BMC Pediatrics

RESEARCH Open Access

BASNEF behavioral transformation: effect of empowerment program on children's knowledge, attitude, self-efficacy, and practice of nail biting

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Abstract

Background Nail-biting or onychophagia is a common phenomenon affecting children. Excessive nail biting is associated with several adverse consequences beyond mere appearance. The aim of this study is to evaluate the effect of an empowerment program based on the BASNEF model on children's knowledge, attitude, self-efficacy, and nail-biting practice.

Method A quasi-experimental study was conducted in the pediatric wards of Menoufia University Hospital and Benha University Hospital. A convenience sample of 135 children (6 to 18 years) was randomly assigned to the study or control group who received routine care. To effectively measure the dependent variables, four questionnaires were developed and tested for content validity, stability reliability and internal consistency. Exploratory Factor Analysis (EFA) identified the underlying factors while the findings of the Confirmatory Factor Analysis (CFA) demonstrated a satisfactory fit. The researcher developed the session objectives, learning activities and designed a booklet with relevant content. The participants of the study group were divided into sub-groups (six children and their mothers) who attended four empowerment sessions based on the BASNEF model, emphasizing (a) age-appropriate information, (b) fostering a positive attitude towards quitting nail-biting, (c) discovering the subjective norms, perceived social expectations, and influences of nail-biting behaviors, and (d) equipping children with enabling factors to quit. The comparison between the two groups was done using the Mann-Whitney (U) test, while the Wilcoxon Signed Rank test conducted for the intragroup comparison.

Results There was a significant improvement in knowledge about nail-biting among children in both groups and a noticeable decline in the nail-biting habits/practices among children in the study group (22.42 ± 5.69) compared to the control group (42.76 ± 6.75). The attitude scores towards nail-biting significantly improved among children in the study group compared to the control group with appositive impact on children's self-efficacy in controlling the habit ($P < 0.001$ for each).

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Conclusion The empowerment program based on the BASNEF model effectively improved children's knowledge, attitude, self-efficacy, and practice of nail biting.

Trial registration number Trial registration number: NCT06471153, ClinicalTrails.gov, Retrospectively registered June 18th, 2024), URL of trial registry record: https://clinicaltrials.gov/ct2/show/NCT06471153.

Keywords BASNEF Model, Children, Knowledge, Nail biting, Practice, Self-efficacy

Introduction

Nail-biting, or onychophagia, is a pathological oral habit of destructive biting and shredding of one's fingernail, cuticles, and surrounding tissue [1]. Nail-biting is a common phenomenon affecting children aged three to four and can extend into adolescence [2, 3]. Darwish (2020) found that children between the ages of 6 and 12 were more likely to bite their nails than other age groups, with a rate of 41.07% [4]. The literature estimates that nail-biting affects 20–30% of the general population [5, 6]. In Egypt, the prevalence of nail biting is 37% among individuals between the ages of 3 and 21 years, where children bite their nails 9.7% of the time [7].

Several factors may contribute to the phenomenon of nail biting. Some children use nail-biting as a coping mechanism in response to feeling stressed and disappointed, bored, nervous, hungry, or lonely [1]. Besides, anxiety, Attention-deficit/hyperactivity disorder (ADHD), nocturnal enuresis, oppositional defiant disorder, and separation anxiety are always associated with nail biting. Pathologically, uncontrollable nail biting is the most common Body-Focused Repetitive Behavior, such as lip-biting, teeth-grinding, hair-pulling, etc [8].

Adverse consequences of excessive nail biting might go beyond mere appearance [9]. Repeated nail biting may lead to various localized problems. The child may experience ingrown nails, nail discoloration, and separation of the nail plate from the cuticles and nail bed (Onycholysis). Habitual nail nibblers can also develop paronychia, a localized inflammation and infection of the fingertip, usually accompanied by redness, swelling of the skin adjacent to the nail, pain or bleeding, and pus formation that requires surgical evacuation [10]. In some cases, nail-biting may lead to accidental oral soft tissue injuries, jaw pain, and gastrointestinal infections, where the microorganisms transmit from the fingers to the mouth and gut. According to the American Dental Association (2023), nail biting may result in dental misalignment or chipped teeth that require corrective care [7]. It can also increase the risk of root resorption and tooth loss for children with braces. If nail biting is not stopped, it can permanently wear down the incisal margins of the anterior teeth [11].

Currently, there is growing awareness of the underlying causes or the possibility of long-term effects of nail biting [9]. Some parents may attempt to force their children to stop this habit. Such a robust approach may only generate a short-term fix and make children feel insecure on social and emotional fronts. Therefore, a thoughtful and progressive stopping strategy such as behavioral therapy is necessary to improve conditions and extend the life span of healthy lifestyle changes [12].

The BASNEF model is one of the educational frameworks used for behavior transformation. It is widely used in educational initiatives to develop new attitudes towards healthy behaviors and break unhealthy habits [13]. This model suggests that an individual's intention to a particular behavior is influenced by their beliefs, attitudes, subjective norms, enabling factors, and self-efficacy. These factors interact and ultimately shape the decision to adopt or reject a specific behavior [14]. It has been documented that "Beliefs" are at the top of the graphical presentation of the BASNEF model. So, empowering children to give up nail biting should start with enriching their knowledge, perceptions, and understanding of the consequences of this act. This mainly influences their attitudes toward nail-biting and stimulates the intention to change their behavior [12].

By the BASNEF model, the intention alone is insufficient to stop nail biting, where significant subjective norms and enabling variables are essential. Subjective norms represent a child's perception of social pressure or influence to commence or not be engaged in nail-biting episodes [12]. It includes the influence of others' expectations, such as family, friends, or healthcare professionals, and the degree to which the child feels obligated to conform to those expectations [15]. Hence, involving the parents in the behavior change process is crucial to foster children's self-efficacy and refrain from engaging in previous unhealthy behaviors [16].

Since there are limited research studies focused on enabling children to quit nail-biting habits, the current study intervention has the potential to address the multifaceted nature of nail-biting behaviors [17]. Incorporating BASNEF model elements would prove that behavior change is not only about knowledge but also about attitudes, social influences, and practical support. By targeting these factors, the program seeks to empower children with the tools and skills necessary to successfully quit the habit, maintain long-term behavior change, and promote their overall well-being.

The study aims to evaluate the effect of an empowerment program based on the BASNEF model on children's knowledge, attitude, self-efficacy, and practice of nail biting.

Research hypothesis

H1: The application of an empowerment program based on the BASNEF model has a positive impact on children's knowledge, attitude, self-efficacy, and practice of nail biting.

Methods

Research design A quasi-experimental, pre-posttest, two-group study was conducted in the pediatric wards of Menoufia University Hospital and Benha University Hospital.

Participants The sample size was determined using G*Power 3.1.9.4 for the difference between two independent variables, with a Power of 95%, an alpha set at 5%, an effect size of 0.89, and allocation N2/N1 = 1 [18]; the sample size required for the former analysis was 134 (67 for each group). A dropout rate of 20% was anticipated; thus, we aimed to recruit an additional 28 participants.
The study subjects comprised a convenience sample of 135 children who fulfilled the following inclusion criteria: Age range from 6 to 18 years, had nail-biting habits, and were willing to attend the educational sessions. However, the exclusion criteria included; children who have a history of mental retardation or any psychiatric illness.

