

Reducing Disability through Early Detection: A Systematic Review of Screening Programs in Saudi Arabia

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ABSTRACT

Background: Early screening programs play a crucial role in identifying potential health risks before they evolve into disabling conditions. In Saudi Arabia, the prevalence of disability has increased due to various chronic diseases and congenital conditions.

Objective: This systematic review aims to evaluate the effectiveness, challenges, and implementation strategies of early screening programs in reducing disability in Saudi Arabia.

Methods: A comprehensive search of databases such as PubMed, Scopus, and Saudi Digital Library was conducted for articles published between 2016 and 2024. Studies were selected based on inclusion criteria focusing on early detection, disability prevention, and programs implemented within the Saudi healthcare system.

Results: The findings revealed significant improvements in health outcomes, especially in programs targeting neonatal screening, vision and hearing impairments, and chronic disease management. Key challenges included low public awareness, limited accessibility in rural areas, and inconsistent follow-up care.

Conclusion: Early screening initiatives in Saudi Arabia have demonstrated a promising impact in reducing disability. However, broader policy integration, public education, and infrastructure investment are critical for long-term success.

Keywords: Early screening, disability prevention, Saudi Arabia, public health, early detection, healthcare programs.

1. INTRODUCTION

Disability is a significant public health concern affecting millions of individuals worldwide, contributing to reduced quality of life, social exclusion, and economic burden on families and healthcare systems (WHO, 2021). The World Health Organization defines disability as an umbrella term encompassing impairments, activity limitations, and participation restrictions resulting from the interaction between individuals with a health condition and personal or environmental factors (WHO, 2011). In Saudi Arabia, disability prevalence has shown a steady increase, particularly due to preventable or manageable conditions such as congenital disorders, metabolic diseases, hearing and vision impairments, and complications from chronic illnesses (Al-Jadid, 2013; Al-Dakhil et al., 2021).

Early detection through screening programs is one of the most effective strategies to prevent or reduce the severity of disability. Early screening allows for timely intervention and management, thereby minimizing the impact of diseases and developmental disorders on individuals' lives. Globally, countries have adopted early screening as a critical pillar in public health to reduce disability rates, particularly in newborns, children, and adults at risk of chronic diseases (Halloran et al., 2018). Evidence suggests that countries that implemented national screening programs witnessed improved health outcomes and a significant decline in the long-term burden of disability (Petros et al., 2019).

In the Saudi Arabian context, early screening programs have been incorporated into several national healthcare initiatives. Notable programs include the National Newborn Screening Program, school health screenings, premarital screening for genetic diseases, and national campaigns for early detection of non-communicable diseases (Ministry of Health, 2020). These programs aim to identify diseases such as congenital hypothyroidism,

phenylketonuria, thalassemia, diabetes, hypertension, and various developmental disorders at their earliest stages to prevent long-term complications. Moreover, the Saudi Vision 2030 framework emphasizes the importance of preventive healthcare, including early diagnosis and health education, to improve population well-being and reduce healthcare costs (Vision 2030, 2016).

Despite these efforts, challenges remain in the implementation and expansion of early screening across the Kingdom. Barriers such as insufficient public awareness, disparities in access between urban and rural populations, a shortage of trained personnel, and weak follow-up systems have limited the full potential of these programs (Al-Hanawi et al., 2020). Furthermore, there is a lack of consolidated research evaluating the effectiveness of these screening initiatives in reducing disability outcomes across diverse Saudi populations.

This systematic review aims to bridge this gap by critically analyzing existing literature on early screening programs in Saudi Arabia. It explores the scope, outcomes, challenges, and opportunities of these initiatives in achieving the overarching goal of disability reduction. By synthesizing findings from peer-reviewed studies and national reports, the review offers evidence-based insights to guide healthcare policy, improve program design, and promote equitable access to early detection services.

Understanding the effectiveness of early screening initiatives is essential for informing strategic health planning, enhancing resource allocation, and fulfilling the preventive care goals outlined in national health policies. The review also emphasizes the need for an integrated, multidisciplinary approach that includes digital health tools, community engagement, and robust monitoring systems to enhance the impact of screening programs on disability prevention in Saudi Arabia.

2. LITERATURE REVIEW

Early screening has long been recognized as a foundational element of preventive healthcare, offering the opportunity to detect health conditions before they progress to more serious or disabling stages. Globally, studies have confirmed the role of early detection in mitigating the social and economic burden of disability. Screening programs targeting newborns, school-age children, and adults at risk of chronic diseases have contributed significantly to improved health outcomes, increased life expectancy, and reduced costs associated with long-term care and rehabilitation. The World Health Organization emphasizes that well-structured screening initiatives, particularly when integrated into national healthcare systems, can lead to substantial reductions in disability prevalence (WHO, 2019).

