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EVALUATION OF THE EFFECT OF AN EDUCATION PROGRAM USING CARTOONS AND COMICS ON DISEASE MANAGEMENT IN CHILDREN WITH ASTHMA: A RANDOMIZED CONTROLLED STUDY

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ABSTRACT

Objective: The aim of this study was to determine the effect of an education program, the Health Promotion Program for Children with Asthma (HPPCA), on disease control and quality of life in children aged between 7 and 11 and diagnosed with asthma. The program was developed using cartoons and color-in materials and was based on the health promotion model developed by Nola J. Pender and brain-based learning theories (Pender, Murdaugh, & Parsons, 2015).

Materials and Methods: The sample of the study consisted of 74 children between the ages of 7 and 11 who presented to the respiratory diseases' unit of a university hospital in Istanbul. All participants were given basic asthma education by their physicians, and were then randomly assigned to a group that received the HPPCA program or a control group that received no further education. After the HPPCA education was applied to the experimental group alone, both groups were administered two post-tests as a follow-up and retest at the end of the first and fourth month after the intervention. The standardized Sociodemographic Question Form, the Childhood Asthma Control Test (C-ACT) and the Pediatric Asthma Quality of Life Questionnaire (PAQLQ) were used for the follow-up.

Results: The asthma control and quality of life scores of the children included in the experimental group were found to be significantly higher compared to the control group at the first- and fourth-month follow-ups ($p<.001$). The rate of school absenteeism decreased significantly in children who received HPPCA education at the first follow-up compared to the children who did not receive the education ($p<.05$).

Practice Implications: The present study found that the HPPCA education, whose design was based on the health promotion model, and which was supported by cartoons in order to attract the attention of the children, was effective. The HPPCA was proven to create a sense of control over asthma and to improve the quality of life in the children. It is recommended that there be an asthma nurse in pediatric allergy and immunology outpatient clinics who can specifically provide an HPPCA. Further studies should be conducted to demonstrate the effectiveness of this program, which was examined in the present study for the first time with a randomized controlled method.

Highlights

- Asthma control is extremely important for the quality of life in children with asthma.
- Asthma education provided to school-age children yields the best results when new teaching techniques and multimedia content are used.
- Asthma education for children must be based on a good theoretical methodology.
- Children can best manage asthma when they learn about it directly.
- Asthma education conducted according to the guidelines is of great importance during the COVID-19 pandemic.

Keywords Pediatric asthma, quality of life in children with asthma, cartoon education in asthma, control education in pediatric asthma

INTRODUCTION

Asthma is the most common chronic disease in childhood. It is a chronic inflammatory disease, involving many different cell types and cellular elements (Al Aloola, Naik-Panvelkar, Nissen, & Saini, 2014; Gibson, 2019; GINA, 2018). Asthma has been reported all over the world at different rates according to the location. According to the CDC's (Center for Disease Control and Prevention's) 2018 report, approximately 6 million children aged between 0 and 17 have a diagnosis of asthma in the USA (CDC, 2018). The prevalence of asthma between the ages of 6 and 12 in Turkey has been reported as 2%-16% (Sağlık Bakanlığı, 2018). According to the World Asthma Day declaration published in Turkey, one out of every 7–8 children suffer from asthma as a result of economic, environmental, social and genetic factors. Because of these high rates, and differences in individual symptoms, the treatment and care of pediatric asthma require special approaches (Abadoğlu et al., 2016; Bakanlık, 2018; Üner S, 2018).

Asthma has variable symptoms specific to each individual, and the symptoms can be made worse by many factors (Abadoğlu et al., 2016). Allergens, irritants and viral infections are among these factors. Viral infections that damage lung tissue, such as COVID-19, can be fatal depending on the severity of the symptoms (CDC, 2020; Shaker et al., 2020). These symptoms have a measurable effect on the child's asthma control, quality of life, school absenteeism and rates of presentation at hospital. When specific age groups are examined, adolescents are more affected than children under 11 years old (Bernstein & Mansfield, 2019; Control & Prevention, 2017). However, when treatment compliance is considered, it has been reported that treatment compliance lessens as age increases (Halwani et al., 2017). With proper theory-based therapeutic education and care, asthmatic children become better able to comply with treatment and are thus better able to control their asthma attacks (CDC, 2013b, 2018).

A sense of control is very important in both managing disease and developing healthy living behaviours in children with chronic diseases such as asthma. The more the child has a sense that they can control their behaviour, the more they will be persistent and put in the effort to accomplish this (Çevik, 2011). Children with asthma should be educated about their condition, both to enable them to develop their skills and to change their behaviours (Alkan, 2016; Murua et al., 2007).