During the study period (April 2023 to December 2023), 135 out of 196 eligible participants were randomly assigned to one of the following groups: the study group received the empowerment program based on the BASNEF model ($n = 67$), and the control group received the routine care ($n = 68$), as illustrated in Fig. 1.

Data collection instruments

To effectively collect the required data, researchers developed four tools about knowledge, practice/habits, attitude, self-efficacy, subjective norms, and enabling factors of nail-biting habits among children. (The tools are attached as supplementary files) [19–21].

Questionnaire development

Initially, the researchers conducted an extensive review of the literature and used the BASNEF model as a framework for developing the four tools. The researchers also conducted two focus groups: one with the experts in pediatric nursing and child psychology (n = 5) and one focus group with 7 mothers of children with nail-biting habits to provide invaluable insights, identify common triggers, and explore intervention strategies. The researchers developed a discussion guide to facilitate the discussion. During the focus group, the facilitator created a supportive environment and asked open-ended questions to keep the participant focused on the topic under the study. Then, the researchers transcribed the participants" verbatim, identifying key codes, themes, and insights. This qualitative analysis provided valuable input for the development of the questionnaires' items and ensured age-appropriate language and relevant content. The findings of both the literature search and the focus group were synthesized, and the researchers pooled the items to create the first draft of the questionnaires. The four tools passed through two rounds of content validity, followed by a pilot study, reliability testing, and construct validity.

Content validity

To evaluate to what extent the research tools measure what they propose to measure, a panel of 7 experts in pediatric nursing was invited to evaluate the content validity for clarity and relevancy. The authors received the panels' recommendations and suggestions and made several amendments accordingly. The item and scale content validity indexes of the final drafts of the questionnaires were calculated for each questionnaire [22].

Pitot study and reliability

A pitot study was done on 82 children to test the items for clarity and understandability and estimate the time needed to complete the questionnaires. The reliability of the questionnaires was assessed by test-retest reliability (stability test) using Cohen's Kappa coefficient and internal consistency using Cronbach's alpha Coefficient [22]. A sample of 20 children was invited to fill out the four questionnaires two times at 14-day intervals to avoid memory interference. Participants who were included in the questionnaire development were different from the participants of the study.

Construct validity

To assess the construct validity of the study questionnaires, the researchers employed both Exploratory Factor Analysis (EFA) and Confirmatory Factor Analysis (CFA). Initially, the Kaiser-Meyer-Olkin Measure (KMO) was done to test the adequacy of the sampling. The KMO value was 0.73, indicating the appropriate quality of the sampling. In addition, the Bartlett test suggested that there is adequate correlation among the items for the factor analysis. The EFA was used to apply rotation for more explicit factor structures and identify the underlying factors. Following EFA, a measurement model for CFA was done, evaluating model fit through goodness-of-fit indices like Root Mean Square Error Approximation (RMSEA), Comparative Fit Index (CFI), Tucker-Levis

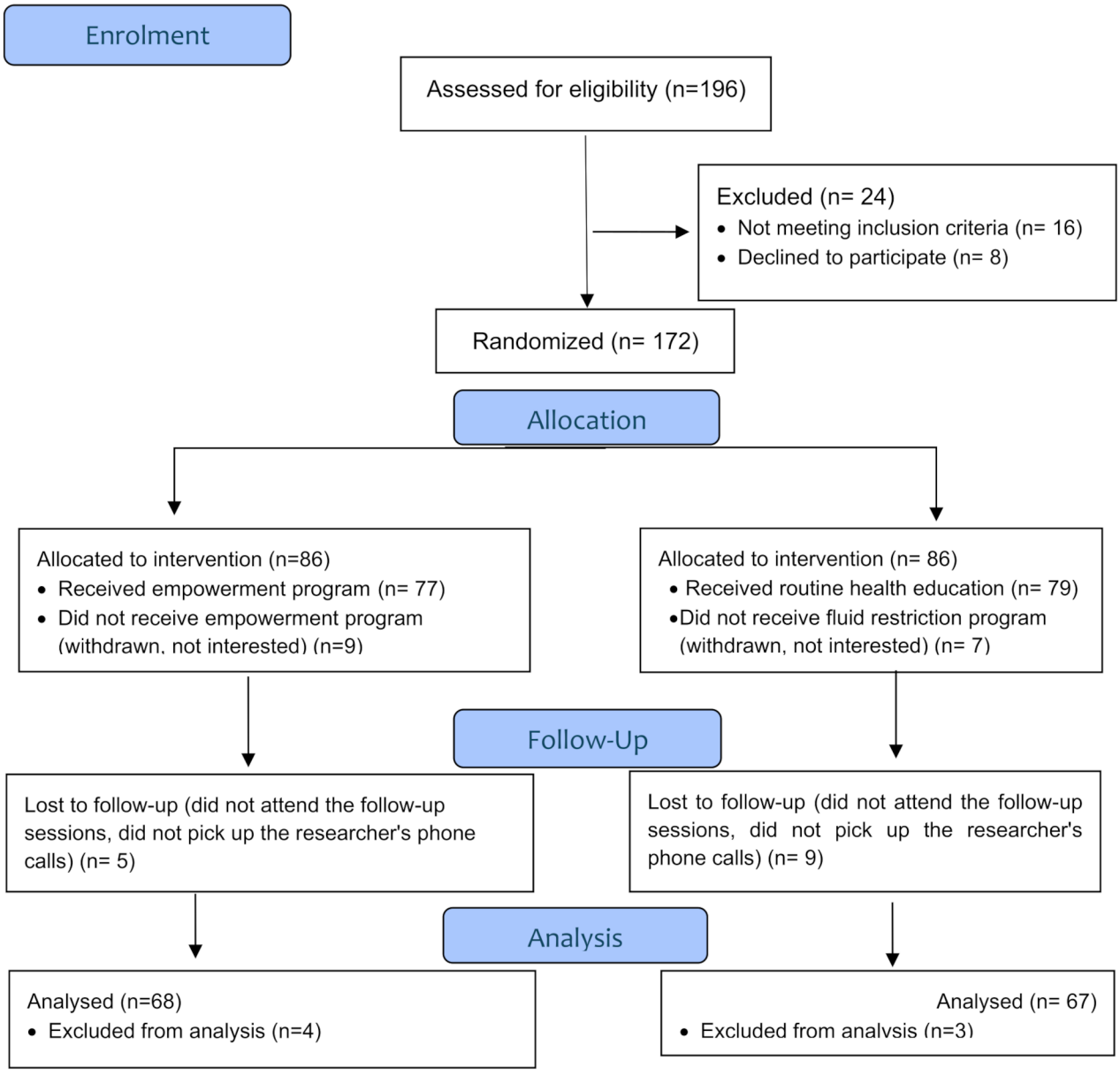

Fig. 1 Consort flow chart of participants' allocation

Index (TLI) to assess the degree to which a group of variables represents the construct to be measured [22].