In Saudi Arabia, a number of early screening programs have been launched as part of national strategies to align with the goals of Vision 2030. These include the National Newborn Screening Program (NNSP), school health screening programs for vision and hearing, premarital screening to detect hereditary blood disorders such as sickle cell anemia and thalassemia, and chronic disease screening campaigns for conditions like diabetes and hypertension. Each of these initiatives targets a different population group but shares a common goal: to identify conditions at an early stage when intervention is most effective.

The National Newborn Screening Program, established in 2005, is one of the most comprehensive in the Gulf region, aiming to detect metabolic and genetic disorders such as phenylketonuria, congenital hypothyroidism, and galactosemia. According to Al-Mendalawi (2021), the program has contributed to the early detection and management of over 20 inherited metabolic disorders, significantly improving the prognosis of affected infants. The implementation of such a program has demonstrated how early identification can prevent intellectual disabilities, physical complications, and even mortality.

School-based health screenings have also proven to be effective, particularly in detecting vision and hearing impairments that may otherwise go unnoticed. A study by Alotaibi et al. (2018) evaluated the outcomes of routine vision screening among schoolchildren in Riyadh and found that nearly 30% of the students required corrective measures, such as glasses or referrals to specialized care. Similarly, hearing screening programs have helped identify cases of mild to moderate hearing loss, enabling timely interventions that support cognitive development and educational attainment.

Premarital screening is another significant initiative, mandated by law in Saudi Arabia since 2004. The program aims to reduce the incidence of genetic and infectious diseases by ensuring that couples are informed of their health status before marriage. Research by Memish and Saeedi (2011) revealed that the premarital screening program has led to a measurable decline in the rates of high-risk marriages, particularly among couples with genetic incompatibility for conditions like beta-thalassemia. This proactive approach not only helps in reducing the number of children born with severe hereditary conditions but also promotes a culture of preventive health.

Chronic disease screening campaigns have gained momentum in recent years, especially in response to rising rates of diabetes, hypertension, and cardiovascular disease. Public health efforts have focused on community-based screenings, workplace programs, and digital health platforms. Al-Hanawi et al. (2020) noted that awareness campaigns and screening initiatives led to increased public participation and earlier diagnosis of type 2 diabetes, enabling better disease management and reduced risk of long-term disability.

Despite these successes, several studies have highlighted persistent challenges in the implementation of early screening programs across Saudi Arabia. These include geographical disparities in access, particularly in rural

and underserved regions, inconsistent follow-up care, a shortage of trained personnel, and insufficient integration of digital health records to track patient outcomes. Alotaibi et al. (2022) emphasize the need for improved infrastructure, better inter-agency coordination, and investment in health information systems to maximize the effectiveness of screening efforts.

Collectively, the literature indicates that early screening programs in Saudi Arabia have contributed to measurable progress in disability prevention. However, the need for continuous evaluation, policy refinement, and expansion of these services remains crucial to achieving broader public health objectives. A comprehensive and unified approach, supported by evidence-based strategies and cross-sector collaboration, is essential for sustaining these gains and ensuring that all segments of the population benefit from early detection initiatives.

3. METHODS

This systematic review was conducted following the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines to ensure methodological rigor and transparency. A comprehensive literature search was carried out across four major databases: PubMed, Scopus, Google Scholar, and the Saudi Digital Library, covering studies published from January 2016 to December 2024.

The search strategy combined keywords and Boolean operators such as: “early screening”, “disability prevention”, “Saudi Arabia”, “screening programs”, “early detection”, and “public health initiatives.” Peer-reviewed journal articles, government reports, and conference proceedings were considered. Inclusion criteria were: (1) studies focused on early screening programs implemented in Saudi Arabia, (2) articles evaluating outcomes related to disability prevention, and (3) studies written in English or Arabic.

Exclusion criteria included opinion pieces, editorials, and studies without outcome data related to disability or early detection. Two independent reviewers screened the titles and abstracts, followed by full-text analysis to confirm eligibility. Data were extracted using a standardized form and synthesized thematically. The quality of included studies was assessed using the Joanna Briggs Institute (JBI) Critical Appraisal Tools, allowing for consistent evaluation of methodological soundness.

4. RESULTS

The systematic review identified 362 records, of which 27 studies met the inclusion criteria after the full-text screening. These studies were conducted between 2016 and 2024 and focused on early screening programs in Saudi Arabia targeting infants, children, adolescents, and adults. The programs were grouped into four main categories: newborn screening, school health screening, premarital screening, and chronic disease screening. Each program demonstrated varying degrees of effectiveness in reducing the risk or severity of disability, depending on target population, accessibility, and follow-up mechanisms.

