Combined screening of early childhood development, hearing and vision by community health workers using mHealth tools in a low-income community

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Abstract: Children in low-income communities are at increased risk for developmental delays and sensory losses. Difficulties should be identified as early as possible to reduce the impact on development and later academic achievement. mHealth or mobile health involves applications on a smartphone or technological device that have the validated screening tests on them and can be done technologically. mHealth screening tools can enable task-shifting, allowing community health workers to detect developmental delays and sensory losses. Combined screening approaches should be trialled to evaluate feasibility. This study aims to describe a combined (developmental and sensory – hearing and vision) mHealth-supported screening programme conducted by community healthcare workers at early childhood development centres in a low-income community. mHealth screening tools for development, pure tone audiometry and visual acuity were used. One community health worker conducted the combined screening programme with children aged four to six years (n=63). Early childhood development practitioners (n=5) assisted with the developmental screening. The referral rates were 30% (n=19) for development, 6% (n=4) for hearing and 5% (n=3) for vision. The total average screening time for the combined screenings was 11.72 minutes (SD 3.45 minutes). Post screening, the community health worker and early childhood development practitioners completed a questionnaire probing their perspectives and experiences of the combined screening programme, which were mostly positive. A combined mHealth-supported screening programme conducted by community health workers and early childhood development practitioners appears viable and can support the early detection of developmental delays and sensory losses in young children from low-income communities.

Keywords: Developmental screening; sensory screening; community health workers; ECD practitioners; combined mHealth-supported screening; low-income community

Introduction

Over 200 million children from low- and middle-income countries (LMICs), including South Africa, are at increased risk for developmental delays and sensory losses due to the cumulative effect of continuous exposure to risk factors, such as premature birth and poverty (Jensen et al., 2017; Scherzer et al., 2012; van der Linde et al., 2015). The co-occurrence of combined developmental delays and sensory losses is therefore becoming more common (Olusanya et al., 2018). Hearing and vision loss are present among children under five years

of age, respectively affecting 15.5 and 25.2 million children globally (Olusanya et al., 2018). Developmental delays in LMICs are even more prevalent among children under five years of age, affecting an estimated 250 million children globally (Olusanya et al., 2018). Adequate vision and hearing are vital for learning and brain plasticity as typical development occurs through natural interaction with the environment, which in turn impacts development, and ultimately, academic success. Visual and hearing loss can therefore exacerbate the risks for developmental delays in young children (Mosca et al., 2015; White et al., 2017; Yousuf Hussein et al., 2018). Developmental delays and sensory losses need to be identified as early as possible using innovative approaches so that children can access intervention to ameliorate the impact of developmental and sensory barriers (Olusanya et al., 2018; Scherzer et al., 2012).

Many children with developmental delays and sensory losses, especially those from low-resourced settings, are only identified when they enter formal schooling (May et al., 2020; Slemming & Bamford, 2018). Late identification occurs due to various factors, including a lack of accessible screening programmes in LMICs, limited caregiver knowledge about early childhood development (ECD), as well as the difficulty in identifying developmental delays and sensory losses in comparison to physical impairments (Brown et al., 2020; Eksteen et al., 2019; Mulwafu et al., 2016; Wapling, 2016). Health and developmental promotion and prevention services in the ECD years are important because these services allow for timely identification, early diagnosis, improved monitoring and intervention, and therefore, optimised learning by school-going age (Eksteen et al., 2019; Shahidullah et al., 2020).

The most effective and timely way to identify and monitor developmental delays and sensory losses in children from LMICs is by conducting regular developmental and sensory screening (World Health Organization, 2018). There are, however, limited guidelines for

developmental and sensory screening in LMICs for children between the ECD ages of four to seven years and those that do exist are not implemented routinely on a national level (Berry et al., 2013; Manus et al., 2021; May et al., 2020; Slemming & Bamford, 2018; van der Linde et al., 2015). Access to services, especially in low-income communities, for children in the ECD stages of four to six years old, which are critical, is therefore poor (May et al., 2020; Working Paper Series, 2015). Although the World Health Organization (WHO) recommends the implementation of increased ECD health services, such as screening, the healthcare systems in LMICs typically do not have the capacity to provide these services, due to equipment costs and a shortage of healthcare professionals and facilities (Eksteen et al., 2019; Manus et al., 2021; World Health Organization, 2021). Innovative solutions to increase accessibility to early screening programmes are consequently needed.