Children's nail-biting knowledge questionnaire

It includes ten questions about nail biting revolving around the definition (2 items), predisposing factors (2 items), complications and adverse effects (3 items), and management (3 items). A score of (1) was given for the correct answer and zero for the incorrect one. The total score was summed up, and children who got scores above 6 (60%) or higher were considered to have satisfactory knowledge. The scale content validity index was S-CVI = 0.91, Cohen's Kappa coefficient was 0.83 and Cronbach's alpha was 0.88. The findings of the CFA demonstrated a satisfactory fit: $\chi 2/$ df = 2.55, RMSEA = 0.079, TLI = 0.95, IFI = 0.93, CFI = 0.94.

Children's nail-biting practice/habits questionnaire

It includes ten items describing the children's nail-biting habit, including frequency and duration (2 items), aggravating factors (2 items), areas involved in nail-biting (3 items), and description of nail-biting behavior (3 items). They are instructed to self-monitor their nail-biting behaviors on five a 5-point Likert scale ranging from very frequent (4) to never (0). The total score was between 0 and 40; the higher score indicates

unsatisfactory practices. The scale content validity indexes (S-CVI) = 0.88, Cohen's Kappa coefficient was 0.86, and Cronbach's alpha was 0.82. The EFA revealed one factor. Initially, the Kaiser-Meyer-Olkin Measure (KMO) was done to test the adequacy of the sampling. The KMO value was 0.73, indicating the appropriate quality of the sampling. The CFA findings were fit: $\chi 2/df = 3.01$, RMSEA = 0.081, TLI = 0.89, IFI = 0.87, CFI = 0.88.

Children's attitude and self-efficacy towards nail-biting questionnaire

It consists of 13 items; 10 items measure the child's attitude, and three items assess their intention to act (self-efficacy). Children were asked to rate their answers on a 5-point Likert scale ranging from Strongly Agree (4) to (0) Strongly Disagree. The higher the score, the lower the attitude. The negative statements (items 1,2,3,4) were reverse-coded. The S-CVI was 0.89, Cohen's Kappa coefficient was 0.90, and Cronbach's alpha was 0.79. The Exploratory Factor Analysis (EFA) revealed two main factors, namely, (F1) Attitude Towards Nail-biting and (F2) Self-efficacy. The findings of the CFA reflected a satisfactory fit: $\chi 2/df = 3.01$, RMSEA = 0.081, TLI = 0.92, IFI = 0.89, CFI = 0.93.

Subjective norms and enabling factors of nail-biting questionnaire

The questionnaire includes ten yes/No questions divided into two categories. The subjective norms category consists of 8 items describing the external factors that influence children neither to increase or quit their nails, such as" *I observe my family members bite their nails*" and "My *teachers see nail-biting as unprofessional or unsanitary behavior*. " However, the enabling factors encompass two items: "*Healthcare professionals provide various strategies to reduce or quit nail-biting habits*.". The S-CVI was 0.86, Cohen's Kappa coefficient was 0.91, and Cronbach's alpha was 0.85. The EFA revealed two main factors: (F1) subjective norms and (F2) enabling factors. The findings of the CFA revealed an acceptable fit: $\chi 2/ df = 2.36$, RMSEA = 0.081, TLI = 0.96, IFI = 0.90, CFI = 0.91.

The research tools underwent a thorough translation of the Arabic process according to the WHO forward-back translation protocol. A panel of three independent bilingual native Arabic speakers translated the tools into Arabic. Then, two monolingual Arabic speakers scrutinized the tools for unclear or ambiguous terms. Eventually, the back-translation into English by two other translators was done [23]. Following this, a panel of three experts in pediatric nursing checked the translated questionnaires and based on their suggestions, some words were modified to better suit the children level and the Egyptian language. Finally, the panel confirmed that the translated tools displayed satisfactory content validity as the Item-Content Validity indexes (I-CVI) ranged from 0.80 to 1. Before utilizing the translated tools, a pre-study involving 12 children which showed that the internal consistency was also good (Cronbach's alpha = 0.83).

Procedures of data collection

The actual fieldwork was done from the beginning of June 2022 to August 2022, three days per week, from 8 a.m. to 2 p.m.

Assessment

Initially, the researcher asked the participants to complete their sociodemographic characteristics, including age, gender, family type, number of siblings, and family history of nail biting.

Initially, the researcher established rapport with children of both groups and their gradians, screened them for the eligibility criteria, explained the aim of the study, the duration, and nature of the training sessions, and obtained informed assent. Eligible participants who meet inclusion criteria and agreed to participate in the study filled out the sociodemographic data (age, gender, parents' employment, family income, family type, and number of siblings) as well as completed the nail-biting knowledge, practice, attitude, and self-efficacy questionnaires. Moreover, researchers asked children about the subjective norms and enabling factors to focus on them during sessions.

Planning phase

The researcher established the session objectives and learning activities, prepared the learning materials such as videos, images, and a PowerPoint presentation, and designed a colored booklet including the relevant content. The researchers also prepared the learning environment in the medical unit's conference room. The participants were divided into groups (six children and their mothers per group) and scheduled the sessions. Each group attended four sessions that lasted roughly 30 to 45 min.

Implementation phase The Empowerment program is implemented in accordance with the BANCEF model for behavior transformation (Fig. 2).

Evaluation phase After the intervention, children's nail-biting knowledge, practice, attitude, and self-efficacy were reassessed.

Control group

Children in the control group received standard health education about the importance of quitting nail-biting. This session included information on psychological

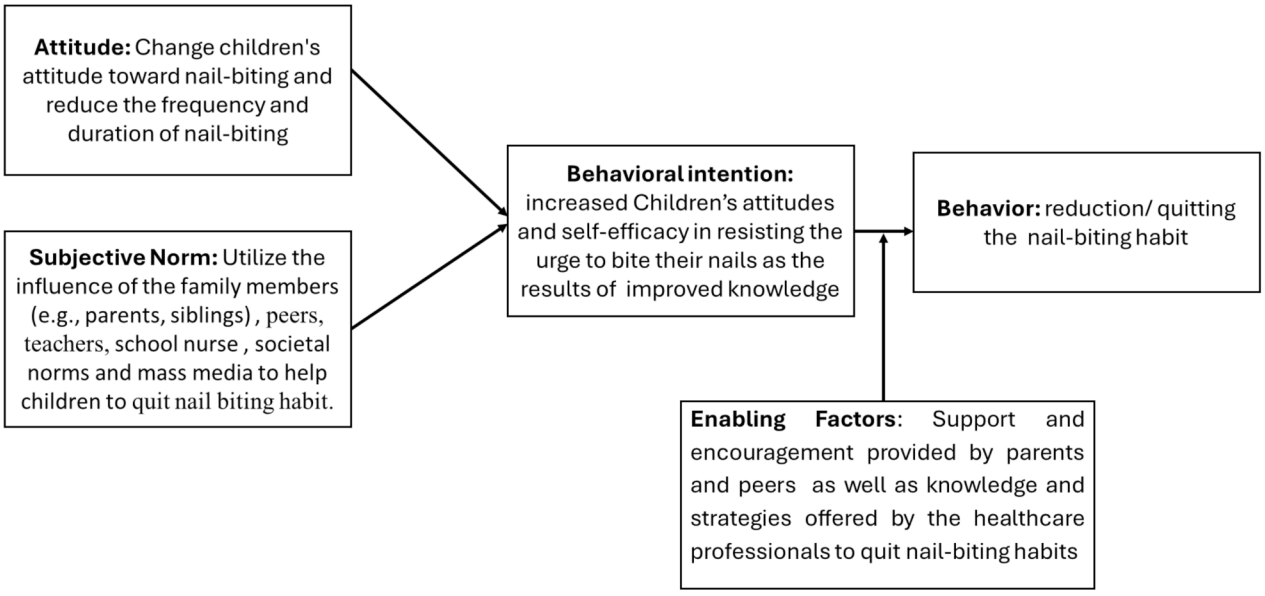

Fig. 2 Application of BANSEF Model in quitting of Nail-biting habit among Childrens

