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Field validation of an app based developmental and speech language screening (SRESHT screener) conducted by grass root workers

Vasudharany Varadharajan[a], **B Subramaniyan**[b,*], **Vidya Ramkumar**[a], **Lakshmi Venkatesh**[a], **Kavyashree Chandrasekar**[a]

[a]Sri Ramachandra Faculty of Audiology & Speech Language Pathology, Sri Ramachandra Institute of Higher Education & Research, Chennai, India

[b]The Cleft & Craniofacial Centre, Department of Speech Language Pathology & Audiology, Sree Balaji Medical College and Hospital, Bharath Institute of Higher Education and Research, Chennai, India

Abstract

This study validated an app-based developmental and speech language screening (SRESHT screener) conducted by Grass Roots Workers (GRWs) among children below six years of age in a rural community in the state of Tamil Nadu (the field).

Method—The study was carried out in two phases, first the training of GRWs and then the validation of the screening conducted by them using the app. For the training, suitable materials were developed, and the GRW's knowledge and skills were evaluated pre- and post-training. Two closed-ended questionnaires were used to evaluate the GRWs' knowledge about the screening tools. The Observed Structured Practical Examination (OSPE) method was used to evaluate their skill. All the participants were selected by convenience sampling and were screened independently by both a Speech Language Pathologist (SLP) and a GRW using the application. Cohen's kappa and percent agreement were used to determine agreement in screening results between the SLP and GRWs.

Results—All the GRWs scored at least 75 % and above in both the knowledge and skill assessments conducted post-training. "Substantial agreement" on kappa-based extent of agreement

*Corresponding author. suraj08@gmail.com (S. B).

Declaration

This work was done when the corresponding author was affiliated as Associate Professor at Sri Ramachandra Faculty of Audiology & Speech Language Pathology, Sri Ramachandra Institute of Higher Education & Research, Chennai.

Conflicts of interest of each author/contributor

None to declare.

Criteria for inclusion in the authors'/contributors' list

Vasudharany Varadharajan: Data collection, data analysis, statistical analysis, manuscript preparation and review.
Subramaniyan B: Conceptualization, data collection support, statistical analysis, manuscript preparation and review.
Vidya Ramkumar: Conceptualization, funding support, manuscript preparation and review.
Lakshmi Venkatesh: Conceptualization and manuscript review.
Kavyashree Chandrasekar: Data collection and manuscript review.
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and “almost perfect” agreement on percent agreement were obtained between GRWs and SLP for the app-based screening.

Conclusion—The findings of this study imply that the app-based developmental and speech language screening performed in the community by GRWs is valid.

Keywords

Grass root workers; App-based screening; Developmental screening; Speech and language disorders; Childhood communication disorders

1 Introduction

The importance of early detection and intervention of developmental delays in infants, toddlers, and young children has been well documented[1] particularly in the context of the “critical period” of neuro-plasticity that occurs between the ages of 0 and 6 years.[2] This is accomplished through child health screening, which includes tracking a child’s developmental status as well as the detection of diseases and delays.[3] A developmental delay is indicated when a child fails to meet milestones in one or more developmental domains (motor, speech, and language, adaptive and cognitive, and personal or social) within the expected timeframe.[4–6]

Developmental screening of children is integrated into the healthcare system in high-income countries.[7] However, in low and middle-income countries (LMIC) like India, integration has been slow and difficult due to a shortage of healthcare professionals involved in intervention for developmental delays (e.g., developmental paediatricians, speech language therapists, occupational therapists, etc.), non-referral or delayed referral or false reassurance to families by physicians,[8] and a lack of context- and culture-specific tools to evaluate developmental domains that can be used by specialists and non-specialists.[9] Another significant challenge in countries such as India is the practical consideration of covering a large number of children, the majority of whom live in rural areas.

