaccine preventable diseases. This may jeopardise their own health as well as the health of younger siblings and may also compromise herd immunity. For example, literature reveals that individuals with co-morbid autism and ID were 9.3 times more likely to be hospitalized than people with COVID-19 without those disabilities. Also, those who had learning disabilities and autism (alone) were 3.8 and 3.6 times, respectively, more likely to be hospitalised than people without those disorders [7]. It is worth mentioning that due to their disabilities, this special group of individuals has difficulties practicing COVID-19 preventive behaviours such as frequent hand washing, putting on face masks and practicing physical distancing. So the most effective way for them to prevent the spread of COVID-19 and other vaccine preventable diseases is to get the corresponding vaccines. Unfortunately, most vaccination services especially in less developed countries are not disability friendly.

It is important to note that vaccine uptake in children is essential in protecting them as well as the community at large. Studies have reported that children with ID and Autism were less likely to complete their recommended doses of vaccination [4, 32]. Concerns about vaccine safety have prevented many children from receiving vaccines and/or completing their required doses. Parents of children with autism have expressed more vaccine concerns [7] as there are misconceptions that autism is linked to childhood vaccination. It has been reported that very few children with autism and other Developmental Disabilities are current with their recommended vaccinations [4, 33] largely due to myths and misconceptions.

A study conducted by Emerson *et al* [4] reported that complete vaccines' coverage rates were significantly lower for children with intellectual disabilities at ages nine months and three years when compared to normally developing children. While incomplete vaccination remained significantly elevated for children with intellectual disabilities at ages nine months and three years. Parents of children with intellectual disability gave reasons for not vaccinating such as service failures, child illness at the time of appointment, missed appointments and parents not being aware of vaccination. Other parents were reluctant due to the controversy of the association between the combined MMR vaccine and autism [34].

To talk about the COVID-19 vaccines for children, pre-existing concern regarding approved vaccines also influence parents' decisions. A study conducted in 2021 revealed that only 40% of parents in the US were willing to vaccinate their children against COVID-19 for fear of side effects and lasting health problems [35]. However, Bonuck *et al* [7] stipulates that parents of children with autism may have less hesitance towards COVID-19 compared to routine childhood vaccines.

Vaccine shortages at health facility level, poor working condition of vaccine refrigerators, and difficulties of transporting vaccines, staff limitation and lack of health facilities in remote areas were commonly reported to significantly hinder immunisation services [4, 35, 36]. Tefera *et al.* [37] found that children whose parents lived at least an hour distance from the vaccination center were less likely to complete vaccination series compared to parents who lived between 30 and 59 minutes' walk away from the center.

Also, lack of trust towards vaccines has been reported as a major barrier to vaccination uptake. Most parents refuse to vaccinate their children due to the belief that vaccines are expired or harmful to their children, and could cause physical disability as well as death [38]. Furthermore, husbands have been mostly reported of being against vaccinating their children; they sometimes stopped their wives from taking their children for vaccination. At other times parents stated that they forgot the next vaccination date, did not know the place and/ or time of vaccination [39]. Again, the nature of occupation of the mother, being a single mother and financial limitation have been reported as major barriers to childhood immunisation [39].

In addition to the parental and health system barriers, factors related to health care providers such as lack of knowledge of vaccine indications and contraindications, and the lack of counseling skills [34] have also been identified as barriers to vaccination attendance. Furthermore, healthcare personnel's unfriendliness and rude attitudes to parents have also been reported [36]. Educational interventions have been used in most developed countries to enhance parental attitudes and levels of awareness on vaccination. Therefore, there is a

need for nurses to always ensure that parents are constantly given the right information regarding childhood vaccination. This could go a long way to improve childhood vaccination attendance and hence, improve on the health of children. The following section discusses the effects of an educational intervention on parental knowledge and attitudes on childhood vaccination uptake.