Changing how individuals behave is the most difficult part of therapeutic education (Alkan, 2016; Murua et al., 2007). In particular, school-age children with asthma should be educated using therapeutic methods and proven nursing models in order that they can learn disease management and control their own asthma (Alkan, 2016). One model which targets behavioural changes is Pender's health promotion model (Alligood, 2017; Çövener, 2012). This learning model has two purposes, the general and specific. The general purpose is enriching and enhancing learning, while the specific aim is to enable the child to demonstrate advanced basic competences and improve their knowledge (Çoruhlu, Nas, & Keleş, 2016; Palavan, 2018). With a good education plan and memorable education methods, children with asthma can learn to permanently manage their symptoms (Çövener, 2012; Ekim, 2012; GINA, 2019). However, Pender's model does not indicate which learning methods provide the best chance for targeting behavioural change (Çövener, 2012).

It has thus been suggested in the literature that the model should be used with different training techniques (Karadağ, Çalışkan, & Baykara, 2017; Ocakçı & Alpar, 2014). Among the current educational and training techniques, the brain-based teaching model, which has been used frequently in educational science in recent years, has received much attention. This theory, also known as the neurophysiological theory, was proposed by Donald Olding Hebb in 1951 and

developed by Caine and Caine in 1995 (Çoruhlu et al., 2016). The neurophysiological theory contends that the symptom management skills of children with asthma can be made permanent through good educational planning and recapitulation methods (Ekim, 2012; GINA, 2019; Gulla & Kabra, 2017).

A pilot study was conducted with a small number of patients in order to test the HPPCA program. The program was designed to ensure that the children aged between 7 and 11 learned about disease management and improved their quality of life through an education program (HPPCA) based on the health promotion model and brain-based learning theories and using cartoon and comic book materials.

Hypothesis

After four months children participating in the HPPCA will have less frequent school absenteeism and presentation at hospital, including unplanned outpatient clinic visits, emergency room visits, nonurgent doctor visits and inpatient admission, and better quality of life and disease management compared to those who do not participate.

MATERIALS AND METHODS

Trial Design

The study was a randomized controlled study. Subjects were assigned to the parallel groups randomly. The trial had two branches. Both of the groups received the normal standard care, which was the standard education given by doctor. In this, the child and their parents met the doctor for a normal examination. They received their asthma diagnosis or other information about their condition. Then the doctor explained to them what asthma is, what medication was required and how to use it. The experimental group and their parents received the same standard care as the control group, but were then also given the HPPCA education. This consisted of a single session of 40 min of education for the child and their parents. Baseline data for the study outcome measures was collected before the intervention on the same day. The second follow-up was conducted at the first month, and the third follow up was conducted at the fourth month after the intervention. The children were asked to complete the PAQLQ and the first four questions of the C-ACT, and the parents were asked to complete the sociodemographic form and the last three questions of the C-ACT.

Study Participants

In children aged between 6 and 12 the prevalence of asthma in Turkey has been reported to be between 2% and 16% (TÜSAD, 2019). 27.2% of Turkey's population, or 22 750 657 individuals, is made up of children. The number of those suffering from asthma is thus between 455 013 and 3,640 000. The focus of this study was a state hospital (because healthcare is free and provided there to individuals of all socioeconomic levels) in order to be able to generalize the population and determine a specific study group within a specific period of time. The study participants were recruited from a group of 386 children who presented to the hospital with asthma between March and December 2019, according to the hospital's records. We chose this age range due to the intersection of the measuring materials and the appropriateness of the color-in materials. The study participants were regular patients of the clinic, and the eligibility criteria were as follows:

Being aged between 7-11 years of age with a diagnosis of chronic allergic asthma,

Being literate

Having no communication problems,

Volunteering to participate in the study and having a legal guardian who had signed the informed consent form,

Not having an active attack (if there is a history of attack, two weeks should have passed since the last acute episode),

Not being allergic to pollen (because the third measurement was taken in the spring, and pollen allergy can exacerbate patients' asthma).