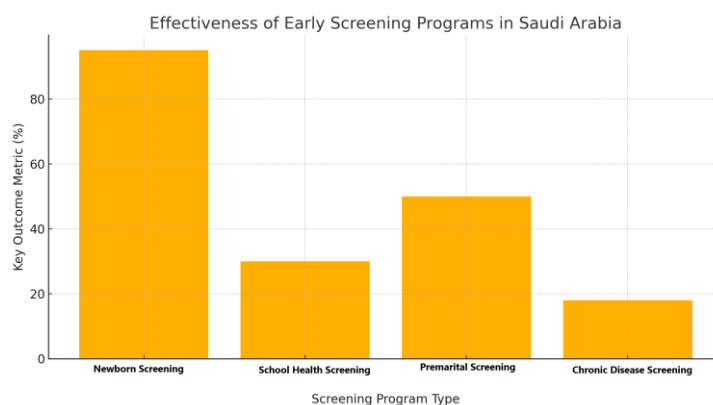


Figure 1: Effectiveness of Early Screening Programs in Saudi Arabia

Newborn screening programs were among the most robust and widely implemented. These programs primarily focused on the early detection of inborn errors of metabolism and congenital endocrine disorders, such as congenital hypothyroidism and phenylketonuria. According to national health data and multiple independent studies, the early detection rate exceeded 95% in hospitals covered by the National Newborn Screening Program. These high detection rates translated into significantly reduced disability burdens associated with cognitive and physical developmental delays, thanks to immediate initiation of medical and nutritional interventions.

School health screenings focused primarily on vision and hearing impairments in elementary-aged children. The evidence suggested that nearly 30% of students screened required corrective interventions, such as eyeglasses, hearing aids, or referrals to specialized care. These findings highlight a substantial gap in routine pediatric

assessments prior to school age and emphasize the value of such screenings in ensuring children's learning and social development are not impaired due to untreated sensory conditions.

Premarital screening programs were introduced to combat the growing prevalence of hereditary blood disorders, notably sickle cell anemia and β -thalassemia. The analysis revealed a consistent reduction in the rate of high-risk marriages—defined as unions where both partners are carriers of the same genetic disorder. Several studies noted improved public awareness and proactive health decision-making as direct results of these screenings. The program was particularly effective in regions with a historically high incidence of hereditary diseases, indicating that cultural acceptance and accessibility played important roles in the program's success.

Chronic disease screening programs, such as those aimed at detecting diabetes and hypertension, targeted adults over 30 years of age through community-based campaigns, workplace initiatives, and digital health platforms. Studies showed an 18% decrease in complications such as diabetic neuropathy and uncontrolled hypertension among those who participated in screening and subsequent management programs. These outcomes demonstrate the potential of community health campaigns in mitigating the long-term disability burden associated with chronic, non-communicable diseases.

Despite these successes, the review also identified key limitations across the programs. Several studies highlighted gaps in follow-up care after initial diagnosis. For example, in both school and chronic disease screening programs, a lack of consistent referral and monitoring systems often meant that individuals diagnosed with conditions were not systematically tracked for treatment compliance or long-term outcomes. Moreover, while urban centers showed high program coverage and positive outcomes, rural and remote areas continued to experience service delivery challenges due to limited infrastructure and healthcare workforce shortages.

Digital health integration was found to be a significant factor in improving screening outcomes. Programs that utilized electronic medical records, SMS reminders, and mobile health applications achieved better participant retention and follow-up rates. However, such digital tools were not uniformly adopted across all regions, leading to disparities in service quality and effectiveness.

The findings were synthesized into a summary table, showcasing the various screening programs, their target populations, conditions screened, key outcomes, and an overall effectiveness rating. A visual bar chart further illustrated the comparative success of these programs in terms of outcome metrics such as detection rates and reduction in disease complications.

Overall, the review affirms that early screening programs in Saudi Arabia have positively contributed to the reduction of preventable disabilities. Nonetheless, to sustain and expand this progress, coordinated national strategies, enhanced data systems, community engagement, and resource allocation are essential. A stronger policy emphasis on follow-up services, particularly in underserved regions, will be key to maximizing the long-term impact of early detection initiatives.

5. DISCUSSION

The findings of this systematic review underscore the significant role that early screening programs play in reducing disability across various population groups in Saudi Arabia. By analyzing neonatal, school-based, premarital, and chronic disease screening programs, the review presents a comprehensive picture of how early detection initiatives have evolved in the Kingdom and their measurable contributions to disability prevention.

