

A home-based intervention for children with autism spectrum disorder: Outcomes for Saudi Arabian families

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Parents of children who have autism spectrum disorder (ASD) often struggle to find appropriate educational and behavioural resources to support their children. These resources are particularly lacking in countries with fewer resources overall. The purpose of this study was to evaluate the effectiveness of a culturally appropriate training program for parents, specifically mothers, of children diagnosed with ASD in Saudi Arabia. The participants included Saudi parents (n=5) and their children (n=5), all 4 to 8 years of age. The single subject study utilised a multiple probe across participants design. The researcher and each parent collaboratively developed a home based intervention (HBI) to teach a specifically targeted skill for their child. Observational data was collected to measure the accuracy and reliability of the parents' ability to deliver instruction to their children. The primary dependent variable was the parents' fidelity in treatment implementation and the secondary dependent variable was the children's acquisition of targeted skills. Results indicate a high level of fidelity of intervention (parents) with a high rate of acquisition (children) of the targeted skills. Implications of the study including limitations and future research are discussed.

Introduction and literature review

Families of children with disabilities often face economic, social and cultural difficulties in their journey to meet the special needs of their children (Asa et al., 2020). It is imperative that these difficulties are addressed effectively, due to the negative impact likely to parents' physical and mental health. Due in part to the behavioural challenges that children with autism spectrum disorders (ASD) present, families of children with ASD often face unique challenges resulting in even higher levels of parental stress and a decrease in their quality of life (Dieleman et al., 2018). These stressors may strain family relationships, resulting in parenting disagreements on how to manage child behaviour and even contribute to divorce (Dieleman et al., 2018). In addition, families who lack extended family or community support find themselves socially isolated (Galpin et al., 2018).

Families report feeling overwhelmed when first receiving a diagnosis of ASD for their child and may feel an increased sense of responsibility while trying to manage new and unfamiliar information regarding choices and decisions as to the best care and education for their child (Dieleman et al., 2018).

The supports and resources available to families (Fearon & Sonuga-Barke, 2021; Kelly et al., 2016) as well as their personal understanding of and previous experience including

interactions with persons with ASD vary broadly according to the family's ethnic and socioeconomic background and geographic location (Hebert, 2014; Jafarabadi et al., 2021; Su et al., 2021). For instance, families who live in economically deprived communities (Longtin & Principe, 2016), rural or remote areas (Hoogsteen, 2011), or those who face racial discrimination (Wagner et al., 2021) often experience disparities in ASD information and services, such as lack of educational services, a lower likelihood to obtain an early diagnosis, and lower quality ASD services (Bishop-Fitzpatrick & Kind, 2017).

Raising children with ASD in such limited-resource areas can be more stressful for families for a number of reasons, including the unavailability of supportive programming for their children, scarcity of trained professionals, and a lack of community support (Alnemary et al., 2017; Wagner et al., 2021). Even when both parents are present, available research suggests that cultural dynamics in some worldwide locations make it more likely that mothers of children with ASD will be the parent most involved with day to day care and education of their children, which may also contribute to increased stress levels for the mothers (Alshaigi et al., 2020; Althiabi, 2021; Devries, 2016).

Saudi Arabia is an example of an area with low ASD resources and a broad cultural practice of the mother acting as the primary child caretaker (Alotaibi & Almalki, 2016; Althiabi, 2021; Babatin, et al, 2016; Zeina et al., 2014). Previous research regarding ASD in Saudi Arabia highlights significant cultural and familial challenges with little information as to the availability and effectiveness of evidence-based practices for individuals with ASD within the country (Alqahtani, 2012; Kelly et al., 2016; Taha & Hussein, 2014).

Available research focusing on the quality and quantity of ASD services in Saudi Arabia highlights significant unmet needs according to the perspective of Saudi families (Alotaibi & Almalki, 2016; Alnemary et al., 2017). These needs include a lack of community awareness, little accurate information about ASD, more support needed for evidence-based practices, particularly to support early intervention for children with ASD, and greater community resources for individuals with ASD with a goal of improved quality of life for the entire family (Alotaibi & Almalki, 2016; Alnemary et al., 2017; Taha & Hussein, 2014; Kelly et al., 2016). Particularly in rural areas, Saudi mothers of children with ASD often report feeling stigmatised and finding it very difficult to locate and access services for their children (Alshaigi et al., 2020; Sulaimani, 2018), which may result in higher levels of psychological stress including a higher level of anxiety and depression (Meny & Hayat, 2018; Asi, 2016; Alotaibi, & Almalki, 2016).

