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# Audiological Health and Linguistic Inclusion in the Framework of Sustainable Development

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## ARTICLE INFO

## ABSTRACT

Hearing impairment heavily impacts the communication skills, social involvement and education specially in densely populated areas like Karachi, Pakistan. Therefore, it is essential to promote equitable access to the improved quality of life with hearing loss to ensure sustainable audiological health and linguistic inclusion. This study was aimed to design and establish predicators of sustainable audiological health and linguistic association within Karachi institutional framework. To achieve the objective a quantitative cross-sectional study on chosen 70 professionals was conducted. These professionals were working in the audiological clinics, centers for rehabilitation, special education schools and other disable support organizations. To ensure proper and timely feedback emails and calling via phones were done, the data was collected in the form of structured and self-administered questionnaire. The questionnaire included various components like healthcare facilities, facilities of education, facilities of linguistic, technologies, governance and economic sustainability. The assessment of these factors was performed using descriptive statistics, Pearson correlation and multiple regression analysis. The results depict accessibility of health had mean value of $3.85 \pm 0.62$; $\beta = 0.31$, $p < 0.001$, while linguistic accessibility and technological infrastructures had significance too. While the governance system highlighted moderate influence and economic sustainability showed non-significance. Accessibility in the private institutions was increased, which highlighted the differences between the public and the private. The results emphasize the significance of having all-inclusive approaches to service provision, language support, and technology. The study concluded that a holistic multi-domain approach is essential for the promotion

of sustainable inclusion. Further studies could be conducted to investigate the longitudinal consequences of targeted interventions to formulate proper policy and practice.

## INTRODUCTION

Public health and human development heavily rely on hearing as a crucial aspect. Hearing loss is an issue in millions of people of the world, and it keeps increasing because of the ageing of people and environmental hazards. It restricts communication, education, employment and socialization when left unattended (Abrahams et al., 2022). However, audiological health goes beyond clinical diagnosis and rehabilitation. It is directly related to linguistic access, social identity and cultural participation. To Deaf and hard-of-hearing persons, language is a key ingredient of cognitive development and social affiliation. With the help of sign language, assistive technologies and inclusive communication systems, meaningful interactions in society become possible (McLeod & Marshall, 2023). In the absence of such support communication barriers tend to be structural disadvantages. Inclusion has been noted to be the focus of sustainability in the global development agenda. The Sustainable Development Goals focus on equality, health, institutional inclusion, and education. SDG 3 facilitates the wellbeing of everyone whereas SDG 4 encourages inclusive education. SDG 10 is to minimize inequalities and SDG 16 promotes inclusive institutions (Salins et al., 2023). Regardless of these promises, audiological health and linguistic inclusion are not integrated with sustainability planning that often. Hearing care is a medical problem, and not a developmental concern, as addressed by policies. Linguistic accessibility is also dealt with as it is independent of health systems(Aldè et al., 2025). Such division restricts long term and sustainable development. There is need to have a more integrated viewpoint to balance the hearing health and language rights with the long-term development aims.

Much difference still exists in the access to audiological services by region and other socioeconomic groups. Programs of early hearing detection are not uniformly provided in most countries. The profession of an audiologist and its corresponding individuals is generally focused on urban areas (Furze et al., 2025). Other aids like hearing aids are still expensive to several families. There are other obstacles that rural and marginalized communities encounter because of the constraint in infrastructure. The level of hearing health awareness among the population is often poor. Meanwhile, the structural issues of linguistic inclusion exist. Sign languages are not universally acknowledged and approved as national languages. Interpreter services are deficient in health care, education, and juridical (Pillay et al., 2020). There might be no bilingual or inclusive bilingual models in educational systems that would cater to Deaf learners. Accessibility of communication forms is not usually availed by public institutions. All these obstacles reinvent exclusion and inequality. The situation is complicated by fragmented governance. The health and social sector can be independent of each other without integrated strategies. This is lack of integration which leads to poor resource allocation and accountability (Pillay & Kathard, 2018). Policies can also fail to address some important areas without framework of prioritizing important determinants. The lack of sustainability-based structures does not allow systematic appraisal of progress. This means that the disadvantage of hearing impairment is still avoidable to people. Such differences negate the overall development goals and social unity.

