Effect of Computer-based Educational Games for improving Self-Efficacy of Children with Hemophilia

Doaa Gharieb Moustafa (1), Amany Sobhy Sorour (2),Sabah Abdou Aly Hagrass(3)

(1) M.Sc. Nursing, Zagazig University–(2)Professor of Community Health Nursing-Faculty of Nursing- Zagazig University,(3)Assistant Professor of Community Health Nursing- Faculty of Nursing -Zagazig University. Egypt.

Corresponding author: Doaa Gharieb Moustafa

E.mal: ghariebdoaa@gmail.com

Abstract

Background: Hemophilia is one of the chronic illnesses affecting children due to deficiency of certain coagulation factors causing frequent bleeding which may lead to pain, arthropathy, joint degeneration, functional limitations, and disablement., Chronically ill children have less chances for healthy play with negative impact on their personal development. **Aim of the study** was to evaluate the effectiveness of the use of educational games for improving the self-efficacy in children with hemophilia. **Subjects and Methods: Research design:** Aquasi-experimental study design with pre-post assessment was used to achieve the aim of the study. Study Subjects: a sample study on 50 children with hemophilia aged 6-12 years old during 2022. **Setting:** The study carried out in the hematology unit at the Health Insurance Organization Hospital (Al-Mabarrah). **Tools of data collection: Part 1:** covered the socio-demographic characteristics of the children with hemophilia and their parents. **Part 2:** for collecting the details of the hemophilia illness. **Part 3:** assessment of the awareness of the children regarding hemophilia. *Part 4*: consisted of the self-efficacy scale questionnaire in children with hemophilia. **Results:** Based on the findings of this study Hemophilia was mostly diagnosed at <1 year age (76.0%) All children had bleeding episodes, mostly due to severe injury (52.0%) and dental work (32.0%). The elbow was the most common site (46.0%), and the effect on joint movement was mostly high (92.0%).Only 40.0% of children were on regular medication, and 86.0% had a weekly hospital visit. Significantly more children with low self-efficacy were among those having unsatisfactory awareness. Only 20.0% of children had high pre-intervention self-efficacy. **Conclusion:** The implementation of an educational intervention based on children's identified needs and using computer-based games, is effective in improving their awareness of the disease as well as their related self-efficacy. **Recommendations:** The use of computer-based gaming should be widely used in the education of children with hemophilia to train them in self-management through improving their self-efficacy. Further research is proposed to assess the long-term effects of training using computer-based gaming on the prognosis and outcomes of children with hemophilia and to assess the usefulness and applicability of training using computer-based gaming in other chronic diseases

Keywords: computer, Educationalgames,improving, Self-Efficacy,children, Hemophilia.

Introduction

Hemophilia is a rare bleeding disorder in which the blood does not clot normally. It is a group of coagulation disorders in which the blood fails to clot normally because of a qualicative or quantitative deficiency of clotting factors. Hemophilia A and B are the two most common forms and involve coagulatior factors VIII and IX respectively, whose genes are located in the X chromosomes and, when defective, causes the X-linked recessive traits hemophilia A and B (Bérubéa et al, 2020). Rare coagulation disorders due to deficiencies of other factors, like prothrombin, Factor V, Factor VII, Factor X, Factor XI, Factor XII, and fibrinogen are autosomal recessive (Di Minmo et al., 2016).

The use of game-based interventions in health care tend to increase motivation, compliance, and overall sustainability of health behaviors (Warsinsky et al., 2021). Hemoaction game is a computerized educational game designed by the World Federation of Hemophilia to educate hemophilia disease and related procedures to the care of children with hemophilia. Children with hemophilia (aged 8-12) are educated by this game in how to increase self-efficacy (Beheshtipoor et al., 2016). Therefore, game interventions may be offered to children with chronic diseases to promote adaptation (de Jong et al. 2020). Digital behavioral interventions have shown high efficacy, but high-quality evidence is still needed (Marcu et al, 2022). However, although digital interventions are increasingly used by adults and adolescents, there has been inadequate care to design and such interventions for children. The developmental stage of children must be considered when designing them (Bogosian et al., 2016).

Communication between health care professionals and small children may be complicated by the fact that small children cannot always express and communicate their feelings and needs verbally. Thieories the researchers used in developing their game; Child Patient Game and narrative theory. Emotion theories have offered valuable models and firameworks for observing, registering, and evaluating how people react emotionally to certain situations. The narrative theory enables understanding and exploring the concept of fictional emotion; the patient could communicate their emotions through the act of the game play (Knutz et al., 2015).

Playing games for health has shown to invoke positive feelings and improve self-efficacy. Arousal is seen as a vital art of the attraction of gaming. These elements (positive affect and high arousal) suggest that playing. games for health (anxiety-inducing context) might be a form of arousal congruent cognitive reappraisal, and this reappraisal starts before gameplay begins at the point of announcing the game The more difficult the announced context is expected to be, the stronger the effect of reappraisal by the game prompt should be on self-efficacy (Sardi et al, 2017; Sharifzadeh et al, 2020).

The revolution in haemophilia care presents exciting opportunities and challenges for haemophilia nurses, and there is great scope for finding different ways of delivering nurse-led care. Haemophilia nurses need to look beyond their own hospital or haemophilia centre and share research and best practice with fellow nurses nationally and globally.