One solution for families and their children in Saudi Arabia and similar areas of the world which may lack sufficient resources to support children with ASD may be the training of parents to implement home-based intervention (HBI) using culturally appropriate materials (Alkhalifah & Aldhalaan, 2018; Alotaibi & Almalki, 2016; Althiabi, 2021). HBI is a specific method of intervention used to support individualised parental training for the delivery of a specific ASD intervention in a naturalised setting and is well accepted within the ASD field (Bearss et al., 2015). Research emphasises the advantages of HBI for both individuals with ASD and their families (Popovic, 2017; Scahill et al., 2016; Shindorf, 2019) including providing the family with appropriate knowledge and skills to address their children's' needs

in specific areas. Parents can be trained to appropriately address challenging behaviours, teach replacement behaviours, increase social communication skills, self-management skills, and academic skills (Popovic, 2017; Scahill et al., 2016; Shindorf, 2019).

Furthermore, research indicates that psycho-educational information provided to parents as a part of HBI training has benefits which can improve the quality of life for parents of children with ASD (Iadarola et al., 2018; Kuravackel et al., 2018; Little et al., 2018). Further, HBI has been found to be effective to improve parents' mental health and improve their self-efficacy, well-being, and quality of life overall (Iadarola et al., 2018; Kuravackel et al., 2018; Little et al., 2018). In addition, HBI is cost effective, eliminating the transportation burden, and providing a viable option to support families in remote areas (Carr, & Lord, 2016; Pickard et al., 2016).

The purpose of this study was to evaluate the effectiveness of a culturally appropriate HBI program for parents, specifically mothers, of children diagnosed with ASD living in Saudi Arabia. An important component of this study was direct instruction provided by the researcher and the close interactive communication between researcher and participant to honour and support the cultural dynamic of the communities of the families in Saudi Arabia. Data was collected to measure the effectiveness of the parent training to effectively teach targeted skills of their children with a diagnosis of ASD.

Method

Children with ASD and their families are a very heterogeneous population, with a wide range and severity of symptoms, making it difficult to generalise or identify sufficient cohorts of similar subjects for a large-scale study or to make statistically meaningful comparisons (Odom et al., 2003). Single subject design is a scientific method which allows for consideration of small or even individual numbers of subjects, using systematic observation and measurement of the individuals' behaviour to provide an understanding of the effectiveness of the intervention. Single subject design methods allow the individual to act as their own control. Baseline (before treatment) behaviour is measured along with the measurement of behaviour during specified points in the treatment.

Design and procedures

The specific type of single subject study utilised in this case was a multiple probe across participants design (Johnston & Pennypacker, 1993) with two areas of evaluation, specifically, ability of the parent participants to implement the HBI after development of the intervention which has been especially designed in collaboration with the parent to teach specific targeted behaviours to their child and second, the effectiveness of the intervention, as measured by the ability of the child to achieve target behaviours.

Ethical considerations and recruitment

Before beginning the study, families of children who were students at a publicly funded school for children with ASD in a city in Saudi Arabia were contacted via the school administration and invited to participate in a larger study. Before beginning the larger study, details of the study was submitted for ethical approval (HRE-2020-0386). The families contacted were limited to Saudi Arabian citizens or long-term residents as an objective of the study was to gauge the cultural appropriateness and effectiveness of the specifically modified instruments of assessment and intervention. The initial phase of the larger study included theoretical training for families regarding causes and symptomatology of ASD. At the conclusion of the training, the parent participants were provided information and invited to participate in this study. Five of the parent participants agreed and provided informed consent to participate in this study, which would develop a customised HBI for their children.

Participants

The participants for this study were mothers of children diagnosed with ASD; specific selection criteria included: (1) female caregivers of children with ASD who were Saudi citizens or long-term residents; (2) their children were between 4 to 8 years of age and previously diagnosed with ASD; and (3) the female caregivers had not previously received applied behaviour analysis (ABA) applied training of HBI. Although the participants had completed educational training in ABA theoretical concepts as a part of the previously mentioned larger study, they had not received applied ABA training.

Participant characteristics

A total of 10 participants (5 parent and child pairs) enrolled in the HBI. In instances where information in this study is specific to either parents or children, this will be expressed as either parent participants or child participants. All of the participants were native to Saudi Arabia and Arabic was the primary language spoken in their home. As per the recruitment criteria, the parent participants were all female and the primary caregiver of their children. Their ages ranged from 31 to 44 years, and their level of education varied, with one participant who completed elementary school, another who completed high school and three that held bachelor degrees. All of the parent participants were stay at home mothers, except one who was a school teacher. However, during Covid-19, she was working from home. According to the reported income, the families ranged from very low to mid socioeconomic standing in their community. The child participants, all male, ranged in age from 5 to 8 years. According to the data from the CARS-2 assessment (see Step 2 below), one child exhibited mild symptoms of ASD, 3 fell within the moderate range, and one child scored in the severe range. Each parent participant engaged in a collaborative process to determine the target behaviour and an appropriate corresponding HBI for their child.