Session	Activities
Session One	**Objectives**: Provide age-appropriate information about nail biting. This includes educating children about the definition, causes, symptoms, potential consequences, and complications of nail biting.
Session Two	**Objectives**: (a) Cultivate a belief that quitting nail biting is achievable. (b) Foster a positive attitude towards quitting nail-biting. The researchers encouraged children to reflect on the negative aspects of the habit and the benefits of stopping it in an attempt to alter their beliefs. Through various activities and discussions, children explored many preventative measures to develop self-confidence in overcoming this habit. The researchers also distributed the educational booklet.
Session Three	**Objectives**: Discover the subjective norms, perceived social expectations, and influences of nail-biting behaviors. In this session, the researchers utilized the children's self-reported information about subjective norms to tailor individualized instruction. Children were provided the opportunity to share their experiences and engage in discussions about nail biting with their family members and peers. This interactive element created a supportive environment that encourages behavior change. By involving parents and emphasizing the importance of their support, the program addressed subjective norms and promoted a social norm that values quitting nail biting.
Sessions four and five	**Objectives**: Equip children with enabling factors to quit nail-biting. In this session, the researchers provided children with different resources, practical strategies, and coping mechanisms to resist the urge to bite their nails. This may involve teaching relaxation techniques and offering alternative activities to keep hands busy. Children were instructed to be engaged in distractive activities such as drawing, coloring, and playing music in case of emotional distress. To facilitate behavior change, the researcher equipped children with a wide variety of enabling factors such as consuming healthy food, receiving biotin supplements, drinking plenty of water, avoiding gel or acrylic nails, and cutting their nails regularly. On the other side, parents were instructed to provide rewards or incentives for progress and establish a support system for ongoing encouragement and motivation.

aspects of nail-biting, including stress relief and habit formation, the health risks or complications associates with such habit, and strategies for quitting, like keeping nails trimmed.

Ethical considerations

The researchers obtained the necessary ethical approval from the faculty of nursing at Menoufia University and Benha University, as well as the study setting (7/2022PEDI2-1), and the study was retrospectively registered on clinicalTrails.gov (NCT06471153). After explaining the study's aim and nature, the researchers obtained informed consent and Ascent from the children's guardians. The researchers were committed to ethical research practices and principles outlined in the Declaration of Helsinki 7th edition (2013) [24].

Data analysis

The data analysis was conducted using SPSS version 23. Descriptive statistics such as numbers and percentages were used to describe the demographic characteristics, knowledge, attitude, self-efficacy, subjective norms, and practice of nail-biting. Before selecting the appropriate statistical tests, the variables were checked for normality using the Kolmogorov-Smirnov test. The two groups were compared using Mann-Whitney (U) tests,

while Wilcoxon Signed Rank conducted the intragroup comparison. Statistical significance was considered at a threshold of $P < 0.05$.

Result

Figure 3 demonstrates that 52.2% of children in the intervention group were 6–8 years old compared to 42.6% of children in the control group. Moreover, approximately half of the children in both groups were males (53.7% and 48.6%, respectively), and more than one-third had two to four siblings (49.3% and 44.1%). It is clear that 49.3% of mothers in the intervention group were homemakers compared to 57.4% of mothers in the control group. A nearly equal percentage of children reported a family history of nail biting (58.2% and 51.5%).

Figure 4 reveals that most children in both the study and control groups reported that their parents expressed a strong preference to stop nail biting (83.6% and 86.8%) as well as 91.0% and 94.1% of children in both groups faced social pressure created by their peer's disapproval of nail-biting where they struggled to conform to their expectations. Similarly, the majority of children mentioned that their teachers considered nail-biting unprofessional or unsanitary behavior 91.0% and 92.6%).

Concerning the enabling factors, the table shows that their parents and peers offer support and encouragement to quite nail-biting 85.1% and 82.4%, respectively.