4. Effects of Health Education on Vaccination Uptake among Parents of Children Under Five Years

Findings from studies have shown a link between health education, parents' knowledge, practices, attitudes and vaccination uptake. Parents have a major role to play in enhancing vaccination rates for children under five years. Parents' knowledge, attitudes and practices regarding immunisation influence their decisions towards vaccination attendance [38]. As said earlier, there are many barriers to vaccination uptake; these include lack of awareness and knowledge, misinformation about vaccines, adverse effects of vaccines, and myths to name a few. Many studies have revealed that parents' lack of knowledge about vaccination results in low vaccination coverage [39, 40]. Children whose parents have knowledge about immunisation and its importance have higher vaccination rates compared to children whose parents lack knowledge [41]. Hence, leading to negative attitudes and practices regarding vaccination among parents [39]. Parents may likely not attend or comply with vaccination schedules if they are not adequately informed about the importance of immunisation [12].

Therefore, to improve vaccination attendance parents' awareness and knowledge on childhood vaccination is paramount. Thus, health care providers especially nurses are expected to provide parents with adequate information about the benefits of vaccines.

Some studies have demonstrated the impact of educational interventions on parents' knowledge, attitudes and practices on childhood vaccination. For instance, studies conducted by Awadh *et al* [25] and Ngala *et al* [42] reported an improvement in parents' knowledge and attitudes after an educational intervention. The study by Ngala *et al* [42] was a community based cross-sectional interventional study aimed at investigating parents' knowledge and attitudes on vaccination attendance at the Mouanko Health Area in Cameroon. The participants were parents of children 0-12 months who were randomly assigned to the intervention and control groups. Health education on vaccination was administered to the intervention group after a pretest.

The pretest data collected on knowledge revealed that only 34.1% of the participants were knowledgeable with a mean knowledge score of 6.33. This suggests that parents' knowledge on vaccination prior to the intervention was insufficient and could negatively influence the compliance to vaccination services. This finding supports Waisbord and Larson [12], who hold that insufficient knowledge underlie low compliance with vaccination schedules if parents are poorly informed about the need for immunisation, logistics (time, date, and venue), and the appropriate series of vaccines to be followed. Other studies reported that because parents may also lack information about how vaccines work and about the infectious diseases that vaccines prevent, they become very hesitant [2, 41]. These findings are in accordance with that of Ngala *et al* [42] indicating that knowledge greatly influences parental decisions and intentions to vaccinate their children. Literature reveals that parents' especially mothers' knowledge has a great impact on their children's immunisation rate and maintaining up-to-date immunisation status [40, 43].

Regarding parental attitudes on vaccination Ngala *et al* [42] reported that only two-third (33.7%) of the parents felt positive when their children were being vaccinated. There was a mix thinking or belief about vaccination among the parents and only one-third of them understood the information on vaccination. Three-quarters (77.8%) of the parents said their tradition and/or religion accepted vaccination. After the intervention mean knowledge and attitudes' scores increased significantly in the intervention group when compared to the control group. In the intervention group, the mean knowledge score increased from 6.30 at baseline to 8.43 at the end of the study (Mean difference = 2.13, $P<0.001$).

Also, in the intervention group attitudes' score was found to increase from an average of 3.40 at baseline to 4.93 at the end of the study (Mean difference=1.53, $P = 0.012$). The proportion of participants who were knowledgeable and had positive attitudes on vaccination increased significantly in the intervention group after the health education [42]. At the end of the intervention period, the proportion of participants with sufficient knowledge on vaccination activities increased from 35.0% to 57.6% while the proportion of parents with positive attitudes increased from 31.0% to 41.9% in the intervention group [42].

These findings indicate that health education produced a positive change in the parents' knowledge and attitudes on vaccination attendance. This is in conformity with to the findings of the study conducted by Choi *et al* [44] who found that the number of parents who agreed to vaccinate their children after receiving an educational intervention increased from 83.57% before the intervention to 90.77% after the intervention. According to Ngala *et al* [42] before the intervention, the participants showed a lot of interest towards vaccination but lacked the right information, which could be a precursor to their poor attendance and negative attitudes towards vaccination. As such, the improved knowledge after the health education could be seen as the main reason for the positive change in the parents' attitudes towards vaccination [42].