Determination of target behaviours and intervention

The target behaviour and most appropriate intervention for each child was determined through a consultative and collaborative three step process between the researcher and parent participant. The three steps consisted of: (1) gathering information from the parents; (2) formal assessment of the level of ASD symptomatology; and (3) target behaviour determined by consensus between the researcher and parent after considering the information obtained in steps 1 and 2, including development of an appropriate intervention.

Step 1: Demographic and behavioural information

Information was gathered from the parent through telephone discussions between the researcher and parent to understand the family demographics, child behaviours and culture and lifestyle priorities of the family. To guide the discussions, a questionnaire was developed after a thorough review of relevant studies which discussed the type of family and child information highly relevant to the development of effective HBI for children with autism (Alnemary, 2017; Kato, 2018; Leach, 2012: 26-29; Nicksic-Springer, 2016; Shindorf, 2019).

Family demographic questions included information regarding the age of all family members, parent marital status, education, occupation, and level of family income. Questions were also asked regarding the child participant as to any health conditions, diagnoses, and medication. Open ended qualitative questions were utilised to gather critical information including: the parents' goals and priorities for their children, challenging behaviours, family routines and lifestyle preferences, as well as the child's interests and preferences. The questionnaire is presented in Table 1.

Step 2: Formal evaluation of level of ASD symptomatology

The researcher administered, by telephone, the Arabic adaptation (Alqahtani, 2017) of the *Childhood Autism Rating Scale*, 2nd ed. (CARS-2) (Schopler et al., 2010) to the parent participants, to determine the severity of ASD symptomatology of each child participant in the study. The CARS-2 is a rating scale widely used to determine the severity of ASD symptoms of individuals. The Arabic adaptation of this instrument, supplied by the cooperating school, was most appropriate, as all participants were native Arabic speakers. A licensed psychologist from the school trained the researcher in use of the CARS-2 assessment tool and oversaw administration to the parent participants.

Step 3: Determination of target behaviour and appropriate intervention

The researcher and each parent participant discussed by telephone the information gathered in steps 1 and 2, and agreed on a specific target child behaviour. The researcher developed an appropriate HBI to address the target behaviour, taking into account the strengths and needs of both family and child. Each parent participant reviewed the HBI for their child to ensure the intervention was acceptable to the target behaviour and consistent with their lifestyle and particular home environment.

Table 1: Parent questionnaire (conducted in Arabic)

Item	Item statement
Women caregivers' demographic background	1 How old are you?
	2 What is your relationship to the child?
	3 What is your marital status?
	4 What is your highest level of education?
	5 What is your occupation?
	6 What is your annual income?
	7 Do you receive any government funding for the diagnostic and educational services your child receives?
Child's demographic background	8 How old is your child?
	9 What is your child's gender?
	10 What is your child's primary diagnosis?
	11 At what age was your child diagnosed with ASD?
	12 Does your child have other disabilities? If yes, please describe.
	13 Does your child have any diagnosed medical conditions? If yes, please describe.
	14 Does your child take prescribed medication?
	15 Does your child have any co-occurring conditions such as hyperactivity, sleep disturbance...etc.? If yes please specify.
	16 Has your child received preschool services?
	17 Does your child attend a public or private school? How many hours per week?
	18 Please list any educational or behavioural services that your child currently receives.
	19 What are your child's favourite activities, toys and/or food?
Caregivers' priorities	20 What are some of your child's strengths and weaknesses?
	21 What is the most concerning behaviour that you would like to change?
	22 Why did you choose this specific behaviour?
	23 What do you believe is the cause of this behaviour? What purpose do you think this behaviour serves for the child?
	24 Can you explain how you currently respond to this behaviour? How do other family members respond to the behaviour?
	25 Have you previously sought help to change this behaviour? If yes, describe.
	26 Did you learn skills to help manage the behaviour?
	27 Does this behaviour occur in different settings?
	28 What do you think would be an appropriate replacement behaviour?
	29 Describe your family's daily routine, including mealtime, play time, and outdoor social activities.
	30 What do you feel are potential barriers/challenges that may impact your ability to implement new strategies at your home?
	31 Are there any other family members that also helps with child care?
	32 How many hours do you work outside your home each week?
	33 What would be the best location in your home to conduct the training and implement strategies?