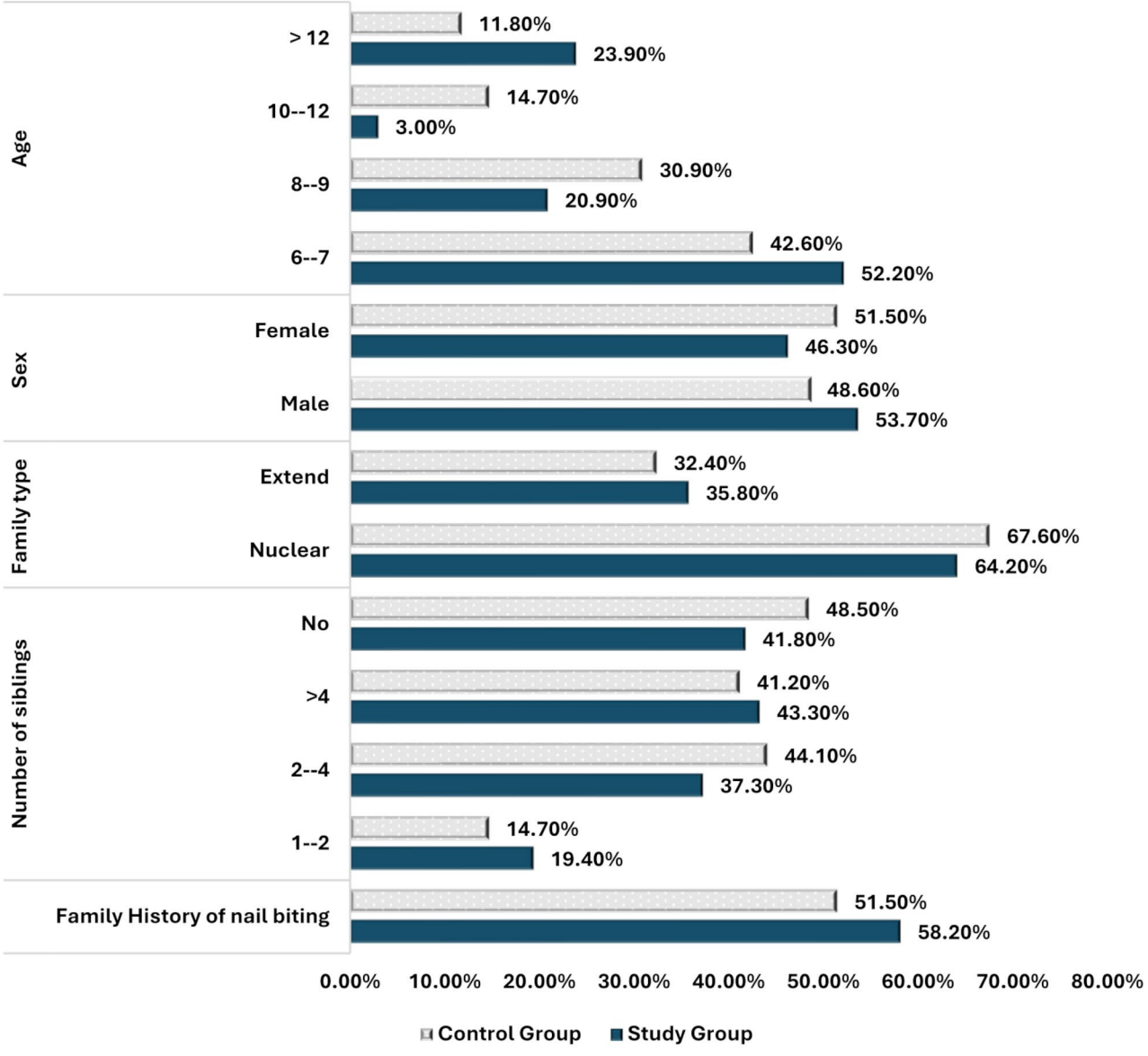

Fig. 3 Distribution of children regarding their characteristics

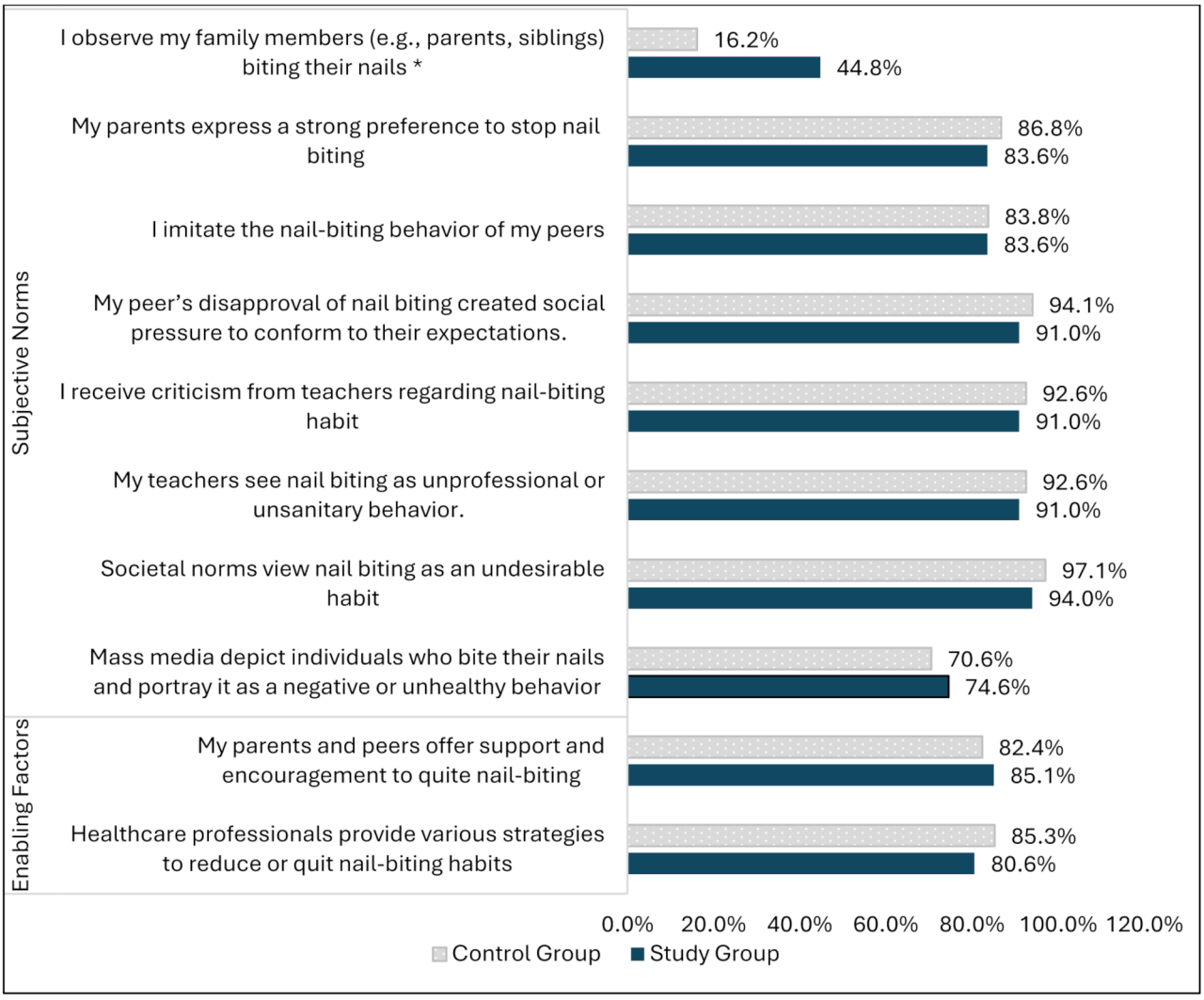

Fig. 4 Initial assessment of children's subjective norms and enabling factors regarding nail-biting

Besides, 80.6% and 85.3% of children reported that healthcare professionals provide strategies to reduce or quit nail-biting habits.

Table 1 illustrates that children of both groups were aware of the definition of nail-biting at the pretest (70.1% and 77.9%, respectively), and they comprehended the fact that Nail-biting can transfer microorganisms buried under the surface of their nails to the Gastrointestinal tract (GIT) (61.2% and 61.8%). A significant improvement in the children's knowledge regarding management strategies was 95.5% for the intervention group compared to 77.9% in children who received routine health education.

Children's Nail-biting practices/ habits are described in Table 2. There was a significant reduction in children's engagement in nail-biting episodes after receiving the empowerment program (from 3.69 ± 0.70 to 1.15 ± 0.91) compared to a slight decline among children in the control group. After teaching children a variety of tension-relief strategies, it is observed that children no longer used nail-biting in case of anxiety (1.27 ± 0.96), emotional stress (1.61 ± 1.00), punishment (1.66 ± 0.99), boredom (1.33 ± 0.81) compared to the control group who showed non-significant change in these habits (2.71 ± 1.26, 3.19 ± 0.93, 3.09 ± 1.12, and 2.97 ± 1.18). It is noticed from the table also that children who received the empowerment program based on the BASNEF model demonstrated a significant reduction in the frequency of behaviors such as chewing and swallowing nails after biting (from 3.33 ± 0.70 to 3.50 ± 0.50) and pulling their nail skin (from 1.16 ± 0.79 to 2.62 ± 1.12). In contrast, children in the control group reported nearly similar frequencies of such behaviors even after receiving routine health education.