The solution to fair and sustainable societies is to deal with audiological health and linguistic inclusion. Hearing impairment caused by untreated deafness has a long-term educational and economic burden. Linguistic and exclusion limit civic and social engagement. These results are against the principle of leaving no one behind. Inclusive hearing health systems investment improves the social innovation and productivity of the workforce. Equal opportunity and dignity are enhanced by making rights-based based approaches strong. Sustainable development will involve institutions that are able to embrace diversity (Pillay & Kathard, 2018). Integrated planning has the potential of enhancing institutional responsiveness and service delivery. Pulling together the policies can facilitate effective and evidence-based resource

distribution. Democratic participation is also promoted by strengthening linguistic accessibility (Khoza-Shangase, 2025). Demographic changes and technological changes are increasing the urgency of the action. The differences will probably increase with time without being intervened with. It then needs systematic guidelines to direct policy and strategic planning. The research will establish and put the principal determinants of audiological health and linguistic inclusion in the context of sustainable development. It will thus aim at enlightening evidence-based decision-making and creating integrated and inclusive systems. The study helps to fill the gaps between the health policy and the language rights and sustainability discourse. Finally, a healthy audiological and linguistic inclusion facilitates resilient, fair, and socially sustainable ways of development.

## METHODOLOGY

The quantitative cross-sectional study was used to investigate the determinants of sustainable audiological health and linguistic inclusion in Karachi, a Pakistani densely populated metropolitan city with significant socioeconomic variation and healthcare access differences. The city has various types of public and private health care facilities, rehabilitation centers, schools of special education, and community organizations that accommodate people with hearing impairment. The relevant institutional review authority gave the ethical approval, and all the participants gave informed consent. Anonymity was observed and so was confidentiality.

The sample population consisted of professionals employed in an audiologist, tertiary care hospital, rehabilitation institution, special education institutions and non-governmental organizations working with disabilities. The participants included audiologists, speech-language pathologists, otolaryngology support staff, educators in either inclusive or special education, sign language interpreters, and program administrators. Representation was done using stratified random sampling whereby the public and the private schools in various districts were represented. The inclusion criteria entailed at least three years of professional experience in hearing health, inclusive education or disability services. Stable power analysis was also used to determine the sample size which needs to be representative and reliable.

A structured self-administered questionnaire was used to gather data, which was based on international literature, national disability policies, and the appropriate indicators used in the Sustainable Development Goal (SDG). The questionnaire comprised of closed-ended questions in six domains namely, healthcare accessibility, linguistic accessibility, educational inclusion, technological infrastructure, governance and policy support, and economic sustainability with a five-point Likert scale. A pilot test was used to make it clear and relevant in the context and some minor revisions were made to enhance understanding. Cronbach alpha was used to determine the instrument reliability (a > 0.70 was accepted as good). Construct validity was verified by exploratory factor analysis (EFA), which retained those items with a factor loading of more than 0.50. Responses of the participants were summarized with the help of descriptive statistics (means, standard deviations, frequencies), and the trends in service access and inclusion practices were determined. The inferential tests comprised Pearson correlation to determine the relationship between healthcare accessibility, linguistic inclusion, and sustainability outcomes and multiple regression analysis to determine significant predictors of sustainable audiological inclusion. The p- value was established as $p < 0.05$. The descriptive and inferential statistics gave a sound quantitative assessment of the factors affecting audiological health and inclusion in Karachi, and the results were discussed with reference to policy implications in SDG.