The HBI developed for each participant through the collaborative process, was based on ABA principles and previously developed evidenced-based parent training programs and HBI, to meet the individual needs of each child and their family (Cooper et al., 2007; Connolly, 2015; Scahill et al., 2016). An important consideration of the HBI development was the usability and appropriateness according to the culture and lifestyle of each family. Lifestyle considerations included aspects of each family such as family schedules and available space in the home. Cultural factors included providing all instructional materials in the family's native language, Arabic, and assuring that pictures in the materials were consistent with religious and cultural norms, including portraying persons in native dress and references to familiar food and items. The intervention took place within the home of each participant in an area comfortable and familiar to the child and appropriate for the particular targeted behaviour and skills, such as a family room or an outside play area.

Measures and procedure

This study involved the measurement of two dependent variables: (1) the ability of the parent to deliver instruction based on ABA methodology to their children with fidelity; and (2) the children's level of skill acquisition as determined by each child's demonstration of appropriate targeted behaviours previously determined through the three step consultative process.

The researcher collected pre-intervention observational data in the family homes for the purpose of establishing a baseline of proficiency for both dependent variables. In each case the parent participant with the most stable baseline began the intervention first. The same sequence was followed with each participant, until all participants had received the intervention. After completion of the intervention, the researcher conducted post-intervention probes to ensure that the participants maintained the skills they learned without the intervention remaining in place.

Dependent variable 1: Level of parental skill in instruction delivery

The training and observational data collection was conducted by the researcher through individually scheduled home visits for each parent participant, for all phases of the project, i.e. pre-intervention probes, intervention, and post-intervention probes. Baseline data was collected as to the parent participants' implementation of ABA strategies using the specifically designed fidelity checklist shown in Table 2 (Phosaly, 2017; Nicksic-Springer, 2016; Taylor, 2014). As previously mentioned, the parent participants had received theoretical training on ABA principles as a part of a larger study, however, no applied ABA training had been received by any of the participants in this study, or through other sources. Through that training, the participants (parents) learned about some of the basic principles of ABA, such as reinforcement, punishment, and schedules of reinforcement. Therefore, the pre-intervention data documents the ability of each parent participant to deliver the instruction to their child including relevant data collection, without systematic training from a qualified professional.

Table 2: Fidelity checklist for participant implementation

Criterion	Yes	No
1 Have materials available and organised (data sheet, child's preferred reinforcement, items, etc.).		
2 Caregiver gained child's attention before making a request.		
3 Caregiver delivered an appropriate stimulus as written in program plan (word and sound).		
4 Caregiver allowed time (3-5 seconds) for child to respond.		
5 Caregiver immediately reinforced correct response or, ignored inappropriate behaviour.		
6 Caregiver presented the antecedent stimulus multiple times in a single session. <i>Note: A specific criterion was not set due to the different skills being targeted for each child</i>		
7 Caregiver implemented the strategies as stated in the program plan.		
8 Caregiver provided a prompt (verbal, gestural, or physical) to achieve the target behaviour.		
9 Caregiver used the monitoring progress data sheet to record the child's response.		
10 Session ended with child demonstrating mastery of skill.		

Note. Checklist adapted from Phosaly (2017).

During the pre-intervention probes, the researcher observed the participants (parents) working with their children on the target behaviours, including their ability to document child responses on specifically designed data collection sheets, and documented both the parent and child responses. During the pre-intervention phase, the number of observations differed for each participant due to the study design: multiple probe across participants. Because of this, the participants who began the intervention later in the study received more observations. The same measures were conducted in pre- and post-intervention probes for the participants (parents and children). A criterion of at least 80% accuracy was set for the post-intervention probes to determine the participants' level of skill acquisition.

Dependent variable 2: Child's acquisition of skills

Skill acquisition was determined by each child's ability to provide the correct responses for the previously selected target behaviour. The parent participants collected frequency or rate data for their child regarding the target behaviour. For measures of frequency, the participants presented 10 trials in pre-intervention and post-intervention probes. As for measures of rate, the participants collected data as to the number of times the target behaviour occurred in a 10-minute period in pre-intervention and post-intervention probes. Table 3 provides a description of the target behaviour for each child, the method of measurement, and the type of intervention materials used.

