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# Training of a robot-based psychological intervention program to prevent inappropriate touching of children

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## Abstract

**Background** This study aimed to evaluate the effect of a robot-based psychological intervention on the prevention of inappropriate touching of children. The trial was registered in the International Clinical Trial Registry Platform with the registration id of ISRCTN17186302.

**Results** In this study, the intervention had a positive effect on inappropriate sexual care in elementary school children ( $P < 0.01$ ). Moreover, education on sexual care heightened children's knowledge about inappropriate touch ( $P < 0.01$ ).

**Conclusion** According to the results, the robot-based psychological intervention had an impact on children's sexual care. It is suggested that this method be applied by counselors and psychologists as a therapeutic approach.

**Keywords** Inappropriate touching, Prevention, Psychological intervention, Robot-based

## Background

Children make up a majority of the population in the world's developed countries and approximately share 50% of the total population [1]. Child sexual abuse is one of the most common and most complicated psychosocial issues in societies. The phenomenon has an undeniable impact on the psychological health of children and is recognized as a social problem that has detrimental effects on the lives of young individuals in the world. Sexual abuse crime rate will continue to rise, plunging the future of hundreds of children into uncertainty [2]. In fact, sexual abuse has the most impact on the life and future of a victim of abuse. Nevertheless, an increase is observed in the child sexual abuse rate every day in all communities.

There are no accurate statistics on child sexual abuse in Iran, and experts' efforts are required to prevent the occurrence of such phenomena. Assessing and providing psychotherapy and counseling services to prevent such crimes are more economical, compared to treatments after an incident, and decrease such disorders [3].

Children over 3 years old begin to understand some concepts related to sexual issues and related care and can increase their personal safety skills and knowledge about these abilities [4]. Children learn communication skills, interpersonal problem solving, and coping skills to deal with these problems through education and counseling by psychological interventions (e.g., cognitive-behavioral behaviors, cognitive-behavioral approaches, support therapies, interpersonal psychological interactions, and mindset) [5]. The education field plays the most important role in the prevention of child sexual abuse.

It has been emphasized that children and adolescents who have been trained at younger ages have properly used their knowledge in this area. However, providing education in a novel and interesting way, such as using robots, will have more effective results [2].

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At around age three, children begin to understand some concepts related to sexual and individual care and can increase their personal safety skills and knowledge about these abilities. Short-term training is effective in this area [6]. According to Ige and Fawole (2011), pre-school children can learn prevention skills and concepts [7]. Children can be taught communication skills, interpersonal problem solving, and coping skills (e.g., the ability to be assertive and the ability to say no) by teaching and informing through psychological interventions (such as behavioral, cognitive, cognitive-behavioral approaches, supportive therapies, interpersonal psychology, and mindfulness). These skills and psychological interventions ultimately help protect children from sexual abuse risks [2]. In a study, Tahan (2019) evaluated the role of artificial intelligence (AI) in psychology, aiming to determine how AI can increase self-awareness through computer psychotherapy tools [8]. Recent studies have shown that human–robot interaction (HRI) plays a considerable role in education, informing, and treatment of many diseases [9]. Applications of robots in the diagnosis and treatment of Autism have been successful, as reported by Soleimani Dehkordi et al. (2015) and Atherton and Goodrich (2011) [10, 11].

Robots can encourage children to interact based on functional communication with robots. In addition, they can increase social interaction skills in children with Autism [12]. A smart robot can teach children with disorders in the age range of 3–10 years. In fact, smart robots are trained to improve social and communication skills in children. Early action increases the possibility of recovery in such children.

Studies show that the use of social assistance robots helps improve children's emotional and social behaviors. The main objective of researchers is to use these robots to help children communicate and learn about psychological interactions. Over the years, social robots have been developed to introduce and improve HRI. These robots are designed to interact with humans to meet specific social needs, such as companionship, play, and entertainment. Among various applications, social robots have been recently applied in the treatment of diseases, including autism spectrum disorder (ASD) [11, 13]. Compared to animals, robots are harmless, compatible devices that can perform predictable actions along with specific voices [14]. Since robots are attractive to children, they can be proper role models for teaching children. In fact, children can learn coping skills against sexual abuse risks by learning to observe and imitate these robots.