In low-resource contexts, decentralising screening and surveillance from professionals to well-motivated Grass Root Workers (GRWs) is a recommended strategy.[10] Since screening and triaging often do not require professional skills and abilities, GRWs such as Accredited Social Health Activists (ASHAs), village health volunteers, or community-based workers promote coverage at the community level with appropriate training and support. Many developing countries, including Southeast Asia, Africa, India, and Latin America, have investigated such alternatives.[3]

The use of locally developed tools in developmental screening is recommended.[9] In India, the National Rural Health Mission launched the Rashtriya Bal Swasthya Karyakram (RBSK), a “Child Health Screening and Early Intervention Services” program, in 2013, with the goal of detecting birth defects, diseases, deficiencies, developmental delays, and disabilities across three age groups: 0–6 weeks, 6 weeks to 6 years, and 6 years–18 years.[11] The RBSK developmental screening tool and Language Evaluation Scale Trivandrum[12,13] are widely used in India as they are culturally appropriate, easy to understand, and easy to

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use by non-professionals. The RBSK developmental screening includes gross motor, fine motor, vision, cognition, hearing, speech, and social skills domains in four age ranges: 0–6 months, 6–12 months, 1–2.5 years, and 2.5–6 years.[14] The term "developmental screening" refers to the screening of all domains of development, including speech and language development.

The resource material for the RBSK[15] recommends using the LEST in addition to this screening for further assessment of speech and language milestones. Nair et al. (2013) developed LEST as a community screening tool composed of items related to receptive and expressive language development.

While these programs are implemented by ASHAs in several states using the traditional paper-and-pencil approach, this approach has several drawbacks. These include the need to spend more time on manual screening, documenting data for a large population, transferring data from paper into statistical programs for analysis of the obtained data, and dealing with manual errors caused during data transfer. Therefore, the judicious infusion of simple technology that supports community-level task shifting has much to offer, including efficient ways of eliciting, recording, retrieving, and eliminating errors in data transfer.[16] By providing an alternative route to delivering developmental screening services, mHealth applications have the potential to make community-based screening more accessible and affordable for caregivers and their children.[17]

In order to attempt such integration in Tamil Nadu's public health system, an app-based developmental and speech-language screener (SRESHT screener) was developed as a part of a project titled "Effectiveness of a Comprehensive Tele-Practice Model for Identification and Rehabilitation of Children with Hearing and Speech Language Disorders in Rural Communities," funded by the DBT India Alliance/Wellcome Trust Grant (IA/CPHI/19/1/504614). For ease in reading this app-based developmental and speech language screener, it is referred to as SRESHT Screener in the rest of the document.

This application is built on a single-board computer and used with a tablet or mobile phone. An app was developed for both hearing screening and speech language screening components for children below 6 years of age. The user interface was designed in a simple manner such that a GRW with minimal training can acquire the necessary skills to screen using this application. The dashboard of the software consists of demographic details, hearing screening, and speech language screening. The speech language screening includes both the RBSK developmental screening tool and the LEST screening tool. Each has a yes-or-no answer. The tools in the application are programmed to automatically score responses as per the tool's standard scoring system and to provide interpretation as "pass" or "refer."

The purpose of this study was to validate the app-based developmental and speech language screening performed by GRWs using the SRESHT screener among children below six years of age in a rural community (the field).

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2 Materials and method

This study was approved by the appropriate Institutional Ethics Committee (REF: IEC-NI/20/OCT/76/113). All participants provided written informed consent prior to their participation in the study.

This study was carried out in two phases, and its flow process is illustrated in Fig. 1.

2.1 Phase 1 training GRWs in carrying out developmental and speech language screening using the SRESHT screener

2.1.1 Development of materials for the training program—A training program was developed for the field validation of the SRESHT Screener. The content of this training program included training on (i) the use of the SRESHT Screener and (ii) the use of the two screening tools, RBSK and LEST. The training program's structure and method of delivery were based on the RBSK's training program for the Mobile Health Team (MHT).[15]

Materials for pre- and post-knowledge and skill assessments were developed to assess the training program's outcomes. Two closed-set (Yes/No) questionnaires in Tamil were developed for knowledge evaluation. Questionnaire 1 (Appendix 01) included ten questions, five of which were related to developmental milestones, and the remaining five were specific to assessing their knowledge of the RBSK screening tool. Questionnaire 2 (Appendix 02) included four questions about the LEST screening tool. The questionnaires were designed and converted to a Google form for participants to complete on their smartphones. The Objective Structured Practical Examination (OSPE) method was used to assess their skills. An evaluation form with a rating sheet (1-skill present, 0-skill absent) was designed to score the GRW's ability to comprehend the question or item in the screening tool, ask the question to the parent, and record the parent's response in the mobile application. This was accomplished by selecting some questions from the screening tools (8 questions for the RBSK screening tool and 5 questions for the LEST screening tool) along with the answer keys. The entire training program and the evaluation tools were developed in Tamil.