In LMICs like South Africa, ECD centres may provide a setting for increased access to screening services. These facilities provide resources for support, care and early childhood programmes that focus on early development and education of preschool-aged children (Ebrahim et al., 2011; Smit et al., 2020). As a result, ECD centres or preschool settings, are becoming important contexts to offer regular sensory and developmental screening for children (Abdoola et al., 2019; Smit et al., 2020). Practitioners who work at the ECD centres are educators of young children. They provide services aimed at early stimulation and can be seen as resources for screening programmes (Ebrahim et al., 2011; Murray, 2012). The number of children attending ECD centres is increasing, and they are spending more time with ECD practitioners, therefore in addition to children's families, ECD practitioners can be considered one of the children's primary caregivers (Abdoola et al., 2019; Smit et al., 2020). ECD practitioners can report on young children's developmental and sensory abilities during screenings because they observe and interact with the children daily in the ECD class context (Abdoola et al., 2019; Smit et al., 2020).

ECD practitioners, as well as community healthcare workers (CHWs), are key role-players who are instrumental in supporting ECD, creating enabling environments for underserved children and promoting health and well-being in their communities (World Health Organization, 2018). In many South African communities, CHWs already visit ECD centres to provide health services and increase health awareness and therefore may be able to offer support to ECD practitioners (Eksteen et al., 2019). CHWs have limited experience with developmental and sensory losses, nevertheless, with minimal training to conduct screening, they can help identify children with difficulties (Eksteen et al., 2019; Manus et al., 2021; Yousuf Hussein et al., 2018). CHWs and ECD practitioners could alleviate some of the burden placed on the healthcare system by conducting screening for developmental delays and sensory losses (Brown et al., 2020).

Recent evidence demonstrates that mHealth-supported screening supports task-shifting by enabling CHWs to offer sensory and developmental screening using validated applications that are automated and easy to operate (Dawood et al., 2020; Manus et al., 2021; van der Merwe et al., 2019). mHealth or mobile health involves applications on a smartphone or technological device that have the validated screening tests on them and can be done technologically (du Toit et al., 2021b; Manus et al., 2021; Swanepoel et al., 2014; Hussein et al., 2018). Task-shifting, which is recommended by the WHO in resource-constrained settings, is thus a way to make services more accessible and contextual in LMICs (Suen et al., 2019; WHO, 2021). mHealth-supported hearing, visual acuity, and developmental screening tools have been identified as low-cost alternatives to paper-based procedures (du Toit et al., 2021b; Eksteen et al., 2019; Manus et al., 2021; van der Merwe et al., 2019). These tools have been used successfully in LMICs in recent years (Eksteen et al., 2019; van der Merwe et al., 2019).

Sensory screening programmes conducted successfully by CHWs in low-income settings for children between the ages of four and nine years have been established (Eksteen et al., 2019; Manus et al., 2021). Developmental screening measures conducted by CHWs have also shown potential for implementation within LMICs for children aged one to six years of age (du Toit et al., 2021b; van der Merwe et al., 2019). mHealth-supported tools are effective in supporting community-based developmental and sensory screening in a time-efficient, low-cost, and accessible manner (du Toit et al., 2021b; Eksteen et al., 2019).