Again, before the health education, the proportion of positive to negative attitudes was 31.4% to 68.6% respectively, and with mean attitudes' score of 3.35. This indicates that not having knowledge on vaccination directly has an influence on parental attitudes. Similarly, Ames *et al.* [45], and Omer *et al.* [2] reported that poor or inadequate knowledge on vaccines can negatively affects vaccination uptake and undermines vaccine acceptance. Many parents believe that mild illnesses are contraindication for vaccination, thus mild illnesses are considered as a reason for not giving children up-to-date vaccines. That is, insufficient knowledge will in turn produce negative attitudes towards vaccination. Their results showed no significant difference in parental knowledge and attitudes on vaccination [42]. The authors later evaluated the changes before and post-intervention of the parents' knowledge and attitudes with regards to vaccination for both the intervention and control groups. They found that there was no significant difference between the knowledge and attitudes of parents in the control and intervention groups (p-value 0.56) and with p-value 0.85 for the intervention and control groups respectively.

Further analysis revealed a change in the mean score for knowledge and attitudes of parents after the health education indicating a significant increase in the intervention group from 6.30 to 8.43 (Mean difference = 2.13, P<0.001).The attitudes' score was found to increase from an average of 3.40 to 4.93 (Mean difference = 1.53, P<0.012) at the end of the study [42]. Therefore, this implies that the health education produced a positive effect on both the parents' knowledge and attitudes on vaccination, even though up to three-quarters of the participants had attended just primary school. This finding is in line with the study conducted among Malaysian parents which showed a significant increase in the parents' knowledge after health education was administered [46].

The study further confirmed the effectiveness of specific educational interventions when used on parents with low educational backgrounds as has been demonstrated by Ngala *et al* [42]. Another study conducted in South Korea also revealed that specific educational interventions involving caregivers is effective in increasing their decision towards vaccination positively and hence, the vaccination coverage of children due to increased level of awareness [47]. This finding ties with the finding of Ngala *et al* [42] which showed that three-quarters of the parents' were unable to correctly state the purpose of vaccination before the health education intervention.

Ngala *et al* [42] holds that generally, insufficient knowledge could be the primary cause of low vaccination uptake which is reflected at the Mouanko Health Area. This is because some parents see their children to be healthy hence, do not take them for the routine vaccines. Moreover, their study demonstrated a slight increase from 35.0% at baseline to 57.6% for knowledge and from 31.0% to 41.9% for attitudes in the intervention group after the intervention as shown in Fig 1.

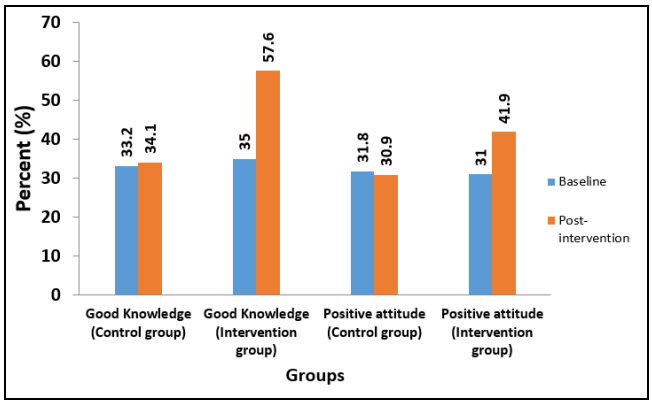

Fig 1: Change in the Proportion of Parents with Sufficient Knowledge and Positive Attitudes after Health Education in the Intervention and Control Groups

This clearly shows that parental knowledge influence attitudes, which can as well influence vaccination uptake.

