

Conceptual framework for speech audiometry materials in the Saudi Arabic dialect



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ABSTRACT

Speech audiometry plays an important role in comprehensive hearing assessment; however, standardized materials designed for the Saudi Arabic dialect are currently unavailable. This study proposes a conceptual framework to guide the development of culturally and linguistically appropriate speech audiometry materials. A systematic literature review covering the period from 2004 to 2025 was conducted following PRISMA guidelines, and Design Science Research principles were applied to structure the framework. The proposed framework consists of four stages: (1) foundational linguistic and clinical analysis, (2) development and validation of core materials, (3) production of standardized assessment tools, and (4) implementation for clinical application and outcomes. The framework addresses key gaps in audiological practice in Saudi Arabia by providing a structured and evidence-based approach to developing ecologically valid assessment tools. It offers a systematic process that moves from identifying the problem to developing practical solutions, with the goal of improving diagnostic accuracy, rehabilitation effectiveness, and patient outcomes within the diverse linguistic context of Saudi Arabia.

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1. Introduction

Speech audiometry constitutes a fundamental component of audiological assessment, directly impacting diagnosis, hearing-aid fitting, and rehabilitation outcomes (Al Matar, 2021). Its clinical validity depends critically on the use of linguistically and culturally appropriate materials that accurately reflect patients' daily communication patterns (Hull, 2016). When assessments employ words or sentences that are phonetically or contextually distant from a patient's lived experience, results can be misleading, ultimately compromising the quality of care.

In Saudi Arabia, audiologists face a significant and specific challenge: the absence of standardized speech audiometry materials developed for the Saudi Arabic dialect. Current clinical resources are often adapted from Modern Standard Arabic or neighboring dialects, failing to capture the unique phonetic, phonological, and prosodic features of

Saudi speech (Alanazi, 2017). This fundamental mismatch between test materials and patients' linguistic reality leads to inaccurate assessments and suboptimal intervention planning, highlighting an urgent need for tailored, ecologically valid tools.

While a growing body of descriptive literature has documented the Saudi audiological landscape, covering topics from hearing loss prevalence to service accessibility, these studies have primarily identified problems rather than providing systematic solutions for tool development. This represents a critical translational gap between recognized clinical needs and the availability of practical, validated resources. A prescriptive, methodology-driven approach is needed to move beyond description and address the core deficiency in standardized assessment materials.

To bridge this gap, this paper proposes a novel conceptual framework to guide the creation of standardized speech audiometry materials for the Saudi dialect. The framework is developed through a synthesis of evidence from a systematic literature review and the application of Design Science Research principles.

The remainder of this paper is structured as follows: Section 2 reviews related works, Section 3 details the methodology, Section 4 presents the proposed framework and findings, Section 5

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discusses implications and future directions, and Section 6 concludes.

2. Related works

Several studies have discussed in the literature review on speech audiometry in Saudi Arabia from different perspectives. For example, [Alkahtani \(2020\)](#) discussed the assessment of sensorineural hearing loss in children in Saudi Arabia as the first step in building reference baseline data for this population. The significant advantage of this work is its dedicated focus on a critical audiological problem in a population that has received very little attention. However, for an unpublished thesis, the work is assumed not to have undergone proper peer review; the findings are limited to a particular area of Saudi Arabia and are therefore not very generalizable to other locations.

[Alsebai \(2024\)](#) explored the integration of speech recognition and the quality of middle ear effusion in children in Saudi Arabia. The most important aspect of this work is that it is current, and the authors assess a prevalent condition in children and its relation to a vital speech outcome, thereby linking the two domains. Unfortunately, this work is a thesis, and its impact on the field and its clinical applicability are not established, and the complete document is likely inaccessible.

[Abdulkader \(2024\)](#) explored the assessment of speech sound production in bilingual children of Saudi Arabic and English through culturally relevant instrumental approaches. The major strength of this work is the commitment to the use of objective instruments and culturally sensitive methods. Unfortunately, the focus is very narrow.