Therefore, given the attractiveness of robots for children, the current research aimed to use the idea of robots in the prevention of child sexual abuse. Robots attract children and can be useful for strengthening their

communication and reducing their problems. With this background in mind, the current research attempted to answer this question: does a robot-based psychological intervention program affect the inappropriate touching of children?

## Materials and methods

This study was conducted as a randomized controlled trial with pretest/posttest designs and control groups, and a follow-up stage was added for the two tests and their control groups. The follow-up stage was carried out 3 months after the intervention. The trial was registered with the International Clinical Trial Registry Platform, and its registration ID is ISRCTN17186302. The statistical population included all elementary school children aged 8–12 years (male and female) in Qaenat, Iran, in the academic year of 2018–2019. In total, 80 children aged 8–12 years were selected by stratified random sampling and were randomly divided into two control and test groups of 40 (20 female and 20 male students per group).

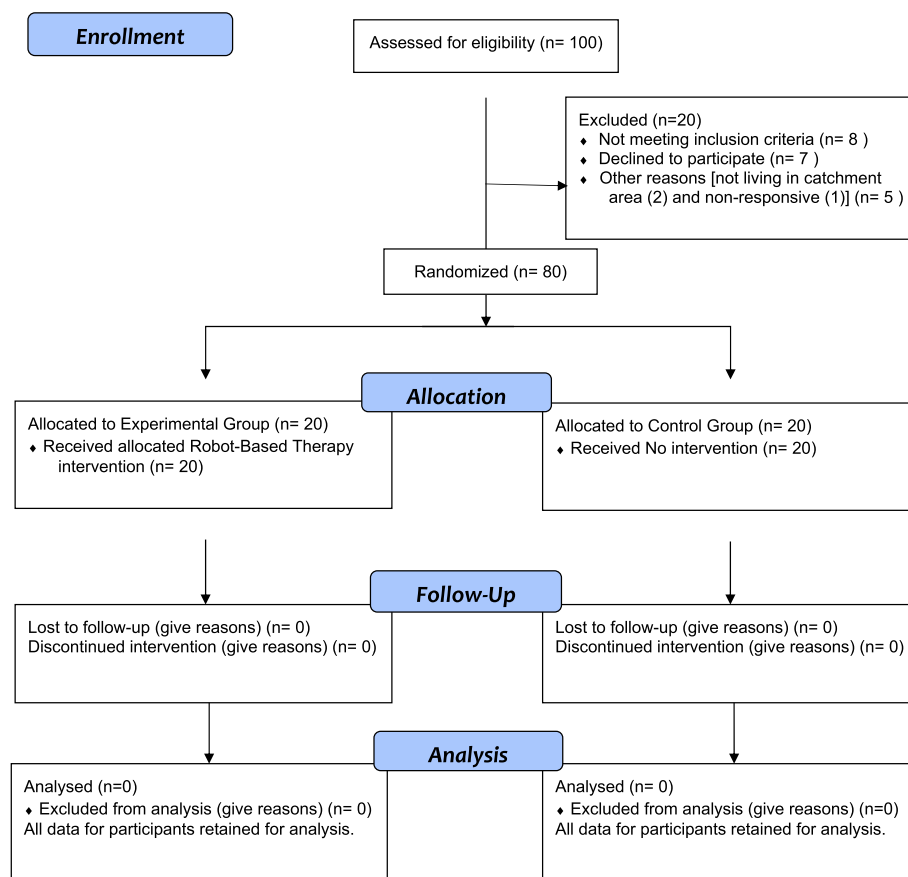
**Inclusion criteria:** A willingness to participate in the study, an age in the range of 8–12 years, no history of acute psychological or physical diseases, and a consent form signed by the parents.