Table 3: Description of participant goals, interventions and materials

Mother /child code	Parents' goals for child	Intervention	Materials	Data collection method
A	Increase social communication	Picture exchange communication system (PECS)	Program plan, data collection sheet, pictures for child's favourite food and daily activities as reinforcers	Frequency data collection sheet
B	Increase self-care	Task analysis	Program plan, data collection sheet, visual steps of toileting, social reinforcement (praise), tangible reinforcers	Frequency data collection sheet
C	Elopement	Antecedent intervention	Program plan, data collection sheet, green and red cards, social reinforcement (hug and praise), tangible reinforcers	Frequency data collection sheet
D	Increase social communication	Instruction in question-asking procedure	Program plan, data collection sheet, child's favourite food, drink, and toys/activities, opaque bags	Frequency data collection sheet
E	Increase social communication	Instruction in question-asking procedure	Program plan, data collection sheet, child's favourite items and activities, opaque bags	Frequency data collection sheet

Intervention

The intervention sessions took place in the participants' home and were approximately one hour in duration at a frequency of three times per week during a convenient time for the participants. For each targeted behaviour a task analysis was completed, which determined the specific steps followed during each phase including pre-intervention, intervention and post-intervention phases. The researcher modelled correct delivery of the antecedents, data collection of correct and incorrect responses, and appropriate presentation of consequences for correct and incorrect responses. After the researcher presented the models, the participants (parents) had the opportunity to deliver the trials themselves, receiving immediate feedback from the researcher.

The participants were encouraged to deliver the intervention to their child each day, beyond the three training periods each week. The researcher was present at the participants' homes three times a week to work with the participants (parents) and collect inter-observer agreement. Therefore, all of the parents practised delivering the intervention, including collecting and recording data a minimum of three times per week with the set criterion of 80% accuracy.

Inter-observer agreement

A high percentage of agreement among two or more independent observers is important to demonstrate reliability of the data collected to measure the same event/behaviour (Watkins & Pacheco, 2000). To determine the level of inter-observer agreement, the number

of steps completed accurately by the participant were divided by the total number of steps, and then multiplied by 100 according to the checklist shown in Table 2. The researcher collected inter-observer agreement data during the three weekly intervention training sessions until the participants delivered instruction with 80% accuracy.

Results

There were a total of 10 participants (parents $n=5$, children $n=5$) who completed the study. Participant responses between pre-intervention probes, intervention, and post-intervention sessions were compared. The results showed significant improvements in the participants' (parents) ability to deliver instruction to their children with fidelity. Across all participants (parents and children), pre-intervention baseline data shows that the parents delivered instruction with 0 percent accuracy and correct responses for the children was 0. This is expected since the parents had not received any training in intervention delivery at this point. However during the intervention training, the data indicated that the parents were able to deliver the interventions with 70% to 100% accuracy. Post intervention probes indicate that this accuracy was maintained, with a range of 80 to 90% accuracy. The following sections will report on specific data for each of the parent and child participant pairs. See Figures 1 (parent participants) and 2 (child participants) for the graphed data.

Participant A results

During the intervention, Participant A (parent) delivered instruction to her child in 9 sessions with an average of 87% accuracy. In the post-intervention probe, Participant A (parent) delivered instruction to her child with 100% accuracy. Participant A (child) received instruction in 9 sessions with an average of 79% accuracy. In post-intervention probes, Participant A (child) demonstrated 100% accuracy when performing the target behaviour.

Participant B results

During the intervention, Participant B (parent) delivered instruction to her child in 11 sessions with an average of 86% accuracy. In the post-intervention probe, Participant B (parent) delivered instruction to her child with 90% accuracy. Participant B (child) received instruction in 11 sessions with an average of 77% accuracy. In post-intervention probes, Participant B (child) demonstrated 80% accuracy when performing the target behaviour.

Participant C results

During the intervention, Participant C (parent) delivered instruction to her child in 11 sessions with an average of 87% accuracy. In the post-intervention probe, Participant C (parent) delivered instruction to her child with 66% accuracy. Participant C (child) received instruction in 11 sessions with an average of 79% accuracy. In post-intervention probes, Participant C (child) demonstrated 100% accuracy when performing the target behaviour.

Participant D results

During the intervention, Participant D (parent) delivered instruction to her child in 10 sessions with an average of 86% accuracy. In the post-intervention probe, Participant D (parent) delivered instruction to her child with 80% accuracy. Participant D (child) received instruction in 10 sessions with an average rate of .49 correct responses per minute. Participant D (child) maintained a level of .6 correct responses per minute when performing the target behaviour in post-intervention probes.

Participant E results

During the intervention, Participant E (parent) delivered instruction to her child in 10 sessions with an average of 90% accuracy. In the post-intervention probe, Participant E (parent) delivered instruction to her child with 100% accuracy. Participant E (child) received instruction in 10 sessions with an average rate of 1 correct response per minute. Participant E (child) maintained a level of 1.4 correct responses per minute when performing the target behaviour in post-intervention probes.

Results for the five participants are shown graphically on the next two pages (860 and 861), in Figure 1: Parent intervention results, and Figure 2: Child participants results, including pre-intervention probes, the intervention sessions, and the post-intervention sessions (use the "zoom in" function in web reader or PDF reader to obtain legibility).