[Raves \(2021\)](#) developed and assessed the Hearing Intervention Battery in Arabic (HIBA), the first tool in Arabic designed to assess auditory perception in children with cochlear implants. Its main advantage is addressing the need for culturally and linguistically appropriate rehabilitation resources for this population. However, this tool is limited to cochlear implant users, and further research may be needed on its use across the various Arabic dialects.

[Alfakir et al. \(2025\)](#) translated, culturally adapted, and validated the HEAR-COMMAND Tool into Arabic and self-rated the tool based on the International Classification of Functioning (ICF). The most significant advantage is that it created the first standard, patient-centered tool to measure hearing and communication disability for Arab speakers. Its most crucial disadvantage is that it was published in 2025, so it has not been widely adopted or referenced in clinical practice.

[Al Matar \(2021\)](#) tackled the development of an Arabic word recognition test for adults, which fulfilled a fundamental need for Arabic speech audiometry to be standardized. Development of a clinical tool for Arabic adults is the test's most significant positive. However, a major drawback is that, as a thesis, the test may be inaccessible to

clinicians due to a lack of commercialization, and it may focus on only one dialect.

[Honu-Mensah \(2015\)](#) explained the development of psychometrically equivalent trisyllabic words for speech audiometry in Fante, one of the languages of Ghana. The key point is the methodology for developing speech test materials that are linguistically valid. The primary downside in this instance is that Fante is not Arabic, and so its relevance to audiology practice in Arabic is limited.

[Alanazi \(2017\)](#) provided an early descriptive overview of the practice of audiology and speech-language pathology in Saudi Arabia. It serves as a valid historical reference point for understanding the profession's development in the region. Its disadvantages include being somewhat dated and lacking empirical data to support its claims as a descriptive article.

[Parmar et al. \(2022\)](#) explored the barriers to applying speech testing within adult audiology, noting specific clinical barriers to the practice. The strength of the approach lies in the potential efforts to refine clinical practice guidelines in an evidence-based manner to improve clinical practice. The limitation, however, is the general nature of the reported findings, as they do not address the specific difficulties posed by the Arabic-speaking world.

The level of awareness regarding audiology and speech-language pathology services within the scope of other healthcare professions in Saudi Arabia was studied by [Alanazi et al. \(2024a\)](#). The merit of this study is that it identifies an important systemic challenge related to patient referral and the integration of care. The downside is that it identifies a gap without presenting or testing a concrete alternative to address the problem of lack of awareness.

[Alanazi et al. \(2024b\)](#) described the practices around preschool hearing screening at primary healthcare centers in Riyadh, Saudi Arabia. It adds empirical data regarding the implementation and gaps in a public health initiative. The greatest limitation is the study's scope, which is limited to one city, Riyadh, and the cross-sectional design, which does not provide insight into the impact of an intervention, only a snapshot in time.

[Parmar and Rajasingam \(2023\)](#) developed a tool for adult speech testing practices. A benefit of this work is that it is short, hands-on, and useful for comparative purposes. The disadvantages are that it is not peer-reviewed, it lacks depth, and a geographic focus makes it even less relevant to the Arab world.

An early assessment of kindergarten children's hearing in the Jazan region of Saudi Arabia was provided by [Alharbi and Ahmed \(2015\)](#). For this location, it contributes foundational information. But given the age of the study, it is likely that its methodology and scope are more limited than what is currently available in the wider field of literature, and that more comprehensive research would address the gaps.

[Alkhamees et al. \(2016\)](#) described the creation of an aural rehabilitation training program for hearing-

impaired adults in Saudi Arabia. The main advantage of this work is that it responds to the urgent need for adult aural rehabilitation services in this part of the world. The lack of effort in the work detracts from the value of the paper, as it is likely that the authors are describing the development of the program rather than providing data that would demonstrate its impact, which would necessitate a separate evaluative study.