The Step Up for Rare Care programme is an initiative to improve global standards of haemophilia care through international sharing of best nursing practice, which nurses can adopt and adapt to improve the care they deliver (Step Up for Rare Care, 2019).

Reducing the complications of haemophilia enables patients to lead more normal lives. For example, historically people with haemophilia were told not to participate in sport because it was thought to be too dangerous, but children benefitting from prophylaxis can now be encouraged to participate in physical activity at an early age. There is, therefore, an increasing role for specialist nurses in supporting patient self-management strategies that improve overall health, such as muscle-strengthening activities that can help maintain joint health (Gilroy, 2019).

Psychosocial issues are increasingly pertinent in haemophilia care. People with haemophilia report depression and lower health-related quality of life (Šalek et al, 2012), and the UK inquiry into the contaminated blood scandal has highlighted the ongoing need for psychosocial support, not just for patients and families affected by contaminated blood, but for all people affected by haemophilia (Bomford, 2020). As quality-of-life issues become more important in haemophilia care, this is another area where specialist nurses can make a difference. Like many people with long-term conditions, through day-to-day self-management, people with haemophilia become experts and partners in their own care. As such, they should be regarded as distinct core members of the comprehensive care team (Srivastava et al, 2020). They (and their parents/caregivers where appropriate) should be involved in decision-making about their care, which should reflect their preferences, values and personal experiences to ensure their concordance with short- and long-term management plans.

All professional members of the care team should engage in truly shared decision-making with patients. This involves having educated discussions about available healthcare options and anticipated outcomes. Such discussions should include evidence-informed guideline recommendations, the benefits and risks of the various choices, and consideration of the patient's/caregiver's expressed concerns and value. They should work together on the development and periodic updating of individualized care and management plans that the patient/caregiver can consult at will and share with others involved in their care (Srivastava et al, 2020).

Significance of the Study

Hemophilia is a chronic lifelong bleeding disease that can interfere with the daily performance of children. These children are both physically and emotionally vulnerable. Improving their self-efficacy would increase their self-confidence in being able to perform specific actions that need to be taken immediately to achieve positive outcomes and prevent complications. The use of a novel approach such as the computer-based educational games for this purpose needs to be investigated.

AIM OF THE STUDY

The aim of this study was to evaluate the effectiveness of the use of educational games for improving the self-efficacy in children with hemophilia.

Hypothesis:

Awareness of children with hemophilia and their self-efficacy will improve after participating in the educational games.

SUBJECTS AND METHODS

The methodology pursued in conducting the study is presented under technical, operational, administrative, and statistical designs.

Research design

A quasi-experimental study design with pre-post assessment was used to achieve the

Setting

The study was carried out in the hematology unit at the Health Insurance Organization Hospital (Al-Mabarrah).

Study Subjects

Sample criteria: The study population was consist of all the children with hemophilia attending the study settings during the time of the study. A sample was selected according to the following criteria:

- Inclusion criteria:
  o Age: 6 to 12 years;
  o Free from any other health problems.
- Exclusion criteria:
  o Children with severe debility and unable to pursue the study procedures.

Sample size calculation:

The sample size is estimated to detect the difference between the mean level of self-efficacy among children before (53.25±13.13) and after (60.95±13.13) according to Beheshtipoor et al. (2015), with a 95% level of confidence, and a study power of 80%. Using the Open-Epi software program for sample size calculation for the difference between two means, the required sample size turned to be 46 children. This was increased to 52 to account for an expected dropout rate of 10%

Tools of Data Collection

A structured interview questionnaire form developed by the researcher based on the review of relevant literature. Consisted of the following parts.

Part 1: This covered the socio-demographic characteristics of the children with hemophilia and their parents such as age, educational level, birth order, siblings, as well as their parents' education and occupation, family income, residence, etc

- Part 2: This was intended to collect data concerning the details of the hemophilia illness, its management, and associated complications, in addition to child's previous medical history.

- **Part 3:** This part was used in the assessment of the awareness of the children regarding hemophilia, causes, symptoms, signs, complications, and management.

  Scoring system: For each item, a correct response was scored 1 and the incorrect zero. For each area of and for the total questionnaire the scores of the items were summed-up and the totals divided by the number of the items, giving mean scores. These scores were converted into percent scores. Knowledge was considered satisfactory if the percent score was 50% or more and unsatisfactory if less than 50%.

- **Part 4:** This consisted of the self-efficacy scale questionnaire in children with hemophilia, developed by Sherer (1982). The tool has 23 items: 17 related to general self-efficacy, and 6 related to experiences in social situations. The items are checked on a 5-point Likert scale ranging from "strongly agree" to "completely disagree." The scores of the items 15, 13, 9, 8, 3, 1 are reverse scored so that a higher total score indicates more self-efficacy. The reliability of the scale is high with Cronbach alpha coefficient 0.79% (Beirami 2008).

Scoring system:

The total scores of the two components and total scale were calculated by summing-up. Then, the sums of scores were converted into percent scores. For the categorical analysis of each component as well as for the total score of self-efficacy. A score of 60% or higher was considered as high while a lower score was considered low.