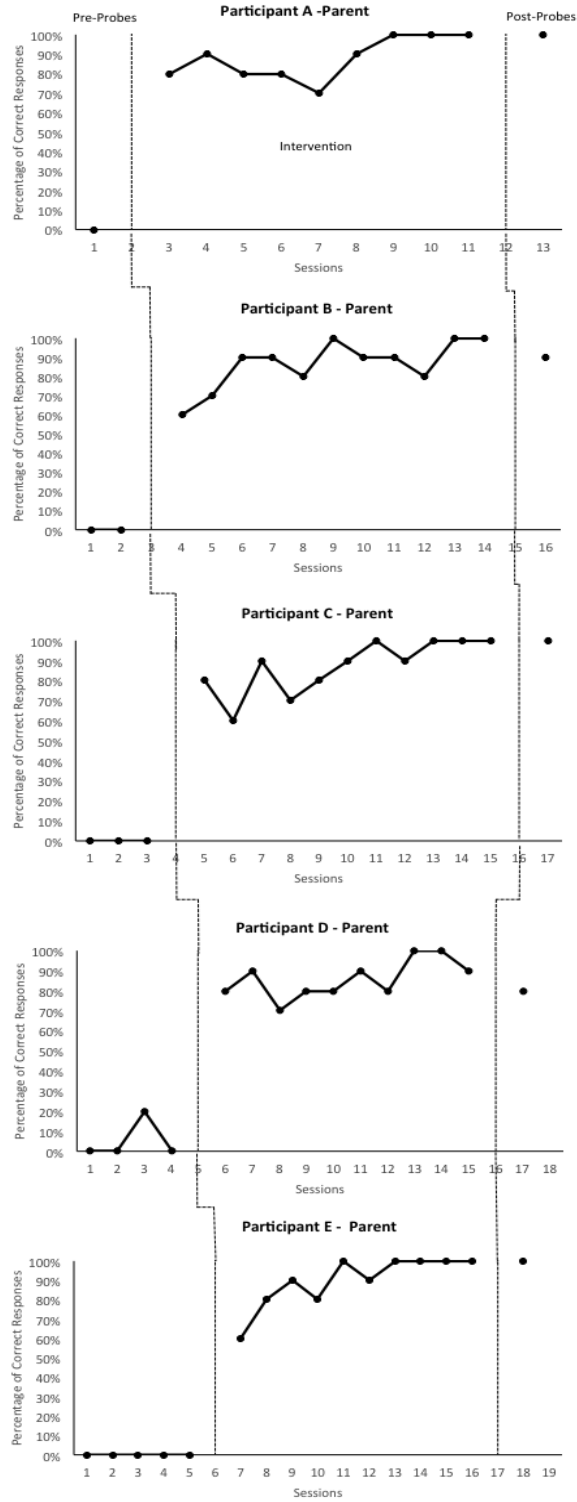
Research findings and discussion

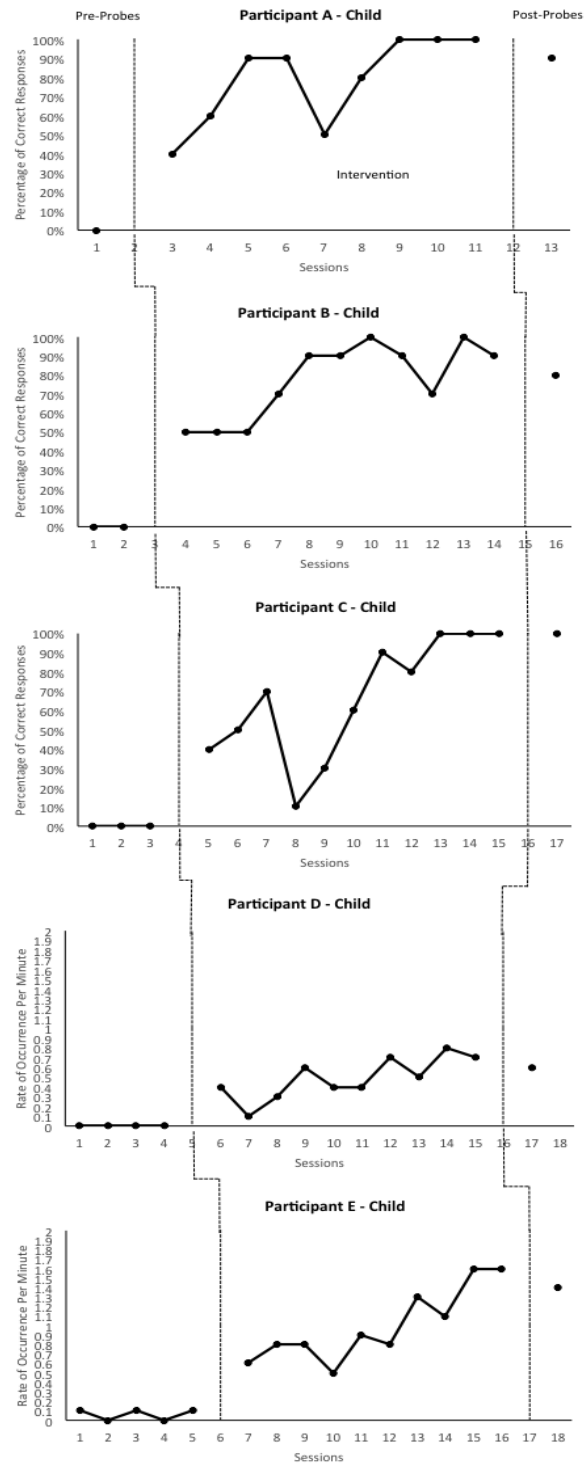
The purpose of this study was to better understand if a specifically designed and culturally appropriate HBI program could be an effective support for mothers of children with ASD who live in areas with few resources, such as Saudi Arabia. In addition, we wanted to learn more about effective ways to train parents to teach their children with ASD in home-based settings using ABA evidence-based practices to understand more about effective ways of supporting parents while they are teaching their children using the ABA evidence-based practices. Further, we wanted to learn more about the effectiveness of adapting the HBI to meet the cultural and lifestyle needs of participants (parents and children).