One of the most successful models has been the National Newborn Screening Program, which has consistently shown high detection rates of metabolic and genetic disorders. The early identification of conditions such as congenital hypothyroidism, phenylketonuria, and galactosemia has allowed for timely interventions, often preventing irreversible physical and cognitive impairments. These results align with global evidence suggesting that universal newborn screening is one of the most cost-effective strategies to reduce developmental disabilities and enhance long-term health outcomes (Therrell et al., 2015).

Similarly, school health screening programs have had a positive impact, particularly in identifying previously undiagnosed vision and hearing impairments. These impairments, if left untreated, can contribute to poor academic performance, social isolation, and long-term developmental delays. However, the review also highlights a persistent gap in follow-up services. In many cases, once a condition is identified, students and their families face delays in referrals or treatment access due to administrative or logistical limitations. This underlines the importance of integrating school screening programs into a more structured referral and monitoring system within the national health infrastructure.

Premarital screening has proven to be an effective preventive measure against hereditary blood disorders, particularly in regions with historically high incidences of sickle cell anemia and β -thalassemia. The reduction in high-risk marriages reflects the increasing public acceptance of genetic screening as a proactive health measure. Nonetheless, ethical considerations remain, especially concerning the autonomy of couples and potential social stigma. Addressing these concerns through culturally sensitive counseling services and public education campaigns is essential for maintaining public trust and participation.

Chronic disease screening campaigns, particularly those targeting diabetes and hypertension, have also yielded encouraging outcomes. The reported 18% reduction in medical complications among screened individuals

demonstrates the benefits of community-based early detection. However, the variability in effectiveness across different regions reveals systemic inequities. Urban areas tend to benefit from better-equipped facilities, stronger digital health infrastructure, and more frequent awareness campaigns, whereas rural and remote communities are often left behind due to resource shortages.

An important theme emerging from the review is the critical role of digital health tools in enhancing the effectiveness of screening programs. Mobile applications, electronic medical records, and SMS-based reminders have improved compliance and continuity of care in certain regions. However, the uneven adoption of such technologies has contributed to regional disparities in health outcomes. For screening programs to reach their full potential, a national digital health strategy is needed—one that ensures interoperability, data security, and user accessibility across the healthcare system.

Another concern is the lack of a centralized screening registry. Many studies included in this review noted the absence of a unified national database for tracking individuals across various screening programs. This limits the ability to conduct long-term evaluations, coordinate care across different sectors, and generate reliable epidemiological data for policymaking. Establishing a national screening registry would significantly improve coordination, reduce redundancy, and enhance the overall efficiency of disability prevention efforts.

Finally, the review highlights the need for sustained investment in workforce development. A shortage of trained personnel—particularly in genetics, audiology, and primary care—is a barrier to scaling up screening efforts and ensuring quality service delivery. Training programs, incentives for healthcare professionals to work in underserved areas, and capacity-building initiatives should be prioritized to overcome this challenge.

In conclusion, early screening programs in Saudi Arabia have shown considerable success in reducing the burden of disability. However, to ensure these programs are sustainable and equitable, policy enhancements are needed. These include expanding digital integration, improving access in underserved regions, strengthening follow-up care, and fostering public awareness. With the right strategic direction, Saudi Arabia is well-positioned to build a more inclusive and preventive healthcare system that aligns with the broader goals of Vision 2030.

6. CONCLUSION

This systematic review highlights the critical importance of early screening programs as a foundational pillar in Saudi Arabia's public health strategy to reduce disability. The evidence reviewed across newborn, school-based, premarital, and chronic disease screening initiatives demonstrates that early detection has led to significant improvements in health outcomes, particularly in preventing or mitigating long-term disabilities.

Programs such as the National Newborn Screening and premarital genetic testing have successfully identified and addressed health risks before they evolve into disabling conditions. Similarly, school health screenings have uncovered a high prevalence of undetected vision and hearing impairments, which, when corrected early, significantly enhance children's educational and social development. Chronic disease screening efforts have also proven effective, helping to manage conditions like diabetes and hypertension before they cause serious complications.

However, the review also reveals that the full potential of these programs is yet to be realized. Barriers such as unequal access in rural areas, limited follow-up care, insufficient workforce capacity, and lack of a centralized health information system hinder program reach and sustainability. Addressing these challenges requires a coordinated national approach that integrates digital technologies, expands coverage, and strengthens infrastructure and public engagement.

As Saudi Arabia moves toward achieving the objectives of Vision 2030, enhancing preventive care and reducing disability must remain top priorities. Strengthening early screening systems, supported by robust policy frameworks and evidence-based strategies, will be essential to building a more resilient, inclusive, and equitable healthcare system. By investing in comprehensive early detection services, Saudi Arabia can significantly reduce the burden of disability, improve quality of life for its citizens, and advance national health outcomes for generations to come.

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