Content Validity & reliability:

Once prepared in their primary form, the tools were presented to three experts, from community health nursing, faculty of nursing in addition medical staff from community medicine department, faculty of medicine They rigorously revised the tools for relevance, comprehensiveness, clarity, applicability, and ease of administration. Minor modifications were required mainly in wording and rephrasing. The reliability of the self-efficacy scale was assessed through measuring its internal consistency. It showed a high level of reliability, with Cronbach's alpha coefficient 0.87

Fieldwork

The fieldwork was achieved through assessment, planning, implementation, and evaluation phases. It was carried out over a period of 12 months, from July 2021 to June 2022. Assessment phase: This phase was started immediately after acquiring all necessary official permission to conduct the study. It involved recruitment of the sample of children with hemophilia according to the inclusion and exclusion criteria. The researcher introduced herself to the child and his family caregiver, explained the purpose of the study in simple words to be clearly understood by them, and invited them to participate.

Those who provided their informed consent to participate were interviewed by the researcher using the prepared interview questionnaire form. Each interview took approximately 30-35 minutes. This was considered as the pretest data. Their telephone numbers and contact information were obtained for contacting them for arrangement of the schedule for attendance of the educational program, as well as for the conduction of the posttest at the evaluation phase.

This assessment phase lasted for months spent in recruiting the children and pretesting them. For this, from July to December 2021, the researcher visited the setting daily.

Planning phase: During this phase, the researcher prepared the educational program. It was based on children's and parents' needs identified through the analysis of the pretest data obtained during the assessment phase, in addition to relevant literature. The program consisted of two main parts: theoretical, and practical. The theoretical part of the program covered the definition, etiology, symptoms/signs, complications, and treatment of hemophilia. It also addressed the factor and effect of factor intake, convalescence, safe and unsafe activities, recommended diet, management of scratch, contusion, and wound, behavior during factor intake, and how to help the nurse during care provision. The practical part consisted of computer-based games, namely "hemoaction" and "hemoheros" games. The researcher prepared an illustrated booklet containing the training program to be handed to each participant child. Implementation phase: Teaching sessions were conducted for every participant child individually. The training program consisted of 12 sessions. The first two sessions were used to explain to the child and his family caregiver the aim and objectives of the program, as well as its importance and procedures, and to set a schedule for the sessions. Then, there were four sessions for the theoretical part, and five for the practical part. The last twelfth session was for wrap-up and posttest.

The educational program was administered by the researcher using the prepared booklet. Each session lasted from 30 to 45 minutes according to child's condition and comprehension. The training involved the use of various teaching media such as paper board, pictures, videos, and games. Different training methods were used including questions and answers, discussion, demonstration and redemonstration, and self-reflection. Evaluation phase: At the end of the program, each child was evaluated during the last twelfth session as a posttest in order to examine the effectiveness of the educational program. This was done using the same data collection tools of the pretest to assess child's awareness and practice, as well as the severity of bleeding, and his self-efficacy.

Pilot study

Was carried out on five children with hemophilia, representing about 10% of the calculated study sample. It was conducted with the aim of testing tools' clarity, applicability, and ease of implementation. The results of the data obtained from the pilot study helped in modification of the tools; items were then corrected or added as needed. Those who shared shared in the pilot study were not included in the main study sample.

ADMINISTRATIVE DESIGN

An official permission for conduction of the study and data collection was granted through submission of a formal letter from the Dean of the Faculty of Nursing, Zagazig University to the Director of the Health Insurance Organization Hospital (AlMabarrah) and its nursing Director. The letter included the study aim and objectives, its procedures, and a copy of the data collection form. Moreover, the researcher met with the nursing administrative personnel

in the hospital to clarify the aim and objectives of the study, and to get better cooperation during the assessment phase of the research.

Ethical considerations

An ethical approval of the protocol was granted by the research and ethics committee at the Faculty of Nursing, Zagazig University. At the initial encounter, each potential child and family caregiver were informed about the nature, purpose, and benefits of the study, and reassured that that participation is totally voluntary. The confidentiality and anonymity of any obtained information were ensured through coding of all data. The researcher assured them that the data collected would be used only to improve their health and for the purpose of the study.

Statistical analysis:

Data entry and statistical analysis were done using SPSS 20.0 statistical software package. Quality control was done at the stages of coding and data entry. Data were presented using descriptive statistics in the form of frequencies and percentages for qualitative variables, and means and standard deviations and medians for quantitative variables. Cronbach alpha coefficient was calculated to assess the reliability of the scale used through its internal consistency. Qualitative categorical variables were compared using chi-square test. Spearman rank was used for assessment of the inter-relationships among quantitative variables and ranked ones in order to 11 identify the independent predictors of the awareness and self-efficacy scores, multiple linear regression analysis was used. Statistical significance was considered at p-value

Results:

The study comprised 50 hemophilic children whose age ranged between 6 and 12 years, median 8.0 years are presented in Table I. Half of them were firstborn children. The great majority were in primary education (96.0 %), but mostly having no regular school attendance (82.0 %). Illness was the most commonly reported reason for irregular attendance (38.0%)

As regards their parents' characteristics, Table 2 indicates approximately two-thirds of their mothers and fathers were 30 or more and 35 or more years old, respectively. The majority were having above secondary education, 88.0% and 90.0% respectively. About two thirds of the mothers were working (64.0%), but the majority reported having insufficient income (90.0%) and were having a high crowing index (84.0%).