**Exclusion criteria:** Being absent from one educational session, simultaneous participation in a similar educational intervention, or an unwillingness to participate in this research. No one dropped out of the study, and all of the participants completed the follow-ups and contributed to the data analyses of the results. The details of enrollment, allocation, and analysis are provided in Fig. 1 (a flowchart for participants' enrollment for trial management). After the intervention, the data were analyzed with SPSS v. 25.

In this study, data were collected using a domesticized questionnaire of children's knowledge and awareness of sexual abuse [15], which is explained below:

## Questionnaire of children's knowledge and awareness of sexual abuse (child sexual care)

The questionnaire is derived from a 33-item scale on children's knowledge and awareness of sexual abuse by Leslie Maureen Tutty [15], the reliability of which has been confirmed at 0.65 and 0.74 by Jacqueline, Holloway, and Pulido (2018) and Gangos et al. (2018), respectively [16, 17]. However, Tahan, Afrooz, and Bolhari (2023) have domesticized and modified the tool based on Iranian culture [18]. The questionnaire has been designed to measure children's level of knowledge about important sexual abuse beliefs. In addition, the tool has been developed in a way that even those with no history of prevention



**Fig. 1** Flowchart for participants' enrollment for trial management

can easily comprehend the questions. The questionnaire encompasses 38 items scored based on a two-point Likert scale (true = 0, false = 1). Therefore, the minimum and maximum obtainable scores include 0 and 21, respectively. The higher the score of children, the higher their awareness of sexual abuse concepts. The questionnaire can be used for children aged 8–12 years. Overall, the tool has a general scale and two subscales of appropriate touch (eight items) and inappropriate touch (thirty items). Data were collected from 80 children, and validity was tested by K-R20 test and confirmed at 0.87.

## Implementation

Teachers recommended parents to participate in a briefing meeting to learn about the research objectives and implementation stages, following necessary approvals from the head of education in Qaenat and a license from the Vice Chancellor for Research at Is IAU, Birjand. Ethical guidelines for research were also provided to the parents. Those parents who expressed interest in participating in the study were required to sign a written

consent letter granting permission for their children to participate in the study.

Although the parents' consent was legally required, it was also crucial to obtain the assent of the children themselves, even though they cannot legally provide informed consent. Assent is a form of affirmative consent in research involving minors. To ensure the children's understanding and agreement, the researcher prepared an assent form and read it aloud to each child. The children were given the opportunity to decide whether they wanted to participate or not, thus empowering them to express their willingness to be part of the study. During a meeting, 80 children were selected and allocated to one of two groups: A test group or a control group. First, all students completed the questionnaire. The scores were recorded as the pretest scores (pretest assessment was carried out 2 days before treatment). The test group subjects attended 10 sessions (each 45 min) of psychological intervention (with robot) spanning 5 weeks (twice weekly group session). The first meeting took place at Payam-Salamat Clinic, where the research

**Table 1** Mann–Whitney *U* results to compare the subjects in the test and control groups regarding mean age

| Variable | Group   | N  | Min  | Max   | Mean | Avg   | Z-statistic | Level of significance |
|----------|---------|----|------|-------|------|-------|-------------|-----------------------|
| Age      | Test    | 40 | 8.00 | 12.00 | 9.75 | 40.50 | 0.000       | 1.000                 |
|          | Control | 40 | 8.00 | 12.00 | 9.75 | 40.50 |             |                       |

**Table 2** Descriptive indexes of research variables in the test and control groups

| Components | Stage     | Test  |                    | Control |                    |
|------------|-----------|-------|--------------------|---------|--------------------|
|            |           | Mean  | Standard deviation | Mean    | Standard deviation |
|            | Pretest   | 12.20 | 3.84               | 14.50   | 4.02               |
|            | Posttest  | 13.57 | 4.36               | 13.42   | 4.18               |
|            | Follow-up | 16.45 | 4.03               | 13.15   | 3.04               |

program was initiated. Each session commenced with the researcher re-explaining the topic, followed by the presentation of educational content delivered by a therapist assisted by a robot using tools such as Power-Point presentations and videos. The material relevant to each session was emphasized after the training, and a review of the educational content was conducted, addressing any questions or tasks from the previous session. Participants were given assignments to complete to apply their newly acquired skills.