In LMICs, including South Africa, there has been no research using mHealth-supported tools evaluating combined developmental and sensory screening programmes for ECD-aged children between four and six years old. The rationale for combining developmental and sensory screening is that the CHW can use the same smartphone device to offer a broader range of screenings of critical aspects related to ECD. The implementation of a combined mHealth-supported developmental and sensory screening programme should be explored (Department of Basic Education, 2014; Eksteen et al., 2019; van der Merwe et al., 2019). The aim of this study was therefore to describe the referral rate, duration, and perception of a combined mHealth-supported developmental and sensory screening programme conducted by CHWs in a low-income community.

Materials and methods

Aim and Study design

This descriptive cross-sectional study has been granted IRB approval (GW20170922HS) by the Faculty of Humanities, The University of Pretoria, Gauteng, South Africa. The objectives were to describe: (1) the referral rate of the combined mHealth-supported screening programme, (2) the duration of the combined mHealth-supported screening programme and (3) the perceived value of the combined mHealth-supported screening programme from key

stakeholders, namely the CHW and ECD practitioners.

Setting and participants

Data was collected over eight separate days in 2021 at three ECD centres, in Paarl, Western Cape, South Africa, as part of a larger ongoing screening project. This screening project is looking at all aspects of accessible mHealth screening in low-income communities through multiple studies. The area has a population of approximately 30 875 residents, with isiXhosa being the predominant language, as documented by the most recent census carried out by Statistics South Africa (Statistics SA, 2011). The majority of the households within the area are classified as low- and middle-income, with 29% of the population earning £107 or less per month and 65% earning £540 or less per month (Statistics SA, 2011).

The caregivers of children who attended one of three ECD centres, the ECD practitioners and the CHW participated and gave consent for the necessary information to be published. Participation was not subject to home language, culture, or any other biological factors. The combined mHealth-supported screening programme was conducted by a CHW for the children, with their ECD practitioners assisting in completing the developmental screening. The mHealth developmental and sensory screening tools used were in English, but were translated into isiXhosa by the CHW. The children (n=63) were between the ages of four years, one month and six years, eleven months, with the average age of the children being 61.78 months (SD 6.131). 56% of the children were male. None of the children had received developmental or sensory screenings before this.

The CHW is a qualified ECD practitioner. She supports all three ECD centres and has previous training and experience with both mHealth-supported hearing and vision screening tools. She had also recently received training to use the mHealth-supported development screening tool. The ECD practitioners (n=5) were employed by the participating ECD centres

and worked with the children in the selected age range. They had not previously been involved in any screening programmes. The ECD practitioners have an average of five years (SD 3.633) experience, and their ages averaged 40 years old (SD 7.497).

Materials and apparatus

The following mHealth screening tools were implemented by the CHW on the same smartphone with the assistance from ECD practitioners for the developmental screening:

(1) The mHealth developmental screening consisted of the Parents' Evaluation of Developmental Status (PEDS) and PEDS Developmental Milestones (PEDS: DM) tools (du Toit et al., 2021b; Glascoe, 2015; Maleka et al., 2016; van der Merwe et al., 2019). The tools are based on child development and developmental milestones that should be present at certain ages as well as caregiver-report on the development observed. The domains screened included expressive language, receptive language, fine motor, gross motor, self-help, social-emotional skills, maths and reading skills. The maths and reading questions are relevant for all the children because the questions are scaffolded according to age. For the four year old children, these are screened by looking at emergent math and literacy skills such as number and letter identification. The PEDS tools consist of 16-18 multiple-choice questions based on the age of the child. The tools have validated referral algorithms and have been used successfully in South Africa (Abdoola et al., 2021; du Toit et al., 2021; van der Merwe et al., 2019). Items in the PEDS tools are specifically phrased for prominent caregivers in children's lives, including parents and ECD practitioners, using questions regarding everyday activities to determine the child's level of development. Further explanations and examples have been added to each question to make it easy for the caregivers to understand what is being asked (du Toit et al., 2021b; Glascoe, 2015). There are multiple specific response options for each question employing a dropdown list, and the most relevant one needs to be chosen by the

ECD practitioner. Predictive concerns are concerns reported by caregivers that can lead to a developmental disability/disorder in future, whereas non-predictive concerns will not. Refer criteria used for the PEDS tools in this study relied on ECD practitioner concerns and therefore interpreted two or more predictive concerns as an immediate refer and only one predictive concern being dependent on passing or referring the PEDS: DM (Glascoe, 2015; Maleka et al., 2019). Non-predictive concerns, caregivers having difficulty communicating their concerns, and no parental concerns were all deemed a pass (Glascoe, 2015; Maleka et al., 2019).