Table 3 shows that all children in the study sample reported having had bleeding episodes. The most common causes were severe injury (52.0%) and dental work (32.0%). The elbow was the most common site (46.0%), and the frequency was mostly <6 times/month (52.0%). The effect on joint movement was mostly high (92.0%). As for treatment, only two-fifth (40.0%) reported being on regular medication, and the most common cause of being irregular was far hospital (50.0%). Yet, the majority were having a weekly hospital visit (86.0%).

Table 4 indicates generally low pre-intervention awareness about hemophilia among the children in the study sample. The areas with the most unsatisfactory awareness were those of the definition (28.0%), symptoms and signs (34.0%), and management of contusion (40.0%). On

the other hand, more than two-thirds of the children had satisfactory awareness regarding unsafe activities and recommended diet (68.0%) and helping nurse (70.0%).

In total, Figure 1 demonstrates that only 30.0% of the children in the study sample were having satisfactory awareness, and the difference was statistically significant (p<0.001).

Concerning self-efficiency, Figure 2 shows that only 00.0% of the children in the study sample were having a high level. And the difference was statistically significant (p<0.001).

In the multivariate analysis (Table 5), the study intervention was the main statistically significant independent positive predictor of children' awareness score, in addition to age, family income, and regular medication. Conversely, child's age at diagnosis was a negative predictor. The model explains 64% of the variation in the awareness score. None of the other children' characteristics had a significant influence on this score.

As for the children's self-efficiency score, Table 6 demonstrates that the study intervention was also its main statistically significant independent positive predicator, in addition to child age and family income. The model explains 50% of the variation in the self-efficiency score.

Discussion

Hemophilia is a chronic disease with high treatment burden in terms of difficulties of injections, physical and emotional health impacts, as well as the interference with daily life (Brod et al., 2023). Innovative treatment modalities are now made available in both developed and low-income countries (Lambert et al., 2022). Since the disease negatively affects the life of patients (Schiavoni et al., 2023), a main goal of its management is to improve patient's quality of life (Kihlberg et al., 2023).

This study aim was to evaluate the effectiveness of the use of educational games for improving the self-efficacy in children with hemophilia. It hypothesized that the awareness of children with hemophilia and their self-efficacy was improved after participating in the educational games. The study results indicate significant improvements in children's post intervention awareness and self-efficacy, with the intervention program being their main positive predictor. This leads to acceptance of the two set research hypotheses.

The present study the sample consisted of 50 children with hemophilia age 6 to 12 years and free from any other health problems.

The majority of the children in the present study sample reported having no regular school attendance. This mostly attributed to their illness and related complications. Such irregular school attendance would certainly have a negative impact on their education, and consequently on their future work opportunities and their life. In agreement with this, a study of hemophilic patients in the Netherlands found higher rates of absenteeism from school among them in comparison with the general population (van Balen et al., 2022).

According to the present study results, the families of the children with hemophilia were from middle class, with most parents having a secondary level of education. Additionally, the majority

reported having insufficient income. These socio-economic factors would certainly negatively affect their children's health care and their self-efficacy.

Slightly more than three-fourth of the hemophilic children in the current study had their illness diagnosed in their first year of life. The importance of early diagnosis of hemophilia and the prognosis of the disease cannot be over emphasized as reported by Kulkarni et al. (2022) in a study in India. In fact, in the present study it was found that child's age at diagnosis was a negative predictor of his awareness score.

The elbow was the most common site of injury as reported by almost a half of the children in the current study. Moreover, almost all children stated that the effect of injury on their joint movement was high. This would lead to severe pain among these children. In congruence with this, a study in Turkey reported that pain is an important problem that is often neglected in the management of such patients. A proper management of this symptom is necessary to improve the quality of life of these patients (Kurçaloğlu and Atay, 2023). Moreover, a study in the United Kingdom emphasized the great burden of joint affection on hemophilia patients' quality of life (Burke et al., 2022)

Concerning medical care, only two-fifth of the children in the present study mentioned that they were on regular medication. This is quite low given the seriousness of the illness. The lack of regular medical care was mainly attributed to the far distance from home to the healthcare setting. In this respect, Ljung et al. (2022) in Sweden found that regular weekly prophylaxis treatment could reduce the bleeding episodes and their consequent complications. Furthermore, Nwagha et al. (2023) in a study in Nigeria stressed that regular prophylaxis is essential to reduce the potentials of bleeding episodes and arthropathy, and to improve hemophilic patients' quality of life.

The present study assessed the awareness of hemophilic children about their illness nature and related care before implementation of the study intervention program. The findings revealed that their awareness was variable but mostly low. Thus, only around one-third of them had satisfactory awareness regarding the definition of hemophilia and its nature, as well as about its symptoms and signs, and how to manage the contusions it may cause. With such low awareness, these children would not be able of self-management. In this respect, a study of hemophilic patients' awareness and beliefs found that their awareness and opinions are of major importance in the success of their pain management (McLaughlin et al., 2022).

The present study has also assessed the self-efficacy of hemophilic children.The results demonstrated that only one-fifth of them were having high self-efficacy. This is quite low and could have a negative impact on these children's ability of self management. In congruence with this, studies of hemophilic arthropathy in Belgium (de Kleijn et al., 2022) and in China (Liu et al., 2023) highlighted the importance of patients' self-efficacy in improving the management of their illness as it enhances their active participation in decision-making related to their treatment plans.