We invited children who met these criteria to join the study and obtained informed consent from their legal guardians (see Figure 1 for enrolment and retention data)

Location and Time of the Study

The preliminary study was carried out in the Pediatric Allergy Immunology Outpatient Clinic of a private hospital in Turkey and the main study was carried out in the Pediatric Pulmonology Outpatient Clinic of a state hospital in Turkey. It was decided that the intervention stages of the study should be carried out in the winter months due to the frequency of symptoms of asthma, while the follow-up should be carried out in the spring months, which may increase the atopy and frequency of symptoms. The intervention and follow-up stages of the study were thus carried out between December 2019 and May 2020 respectively.

Recruitment

The patients' records were used to evaluate them in terms of the inclusion and exclusion criteria. The contact information for the families of the children who met the inclusion and exclusion criteria was obtained from the hospital records. The researcher introduced herself and the study and then explained that more. It was stated that more detailed information would be given when the families came to the hospital on the day of their appointment. Those who did not agree to participate in the study at this point were excluded from the study.

Enrolment

Those who agreed to participate in the study met in the hospital waiting room on the day and time of their appointment. It was explained that the study was an experiment, that it would be randomized, that if the child was placed in the experimental group, HPPCA would be provided to teach the child asthma management, and that the parent could participate if they wished (during the experiment all of the parents wanted to participate). It was also stated that if the child was placed in the control group after randomization, the same education would be given to their child after the follow-up tests. It was planned to give the HPPCA to face-to-face, but because of COVID-19 it was instead provided via video). In addition, the researcher explained that whether the child was in the experimental or the control group, the family would be contacted by phone to repeat the tests one month and four months later. After this explanation, and once the parents had signed a written consent form, all the families went to their doctor's examination room. During the examination, the doctor provided education to both parent and child.

Sample Size

Power and Sample Size software was used to calculate the sample size (Power and Sample Size Calculator, October 2018). Because the primary outcome was quality of life, the rate of increase

in the quality-of-life variable resulting from asthma education in the study conducted by Kocaslan in 2016 was taken as a reference. In Kocaslan's study, an 8-point increase was reported in quality of life as a result of asthma education, with 95% confidence and 80% power in 24 experimental and 24 control group individuals (Kocaaslan, 2016b). Additional subjects were included in the sample for this study in order to prevent the effects of the participants who discontinued or did not complete the study. This was calculated at 20% extra, and the experimental and control groups were targeted to include 35 individuals.

Outcomes

The primary outcome of the study was quality of life. Other outcomes were school absenteeism due to asthma, frequency of presentations at hospital (include unplanned outpatient clinic visits, emergency room visits, nonurgent doctor visits and inpatient admission), quality of life, and asthma control.

Randomization

After the examination and education had been completed, a shift nurse (independent from the researcher) took the parents and child to the waiting room and conducted the randomization.

Random assignment of the participants was done with the URN method (this method has been reported to be the most effective method for randomization in small groups) (Beller, Gebski, & Keech, 2002; Kanik, Taşdelen, & Erdoğan, 2011; Rosenberger & Lachin, 2015). Assignment to the experimental groups was made by a nurse (who worked as day shift nurse) independent of the researcher (for reduce the possibility of the bias). This randomization was conducted with the child and parents present, so they learned the outcome at the same time. The researcher and the subjects did not know which subjects would fall into which group until the intervention was implemented. In this way, possible bias was prevented.

Data Collection

After the study participants had all received education from their physician and then been randomly assigned to the experimental or control group, baseline for the study data was collected in a room used only for data collection. If the participant was assigned to the control group, both the child and the parents went to the test room, took the test and were then released. If the participant was assigned to the experimental group, the nurse sent them first to the test room and then to the experimental/education room to receive the HPPCA education (the detailed information about rooms are given under Intervention section).

The first- and fourth-month follow-ups were conducted by phone with both the parent and the child.

Interventions

During the examination, both groups and their parents received the standard educational information from their doctors. The control group was then released, while in the experimental group both the child and their parents were given the HPPCA. Researchers met with all the children and their families individually. The child sat at the front, separately from their parents, but if the parents/legal guardian had any questions, the researchers answered them at the end of the education. Experimental room designed like classroom area. It has computer and sound system, education and cartoons showed that area, and also the researcher provided children with painting materials, which they could use there and take home with them.