Table 3 highlights an improvement in children's attitude after receiving the empowerment program, where children reported less intention to bite their nails to relieve

Table 1 Comparison between children's knowledge about nail-biting in control and intervention groups, before and after intervention

Knowledge about Nail-Biting	Pretest		Posttest	
	Study Group (*n* = 67)	Control Group (*n* = 68)	Study Group (*n* = 67)	Control Group (*n* = 68)
	No. (%)	No. (%)	No. (%)	No. (%)
Nail-biting is a habitual behavior that involves biting or chewing on the nails, cuticles, or surrounding skin.	47(70.1)	53(77.9)	63(96.0)	65(95.6)
Nail-biting is one of the self-soothing or tension-relieving behaviors seen in both children and adults.	39(58.2)	36(52.9)	62(92.5)	54(79.4)
Nail biting can be stimulated by stress, anxiety, and boredom and can occur unconsciously during periods of concentration or relaxation.	29(43.3)	33(48.5)	65(97.0)	46(67.6)
Nail-biting can be learned by imitating these habits among parents, siblings, or colleagues.	22(32.8)	35(51.5)	57(85.1)	48(70.6)
Nail-biting may cause pain and bleeding and increase the risk of infections to the nails and surrounding skin.	36(53.7)	34(50.0)	56(83.6)	44(64.7)
Nail biting may be associated with oral problems, such as gingival injury and malocclusion of the anterior teeth.	22(32.8)	28(41.2)	59(88.1)	44(64.7)
Nail-biting can transfer microorganisms buried under the surface of the nail to GIT.	41(61.2)	42(61.8)	58(86.6)	43(63.2)
A temporary relief or distraction from emotional or psychological discomfort can redirect the urge of nail biting.	33(49.3)	24(35.3)	64(95.5)	53(77.9)
Simple praise for remembering is a helpful strategy to quit nail biting.	22(32.8)	28(41.2)	60(89.6)	46(67.6)
Punishment is quite a helpful strategy to quit nail biting. *	25 (37.3)	23(33.8)	66(100.0)	53(77.9)

* Reversely coded

Table 2 Comparison between children's nail-biting practice/ habits in control and intervention groups before and after intervention

Nail-biting Practice	Pretest		Posttest	
	Study Group (*n* = 67)	Control Group (*n* = 68)	Study Group (*n* = 67)	Control Group (*n* = 68)
	Mean ± SD	Mean ± SD	Mean ± SD	Mean ± SD
Frequency and Duration				
I am engaged in daily nail-biting episodes	3.69 ± 0.70	3.53 ± 0.84	1.15 ± 0.91	2.96 ± 1.01
My nail-biting episodes last more than five minutes	3.10 ± 0.86	3.29 ± 0.46	1.39 ± 1.21	2.91 ± 0.89
Aggravating Factors				
Anxiety	3.42 ± 0.78	3.40 ± 0.93	1.60 ± 0.92	2.71 ± 1.26
Emotional Stress	3.18 ± 0.65	3.35 ± 0.64	2.21 ± 1.05	3.19 ± 0.93
Punishment	3.54 ± 0.59	3.49 ± 0.78	1.01 ± 0.79	3.09 ± 1.12
Boredom	3.39 ± 0.94	3.44 ± 1.03	1.33 ± 0.81	2.97 ± 1.18
Concentration or Relaxation	3.37 ± 0.88	3.32 ± 0.97	1.54 ± 0.99	3.10 ± 1.08
Areas Involved in Nail Biting				
Fingernails	3.30 ± 0.87	3.47 ± 0.84	1.27 ± 0.96	3.18 ± 1.11
Nail plates	3.36 ± 0.83	3.56 ± 0.72	1.61 ± 1.00	3.06 ± 1.06
Nail folds	3.43 ± 0.78	3.57 ± 0.72	1.66 ± 0.99	2.94 ± 1.17
Cuticles	3.49 ± 0.59	3.46 ± 0.78	1.49 ± 1.04	3.13 ± 0.91
Behavior Description				
I pull out nails	3.31 ± 0.87	3.49 ± 0.66	1.90 ± 1.00	2.50 ± 1.22
I pull out my nail skin	3.28 ± 0.69	3.40 ± 0.49	2.31 ± 0.96	2.75 ± 0.92
I chew and eat my nails after biting.	3.33 ± 0.70	3.50 ± 0.50	1.16 ± 0.79	2.62 ± 1.12
I continue biting my nails to the point of bleeding and soreness.	3.40 ± 0.72	3.53 ± 0.50	0.79 ± 0.99	1.66 ± 1.42

negative feelings (2.94 ± 1.01 at the pretest and 1.70 ± 0.90 at the posttest). Likewise, the mean score of the tension feeling associated with resisting the nail-biting habits urge was decreased from 2.75 ± 1.06 to 1.30 ± 0.85 compared to minor reduction in the mean scores of children in the control group were 2.82 ± 1.05 and 2.72 ± 1.03 respectively.

The table also reveals that following program instructions and quitting the nail habit resulted in a noticeable reduction of inferiority feelings such as shame (1.76 ± 1.06), embarrassment (1.85 ± 1.03), and avoidance of public situations (1.55 ± 0.74) compared to children who received the routing health education (2.87 ± 1.01, 2.66 ± 1.13 and 2.90 ± 1.11).

Table 3 Comparison between children's attitude and self-efficacy towards nail-biting in control and intervention groups, before and after intervention

Attitude and Self-efficacy towards Nail-biting	Pretest		Posttest	
	Study Group (*n* = 67)	Control Group (*n* = 68)	Study Group (*n* = 67)	Control Group (*n* = 68)
	No. (%)	No. (%)	No. (%)	No. (%)
Attitude				
I feel relieved of negative feelings when biting my nails. *	2.94 ± 1.01	2.45 ± 1.16	1.70 ± 0.90	3.07 ± 0.90
I feel pleasure when biting my nails. *	2.66 ± 1.01	2.59 ± 1.27	1.55 ± 1.06	2.43 ± 1.07
I feel tension when resisting the urge to bite my nails. *	2.75 ± 1.06	2.82 ± 1.05	1.30 ± 0.85	2.72 ± 1.03
I am not aware of biting my nails. *	2.88 ± 0.96	2.96 ± 0.98	1.79 ± 0.93	2.91 ± 0.97
Nail biting reduces the need for frequent nail trimming and cutting.	2.73 ± 1.19	2.76 ± 1.08	1.79 ± 1.14	2.87 ± 1.12
I feel ashamed when my colleagues make negative remarks or jokes about my biting habit.	2.91 ± 0.87	3.13 ± 0.88	1.76 ± 1.06	2.87 ± 1.01
My jagged, unsightly nails are a source of embarrassment.	3.01 ± 0.93	2.97 ± 0.93	1.85 ± 1.03	2.66 ± 1.13
I avoid school and other social settings because of my biting habit.	2.85 ± 0.97	3.18 ± 0.91	1.55 ± 0.74	2.90 ± 1.11
I try to hide and/or camouflage my nails in public situations to conceal the effects of nail biting.	3.03 ± 0.67	2.93 ± 1.03	1.78 ± 0.98	2.43 ± 1.03
I wish to have regular nails shaped like my colleagues.	3.19 ± 0.96	2.94 ± 1.13	1.76 ± 1.03	2.78 ± 1.16
Intention to Act (Self-efficacy)				
I am unable to control/stop my biting habit.	2.46 ± 1.18	2.51 ± 1.10	1.37 ± 0.79	2.32 ± 1.04
I made repeated unsuccessful attempts to reduce or stop nail biting.	2.72 ± 0.85	2.69 ± 0.92	1.39 ± 0.76	2.34 ± 1.05
Learning about biting nail prevention is worthless.	2.64 ± 1.12	2.59 ± 0.88	1.75 ± 0.80	2.47 ± 1.07