Other factors positively influencing children's post intervention awareness were child's age, family income, and being on regular medication. The positive effect of child's age could be explained by more maturity. The effect of family income is quite conceivable and could be attributed to better health behaviors and care in the family. Lastly, being on regular medication could be due to the effect of child's high awareness.

The implementation of the current study intervention program with computer-based gaming led to significant improvements in hemophilic children's self-efficacy. Thus, the great majority of them were having high post-intervention self-efficacy. The finding leads to acceptance of the second research hypothesis. The improvement was certainly due to the direct effect of the intervention, which was identified as a main independent positive predictor of the self-efficacy score. In agreement with this, a study in Iran found that self-efficacy can be fostered through proper training (Lino et al., 2021). Additionally, a scoping review of nurse-led educational programs for patients with bleeding disorders documented their positive effect on patients' self-efficacy and self-management (Ballmann and Ewers, 2022)

CONCLUSION

. The implementation of an educational intervention based on children's identified needs and using computer-based games, namely "hemoaction" and "hemoheros" games, is effective in improving their awareness of the disease as well as their related self-efficacy. The improvement of self-efficacy is due to the direct effect of the program as well as its indirect effect through improving children's awareness.

RECOMMENDATIONS

In the light of the study results, the following recommendations are proposed. The use of computer-based gaming should be widely used in the education of children with hemophilia to train them in self-management through improving their self-efficacy.

Table 1: Demographic characteristics of children in the study sample (n=50)

Demographic characteristics	Frequency	Percent
Age:		
6-9	39	78.0
10-12	11	22.0
Range	6-12	
Mean±SD	8.1±1.8	
Median	8.0	
Firstborn:		
No	25	50.0
Yes	25	50.0
Education:		

Illiterate	2	4.0
Primary	48	96.0
Regular school attendance (n=48):		
No	41	82.0
Yes	7	14.0
Reasons for irregular attendance (n=41):[@]		
Illness	19	38.0
Fear of bleeding at school	16	32.0
Time lost at hospital	7	14.0

Table 2: Demographic characteristics of families of children in the study sample (n=50)

Demographic characteristics	Frequency	Percent
Mother age:		
<30	17	34.0
30+	33	66.0
Range	22-43	
Mean±SD	31.9±5.0	
Median	32.0	
Mother education:		
Secondary	6	12.0
Above secondary	44	88.0
Marital status:		
Married	1	2.0
Divorced	49	98.0
Mother job:		
Working	18	36.0
Housewife	32	64.0
Father age:		
<35	17	34.0
35+	33	66.0
Range	27-50	
Mean±SD	36.9±5.4	
Median	37.0	
Father education:		
Secondary	5	10.0
Above secondary	45	90.0
Father job:		
Unemployed	3	6.0
Working	47	94.0

Income:		
Insufficient	45	90.0
Sufficient	5	10.0
Crowding index:		
<2	8	16.0
2+	42	84.0

Table 3: Hemophilia disease characteristics of children in the study sample (n=50)

Hemophilia disease characteristics	Frequency	Percent
Had bleeding episodes	50	100.0
Causes:		
Severe injury	26	52.0
Dental work	16	32.0
Surgery	14	28.0
Spontaneous	13	26.0
Minimal injury	10	20.0
Site:		
Elbow	23	46.0
Knee	22	44.0
Foot	5	10.0
Number/month:		
<6	26	52.0
6+	24	48.0
Range	3-9	
Mean±SD	5.3±1.6	
Median	5	
Effect on joint mobility:		
None	1	2.0
Minimal	3	6.0
High needing assistance	46	92.0
Regular medication:		
No	30	60.0
Yes	20	40.0
Reasons for no:		
Far hospital	25	50.0
Effect on school attendance	2	4.0
Risk of blood transfusion	3	6.0
Frequency of hospital visits:		
Weekly	43	86.0

Monthly	1	2.0
Ad-Hoc	6	12.0

Table 4: awareness about hemophilia among children before and after intervention

Correct awareness of hemophilia:	Pre (n=50)		Post (n=50)		Chi-squared Test	p-value
	No.	%	No.	%		
Definition	14	28.0	41	82.0	29.455	<0.001*
Etiology	21	42.0	47	94.0	31.066	<0.001*
Symptoms/signs	17	34.0	48	96.0	42.242	<0.001*
Complications	21	42.0	46	92.0	28.268	<0.001*
Treatment	29	58.0	49	98.0	23.31	<0.001*
Factor	26	52.0	49	98.0	28.213	<0.001*
Effect of factor intake	20	40.0	47	94.0	32.972	<0.001*
Convalescence	24	48.0	48	96.0	28.571	<0.001*
Safe activities	30	60.0	49	98.0	21.76	<0.001*
Unsafe activities	34	68.0	47	94.0	10.981	<0.001*
Recommended diet	34	68.0	47	94.0	10.981	<0.001*
Management of scratch	24	48.0	49	98.0	31.71	<0.001*
Management of contusion	20	40.0	44	88.0	25.00	<0.001*
Management of wound	22	44.0	48	96.0	32.19	<0.001*
Behavior during factor intake	34	68.0	43	86.0	4.574	0.032*
Helping nurse	35	70.0	47	94.0	9.756	0.002*