Two Speech Language Pathologists (SLPs), co-investigators in this study, with experience in task shifting, community-based approaches, and mHealth applications validated the content. The content was modified as per the suggestions received from the validation process. The content was reviewed by two native Tamil speakers for linguistic appropriateness (SLP and project staff involved in community-based work) and ease of understanding. The provided feedback was incorporated, and the training program content was finalized.

This program was designed to be delivered over two days and included didactic lectures as well as hands-on training. The training program's structure is included as an appendix (Appendix 03).

2.1.2 Conduct of the training program—Purposive convenience sampling was used, and a total of nine (03 males; 06 females) GRWs aged between 35 and 40 years from the districts of Cuddalore (n = 4), Tiruvannamalai (n = 2) and Kanchipuram (n = 3) were identified as potential participants for the study. All these participants had (a) more than

three years of work experience in community-based programs; (b) prior knowledge and skills related to the identification of children with communication disorders (specifically cleft lip and palate); and (c) exposure to the use of smartphones. Each participant was contacted over the phone, and they were explained about the study and its objectives.

The first day began with device orientation. Following that, the GRWs received hands-on training on the SRESHT screener. They were instructed to practice by entering dummy data into the SRESHT screener. A brief introduction to the developmental milestones was given prior to the start of the next session. The following session focused on the administration and comprehension of the RBSK screening tool. The second day was devoted to administering and comprehending the LEST screening tool. Both days' sessions began with a baseline assessment of knowledge and skill with the RBSK and LEST screening tools. At the end of each day, a post-assessment was conducted. A cut-off score of 75 % in the post-training assessment of knowledge and skill for each tool separately was required for GRW to participate in the second phase of the study.

2.2 Phase 2 field validation of the SRESHT screener

Post-training, the GRWs coordinated with the local authorities of the villages, anganwadis, and primary healthcare centres and disseminated information about the developmental screening camps that were scheduled in their respective communities (Cuddalore, Tiruvannamalai, and Kanchipuram). Informed consent was obtained from parents/caregivers (n = 109) who expressed a willingness to participate in this study. For ease of understanding, the parent-child pair is referred to as participants in the study. Table 1 shows the distribution of participants by age group.

Screening was carried out using the SRESHT screener independently by the SLP (primary investigator) and GRWs. The participants were assigned to the SLP and GRW in a random order and with single blinding by the camp coordinator.

2.3 Statistical analysis

For measuring the pre- and post-training outcomes, a Wilcoxon signed rank test was used to measure the knowledge and a parametric T test for the skill component. The agreement of screening results obtained as pass and refer between the GRW and SLP screening was determined using Cohen's Kappa and percent agreement with values of 0 (poor agreement), 0.0–0.20 (slight agreement), 0.21–0.40 (fair agreement), 0.41–0.60 (moderate agreement), 0.61–0.80 (substantial agreement), and 0.81–1.00 (almost perfect agreement).[18]

3 Results

3.1 Outcomes of training program GRWs in carrying out developmental and speech language screening using SRESHT screener

The knowledge and skill components were assessed independently. Pre- and post-training assessment scores of the knowledge component in RBSK and LEST are tabulated in Table 2.

The Wilcoxon signed rank test showed a significant difference in knowledge between the pre- and post-evaluations ($w = 0$; $p < 0.05$). In the skill component, each GRW's ability to

administer screening tools RBSK and LEST using SRESHT screener was evaluated. The pre-post percentage scores of each GRW are presented in Fig. 2a–b (RBSK) and 2c–2d (LEST), respectively.

Table 3 shows that the overall scores obtained in the skill assessment improved after the training. The parametric T test showed a statistically significant difference ($p < 0.01$) in the GRWs' performance of screening pre- and post-training.

3.2 Field validation of the SRESHT screener

Developmental and speech language screening was completed for 109 children (59 male, 50 female; 0–6 years) using the SRESHT app. Complete data for 104 out of the 109 children was available for analysis in the RBSK developmental screening. Agreement in screening results between SLP and GRW was observed in 85 of the 104 children (pass 54; refer 31). In the "refer" category, 12 out of 31 children in the age group (<3 years) had "refer" results on the same items, while 19 out of 31 in the age group (>3 years) had refer' results on different items. Disagreement was observed in 19 out of 104 children (17 children with "pass" in SLP screening and "refer" in GRW screening; 2 children with "refer" in SLP screening and "pass" in GRW screening). The overall analysis of RBSK developmental screening results revealed "substantial agreement" on the kappa-based extent of agreement ($k = 0.62$; Cohen's kappa coefficient). An "almost perfect agreement" (0.81) was obtained on the percent agreement between the outcomes of screening performed by SLP and by GRW.