(2) There is an integrated suite for both sensory screening applications (hearX Group) and they have been used in studies previously conducted in LMICs (Eksteen et al., 2019; Manus et al., 2021). Firstly, the hearScreen™ (hearX Group) hearing screening application (Dawood et al., 2020; Manus et al., 2021; Swanepoel et al., 2014) was used on a Samsung A3 smartphone with the latest Android operating system at the time of screening, connected to supra-aural Sennheiser HD280 headphones and was calibrated according to prescribed standards to monitor environmental noise (International Organization for Standardization, ISO 389–1) (Yousuf Hussein et al., 2018). hearScreen™ has been validated and is an accurate pure tone audiometry screening tool for children (Eksteen et al., 2019; Manus et al., 2021; Swanepoel et al., 2014). Refer criteria for the screen was an inability to hear at the 25 decibel (dB) hearing level at 1, 2 or 4 kilohertz (kHz) in either ear.

(3) Secondly, the Vula Vision application (Mapham & Swanepoel, 2020) was used to screen visual acuity at a distance on the same smartphone. This test follows the standard Early Treatment Diabetic Retinopathy Study chart design, using a Tumbling E optotype, and is capable of acuity measurements consistent with test-retest variability of acuities measured using 5-letters-per-line-retro-illuminated LogMAR (Logarithm of Minimum Angle of Resolution) charts (Bastawrous et al., 2015). Refer criteria for the vision screen was a visual

acuity of less than 0.2 LogMAR in both eyes, or less than 0.3 LogMAR in one eye regardless of acuity in the other eye.

(4) Post the combined mHealth-supported developmental and sensory screening programme, the CHW and ECD practitioners each completed a five-point Likert Scale questionnaire. The questionnaires were adapted from a previously published study (van der Merwe et al., 2019) and consisted of eight to ten questions, respectively, ranging from strongly agree to strongly disagree, regarding their perspectives of the combined mHealth-supported screening programme. The ECD practitioners only answered about the mHealth developmental screening as they were not involved in the sensory screening. Questions explored the effectiveness, efficiency and efficacy of the training, actual combined screening, language and phrasing used, location, participants chosen, and the overall perception of the screening programme. An open-ended question was asked at the end of the questionnaire for additional comments.

Procedures

The current study prospectively analysed data from a larger screening project. In the project, the CHW, already trained in sensory screening, received training to administer the developmental screening using the PEDS tools application. Before screening took place, the CHW attained assent from the children by explaining how it would work and then asking them if they were willing to participate. Hearing and vision conditioning then took place with the children prior to the formal screening. Finally, the combined mHealth-supported screening programme was conducted.

The CHW first conducted the hearScreen™ and Vula Vision screening tools with each child, which took approximately three minutes in total. She then administered the PEDS tools for each child, with the ECD practitioner answering the questions about the children.

The developmental screening took approximately nine minutes. The algorithm was automatically applied on the smartphone application and the results were generated, including referrals. The CHW then recommended that children who did not pass the hearing screen were rescreened, and if they did not pass a second time, they were referred on to the audiologist at the local government hospital for a comprehensive hearing test. Children who did not pass the vision screening were rescreened and, if they did not pass a second time, were then referred to primary healthcare facilities for a diagnostic optometric evaluation. The hearing and vision rescreens in this study are standard protocol. The applications have been developed this way to reduce over referrals. Children who did not pass the developmental screening with one predictive concern received guided interventions in class from the ECD practitioners, and those who identified as high risk, with two or more predictive concerns for developmental delays, were referred for further developmental intervention at the local hospital. The CHW and ECD practitioners were lastly asked to complete a questionnaire based on their perspectives of the screenings once all 63 children were screened.