Cartoon and Color-In Materials: Iggy and the Inhalers

In the brain-based learning methodology, specific educational materials play an important role (Hebb, 1955). The health promotion model and brain-based training model in asthma education can best be applied using a multimedia format. Education given with multimedia has been found to be more effective than education given with printed materials alone (Brown, Lehr, French, & Giuliano, 2017; King, Kho, Tiong, & Julaihi, 2015; C. Mickel, K. Shanovich, M. Evans, & D. Jackson, 2017). The cartoons and color-in materials about characters called Iggy and the Inhalers, which were the educational materials used in this study, were first designed and published by Thomas and Ashwall in 2014 for children aged between 7 and 12. The materials were developed by a pediatric allergist who is medical doctor also cartoonist, and a healthcare communications specialist, in the light of the international guidelines (National Asthma Education and Prevention Program (NAEPP), Global Initiative for Asthma (GINA))(GINA, 2019; Catherine F Mickel, Kathleen K Shanovich, Michael D Evans, & Daniel J Jackson, 2017; NAEPP, 2018). Iggy and the Inhalers were developed so that school children could understand the pathophysiology and symptoms of asthma, the medications used for it, and inhaler techniques in an age-appropriate way. The cartoons and comic strips also teach which triggers worsen symptoms as well as methods to avoid these triggers. The translation into the Turkish language was simultaneously checked by 10 experts who knew both languages well, and the dubbing process was performed by the researcher in a professional studio. The recordings were sent to the Booster Shot Media company to be embedded in the video. In addition, the English words used in the coloring-in materials were translated into Turkish.

Health Promotion Program for Children with Asthma (HPPCA)

For the HPPCA, the researcher prepared a presentation about specific asthma topics, including pathophysiology, symptoms, medications, and inhaler techniques. First, the researcher defined the terms and explained the topic to the child and parent with the power point presentation (this presentation and education technique approved by child health nursing professor and 5 child health nursing specialists). The researcher then showed them the cartoon episode about the topic (e.g., 'symptoms') after the presentation. The child was then given the color-in comic strip material related to that section and asked to color it in. Every cartoon episode had its own tie-in materials. Every child colored them in on their own, but their parents remain with them. To better understand the HPPCA Model, a conceptual map of a sample of the program is given in Figure 2. These Iggy and the Inhalers cartoons and color-in comics were used here for the first time in Turkey. The effectiveness of these materials was first demonstrated by Thomas and Ashwall in 2014, and were used again by Catherine et al. in 2017 (C. F. Mickel, K. K. Shanovich, M. D. Evans, & D. J. Jackson, 2017; Thomas & Ashwall, 2014).

In order to evaluate the effectiveness of the education program, both groups were called one month later, and the first-month measurements were performed. Three months after the first post-test, the patients were again called by phone and the measurements were made in the fourth month. The personal information of the subjects was only available to the researcher. All pre- and post-intervention tests were recorded using subject numbers. The HPPCA program consisted of four units of 10 min each, prepared in the light of the literature and in accordance with the current guidelines. Each child received a total of 40 min education. At the end of the trial (after the all of the follow-ups) the HPPCA was also given to the control group via online streaming (because of COVID-19) in order to prevent ethical bias.

Instruments

Sociodemographic Questionnaire Form:

This questionnaire form, which was developed in line with the literature and intended for children aged 7–11, consisted of 22 questions in total. This form aimed to determine the age, gender, living environment, asthma-related presentations at the hospital and school absenteeism in the children who participated in the study. There were two questions to measure school absenteeism and hospital presentation. We asked the following questions: ‘In the past four weeks have you ever been absent from school because of your asthma getting worse?’; ‘In the past four weeks have you ever been admitted to hospital when you have been absent from school?’ (Akdeniz & Öncel, 2019; Butz et al., 2005; Juniper et al., 1996; Kocaaslan, 2016a; P.-C. Liu, Kieckhefer, & Gau, 2013). The hospital presentation question include unplanned outpatient clinic visits, emergency room visits, nonurgent doctor visits and inpatient admission. In Turkey, regular follow-up administration and adherence to treatment is low in children, especially when compared with adults (Gemicioglu et al., 2019). Because of that, all the hospital admissions were considered in one question. For the validity of the sociodemographic form, a pilot study was conducted with five children and these data were not included in the study.

Pediatric Asthma Quality of Life Questionnaire (PAQLQ):

This was developed by Juniper et al. in 1996 in Canada, with the aim of assessing the quality of life of children with asthma (Juniper et al., 1996). The questionnaire aims to determine the disease-related mental, physical, or social disorders of children with asthma between the ages of 7 and 17. The questionnaire was translated into Turkish by Fidaner et al., and the validity and reliability tests were carried out by Bozkurt. Bozkurt and Yıldız determined the Cronbach's alpha value of the questionnaire as 0.85 in the first application, and as 0.91 in the second application (Bozkurt & Yıldız, 2004). The questionnaire has three subdimensions: symptoms, activity limitation and emotional function. The lowest score that can be obtained from the scale is 23, and the highest score is 161. The scores of all the subdimensions are added together and the mean scores are calculated. Higher scores indicate better quality of life (Juniper et al., 1996).