Complete data for 108 of the 109 children was available for analysis in the LEST screening. Agreement in screening results between SLP and GRW was observed in 93 out of 109 children (pass 66; refer 27). Disagreement was observed in 15 out of 108 children (13 children with "pass" in SLP screening and "refer" in GRW screening; 2 children with "refer" in SLP screening and "pass" in GRW screening). The overall analysis of LEST developmental screening results revealed "substantial agreement" ($k = 0.68$; Cohen's kappa coefficient). An "almost perfect agreement" (0.86) was obtained on the percent agreement between SLP and GRW screening results.

4 Discussion

The study findings revealed that GRWs' knowledge and skills improved after training, with all GRWs scoring above the 75 % passing threshold. The successful outcomes of the training program in imparting knowledge and skill may be attributed to the simple language used to deliver the training module,[19,20] the grass-root worker's prior field experience,[21] and the opportunities for practical learning provided during the training.[20,22,23] A well-designed training program that takes into account all of the aforementioned factors has the potential to enhance knowledge and skills in health care surrogates.[23] Periodic training, also known as refresher training or regular follow-up training, is advised in the training of grass root workers.[20,24,25] The importance of a follow-up training program is recognised and will be incorporated during the community-level implementation of this application.

The inter-rater agreement between SLP and GRWs for both RBSK and LEST screening conducted using the SRESHT screener was found to be “substantial” (0.61–0.80). In a similar effort to detect oral cancer, near-perfect agreement was obtained between the screening results of trained GRWs and onsite specialists using a mHealth application.[26] The disagreements between the screening results of SLP and GRW were mostly related to GRWs overidentifying (SLP screening ‘pass’ and GRW screening ‘refer’) the children. This could be due to their misinterpretation of the reverse questions of the RBSK screening tool in the higher age group. Also, the lengthy nature of the LEST screening tool may have resulted in poor responses from the caregivers and participant. Therefore, the RBSK screening tool can be used as the primary development screening tool for mass coverage, and the LEST screening tool can be used as a second-level tool or as a progress monitoring tool considering the longer time taken to administer the LEST tool.

This study involved training a small number of GRWs from a few districts in one state of India. Also, long-term retention of skills was not evaluated as a part of this study. The performance of the GRWs is likely to improve with the incorporation of refresher training programs with a specific focus on the administration of the test tools and scoring.

5 Conclusion

The importance of task shifting and the infusion of simple technology is recommended to reach services to the last mile and overcome challenges of demand versus capacity.[3,10] The findings of this study suggest that the developmental and speech language screening carried out in the community by trained GRWs using the SRESHT screener is valid. This study also demonstrates that, with appropriate training, GRWs can perform surveillance of developmental delays and speech language disorders at the community level.