For the current study, anonymised Excel spreadsheets from the screening project's data were analysed, specifically the variables for referral rates and the duration of the combined mHealth-supported screening programme were identified. The anonymous questionnaires were also reviewed and analysed to qualitatively describe the perspectives of the key stakeholders (CHW and ECD practitioners) regarding the combined mHealth-supported screening programme.

Data analysis

Descriptive and inferential statistics were employed to describe the quantitative data. The Statistic Package Social Sciences (SPSS, v27) was used for statistical calculations and analyses. The Chi-square test with pairwise z-tests was used for analysing associations

between referral rates.

Qualitative thematic analysis was used to analyse the qualitative data which was the CHW and ECD practitioner perspectives of the combined screening programme from the screening outcomes and comments in the questionnaire. A deductive approach was used to determine preconceived themes, based on theory and existing research. The themes included: reported misalignment between developmental areas screened and areas covered in the ECD centre programmes, the understanding of the developmental screening questions, and the benefit of and need for the combined screening.

Results

Over eight separate days, one CHW screened a total of 63 children between the ages of four and six years attending one of the three ECD centres in the low-income community using the combined mHealth screening programme. The overall referral rate of the developmental screening was 30% (n=19), the hearing screening was 6% (n=4), and the vision screening was 5% (n=3).

Most children (64%; n=40) passed all three screening tests. No children referred both sensory screenings. One child (2%; n=1) referred the developmental screening and vision screening, and two children (3%; n=2) referred the developmental screening and the hearing screening. Some children (25%; n=16) referred the developmental screening only, two children (3%; n=2) referred vision screening only and two (3%; n=2) hearing screening only. The developmental screening referral rate was significantly higher (30%) when compared to the referral rate for vision (5%; $z=4.183$, $p<0.001$) and hearing (6%; $z=3.908$, $p<0.001$), respectively.

Conditioning for the sensory screening took place but was excluded from the total screening time due to the informality and variation each time. The average total screening

time for the combined screen was therefore 11.72 minutes (SD 3.45 minutes) per child. The mean test duration for the developmental screening was 8.80 minutes (SD 2.97 minutes), 2 minutes (SD 1.50 minutes) for the vision screening and 54 seconds (SD 27 seconds) for the hearing screening. More than 50% of the screenings were conducted faster than the mean test durations.

In the questionnaire, the CHW reported that the combined developmental and sensory screening can have a positive impact on the community and should be done at ECD centres on a regular basis. She indicated that the additional training she received for the developmental screening was clear and adequate for using the PEDS tools application. She felt that it was easy to add the developmental screening knowledge to her existing sensory screening knowledge and that the developmental screening tool was easy to use within the ECD centre setting. The CHW was neutral on whether she felt that the children and ECD practitioners understood the developmental questions asked and whether she thought the developmental screening results obtained reflected the children's abilities. The CHW, however, felt that (1) the instructions in the PEDS tools application were not always easily understandable (2) that the developmental screening was not easy to administer to the ECD practitioner and children and (3) that the developmental screening was not quick to use in addition to sensory screening. This contradiction acknowledges that while the training for the PEDS tools was reportedly adequate, implementing it practically was reportedly more challenging.

ECD practitioners (n=5) indicated that the instructions from the CHW were clear and easy to understand, that the developmental screening was quick for the CHW to administer (n=4) and that they could answer the developmental screening questions about the children correctly because they spend a lot of time with them (n=4) (Table 1). For the older age group, the children had to participate in some of the questions, for example, pointing to the correct

colours on the screen or demonstrating a gross motor skill. The ECD practitioners agreed that the combined screening should be done at their centres as it would help identify those children with developmental delays and sensory losses. While the ECD practitioners (n=5) were not involved in the sensory screenings, they reported that the combined screening programme can have a positive impact on the community and should be done regularly at ECD centres.