Similarly, Awadh *et al* [25] conducted a study to assess the impact of a short educational intervention regarding parents' knowledge on childhood immunisation. The study was conducted in Kuantan, the state capital of Pahang, Malaysia among parents who were attending the Health Clinic Indera Mahkota, which provides maternal and child health services to Malaysian citizens. The authors employed a one group pre-test – post-test design, baseline data was collected on knowledge about immunisation and a post evaluation data was collected after the educational intervention was administered.

Just like the study by Ngala *et al* [42] this study demonstrated that providing an educational seminar to parents is an effective and practical approach to increase parents' knowledge on childhood immunisation. Their findings showed a significant improvement in Malaysian parents' knowledge about immunisation compared to baseline results [49]. Thus indicating that administering a short educational intervention is generally an effective way to improve parents' knowledge on childhood immunisation.

These findings are very important to health care providers especially nurses as they are the main source of information for parents. Understanding parents' level of knowledge regarding vaccination and reasons while some of them do not comply with vaccination schedules is important in putting in place measures to curb the rate of vaccine hesitancy. It is worth mentioning that educational interventions designed for parents can greatly improve vaccine uptake. According to Owais *et al* [47] when parents with low level of schooling were taught using pictorial messages and very simple language the completion rates of DPT-3/Hepatitis B vaccine improved by 39%.

Similarly, a study conducted in Germany reported that using balanced health information leaflets can increase girls' and parents' knowledge of the human papillomavirus vaccination and vaccination uptake Wegwarth *et al* [48]. The study by Qutaiba *et al*, [49] reported that the levels of Knowledge and practice among parents were positively associated with their children's immunisation rate. In other words it has been shown that knowledge on vaccination correlates with immunisation rates. A 20-minute educational presentation regarding human papillomavirus vaccination improved college females' intent to vaccinate by nearly threefold Gross *et al*, [50]. A study by Barrera *et al*, [51] revealed that parents in Guatemala repeatedly stated that workshops at the community level are the best way to increase their awareness and knowledge regarding vaccinations. Therefore, if parents lack knowledge regarding vaccination they are likely not to complete the immunisation schedule.

5. Conclusion

Globally, vaccines have been effective in preventing childhood diseases and reducing mortality rates through the Expanded Programme of Immunisation. Parental knowledge and attitudes regarding vaccination influence childhood vaccination uptake as well as other factors such as income, concerns about vaccines' safety, health care related barriers, myths and misconceptions among others. In the past, parents have associated vaccines with autism and low vaccines coverage rates have been reported among normally developing children as well as those with developmental disabilities. Sufficient knowledge on vaccines is very vital for vaccine acceptance and effective utilisation of vaccination services by parents of children with and without disabilities.

Low vaccination coverage rates in children is largely a result of the lack of adequate knowledge on vaccines by parents. Parents with low education and low socioeconomic status have demonstrated poor attitudes and practices towards childhood vaccination attendance. Educational interventions have been used to improve parental knowledge and attitudes towards childhood vaccination uptake.

The study conducted by Ngala and others showed that health education improved parental knowledge and attitudes towards vaccination attendance. In addition, their study demonstrated that there is a significant association between the socio- demographic characteristics of parents (such as being older, married, educated) and their knowledge and attitudes on vaccination. Overall, health education has a positive impact on parents' knowledge and attitudes towards vaccination. This indicates the necessity of health education prior to or during routine vaccination sessions

This information can enable policy makers to develop short, community-based, educational programmes at the clinics that provide vaccinations, especially for parents who have lower income and educational levels as well as those having children with disabilities. This is because the constant use of health talks especially by nurses and massive sensitisation campaigns within communities could improve parents' knowledge and attitudes regarding vaccination. This in turn will augment the attendance rates for childhood vaccination. This could go a long way to reduce exposure to vaccine preventable diseases and hence, reduce child morbidity and mortality rates.

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