Expansion of developmental and speech language screening using the SRESHT screener is planned for other underserved districts of the country with suitable collaborators to determine the generalizability and replicability of this mHealth screening application. Future studies should explore the impact outcomes of conducting such decentralised, technology-enabled, digitally documented screening programs with respect to identification and rehabilitation outcomes.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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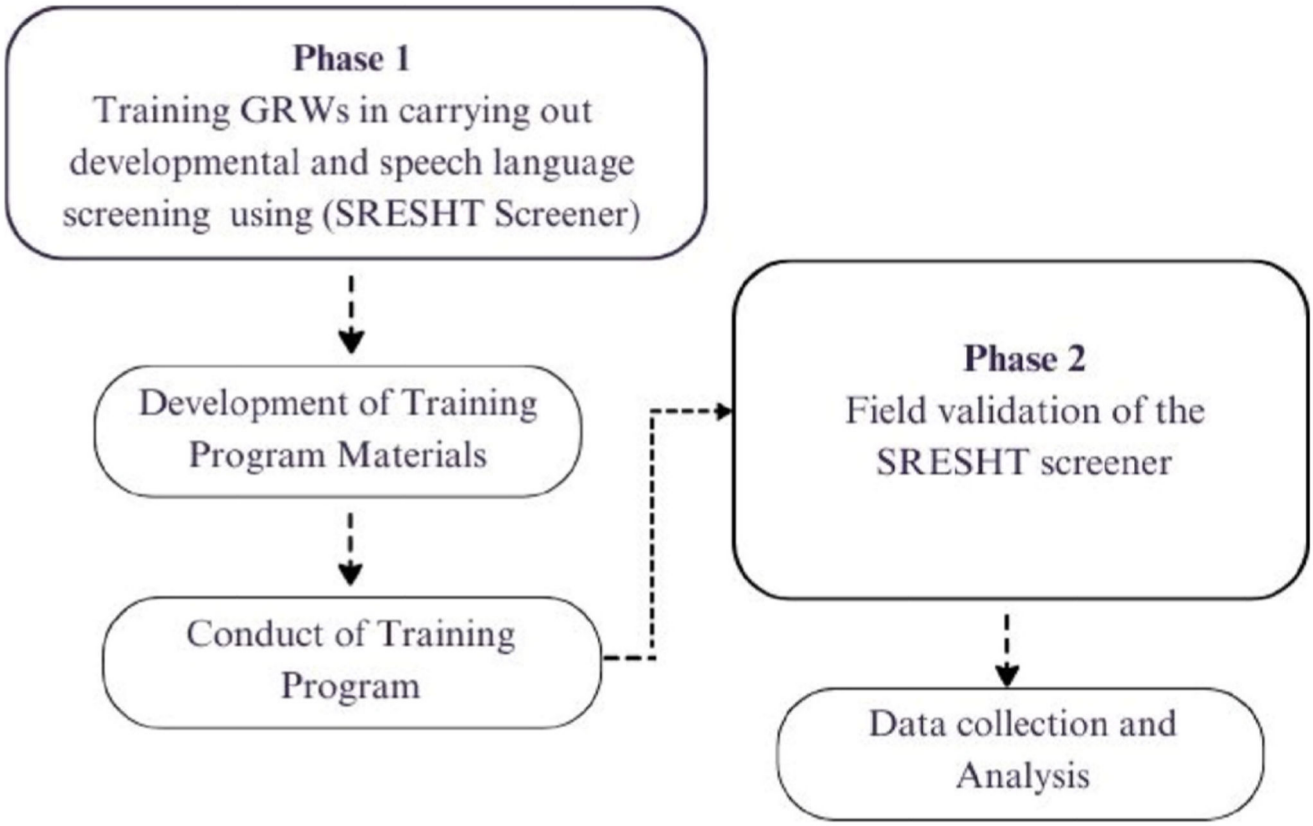

Fig. 1. Schematic representation of the flow process of the study.