(*) Statistically significant at p<0.05
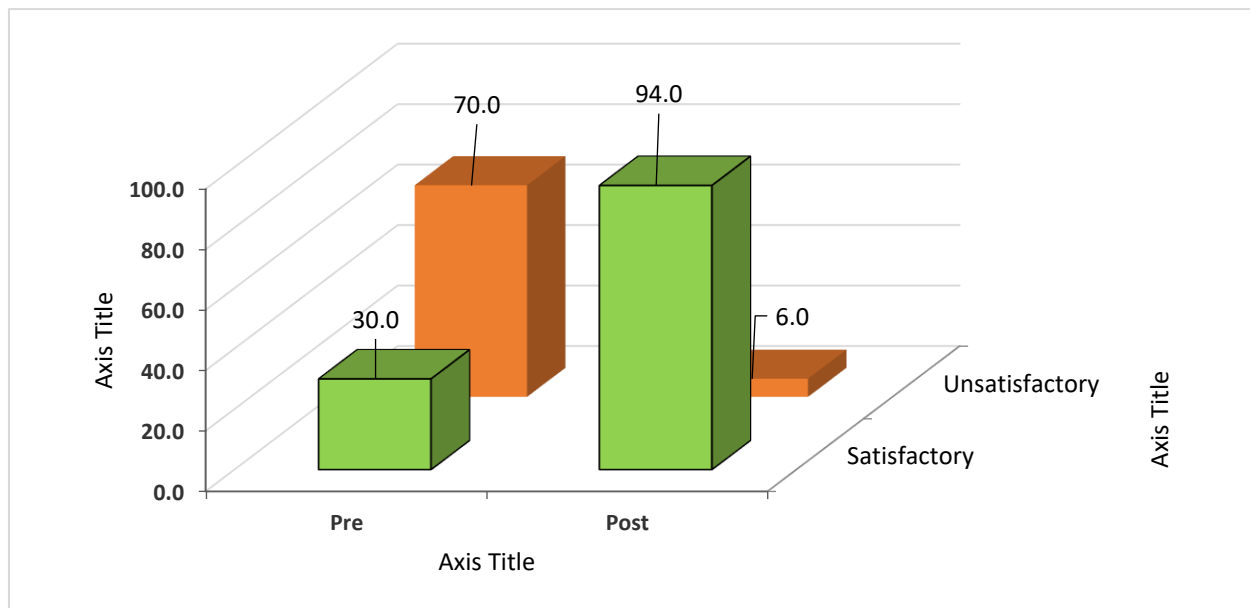
(*) Statistically significant at p<0.05

Figure 1: Total awareness about hemophilia among children.
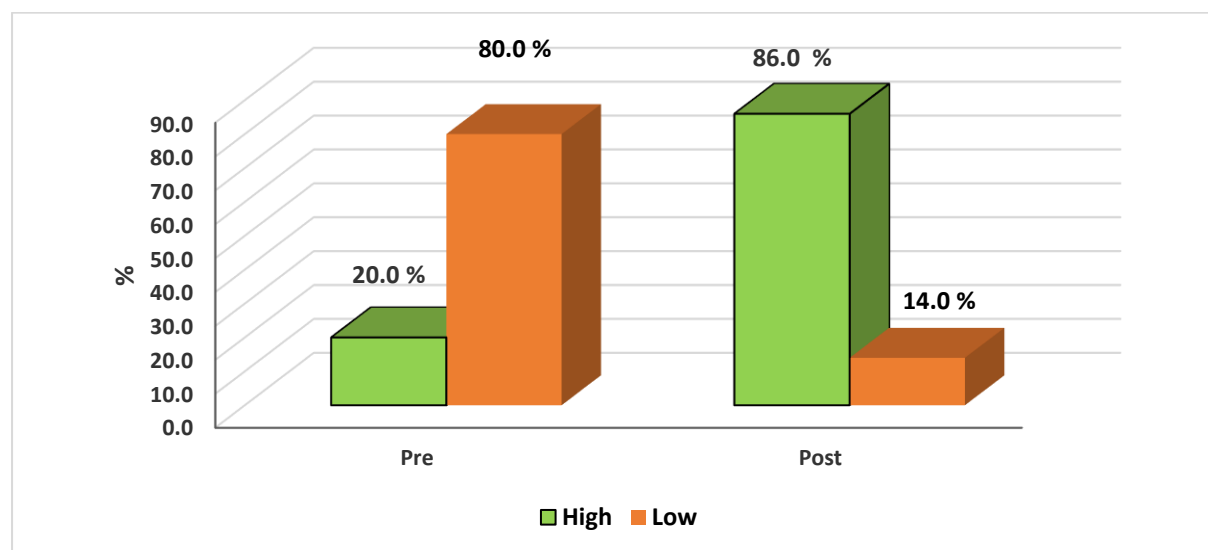
(*) Statistically significant at p<0.05

Figure2: Total self-efficiency among children before and after intervention

Table 5: Best fitting multiple linear regression model for the awareness score

Awareness variables	Unstandardized Coefficients		Standardized Coefficients	t-test	p-value
	B	Std. Error			
Constant	-6.38	12.91		-0.494	0.622
Intervention	52.25	4.34	0.75	12.028	<0.001