The prevalence, characteristics, and treatment of tinnitus are investigated by Alanazi (2024). Strength lies in providing up-to-date information on a widespread and troubling audiological condition, highlighting potential areas of unmet needs in care. Self-reported data has its own limitations due to bias. Alothman and Alanazi (2024) looked into the feasibility of school-based hearing screenings for first graders in Saudi Arabia. Its advantage is that it offers initial information that can be used to structure larger and more detailed screening programs. This being a pilot study, the main disadvantage lies in the small scale and preliminary nature of the study. Alshamrani et al. (2022) studied the impact of different personal listening device (PLD) usage patterns on the hearing of university students in Saudi Arabia. The relevance to an evolving and increasingly significant public health issue for the young adult demographic is a noteworthy strength. However, a primary limitation

is that the study is correlational and cannot establish that PLD use solely causes hearing loss.

Yousef et al. (2024) explained the development and cultural adaptation of the Saudi Pediatric Speech Intelligibility Test. Its most substantial merit is the provision of a critically important, standardized tool for evaluating speech intelligibility in Saudi children, which addresses a prominent clinical deficiency. As this is a very recent tool, it is understandable that it needs further validation and a more comprehensive set of normative data to be ready for broad clinical use.

3. Methodology

This study employs a Design Science Research (DSR) methodology (Hevner et al., 2004) to develop a conceptual framework for creating speech audiometry materials tailored to the Saudi Arabic dialect. To rigorously establish the problem domain and inform the design requirements, a Systematic Literature Review (SLR) was first conducted. The reporting of this review adheres to the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines (Sarkis-Onofre et al., 2021) to ensure transparency and reproducibility. The integrated research workflow, illustrating how the SLR informs the DSR process, is depicted in Fig. 1.

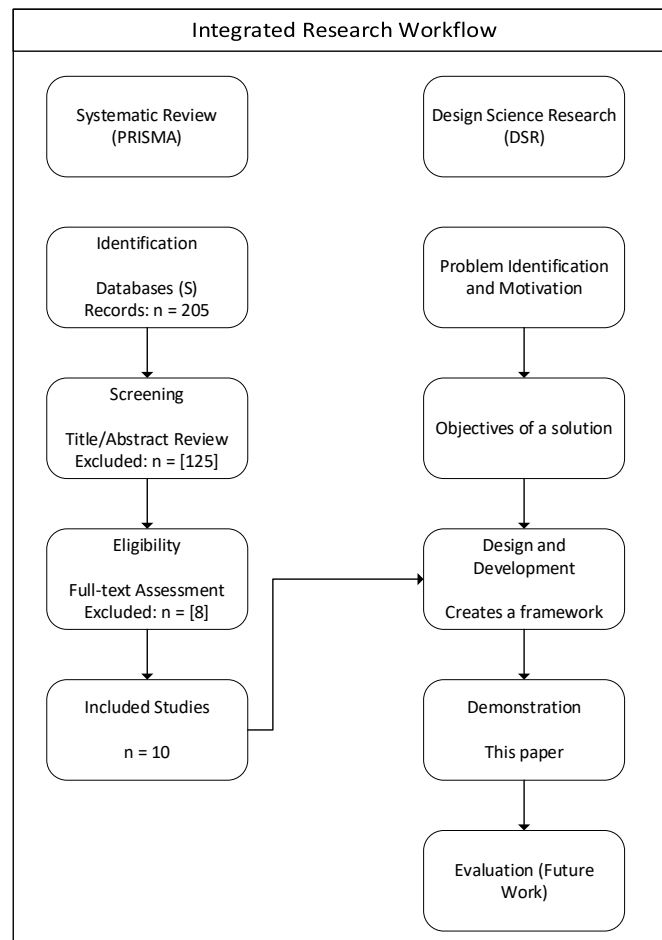


Fig. 1: Integrated workflow showing how the systematic review feeds into the design science research cycle for framework development

3.1. Systematic literature review (following PRISMA guidelines)

A systematic literature review was conducted to comprehensively map existing research related to speech audiometry in the Saudi context. This review followed the PRISMA framework through four stages:

1. Identification phase: Five electronic databases (IEEE Xplore, Scopus, Web of Science, SpringerLink, and Google Scholar) were searched using the keywords "Speech Audiometry," "Saudi Arabic Dialect," "Hearing Assessment," and "Audiological Rehabilitation" for publications between 2004 and 2025. Initial searches yielded 205 records.
2. Screening and eligibility phase: Records were screened against inclusion criteria: (1) focus on speech audiometry materials or tools, (2) specific relevance to Saudi Arabia or Arabic dialect, (3) clinical or developmental focus. Studies addressing general audiology without Saudi-specific linguistic considerations were excluded. The screening process is detailed in the PRISMA flow diagram as shown in Fig. 2.
3. Included studies: Ten studies met all inclusion criteria and formed the evidence base for problem identification and framework development. Table 1 displays the models focused on speech audiometry in Saudi Arabia.

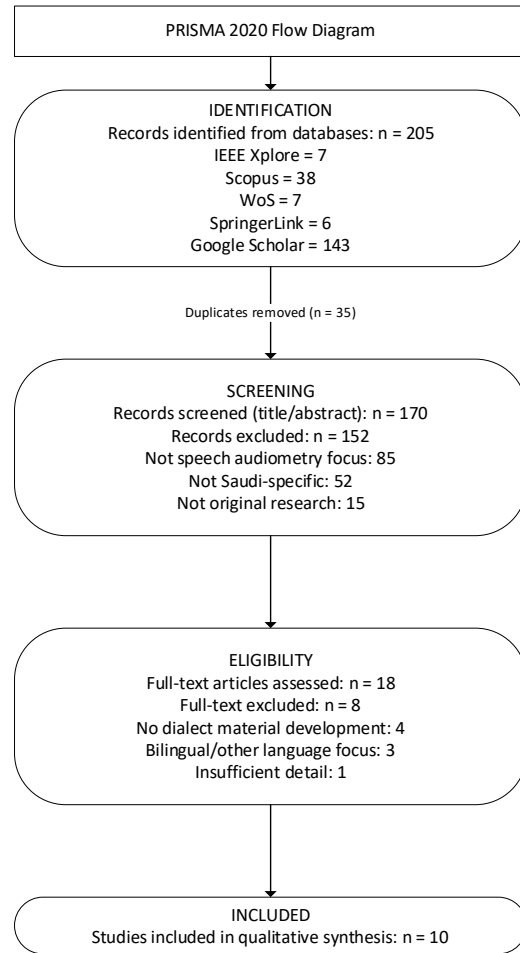


Fig. 2: PRISMA flow diagram

Table 1: Models focused on speech audiometry in Saudi Arabia

Study	Study type	Focus area	Population	Key theme
Alharbi and Ahmed (2015)	Empirical	Hearing evaluation	Children	Early regional assessment
Alkhamees et al. (2016)	Development	Aural rehabilitation	Adults	Rehabilitation program design
Alanazi (2017)	Descriptive	Professional practice	General	Audiology landscape overview
Alkahtani (2020)	Thesis	Hearing loss assessment	Children	Baseline clinical data
Alshamrani et al. (2022)	Empirical	Hearing conservation	University students	Impact of listening devices
Alanazi et al. (2024a)	Empirical	Professional awareness	Healthcare professionals	Service awareness gaps
Alanazi et al. (2024b)	Empirical	Hearing screening	Children	Primary care screening
Alanazi (2024)	Empirical	Tinnitus	Adults	Prevalence and characteristics
Allothman and Alanazi (2024)	Pilot study	Hearing screening	Children	School-based feasibility
Yousef et al. (2024)	Development	Speech intelligibility	Children	Tool development

4. Framework development using design science research: The DSR approach was applied to translate the findings from the systematic review into a practical conceptual framework. This process followed the key DSR phases:

- Problem identification and motivation: The SLR results in Section 4.1 established a clear gap in standardized, dialect-specific speech audiometry materials for Saudi Arabia, justifying the need for this research.
- Objectives of a solution: Based on the identified gap, the objectives for the framework were defined: to provide a systematic, linguistically

informed, and clinically practical development pathway for Saudi-specific materials.