In contrast, the control group received no treatment throughout the study. Two days after the educational sessions, both groups were administered a questionnaire as a posttest. As part of the follow-up stage, all participants completed the questionnaire once more 3 months after the intervention. This follow-up facilitated an assessment of the participants' retention of knowledge and skills over time. It is worth noting that the response rate of the program was 100% due to the fact that the interventions were performed free of charge. In order to adhere to research principles, educational sessions were held for the control group at the end of the study.

## Findings

The present study included two test and control groups of 40 (20 female and 20 male participants per group).

According to Table 1, no significant difference was observed between the groups in terms of age ( $P=1.00$ ). Therefore, the two groups were homogenous in this regard. Hence, the difference in the inappropriate touching of the participants was not affected by their age.

Table 2 shows the descriptive indexes of the research in the control and test groups in three pre/posttest and follow-up stages.

According to Table 2, the mean inappropriate touching score of the children increased in the posttest and follow-up stages, compared to the pretest stage. Therefore, descriptive statistics confirmed the positive effect of the robot-based psychological intervention on inappropriate touching of children. In order to select the appropriate statistical method, the normality of data distribution was first investigated using the Kolmogorov–Smirnov statistical test.

The results presented in Table 3 confirmed the normal distribution of the research variables, which led to the use of parametric tests to analyze the data.

The research questions are as follows:

*“Does the robot-based psychological interventional program affect inappropriate touching of children?”*

The mentioned question was tested applying the analysis of covariance. An important point to consider in the analysis of covariance is the assumption of slope homogeneity. The results will not be accurate as long as it is not assumed that the regression slopes (b coefficients) are linear or homogeneous.

According to Table 4, the amount of *F* interaction between “group\*pretest of inappropriate touching of

**Table 3** Evaluation of the normal distribution of the data

| Components             | Stages    | Test           |                   |         | Control        |                   |         |
|------------------------|-----------|----------------|-------------------|---------|----------------|-------------------|---------|
|                        |           | K-s statistics | Probability value | Results | K-s statistics | Probability value | Results |
| Inappropriate touching | Pretest   | 0.12           | 0.13              | Normal  | 0.10           | 0.20              | Normal  |
|                        | Posttest  | 0.14           | 0.33              | Normal  | 0.15           | 0.19              | Normal  |
|                        | Follow-up | 0.10           | 0.20              | Normal  | 0.17           | 0.07              | Normal  |

**Table 4** Results of homogeneity assessment of regression line slopes related to inappropriate touching

| Source of changes                                   | Sum of squares | DF | Mean squares | F    | Significance |
|---|----------------|----|--------------|------|--------------|
| Group*Pretest of inappropriate touching of children | 42.36          | 11 | 3.85         | 0.48 | 0.91         |

children” was insignificant ( $P=0.91$ ). The assumption of homogeneity of the regression line slope was observed, which led to the implementation of analysis of covariance.

According to Table 5, the amount of ( $F_{1,75}=5.51$ ) showed the effect of the independent variable, which was significant ( $P=0.02$ ). In other words, there was a significant difference between the two groups (after modifying the effect of the pretest) in terms of the scores of inappropriate touching of children in posttest stage.

According to Table 6, the level of significance was above 0.05 for the variable of inappropriate touching (Box’s  $M=16.06$ ,  $F=1.70$ ,  $P=0.08$ ). As such, the assumption of homogeneity of variance–covariance matrixes was observed accurately.

In Table 7, Levene’s test results were indicative of the significance of results in the posttest ( $P=0.71$ ) and follow-up ( $P=0.19$ ) stages. Therefore, the assumption of equivalence of intergroup variances was observed, and the groups were homogenous in terms of the level of the error variance of the dependent variables.