Child age	3.00	1.24	0.15	2.424	0.017
Child age at diagnosis	-11.48	5.41	-0.14	-2.122	0.037
Family income	15.13	7.44	0.13	2.033	0.045
Regular medication	9.96	4.68	0.14	2.130	0.036

r-square=0.64   Model ANOVA: F=32.72, p<0.001

Variables entered and excluded: parents' age, education, marital status, residence, crowding index, bleeding times

Table 6: Best fitting multiple linear regression model for the self-efficacy score

self-efficacy variables	Unstandardized Coefficients		Standardized Coefficients	t-test	p-value
	B	Std. Error			
Constant	-7.43	11.82		-0.628	0.531
Intervention	36.70	4.09	0.65	8.973	<0.001
Child age	3.51	1.17	0.22	3.014	0.003
Family income	12.69	6.85	0.14	1.853	0.067

r-square=0.50   Model ANOVA: F=31.42, p<0.001

Variables entered and excluded: parents' age, education, marital status, residence, crowding index, age at diagnosis, regular treatment, bleeding times.

Reference:

[1]   Bérubéa S, Amesse C, and Sultan S (2020): Illness perceptions and their relation to physical activity in children and adolescents with hemophilia. HEALTH PSYCHOLOGY AND. 1(8): 461-474.

[2]   Di Minno, M. N. D., Ambrosino, P., Quintavalle, G., Coppola, A., Tagliaferri, A., Martinoli, C., & Rivolta, G. F. (2016, July). Assessment of hemophilic arthropathy by ultrasound: where do we stand?. In Seminars in Thrombosis and Hemostasis (Vol. 42, No. 05, pp. 541-549). Thieme Medical Publishers.

[3]   Warsinsky, S., Schmidt-Kraepelin, M., Rank, S., Thiebes, S., & Sunyaev, A. (2021). Conceptual ambiguity surrounding gamification and serious games in health care: literature review and development of game-based intervention reporting guidelines (GAMING). Journal of Medical Internet Research, 23(9), e30390.

[4]   Beheshtipoor, N., Ghanavati, S., Edraki, M., Karimi, M., & Haghpanah, S. (2016). Hemoaction game: an educational step to improve hemophilia children and nurses self-efficacy. Journal of Advances in Medical Education & Professionalism, 4(4), 206-206.

[5]   de Jong, N. B., Elzinga-Plomp, A., Hulzebos, E. H., Poppe, R., Nijhof, S. L., & van Geelen, S. (2020). Coping with paediatric illness: Child's play? Exploring the effectiveness of a play-

and sports-based cognitive behavioural programme for children with chronic health conditions. Clinical Child Psychology and Psychiatry, 25(3), 565-578.

[6]   Marcu, G., Ondersma, S. J., Spiller, A. N., Broderick, B. M., Kadri, R., & Buis, L. R. (2022). Barriers and considerations in the design and implementation of digital behavioral interventions: qualitative analysis. Journal of Medical Internet Research, 24(3), e34301.

[7]   Bogosian, A., Van Vliet, L. M., Craig, G., Fraser, L. K., & Turner-Cobb, J. (2016). Minding the gap and moving forward in children's long-term conditions: A vital role for health psychology. British Journal of Health Psychology, 21(3), 493-498.

[8]   Knutz, E., Ammentorp, J., & Kofoed, P.-E. (2015). Why Health Care Needs Design Research: Broadening the Perspective on Communication in Pediatric Care Through Play. Health Communication, 1-14.

[9]   Sardi, L., Idri, A., & Fernández-Alemán, J. L. (2017). A systematic review of gamification in e-Health. Journal of biomedical informatics, 71, 31-48.

[10] Sharifzadeh, N., Kharrazi, H., Nazari, E., Tabesh, H., Edalati Khodabandeh, M., Heidari, S., & Tara, M. (2020). Health education serious games targeting health care providers, patients, and public health users: scoping review. JMIR serious games, 8(1), e13459.

[11] Srivastava, A., Santagostino, E., Dougall, A., Kitchen, S., Sutherland, M., Pipe, S. W., ... & WFH Guidelines for the Management of Hemophilia panelists and co-authors. (2020). WFH guidelines for the management of hemophilia. Haemophilia, 26, 1-158.

[12] Srivastava, A., Santagostino, E., Dougall, A., Kitchen, S., Sutherland, M., Pipe, S. W., ... & WFH Guidelines for the Management of Hemophilia panelists and co-authors. (2020). WFH guidelines for the management of hemophilia. Haemophilia, 26, 1-158.

[13] Beheshtipoor, N., Ghanavati, S., Edraki, M., Karimi, M., & Haghpanah, S. (2016). Hemoaction game: an educational step to improve hemophilia children and nurses self-efficacy. Journal of Advances in Medical Education & Professionalism, 4(4), 206-206.

[14] Carroll, L., Benson, G., Lambert, J., Benmedjahed, K., Zak, M., & Lee, X. Y. (2019). Real-world utilities and health-related quality-of-life data in hemophilia patients in France and the United Kingdom. Patient preference and adherence, 941-957.

[15] Schiavoni, M., Pruneti, C., Guidotti, S., Moscatello, A., Giordano, F., Coluccia, A., ... & De Cristofaro, R. (2023). A Health Related Quality Of Life And Psychopathological Symptoms In People With Hemophilia, Bloodborne Co-Infections And Comorbidities: An Italian Multicenter Observational Study: Psychological Dinamics Of A Group Of Italian Hemophiliacs With And Without (Co) Infections And Comorbidities: A Multicenter Study. Mediterranean Journal of Hematology and Infectious Diseases, 15(1), e2023005-e2023005.