- Design and development: The conceptual framework was designed as a four-stage model, as shown in Fig. 3, integrating linguistic analysis, clinical needs assessment, material development protocols, and validation procedures.
- Demonstration: This paper presents the developed framework, demonstrating its structure and logical flow as a viable solution to the identified problem.
- Evaluation: (Future work) The framework's utility will be evaluated through its application in developing actual speech audiometry materials, followed by clinical testing and validation studies.

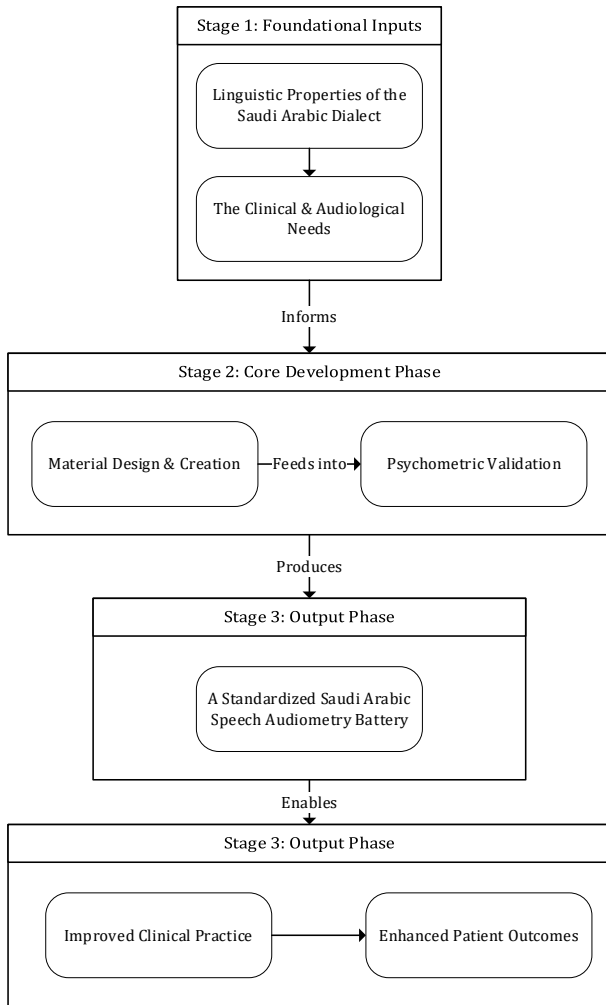


Fig. 3: Conceptual framework for speech audiometry materials in the Saudi Arabic dialect

- ❖ Stage 1: Foundational inputs: This initial stage establishes the essential groundwork that informs the entire project. It involves a deep analysis of two core areas. First, it focuses on the Linguistic Properties of the Saudi Arabic Dialect, meticulously documenting its unique phonetic, phonological, and prosodic features to ensure the resulting materials are authentically aligned with how Saudi patients speak and hear, rather than relying on Modern Standard Arabic. Second, it defines the Clinical and Audiological Needs by identifying the specific gaps in Saudi audiology practice, such as the lack of standardized tools for different patient groups (both children and adults) and key clinical tasks. This stage ensures the framework is built on a solid base of linguistic accuracy and practical clinical necessity.
- ❖ Stage 2: Core development phase: This is the active construction and testing phase, where the foundational inputs are transformed into a tangible product. It consists of two interconnected processes. Material Design and Creation involves the systematic selection of linguistically appropriate words and sentences, their high-fidelity recording by native speakers, and their formatting into clinically useful lists. This work directly feeds into Psychometric Validation, where the developed materials are rigorously tested for

reliability (e.g., consistency across repeated tests) and validity (e.g., accurately measuring speech recognition). This phase also includes collecting normative data from a large sample of normal-hearing individuals, which is crucial for clinicians to interpret patient results accurately.