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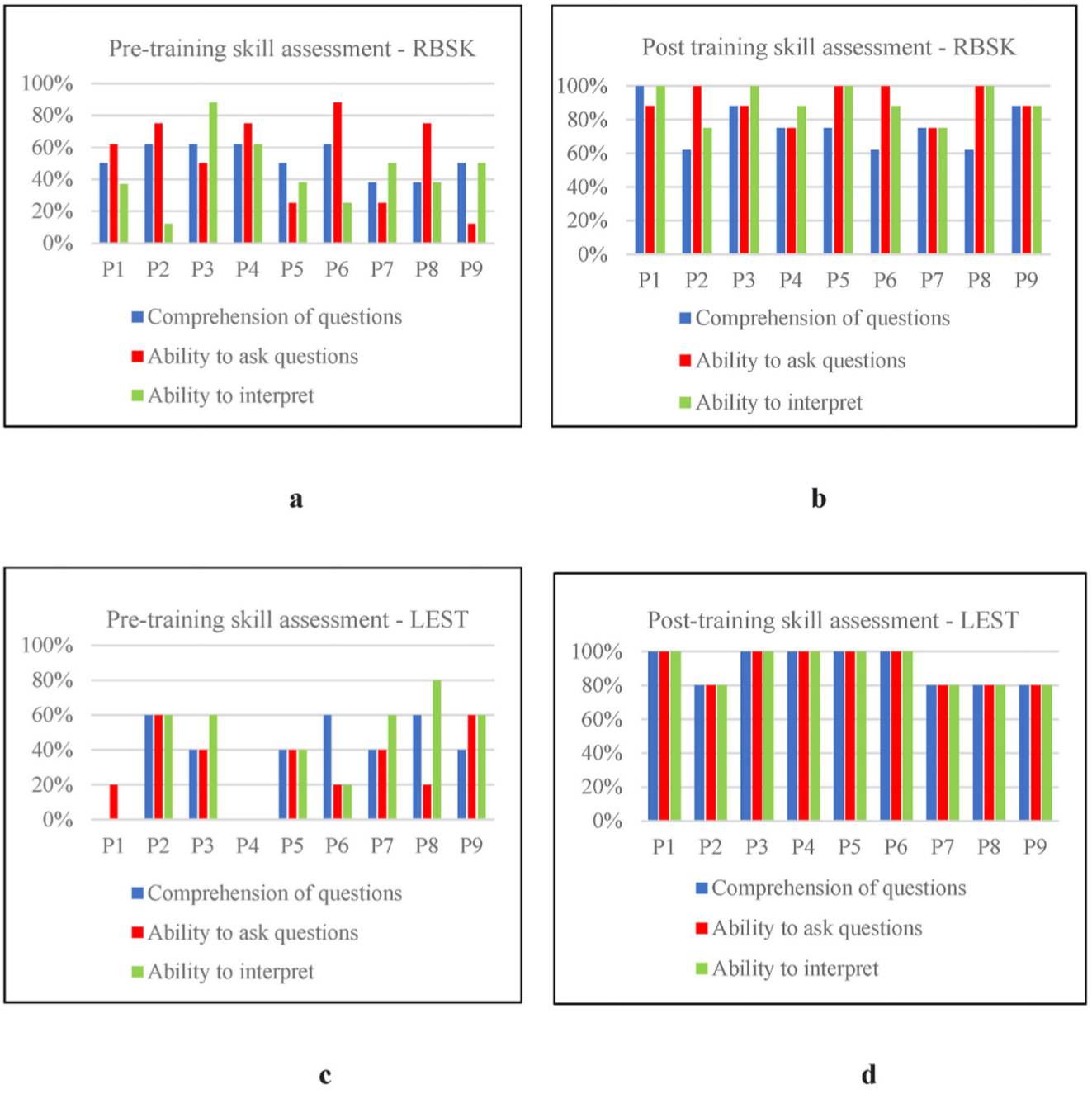

Fig. 2. Pre-post percentage scores of knowledge and skills for each GRW for RBSK (2a-2b) and LEST (2c-2d).

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Table 1

Distribution of data.

Age Groups	Total no of participants	Gender	
		M	F
0–1 years	12	07	05
1–2 years	21	11	10
2–3 years	24	12	12
3–4 years	21	13	08
4–5 years	20	10	10
5–6 years	11	06	05
Total	109		

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Table 2

Pre and post training knowledge assessment scores of RBSK and LEST.

GRW	RBSK		LEST	
	Pre training score (in %)	Post training score (in %)	Pre training score (in %)	Post training score (in %)
1	80 %	90 %	75 %	75 %
2	60 %	80 %	75 %	100 %
3	50 %	90 %	100 %	100 %
4	80 %	100 %	100 %	100 %
5	60 %	90 %	75 %	100 %
6	60 %	80 %	75 %	100 %
7	50 %	90 %	75 %	100 %
8	80 %	80 %	75 %	100 %
9	50 %	100 %	75 %	100 %
w value	**0**		**0**	
P	**0.005**[a]		**0.005**[a]	

[a]Significant at $p \leq 0.05$.

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Table 3

Pre and Post training skill assessment scores of RBSK and LEST.

GRW	RBSK		LEST	
	Pre training score (in %)	Post training score (in %)	Pre training score (in %)	Post training score (in %)
1	50 %	96 %	6 %	100 %
2	50 %	79 %	60 %	80 %
3	67 %	92 %	46 %	100 %
4	67 %	79 %	0 %	100 %
5	38 %	92 %	40 %	100 %
6	58 %	83 %	33 %	100 %
7	38 %	75 %	46 %	80 %
8	50 %	88 %	53 %	80 %
9	38 %	88 %	53 %	80 %
P	**0.01**[a]		**0.01**[a]	

[a]Significant at $p \leq 0.01$.