* Reversely coded

Table 4 Knowledge, attitude, Self-Efficacy, and practice of nail biting among study and control groups at pre- and post-intervention

Scales	Study Group (*n* = 67)	Control Group (*n* = 68)	Significance
	Mean ± SD	Mean ± SD	
Children's Knowledge About Nail-Biting			
Pretest	4.58 ± 1.84	4.75 ± 1.48	U=-1.07, *P* = 0.287
Posttest	8.57 ± 2.24	7.00 ± 1.56	U=-5.92, *P* = 0.006*
Significance	Z^{Wil}=6.496, *P* < 0.001**	Z^{Wil}= -5.622, *P* < 0.001**	
Children's Nail-Biting Practice/Habits			
Pretest	50.60 ± 4.01	51.79 ± 3.98	U=-1.627, *P* = 0.104
Posttest	22.42 ± 5.69	42.76 ± 6.75	U = 0.104, *P* < 0.001**
Significance	Z^{Wil}=-7.119, *P* < 0.001*	Z^{Wil}=-6.54, *P* = 0.034*	
Children's Attitude Towards Nail-biting			
Pretest	28.96 ± 3.29	28.69 ± 4.19	U=-0.102, *P* = 0.919
Posttest	16.84 ± 5.11	27.63 ± 4.57	U=-8.73, *P* < 0.001**
Significance	Z^{Wil}= -7.018, *P* < 0.001**	Z^{Wil}=-1.109, *P* = 0.267	
Children's Self-efficacy of Nail-biting			
Pretest	7.82 ± 1.71	7.79 ± 1.59	U=-0.161, *P* = 0.872
Posttest	4.51 ± 1.43	7.13 ± 2.09	U=-6.94, *P* < 0.001**
Significance	Z^{Wil}= -6.533, *P* < 0.001**	Z^{Wil}=-1.82, *P* = 0.068	

U: Mann-Whitney U-test, Z^{Wil}=Wilcoxon Signed Rank *$p < 0.01$, **$p < 0.001$

Table 4 illustrates an improvement of knowledge about nail-biting among children in both groups, where the mean scores increased from 4.58 ± 1.84 to 8.57 ± 2.24 in the study group (ZWil = 6.496, $P < 0.001$) compared to less increment in the scores of the control group from 4.75 ± 1.48 to 7.00 ± 1.56 (Z^{Wil}= -5.622, $P < 0.001$). However, there is a noticeable decline in the nail-biting habits/practices scores among children in the study group (22.42 ± 5.69) in comparison to the control group (42.76 ± 6.75) with significant statical differences between the groups (U = 0.104, $P < 0.001$).

After receiving the empowerment program, children's attitude scores towards nail-biting showed a significant decline among children in the control group (from 28.96 ± 3.29 to 16.84 ± 5.11). In contrast, the attitude scores remained nearly the same among the control group, with significant differences between the groups

(28.69 ± 4.19 to 27.63 ± 4.57), and the p-value was significant ($P < 0.001$).

The same table shows that the successful attempt of gradually reducing/quitting the nail-biting habit enhanced children's self-efficacy while receiving the routing care did not impact children's belief in their ability to control this habit, where the total scores were 4.51 ± 1.43 for the study group and 7.13 ± 2.09 for the control group (U=-6.94, $P < 0.001$).

Discussion

Nail-biting is a chronic disorder that is repeated and obsessive in nature. The present study's findings revealed that most children in both groups were 6–8 years old; approximately half of them were males and had two to four siblings. A nearly equal percentage of children reported a family history of nail biting. Similarly, Winebrake et al. (2018) reported that nail biting is more common in youngsters, with a 37% prevalence among those aged 3–21 [7]. Nail biting can be a chronic and debilitating behavior that can last into adulthood and be both a source and a carrier of the disease. Knowing the necessary preventative procedures and treatment approaches for children and adolescents can help avoid habit persistence [8]. Our findings were consistent with Siddiqui and Qureshi (2020), where 50% of participants who bite their nails were at the school-age stage [25].

Regarding subjective norms, the results of the present study revealed that most children in both the study and control groups reported that their parents expressed a strong preference for stopping nail-biting as well. The majority of children in both groups faced the social pressure created by their peer's disapproval of nail-biting, where they struggled to conform to their expectations. Similarly, most children mentioned that their teachers considered nail-biting unprofessional or unsanitary behavior. The combination of peer and teacher social pressures creates a stigma around nail-biting, compelling children to break the habit. The expressed disapproval, and the continuous labeling nail-biting as unprofessional or unsanitary behaviors might make children feel self-conscious about their behavior and obligate them to conform the social expectations to avoid judgment and align with perceived norms. In agreement with the current study's findings, Gholamian et al. (2019) and Najmudin and Syihabudin (2022) identified the subjective norm as a significant aspect in deciding whether or not a person or group of people will endorse and support a specific activity [26, 27]. Halteh et al. (2017) also confirmed that various factors, including school stress and family problems, can exacerbate impulsive nail-biting. Furthermore, Waseem et al. (2020) asserted that the frequency of nail biting was strongly influenced by a child's mother, peers, and teachers [28].

The BANEF model signifies the role of the enabling factors in changing unhealthy behaviors. In this regard, the present study showed that the majority of parents and peers offer support and encouragement to children to quit nail-biting. Comparable findings were reported by Abedini et al. (2020), who claimed that the enabling factors, such as parents and peers, are the essential elements to consider when strengthening agents and developing educational programs for the general public and healthcare professionals [29]. Additionally, Setijanto and Bramantoro (2019) observed that mothers are the most effective in influencing their children's oral hygiene and dental care [21].

Providing knowledge about nail-biting habits develops children's self-awareness, empowers self-control behaviors, and boosts their self-esteem (Amin et al., 2022). It allows them to understand the underlying causes of the habit, promote healthy coping mechanisms, and prevent physical consequences. In this context, the results of the current study revealed a significant improvement in the children's knowledge regarding the management strategies for the intervention group compared to children who received routine health education [9]. This could be attributed to provide age-appropriate information about nail biting and documenting such information in the colored booklet that kept available to remind them with given instruction. Congruently, Rajan's (2023) findings demonstrated significant changes in children's knowledge following the intervention, particularly in the items that address the consequences of nail biting and poor personal cleanliness [30]. The current study findings also agreed with those of Elsabagh et al. (2016), who found a significant increment in the children's scores regarding the harm of nail-biting after the program [31].

Undoubtedly, The BASNEF model recognizes that behavior change is a complex process influenced by multiple interconnected factors [12]. So, it is no surprise that the result of the present study illustrates that children who received the empowerment program based on the BASNEF model demonstrated a significant reduction in the frequency of behaviors such as chewing and swallowing nails after biting and pulling their nails skin while children in the control group reported nearly similar frequencies of such behaviors even after receiving the routine health education. These noticeable changes in children's behaviors could be related to the nature of the empowerment program and the utilization of the BASNEF model as a framework for educational sessions. The researchers in the present study utilized the findings of the subjective norms to provide individualized consultation and tailored health education according to the child's knowledge, beliefs, and enabling factors. All these elements worked together to reshape children's behavior and empower them to quit the unacceptable habit. The

study's findings are parallel to a study done by Gur et al. (2018), who found that children's nail-biting frequency decreased after the intervention, whereas 57.7% of children say they do it occasionally, while 11.7% say they do it constantly. However, 30.8% of children reported that they have a habit of biting their nails infrequently [13]. On the contrary, Javed and Ali (2017) found that 40% of school-age children's cuticles bleed when they bite their nails or skin, but only 24% reported feeling pain after receiving post-intervention treatment.