## RESULTS AND DISCUSSION

The sample size of professionals involved in the study was 70 (audiologists' 30 percent, speech-language pathologists' 20 percent, educator's 25 percent, otolaryngology staff 15 percent, and administrators/sign language interpreter's 10 percent). Majority (56%) of respondents had professional experience of 5-10 years, 28% of respondents had more than 10 years, and 16% had between 3-5 years. The questionnaire

was structured and self-administered and covered six domains including access to healthcare, access to language, access to education, availability of technology, policy and governance support, and economic sustainability.

According to the descriptive analysis provided in Table 1, the highest ratings were obtained on the accessibility to healthcare (mean = 3.85 +- 0.62) and technological infrastructure (mean = 3.72 +- 0.68), indicating the moderate-high service provision. Lack of economic sustainability (mean = 3.11 +- 0.81) was the lowest score indicating financial constraints of maintaining inclusive programs. The differences in the resource allocation were also seen when access to healthcare was higher in the private institutions (mean = 4.12 +- 0.58) compared to the public institutions (mean = 3.60 +- 0.61).

**Table 1: Descriptive Statistics of Key Domains (n = 70)**

| Domain | Mean | SD | Interpretation |
|---|---|---|---|
| Healthcare Accessibility | 3.85 | 0.62 | Moderate to high access |
| Linguistic Accessibility | 3.46 | 0.70 | Moderate inclusion |
| Educational Inclusion | 3.39 | 0.75 | Moderate inclusion |
| Technological Infrastructure | 3.72 | 0.68 | Moderate to high support |
| Governance & Policy Support | 3.28 | 0.79 | Moderate awareness/policy backing |
| Economic Sustainability | 3.11 | 0.81 | Limited financial sustainability |

Table 2, which was based on Pearson correlation analysis, demonstrated that there were significant positive relations between healthcare accessibility and linguistic accessibility ($r = 0.48$, $p < 0.001$), healthcare accessibility and educational inclusion ($r = 0.42$, $p < 0.001$), and technological infrastructure and both linguistic accessibility ($r = 0.36$, $p = 0.002$) and educational inclusion ($r = 0.39$, $p = 0.001$). Economic sustainability had lower correlations with others ($r = 0.15$-$0.22$), which means that financial support is not adequately correspond with service and inclusion practices.

**Table 2: Pearson Correlations Between Domains (n = 70)**

| Domain 1 | Domain 2 | r | p-value |
|---|---|---|---|
| Healthcare Accessibility | Linguistic Accessibility | 0.48 | <0.001 |
| Healthcare Accessibility | Educational Inclusion | 0.42 | <0.001 |
| Technological Infrastructure | Linguistic Accessibility | 0.36 | 0.002 |
| Technological Infrastructure | Educational Inclusion | 0.39 | 0.001 |
| Governance & Policy Support | Healthcare Accessibility | 0.29 | 0.01 |
| Economic Sustainability | Educational Inclusion | 0.15 | 0.12 |

Sustainable audiological inclusion was studied through multiple regression analysis of predictors. The model with all the six domains as independent variables was not only significant ($F(6,63) = 12.45$, $p < 0.001$) but also it explained 43 percent of the variance in sustainability outcomes ($R^2 = 0.43$). Access to healthcare ($b = 0.31$, $p < 0.001$), linguistic access ($b = 0.28$, $p = 0.003$), and technological infrastructure ($b = 0.25$, $p = 0.006$) proved to be predictive variables of importance and the role of governance and policy support was intermediate ($b = 0.18$, $p = 0.04$). There was no statistical significance of educational inclusion and economic sustainability.