- ❖ Stage 3: Output: The rigorous work of the Core Development Phase culminates in this stage, delivering the framework's primary tangible product: A Standardized Saudi Arabic Speech Audiometry Battery. This output is a comprehensive, ready-to-use set of clinical tools that typically includes standardized word lists for measuring speech recognition thresholds, monosyllabic word lists for scoring word recognition, and sentence lists for assessing hearing in noisy environments. This battery is the direct solution to the problem identified at the start, providing clinicians with a validated, ecologically valid resource explicitly tailored to their patient population.
- ❖ Stage 4: Outcome and impact: This final stage describes the long-term real-world benefits and effects of implementing the standardized battery from Stage 3. The framework leads to two primary positive impacts. First, it improves clinical practice by equipping audiologists with precise, culturally tailored tools. This enables more accurate diagnoses, better-fitting hearing aids (which means programming and adjusting hearing aids based on exact, dialect-specific test results to accurately match the individual's real-world listening needs and linguistic environment), and more effective, personalized rehabilitation plans. Second, these clinical improvements directly translate into Enhanced Patient Outcomes. By ensuring that assessments and interventions are accurately matched to the patient's linguistic reality, the framework ultimately leads to a higher quality of life and more successful long-term management of hearing loss for individuals across Saudi Arabia.

According to the framework, authors can develop a standardized and ecologically valid tool during Stage 3, provided they have a clear understanding of the Saudi Arabian linguistic characteristics and clinical context established in Stage 1, and have also designed a comprehensive and methodologically sound validation plan in Stage 2. By systematically applying this structured approach, the resulting tool can effectively address existing gaps in practice, enhance diagnostic and intervention processes, and ultimately contribute to improving patient outcomes in Stage 4. Consequently, this process leads to clinical findings that are not only meaningful but also practically applicable and effective in real-world settings.

Despite its critical importance in identifying needs and addressing gaps, Saudi audiology research has predominantly focused on describing existing problems rather than developing actionable solutions. In contrast to the existing body of

literature, the proposed conceptual framework adopts a systematic and integrated approach to develop end-to-end, context-specific, and standardized tools. Rather than relying on purely descriptive or foundational analyses, this framework

emphasizes a problem-solving orientation that bridges theory and practice. Furthermore, as illustrated in Table 2, the proposed framework is comprehensively compared with existing models to highlight its advantages and practical contributions.

Table 2: Proposed framework vs. existing models

Aspect of comparison	Existing models	Proposed conceptual framework
Primary focus	Descriptive and foundational. Focus on identifying problems (e.g., prevalence of hearing loss, awareness gaps, mapping professional practice).	Prescriptive and solution-Oriented. Focus on systematically creating a standardized clinical tool to solve the identified core problem.
Methodology	Varied and often implied. Includes cross-sectional surveys, pilot studies, and ad-hoc tool development without a unified, rigorous methodology.	Structured and rigorous. Employs a formal design science research methodology, with defined phases for development and validation.
Linguistic target	Mainly not the primary focus. Only one model explicitly develops a dialect-specific tool.	Explicitly central. The "linguistic properties of the Saudi Arabic dialect" is a foundational pillar (Stage 1) of the entire framework.
Target population	Fragmented. Individual studies focus on specific groups (e.g., children, adults, industrial workers, professionals).	Comprehensive. Designed to serve both children and adults through a unified battery, addressing a wider demographic.
Primary output	Knowledge and specialized tools. Outputs are predominantly data (prevalence, awareness) or narrow-scope tools (e.g., for pediatrics or rehabilitation only).	A standardized clinical battery. The output is a tangible, multi-component set of tools (word lists, sentence tests) for core audiological tasks.
Validation approach	Often limited or separate. Validation is not always a core component; some tools note a need for "further validation."	Integrated and core. Psychometric validation (reliability, validity, norms) is a mandatory, built-in stage (stage 2) of the framework.
Intended impact	Highlights systemic gaps. Identifies challenges (e.g., underdeveloped services, lack of integrated care) but does not resolve them.	Aims to close identified gaps. Designed to directly improve the audiological care pathway by providing the missing foundational tools, leading to better diagnosis, rehabilitation, and patient outcomes.