Table 1. *ECD practitioner's perspectives regarding the mHealth-supported developmental screening (n=5)*

Questions	1 Strongly agree	2 Agree	3 Neutral	4 Disagree	5 Strongly disagree	Unanswered
I understood the questions that were asked	1	3	1	-	-	-
The PEDS app was easy to implement at the ECD centre with me helping and answering the questions	-	2	3	-	-	-
I think the children understood the questions that were asked of them	-	-	1	2	-	2
I think the screening results were correct	-	2	2	-	1	-

Thematic analysis of the CHW and ECD practitioners' responses to the open-ended question identified three main themes including (1) the reported misalignment between developmental areas screened and areas covered in the ECD centre programmes, for example early literacy which was screened for but not taught in ECD curriculums, (2) the consequent understanding of the developmental screening questions and (3) the resulting benefit of and need for the combined screening (Table 2).

Table 2. *Thematic analysis of the CHW's (n=1) and ECD practitioners' (n=5) perspectives of the combined screening programme*

Themes	Quotes
Misalignment between developmental areas screened and areas covered in the programme at the ECD centres	"Some questions on the PEDS tools app were not relevant to the programme that is used at the ECD centres" - *CHW* "Some of the questions asked in the PEDS tools app do not correspond with the programmes implemented at the ECD centres" - *ECD practitioner (n=2)*
Understanding of developmental screening questions	"Some questions were not easy enough to understand what is really needed from the child" - *CHW*
Benefit of combined screening	"The combined screening programme helps me and parents identify developmental problems in the children that we would not have noticed otherwise" - *ECD practitioner (n=3)*

Discussion

This study described the referral rate, duration, and perspective of a combined developmental and sensory mHealth-supported screening programme conducted by a CHW for children aged four to six years of age in a low-income South African community. A high referral rate (30%) from the developmental screening was identified, which is similar to elevated referral rates (ranging from 25% to 69%) for developmental delays reported in other studies conducted in underserved South African communities (Abdoola et al., 2021; Maleka et al., 2016; van der Linde et al., 2015; van der Merwe et al., 2019). Elevated referral rates may be due to exposure to common environmental risk factors such as poverty, low parental education level or lack of access to healthcare in LMICs. These risk factors raise the prevalence rate of developmental delays to as much as 35% (Correia et al., 2019; Cree et al., 2018; Jensen et al., 2017; Lu et al., 2016; Olusanya et al., 2018). The referral rate on development, however, is in line with previous reports of these at-risk populations (Abdoola et al., 2021; du Toit et al., 2021a; Maleka et al., 2016; van der Linde et al., 2015; van der Merwe et al., 2019).

Referral rates for vision (5%; n=3) and hearing (6%; n=4) screening were similar to the rates of 2-4% for visual loss and 2-5% for hearing loss reported previously in children of the same age, from similar LMIC communities in South Africa (Eksteen et al., 2019; Mahomed-Asmail et al., 2016; Manus et al., 2021). The significant difference between the developmental and sensory referral rates may be because the scope covered by each differs. The sensory screening tools each consider a single modality, whereas developmental screening evaluates multiple domains, including fine- and gross motor skills, social-emotional skills, literacy, receptive and expressive language, and global cognitive functioning. Based on this, it is evidently important to evaluate at-risk children using a holistic screening programme where vision and hearing are evaluated in conjunction with developmental screening.

In combined screening programmes, duration is another important factor. No other study in LMICs has considered combined screening duration to ensure a holistic view of each child as well as a holistic view of an overall screening programme as investigated in the current study. The majority (>50%) of the combined screening programmes were conducted faster than the mean test durations in this study. The ECD practitioners reported that the screening was quick, but the CHW felt it took longer than necessary, which indicates that the combined mHealth-supported screening programme could be viable in the ECD context, with adaptations in language, phrasing, and standardisation to shorten the duration.