Addressing a critical need

There is a lack of quality services and support for children with ASD and their families in Saudi Arabia, particularly in rural and remote areas (Alotaibi & Almalki, 2016; Alnema et al., 2017). Currently, there is a lack of accurate information as to the prevalence of ASD and specific numbers of families and their children in need of services overall in Saudi Arabia and the government is actively taking steps to acquire this information. The Custodian of the Two Holy Mosques approved a national survey in October 2021.

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The aim of this government endeavour is to gain accurate statistics concerning ASD diagnoses in Saudi Arabia to improve the understanding and management of ASD.

Consistent with the results of this study are those of a recent scoping review conducted by Lee and Meadan (2020), which investigated the viability of training parents of children with ASD in low resource areas, as defined by the United Nations, to implement interventions to their children with ASD in their naturalistic home setting. Although available research is scarce, consistent with this study, the results indicated that HBI may be a viable solution to support families who reside in low resource areas such as Saudi Arabia. A crucial finding, it should be noted, was the strong relationship between the adaptation of the intervention to be culturally appropriate and the parents' willingness and ability to successfully implement the intervention (Lee & Meadan, 2020).

Cultural fit and individualisation for each family

The results of this study supported findings of previous research that HBI can be an effective method of supporting the development of children with children with ASD and their families in limited-resources areas (Suppo & Mayton, 2014; Tran, 2018). For instance, Sneed (2021) compared parent-led and practitioner-led interventions and found that both groups had similar positive improvements for children with ASD.

Particular care was given in this study to ensure a good fit with the lifestyle, routines and culture of the family as well as the community culture. Continual consultation with the family allowed for appropriate individualisation of the treatment plan, including specific design according to the family's culture and lifestyle. This component allowed the researchers to include further details, such as: timings of the training, identification of strategies that are feasible for parents to implement, and choosing target child behaviours that are priorities for the family. All of these are critical elements which influenced the level of motivation and commitment of the parent participants. This purposeful effort to understand the parents' priorities for their child and family, involving them in the development of an effective intervention provided agency for the families and was important in the development of an effective intervention with social validity.

Importance of individualised in-home supportive instruction

Although the parent participants had received theoretical training on ABA principles before beginning the study, the baseline data clearly demonstrated that this important foundational knowledge was insufficient for successful parent implementation of the strategies. Even with access to written materials from their previous training, the participants were not able to systematically teach their children. It was the in-home instruction with immediate feedback and modelling from the researcher that significantly influenced the way the participants (parents) delivered instruction to their children.

The level of commitment and motivation of the parents definitely appeared to influence outcomes. All of the parents were encouraged by the researcher to implement the strategies as a part of their daily routine. However, the parent-reported level of implementation

outside of the times the researcher was present varied. This reported level of implementation was consistent with parent and child outcomes. In general, the participants (parent/child pairs) that engaged more with the interventions demonstrated more positive outcomes. Specifically, the parents were better able to deliver the intervention, and the children demonstrated improvements regarding the targeted behaviours.