According to Table 8, the significance of the stage impact was indicative of a significant difference between the test and control groups in terms of mean scores of inappropriate touching in children in the posttest and follow-up stages. In other words, there was a significant difference between the scores of these stages of the groups ( $P<0.01$ ). Moreover, the interaction between stages and the group demonstrated a significant difference in the appropriate touching in children in the two groups. In other words, there was a considerable increase in the appropriate touching in children of the two groups

**Table 6** M Results of Box’s M test for the assumption of homogeneity of variance–covariance matrixes

| Box’s M test | F    | DF 1 | DF 2      | Level of significance |
|--------------|------|------|-----------|-----------------------|
| 16.06        | 1.70 | 9    | 66,191.85 | 0.08                  |

**Table 7** Levene’s test results for assessment of the homogeneity of variances in inappropriate touching

| Variable  | F    | DF 1 | DF 2 | Level of significance |
|-----------|------|------|------|-----------------------|
| Posttest  | 0.46 | 3    | 76   | 0.71                  |
| Follow-up | 1.62 | 3    | 76   | 0.19                  |

following the elimination of the pretest’s impact at the beginning of the study. Therefore, the robot-based psychological intervention had a positive effect on inappropriate touching in children ( $P<0.01$ ).

The results showed a higher increase in the mean inappropriate touching score of the subjects in the test group, compared to the control group. Overall, it could be concluded that educational programs designed for the test group increased the participants’ score of inappropriate touching in the posttest stage, compared to the control group, showing sustainability considering the difference between the pretest and follow-up stages.

## Discussion and conclusion

The present study aimed to determine the effectiveness of a robot-based psychological intervention program on the prevention of inappropriate touching of children. The main question was as follows: “does a robot-based psychological intervention program affect inappropriate touching in children?” According to the results, the results of the analysis of covariance showed a significant impact of the independent variable on the dependent variable considering the value of ( $F_{1,75}=5.51$ ) ( $P=0.02$ ). In other words, there was a significant difference between the test and control groups in terms of the mean scores of knowledge of inappropriate touching in children in the posttest stage (with the modification of the pretest’s

**Table 5** Results of analysis of covariance related to inappropriate touching in two tests and control group in posttest

| Source of changes | Sum of squares | Degree of freedom | Mean squares | F     | Significance |
|-------------------|----------------|-------------------|--------------|-------|--------------|
| Pretest           | 642.79         | 1                 | 642.79       | 66.57 | 0.00         |
| Gender            | 6.10           | 1                 | 6.10         | 0.63  | 0.43         |
| Group             | 53.17          | 1                 | 53.17        | 5.51  | 0.02         |
| Group*gender      | 4.58           | 1                 | 4.58         | 0.47  | 0.49         |
| Error             | 724.11         | 75                | 9.66         |       |              |



**Table 8** Variance analysis with repeated measurements to compare posttest and follow-up component of inappropriate touching for children in test and control groups with pretest variable control

| Factors            | Source of impact   | Sum of squares | DF | Mean square | F     | Significance | Eta-squared | Impact size |
|--------------------|--------------------|----------------|----|-------------|-------|--------------|-------------|-------------|
| Intra-group factor | Stage              | 43.11          | 1  | 43.11       | 9.66  | 0.00         | 0.11        | 0.87        |
|                    | Stage-pretest      | 21.73          | 1  | 21.73       | 4.87  | 0.03         | 0.06        | 0.59        |
|                    | Stage*group        | 70.42          | 1  | 70.42       | 15.77 | 0.00         | 0.17        | 0.97        |
|                    | Stage*gender       | 2.08           | 1  | 2.08        | 0.47  | 0.50         | 0.01        | 0.10        |
|                    | Stage*gender*group | 0.74           | 1  | 0.74        | 0.17  | 0.69         | 0.00        | 0.70        |
|                    | Error              | 334.82         | 75 | 4.64        |       |              |             |             |
| Intergroup factor  | Pretest            | 973.04         | 1  | 973.04      | 73.71 | 0.00         | 0.50        | 1.00        |
|                    | Group              | 349.82         | 1  | 349.82      | 26.50 | 0.00         | 0.26        | 0.99        |
|                    | Gender             | 4.20           | 1  | 4.20        | 0.32  | 0.57         | 0.00        | 0.09        |
|                    | Group*gender       | 15.10          | 1  | 15.10       | 1.14  | 0.29         | 0.02        | 0.18        |
|                    | Error              | 990.11         | 75 | 13.20       |       |              |             |             |