[16] Kihlberg, K., Baghaei, F., Bruzelius, M., Funding, E., Andre Holme, P., Lassila, R., ... & Astermark, J. (2023). No difference in quality of life between persons with severe haemophilia A and B. Haemophilia. Feb 15. doi: 10.1111/hae.14759. PMID: 36791275.

[17] van Balen EC, Hassan S, Smit C, Driessens MHE, Beckers EAM, Coppens M, Eikenboom JC, Hooimeijer HL, Leebeek FWG, Mauser-Bunschoten EP, van Vulpen LFD, Schols

SEM, Rosendaal FR, van der Bom JG, Gouw SC. Socioeconomic participation of persons Results from the sixth hemophilia in :with hemophiliathe Netherlands study. Res Pract Thromb Haemost. 2022 Aug 26;6(6):e12741.

[18] Germini, F., Noronha, N., Abraham Philip, B., Olasupo, O., Pete, D., Navarro, T., ... & Iorio, A. (2022). Risk factors for bleeding in people living with hemophilia A and B treated with regular prophylaxis: A systematic review of the literature. Journal of Thrombosis and Haemostasis, 20(6), 1364-1375.

[19] Kulkarni, S., Hegde, R., Hegde, S., Kulkarni, S. S., Hanagvadi, S., Das, K. K., ... & Bulagouda, R. S. (2022). Clinical profile of hemophilia B patients from Karnataka. Journal of Family Medicine and Primary Care, 11(6), 2735-2738.

[20] Ljung, R., de Kovel, M., van den Berg, H. M., & PedNet Study Group. (2022). Primary prophylaxis in children with severe haemophilia A and B—Implementation over the last 20 years as illustrated in real-world data in the PedNet cohorts. Haemophilia. Dec 26. doi: 10.1111/hae.14729. Epub ahead of print. PMID:36571801.

[21] van Balen EC, Hassan S, Smit C, Driessens MHE, Beckers EAM, Coppens M, Eikenboom JC, Hooimeijer HL, Leebeek FWG, Mauser-Bunschoten EP, van Vulpen LFD, Schols SEM, Rosendaal FR, van der Bom JG, Gouw SC. Socioeconomic participation of persons with hemophilia: Results from the sixth hemophilia in the Netherlands study. Res Pract Thromb Haemost. 2022 Aug 26;6(6):e12741.

[22] Kulkarni S, Hegde R, Hegde S, Kulkarni SS, Hanagvadi S, Das KK, Kolagi S, Gai PB, Bulagouda RS. Clinical profile of hemophilia B patients from Karnataka. J FamilyMed Prim Care. 2022 Jun;11(6):2735-2738.

[23] Ljung, R., de Kovel, M., van den Berg, H. M., & PedNet Study Group. (2022). Primary prophylaxis in children with severe haemophilia A and B—Implementation over the last 20 years as illustrated in real-world data in the PedNet cohorts. Haemophilia. Dec 26. doi: 10.1111/hae.14729. Epub ahead of print. PMID:36571801.

[24] Nwagha, T. U., Okoye, H. C., Yuguda, S., Udo, C. E., Ogunfemi, M. K., Gwarzo, D. H., & Osuji, N. J. (2023). Adherence to prophylaxis and bleeding outcome: A multicenter Nigerian study. Plos one, 18(2), e0264600.

[25] Germini, F., Noronha, N., Abraham Philip, B., Olasupo, O., Pete, D., Navarro, T., ... & Iorio, A. (2022). Risk factors for bleeding in people living with hemophilia A and B treated with regular prophylaxis: A systematic review of the literature. Journal of Thrombosis and Haemostasis, 20(6), 1364-1375.

[26] Lino, F., Arcangeli, V., & Chieffo, D. P. R. (2021). The Virtual Challenge: Virtual Reality Tools for Intervention in Children with Developmental Coordination Disorder. Children, 8(4), 270.

[27] Ballmann, J., & Ewers, M. (2022). Nurse-led education of people with bleeding disorders and their caregivers: A scoping review. Haemophilia, 28(6), e153-e163.

[28] Fan, G., Shen, Y., Cai, Y., Zhao, J. H., & Wu, Y. (2022). Uncontrollable bleeding after tooth extraction from asymptomatic mild hemophilia patients: two case reports. BMC Oral Health, 22(1), 1-8.

[29] Khair, K., Holland, M., Dodgson, S., McLaughlin, P., Fletcher, S., & Christie, D. (2021). Fitness enhances psychosocial well-being and self-confidence in young men with hemophilia: results from Project GYM. Research and Practice in Thrombosis and Haemostasis, 5(8), e12622.

[30] Wang, Y., Wang, Z., Liu, G., Wang, Z., Wang, Q., Yan, Y., ... & Pang, X. (2022). Application of Serious Games in Health Care: Scoping Review and Bibliometric Analysis. Frontiers in Public Health, 10.

[31] Brod, M., Bushnell, D. M., Neergaard, J. S., Waldman, L. T., & Busk, A. K. (2023). Understanding treatment burden in hemophilia: development and validation of the Hemophilia Treatment Experience Measure (Hemo-TEM). Journal of Patient-Reported Outcomes, 7(1), 17.