The CHW and ECD practitioners reported that the combined mHealth-supported screening programme can have a positive impact and benefit the community due to early identification and should, thus, be done regularly, which agrees with previous research (Botes et al., 2022; Eksteen et al., 2019; Manus et al., 2021; Smit et al., 2020; van der Merwe et al., 2019). The ECD centre provides a viable platform to implement the screening, especially for the age range targeted in this study, due to accessibility, time, costs, and staff resources.

Screening procedures using mHealth-supported technology in ECD centres are being investigated further to establish better intervention strategies for LMIC communities (du Toit et al., 2021b; Manus et al., 2021; van der Linde et al., 2015). This study is showing potential to combine screening procedures by implementing mHealth and training of ECD practitioners in the areas of development, hearing and vision as illustrated to be effective by another recent study (du Plessis et al., 2022). This combined mHealth-supported screening programme could reduce the demand on health professionals in typical healthcare settings by rather having CHWs and ECD practitioners in ECD centres identify children with developmental delays and/or sensory difficulties.

Intervention strategies, such as ECD practitioner support, will need to account for the reported misalignment between the developmental areas screened and ECD centre programmes. This misalignment motivates further investigation through future research. The misalignment and possible gaps within ECD programmes have been investigated in another study where it was found that there is no central curriculum in ECD centre programmes and therefore there is not much guidance on teaching (Smit et al., 2020). While the developmental screening information is deemed accurate, the gaps in ECD programmes exist due to differences in ECD practitioner qualification, ECD centre resources and financial constraints, caregiver support, community involvement, and health needs (Chikwiri & Musiyiwa, 2017; Sharma et al., 2022). Due to the reported gaps, future research needs to explore whether the reported developmental referral rate is accurate and valid by having follow-up services where full developmental assessment can be done on all children who referred.

This combined mHealth-supported screening programme, used in an LMIC setting with children in this age range, CHWs, and ECD practitioners, has the potential to become a standardised service. The screening can be conducted by minimally trained persons in a short duration and was demonstrated to be feasible with potential for widespread implementation.

Based on the feedback from the key stakeholders who are central to the enabling environment of the children, it is evident that they see the value of implementing the combined mHealth screening programme at ECD centres. Limitations of the study included the small sample size, as well as the environmental risk factors experienced by the children, including the COVID-19 pandemic, as well as an unfortunate fire at one of the ECD centres. Another concern to consider in multilingual and multi-cultural contexts is the translating and understanding of developmental screening questions, as reported by the CHW, because if questions are misunderstood, it may present as a possible developmental delay and in turn inaccurately increase the prevalence rate. Evaluating the language and phrasing of questions is therefore warranted. A recent study has reported on the adaptation of the PEDS tools to ensure cultural and linguistic applicability in South Africa (Botes et al., 2022).

Conclusion

Previous studies have demonstrated the effectiveness of involving CHWs and ECD practitioners in developmental and sensory screening procedures that identify children who require early intervention (Eksteen et al., 2019; Maleka et al., 2016; Manus et al., 2021; van der Merwe et al., 2019). This study proceeded by describing the feasibility and potential of merging developmental and sensory screening into a combined mHealth-supported screening programme so that a holistic, time- and cost-effective screening can be provided at accessible sites, such as ECD centres. Adjustments to the developmental screening are evidently needed and will aid in the implementation of this combined mHealth screening programme. This study suggests that a combined mHealth-supported screening programme is viable, and that implementation could support referral to relevant healthcare professionals before formal schooling. This may ultimately improve access to developmental and sensory monitoring in low-resource settings at a young age.

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Declaration of interest

No potential conflict of interest was reported by the authors.

Data availability statement

Due to the nature of this research, participants of the screening project did not agree for their data to be shared publicly, so supporting data is not available due to ethical restrictions.

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