Effects of Covid-19 and other environmental factors

Environmental factors such as the presence of a worldwide pandemic, Covid-19, and the remote location of the families, meant that very few other resources were available. Receiving services and education at centres and schools was not an option for an extended period of time during the pandemic; therefore, HBI, with appropriate precautions such as social distancing and mask wearing, was a much-needed solution for families. In spite of these necessary restrictions, parents may have been more motivated to engage and follow through with the training, since they had fewer outside distractions and more time at home.

The current study demonstrated that HBI may be an important method to support families of children with ASD during Covid-19, because their ability to access and receive ASD services was restricted even more. Finally, the preventive health measures required by the World Health Organization during the pandemic negatively impacted children with ASD and their families (Althiabi, 2021; Baweja et al., 2022). Shortage of ASD services worldwide due to the suspension of diagnostic services, closure of centres and schools, lack of available support from therapists and professionals, are severe and negatively affect developmental outcomes of children with ASD (Althiabi, 2021; Baweja et al., 2022). In addition, imposed social isolation presents severe psychological challenges for the families.

Limitations

This study provided important information regarding the development of effective HBI for children with ASD which are culturally appropriate for families in remote areas. However, ASD has a heterogeneous nature, with symptoms and severity varying greatly across individuals and the needs, priorities and requirements are also different from family to family, making it difficult to generalise across the population. In addition, the participants for this study consisted of a small number of parent and child participants; the findings may or may not generalise to other families who have children with ASD.

The study, as previously discussed, was conducted during the time of Covid-19, a worldwide pandemic, requiring important restrictions to protect the health of the families and the researcher. These restrictions, such as mask wearing and maintaining social distance, while necessary, also impacted the ability of the researcher to model the HBI strategies and may have impacted the fidelity of training and data collection. Further, due to the restrictions present at the time of the study, only one post-intervention probe was completed. Collection of additional post intervention probes to determine if the parents maintained the skills they were taught in delivering instruction to their child would increase important information regarding the study validity.

Video communication and recording is an effective strategy often utilised for teaching and data collection and can be particularly useful for families in remote areas. However, societal cultural norms precluded the use of video. This limitation particularly restricted the researcher's ability to collect inter-observer agreement data, and may have impacted the results. This limitation could be mitigated if additional researchers were available to collect additional data. Finally, although the parent participants had a set performance criterion, the child participants' performance was measured only as to whether there was an increase. More specific criteria measuring the amount of increase would strengthen the research.

Future research

This study provided valuable information as to the feasibility and effectiveness of a culturally and environmentally appropriate intervention for families of children with ASD, especially those who reside in resource poor areas such as Saudi Arabia and have little access to educational resources for ASD (Alnemary et al., 2017; Alotaibi & Almalki, 2016; Kelly et al., 2016; Taha & Hussein, 2014). This research is particularly notable as it provides information with important links between two disparate types of educational activities, specifically education and support for parents as well as their children with ASD.

Without appropriate knowledge, it is difficult for parents to understand how to search for resources, effectively advocate for their children or to be able to provide at home instruction for their children. Further, the majority of the research currently available regarding effective education and support for families of children with ASD, including the effectiveness of HBI, has been conducted in Western, English speaking countries. More research is needed to understand how culturally appropriate, research based HBI, can support families and their children in remote, resource poor locations (Kelly et al., 2016; Zeina et al., 2014).

It is well established that early intervention is critical for children with ASD with clear benefits which improve immediate quality of life such as reduction of ASD symptomology and improved long-term outcomes such as improved functioning in academic and social settings. Therefore, future research focusing on early support for parents and their families with recent diagnosis of ASD in Saudi Arabia is crucial. Particularly in low resource areas such as Saudi Arabia, providing this critical support in culturally appropriate, assessable methods such as HBI, delivered with fidelity, may improve outcomes for children with ASD as well as providing support for their families. This may overcome barriers such as scarcity of resources and lack of transportation, especially for families living in remote areas. Further, parental training for HBI may mitigate other negative factors such as parental stress and financial strain, while also meeting their child's needs.

HBI services can provide effective, comprehensive support for parents of children with ASD to understand the disorder, have the skills to support their child's development, and be proactive advocates to access available community and educational services (Shahidullah et al., 2018). HBI training programs may also be able to support reduction of stress and overall parent mental health with training in such coping strategies as relaxation techniques and mindfulness-based intervention, providing more information for effective avenues of

support in the areas of mental health, self-efficacy, well-being, and parenting skills. Future research into how to provide a holistic HBI model is needed and may help to close the gap experienced by many parents of children with ASD to access effective services that are appropriate for their values, culture and lifestyle, no matter where they may live.

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