Furthermore, Ergün et al. (2013) reported that the nail-biting rate among children in the intervention group decreased dramatically with time, and this impact lasted for eight weeks [17]. It was also discovered that the damaged nail beds of the children in the intervention group recovered in the four weeks following recruitment to the trial. The study found that children who received the intervention were more likely to change their nail-biting behavior. In the same line, Rajan (2023) examined the effect of health education on children's knowledge, attitude, and practice of personal hygiene in Malaysia and found that the intervention program resulted in a statistically significant improvement in practice ($p < 0.001$) [30].

Self-efficacy is one of the potential determinants for quitting nail biting. By addressing children's beliefs, attitudes, and subjective norms towards nail-biting, the current study intervention provides a promising opportunity to enhance children's intention to quit. Our study findings illustrate a noticeable improvement in self-efficacy and environmental behavior change interventions. These findings may be related to the nature of the program creates a comprehensive approach that increases the likelihood of sustainable behavior change. Besides, a wide variety of enabling interventions that increase children's self-confidence in their ability to quit the nail-biting habit. This finding is incongruent with Javed and Ali's (2020) study, which found that 63% of students pulled their nails using their teeth [32]. Following the intervention, just 34% of pupils continued to detach their nails, whereas 52% did so through the skin. Research indicated that improving self-efficacy can effectively reduce nail-biting habits among children. The empowerment intervention in the current study focused on enhancing self-efficacy, such as cognitive-behavioral techniques, goal setting, and positive reinforcement, which have shown promising results in reducing nail-biting behavior. By implementing effective strategies, parents and caregivers can support children in overcoming their nail-biting habits and promoting overall well-being. So, by implementing effective strategies, parents and caregivers can support children in overcoming their nail-biting habits and promoting overall well-being. In parallel, Ergün et al. (2013) found that the study's findings support the efficacy of the healthy nail program in reducing nail biting. Further difficulties can be avoided by effectively managing nail irregularities, resulting in improved self-image [17].

The present study's findings highlight an improvement in children's attitudes after receiving the empowerment program, where children reported less intention to bite their nails to relieve negative feelings. Likewise, the mean score of the tension feeling associated with resisting the nail-biting habit urge was decreased compared to a minor reduction in the mean scores of children in the control group. The results also reveal that following program instructions and quitting the nail habit resulted in a noticeable reduction of inferiority feelings such as shame, embarrassment, and avoidance of public situations compared to children who received the routing health education. The present study findings concurred with Zareipour et al. (2018), who proclaimed that children should wear gloves, sticky bandages, and colored stickers on their nails as reminders not to bite [33]. The authors of this study also suggested teaching children to snap a rubber band on the inside of their wrists when they begin to bite their nails. Van Doremalen et al. (2020) also suggested strongly supported advice to refrain from touching the face, which also holds for the advice to stop biting their nails. Magid et al. (2017) further suggested that children engage in alternative activities to divert their attention from the intrusive compulsions of nail-biting [34]. These activities include arts and crafts, sports, and musical instruments to boost their focus and confidence and lessen distress.

Strength and limitations

The researchers in this study carefully designed materials and delivered interactive learning sessions based on the BASNEF model. This model is widely used to facilitate behavior change and equip participants with strategies to break away from detrimental behaviors, such as nail-biting. Allowing mothers to attend the educational session was also helpful in fostering sustained behavior change. Although the study yielded intriguing results, it is essential to acknowledge its limitations. One notable limitation is the lack of diversity among the study participants, which may hinder the generalizability of the findings. Further research is needed to assess the generalizability of the findings to different age groups, cultural backgrounds, and settings. The use of convenience sampling could potentially limit control over the representativeness of the subjects. Additionally, the researchers faced challenges in controlling access to information about nail biting. Furthermore, the study encountered difficulties with participant withdrawals and refusals, particularly among the younger children. Long-term follow-up studies could provide insights into the sustained effects of the program and its potential for preventing relapse.

Future studies are also suggested to adopt the BASNEF model for changing other unhealthy behaviors among children, such as consuming unhealthy food and internet addiction…etc.

Conclusion

The program successfully increased children's knowledge about nail biting and improved their attitudes toward the habit. It also enhanced their self-efficacy in resisting the urge to bite their nails and led to improvements in their nail-biting practice/habit.

Recommendations

This study has important implications for parents and healthcare professionals using the BASNEF model's comprehensive approach, combining education, attitude change, and behavioral strategies to combat children's unhealthy habits. Firstly, the nurse may help children to understand the adverse effects of undesired behavior (nail biting) on overall health. This enhanced knowledge can contribute to adopting preventive measures and encourage children to pursue healthier habits. Secondly, the program helped change their perception of nail-biting from a harmless habit to a behavior requiring attention and intervention. Nurses can also utilize subjective norms and social pressures to decrease the frequency of unhealthy habits. By fostering a more negative attitude towards the unhealthy habit (nail biting), the program assisted in motivating children to reduce or eliminate the habit. Thirdly, the nurse can empower children by providing various educational and behavioral techniques to increase their self-efficacy and enhance their belief in their ability to resist the urge of unhealthy habits (nail biting). This increased self-efficacy can empower children to engage in self-control strategies and ultimately overcome the habit actively. The empowerment program provided practical strategies and guidance to help children break the habit. The program facilitated behavior change by employing techniques such as habit reversal training and alternative coping mechanisms and encouraged children to replace nail biting with healthier alternatives.

Supplementary Information

The online version contains supplementary material available at https://doi.org/10.1186/s12887-025-05450-w.

Supplementary Material 1

Acknowledgements

The authors are grateful to all school-age children and their parents who participated in the study.

Author contributions

ZIR: Conceptualization, Methodology, Investigation, Formal analysis, Writing- original draft, Writing- review & editing, Supervision. HAD: Conceptualization, Data collection, Methodology, Writing- original draft, graphics. FAE: Conceptualization, review, editing& final draft, graphics. MAN: Conceptualization, Data collection, Methodology, Writing- original draft, & final draft.

Funding

This study was written without grant funding.

Data availability

The datasets used and/or analyzed during the current study are available from the corresponding author upon reasonable request.

Declarations

Ethics approval and consent to participate

The researchers obtained the necessary ethical approval from the faculty of nursing at Menoufia University and Benha University, as well as the study setting (7/2022PEDI2-1), and the study was retrospectively registered on clinicalTrails.gov (NCT06471153). After explaining the study's aim and nature, the researchers obtained informed consent and Ascent from the children's guardians. The researchers were committed to ethical research practices and principles outlined in the Declaration of Helsinki 7th edition (2013) [24].

Consent for publication

Not applicable.

Competing interests

The authors declare no competing interests.

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Received: 7 June 2024 / Accepted: 20 January 2025
Published online: 22 April 2025

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