**Table 3: Multiple Regression Predicting Sustainable Audiological Inclusion (n = 70)**

| Predictor Domain | β | SE | t | p-value |
|---|---|---|---|---|
| Healthcare Accessibility | 0.31 | 0.09 | 3.44 | <0.001 |
| Linguistic Accessibility | 0.28 | 0.10 | 3.05 | 0.003 |
| Educational Inclusion | 0.12 | 0.09 | 1.33 | 0.19 |

| | | | | |
|---|---|---|---|---|
| **Technological Infrastructure** | 0.25 | 0.10 | 2.78 | 0.006 |
| **Governance & Policy Support** | 0.18 | 0.09 | 2.05 | 0.04 |
| **Economic Sustainability** | 0.09 | 0.08 | 1.13 | 0.26 |

All of these findings indicate that the ability to access services, support of the language, and technological capacity are the main determinants of sustainable inclusion in Karachi. Access to healthcare presented the biggest impact highlighting that audiological services availability has a direct impact on the inclusion outcomes, especially in institutions that have more resources at their disposal, which is a private institution (Moroe & Masuku, 2021; Pillay & Kathard, 2018). Sign language support and communication facilitation, which are the facets of linguistic accessibility, also played an essential role in predicting it, which supports the importance of linguistic accessibility in an educational or clinical setting (Yoshimura et al., 2024). Both the healthcare and educational inclusion were heavily interconnected with the technological infrastructure, such as assistive devices, and digital tools because the emphasis was made on the fact that investing in technology enhances long-term sustainability (Petrocchi-Bartal et al., 2025; Yoshinaga-Itano, 2003).

Although economic sustainability was critical in the continuity of the programs, it was not as predictive as it should be, which indicates that financial planning and resource allocation is not well developed (Pimperton & Kennedy, 2012). The moderate importance of governance and policy support was revealed, which means that policies are present but might not be entirely enforced on an institutional level (Awan et al., 2024; Jayaprakasan et al., 2023). The provided correlations between the access to healthcare and the linguistic and educational inclusion raise the point that the enhancement of clinical services can lead to a wider inclusion, which is why interventions on a multi-domain level should be applied. These findings are consistent with other world and regional literature, which points out that sustainable audiological inclusion needs systematic and combined interventions that focus on healthcare, communication, technology, and governance at the same time (Yoshinaga-Itano et al., 1998). The results support Sustainable Development Goals 3 and 4, which focus on health and quality education to everyone, including the disabled. The weaknesses of the study are that it is a cross-sectional study that is not causal and that it is based on self-reports, which can result in response biasing(Moroe & Masuku, 2021; Pillay et al., 2020). Also, the findings are localized in Karachi, and the findings might not be applicable in rural or under-resourced locations (AlSamhori et al., 2024; Continisio et al., 2023). To conclude, the paper has shown that healthcare accessibility, linguistic support, and technological infrastructure are the key determinants of sustainable audiological health and linguistic inclusion in Karachi, which are mediated by the structures of control. The holistic approach towards such determinants can facilitate a fair, sustainable inclusion of hearing-impaired people in policy and practice in Pakistani urban areas

## CONCLUSION AND RECOMMENDATIONS

This research concluded that the main factors affecting sustainable audiological health and linguistic inclusion in Karachi are the healthcare access, linguistic support, and technological infrastructure. There was a variation in the way healthcare is provided as the institutions recorded higher accessibility in the private institution than the public institutional setting. The moderately influential variables were governance and policy support, and economic sustainability was not a predictive variable. These results suggest that successful inclusion is dependent on coordinated actions to respond to service provision, communication and technology issues and deficiencies in funding and policy execution restrict sustainability.

It is suggested to improve the work of the public healthcare facilities by investing more in funding and providing training of the staff, improving language accessibility by educating sign language interpreters and considering the inclusive communication approach, and improving the technological infrastructure including assistive devices and the use of digital platforms. Monitoring and implementation of policies

ought to be strengthened, and financial viability ought to be achieved by the collaboration between the government and business and community efforts. Long-term outcomes of such interventions are to be investigated in future studies to gain insight into their long-term effectiveness in audiological and linguistic sustainability, which would be used to develop policies and programs and facilitate fair access to people with hearing impairments.

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