impact). In this respect, our findings are in line with the results obtained by Najari (2018) [19], Kahrazehi and Riki-Kote (2017) [20], and Faramarzi et al. (2013) [21], which demonstrated the effectiveness of the psychological intervention in children's problems, and those obtained by Tahan (2019) [22] and Jaberzadeh Ansari (2016) [23], which confirmed the impact of education on the prevention of sexual abuse. In addition, Kozima et al. (2009) [24] and Robins (2005) [25] reported the effectiveness of robots in the treatment of children. Furthermore, Wight and Fullerton (2013) [26], Lindberg and Maddow (2012) [27], Ladapo et al. (2012) [28], and Jin (2017) [29] indicated that timely and accurate sexual training could prevent the destructive consequences.

Education of sexual care is a method to prevent child sexual abuse, which has been forgotten in children's moral, social, and cultural education. Meanwhile, the central core of the formation of the child's personality in the future is their sexual education [30]. Sex is part of the physiology and nature of an organism, and it needs to be addressed from childhood [31]. The robot-based psychological intervention increased children's sexual knowledge through the provision of accurate and clear information, thereby changing their attitudes toward appropriate and inappropriate touch. In fact, this type of training equipped children with tools against sexual and physical abuse to a great extent. The intervention was able to improve children's attitudes, coping styles, and behaviors in risky situations to a large extent by emphasizing changing children's attitudes through role modeling and playing with robots and establishing relationships with their peers and teaching them sexual care to avoid dangers [2, 32]. The more children are informed about this educational program, which is planned for their safety and health, the more they will be protected from sexual harassment [33]. The

robot-based psychological intervention was able to prevent problems such as sexual perversion, sexual abuse, and high-risk behaviors by changing children's attitudes in inappropriate touch care [34]. Therefore, our findings confirmed the effectiveness of the intervention implemented in the research.

One of the major drawbacks of the present study was a lack of domestic research on this interventional program and collecting information through self-report. It is recommended that all the facilities such as visual and written media, appropriate scientific content on websites, training of professional instructors to attend schools and universities at various levels, and creating specialized courses by medical and psychological organizations be used to improve this area.

In Tahan's research (2019) [22], other findings were further experienced as follows. The reluctance and concerns in some of the subjects' parents were observed, because they found the work difficult due to their misconceptions and shame about sexual issues, sexual care, and ignorance of raising sexual issues with their children. Sex and any related subjects even in the field of research and prevention could also produce special fears, concerns, and taboos in most managers, while welcomed by many parents and teachers. Creativity in education could thus lead to indefinable excitement in the students, and what was not so much a taboo could be the ugliness of the words, sexual, and immoral. The feeling of the researcher and the colleagues, like many parents, was a kind of transformation of joy and hope, while at the same time, impression and disgust were lost from the lack of such methods and experiences in families and schools.

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### Authors' contributions

MT wrote the manuscript. MT, GA, and JB assisted in the methodology and planning of the clinical trial. GA, JB, and MT revised the draft of the manuscript. All authors have read and agreed to the published version of the manuscript.

### Funding

Not applicable.

### Availability of data and materials

The authors confirm that the data supporting the findings of this study are available within the article.

### Declarations

#### Ethics approval and consent to participate

As a part of adhering to ethical considerations in this study, the parents of children who were interested in participating were asked to sign a written letter of consent for their child. These participants were assured that their personal and private data would remain confidential and that this study complies with all religious and cultural standards. For the record, this research was approved by the Ethics Committee at the Islamic Azad University with a code of IR.IAU.BOJNOURD.REC.1398.004 and a number of ISRCTN17186302 on the International Clinical Trial Registry Platform.

#### Consent for publication

Not applicable.

#### Competing interests

The authors declare that they have no competing interests.

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