4. Results and discussions

This section presents the findings from the systematic review and details the proposed conceptual framework. It synthesizes the identified research gaps, outlines the framework's prescriptive stages, and discusses the practical implications, challenges, and necessary future steps for developing standardized speech audiometry materials for the Saudi Arabic dialect. The discussion transitions from problem analysis to solution-oriented pathways, linking the framework's design directly to clinical and linguistic needs.

1. Synthesis of systematic review findings: The systematic review confirms a critical gap: Despite growing awareness of audiological needs in Saudi Arabia, no comprehensive framework exists for developing standardized, dialect-specific speech audiometry materials. Existing studies predominantly describe problems rather than providing systematic solutions.
2. The proposed framework: Beyond description: Our four-stage framework (Fig. 2) represents a prescriptive shift from problem identification to solution development. Unlike previous descriptive models, it provides a structured pathway from linguistic analysis to clinical implementation.
3. Practical implementation challenges and limitations: The framework's implementation faces several challenges:
 - Intra-dialectal variation: Saudi Arabia encompasses multiple regional dialects (e.g., Najdi, Hijazi, Gulf). The framework must address whether to develop materials for a "standard"

Saudi Arabic or create multiple regional versions. We propose an initial focus on standard linguistic features across major dialects, with future adaptations for regional variations.

- Resource requirements: Developing and validating materials requires substantial resources, including linguistic expertise, native speaker recruitment, acoustic recording facilities, and access to diverse clinical populations for normative data collection.
 - Clinical adoption barriers: Even with validated tools, changing established clinical practices presents challenges that require training programs and evidence of superior outcomes.
4. Clear steps for future empirical work: Moving from framework to functional tools requires:
 - A. Detailed linguistic analysis: Comprehensive documentation of Saudi Arabic phonetic inventories, phonological rules, and prosodic patterns.
 - B. Pilot material development: Creation of initial word and sentence lists based on linguistic analysis, recorded by native speakers.
 - C. Psychometric validation: Rigorous testing of reliability (test-retest consistency) and validity (correlation with existing measures, sensitivity to hearing loss).
 - D. Normative data collection: Establishing performance benchmarks from large samples of normal-hearing individuals across age groups and regions.
 - E. Clinical field testing: Evaluating the materials' utility and accuracy in real-world audiological practice with hearing-impaired populations.

5. Conclusion

This study presents a comprehensive conceptual framework for developing standardized speech audiometry materials tailored to the Saudi Arabic dialect, addressing a persistent and critical gap in regional audiological practice. By integrating findings from a systematic literature review with Design Science Research methodology, the framework establishes a structured, evidence-based pathway from linguistic analysis through to clinical implementation. Its four-stage structure, encompassing foundational inputs, core development, tangible output, and measurable outcomes, provides both researchers and clinicians with a clear roadmap for creating ecologically valid assessment tools. The framework's primary contribution lies in its prescriptive, solution-oriented approach, contrasting with the predominantly descriptive nature of existing Saudi audiology literature. It acknowledges and addresses key implementation challenges, including intra-dialectal variation, resource requirements, and barriers to clinical adoption, and proposes practical strategies for each. By centering on linguistic authenticity and clinical utility, the framework ensures that the resulting materials accurately reflect the communication realities of Saudi patients while meeting rigorous psychometric standards. Future research should operationalize this framework through concrete steps: Conducting detailed phonetic and phonological analyses of major Saudi dialects, developing pilot word and sentence lists, establishing normative data across demographic groups, and validating the materials in diverse clinical settings. Successful implementation will ultimately enhance diagnostic precision, improve hearing-aid fitting outcomes, and optimize rehabilitation strategies, thereby contributing to better hearing healthcare across Saudi Arabia's linguistically diverse population.

Compliance with ethical standards

Conflict of interest

The author(s) declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

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