Childhood Asthma Control Test (C-ACT):

This scale was developed by Liu et al. in 2007 in order to measure the asthma control levels of children aged between 4 and 11, in the light of the Global Initiative for Asthma (GINA) guidelines (A. H. Liu et al., 2007). The validity and reliability studies of the Turkish version of the C-ACT were carried out by Sekerel et al. in 2012 (Sekerel et al., 2012). The cut-off point for the scale is 19. A score of 19 points or less from the scale indicates that the asthma is not under the control of the child. In order to measure the internal consistency of the scale, it was repeated with five hospital visits, and a separate Cronbach's alpha value was reported for each visit. For the C-ACT1 and C-ACT5, the values were 0.82, 0.83, 0.82, 0.82 and 0.83, respectively (there was one value for each form of the scale). In addition, the test-retest value of the scale was 0.71 (Demirbaş, Çekiç, Canitez, & Sapan, 2017; A. H. Liu et al., 2007; Sekerel et al., 2012; Somashekar & Ramakrishnan, 2017). In the present study, the Cronbach's alpha value was 0.82 in the first application, 0.91 in the second application, and 0.89 in the third application.

Statistical Methods

The data obtained in the study were evaluated using statistical analysis. The SPSS 26.0 analysis program was used for this evaluation (SPSS, 2019). In order to evaluate the effectiveness of the intervention in the study data, the differences between the groups before and after the intervention were evaluated through parametric tests according to the normal distribution characteristics of the data. When the scores obtained from the scales were checked for normal distribution, it was seen that the skewness and kurtosis values were suitable for normal distribution (George & Mallery, 2010; Tabachnick, Fidell, Tabachnick, & Fidell, 2014). Among the

parametric tests, we first performed the chi square test to control the baseline of the data. When the homogeneity of the two groups for follow-ups was observed, the independent intergroup t-test was performed, and repeated measures ANOVA was used to determine the relationship between the asthma control and quality of life variables. When differences were observed in the ANOVA test, Bonferroni analysis was added to prevent a type 1 error: Bonferroni analysis is conducted for showing the measurement of within-group change over time.

RESULTS

This part of the study contains the results obtained from the total of 74 participants. In the chi-square test performed to reveal the homogeneity of the experimental and control groups included in the study, it was observed that there were no statistically significant differences between the groups in terms of all variables. At baseline, before the comparison the outcomes at follow-up, school absenteeism and presentation at hospital, including unplanned outpatient clinic visits, emergency room visits, nonurgent doctor visits and inpatient admissions before the intervention were compared. There were slight differences between the two groups, but these had no clinical or statistical significance.

In terms of the children's allergies, it was observed that the most important factor that worsened asthma was house dust. In the experimental group, 76.3% ($n = 20$) of the children, and in the control group 75.0% ($n = 27$) of the children were allergic to house dust. The second most important factor affecting the participants was smoking. In the experimental group, 52.6% ($n = 20$) of the children, and in the control group, 41.7% ($n = 15$) of the children were affected negatively by the smoke. There were no children with pollen allergy in either group. Since the follow-up phase of the study involved the spring months, children with pollen allergy were not included in the study in order not to affect the results of the study (Table 1). Absenteeism and presentation at hospital of the children in the experimental and control groups were compared in terms of their frequency before and after the intervention. Hospital presentations included unplanned outpatient clinic visits, emergency room visits, nonurgent doctor visits and inpatient admission) (Table 2).

Before the intervention, the baseline total score of the PAQLQ showed no statistical significance (Table 3). This shows the homogeneity of the group's quality of life at the beginning. The scores obtained by the experimental group in the first- and fourth-month measurements of the PAQLQ and all its subdimensions were found to be higher than the scores obtained by the control groups (Table 3). Similar results for asthma control are shown in Table 4. There was a significant difference between the scores obtained by the groups in the first- and fourth-month follow-up of the C-ACT (Table 4).

In the Bonferroni assessment, which was an advanced analysis (this is additional measure of within-group change over time), it was found that the first- and fourth-month measurements were higher in the experimental group in terms of all variables (PAQLQ Total Scores and subdimension scores, total C-ACT scores); however, for both the PAQLQ and C-ACT only the fourth-month measurements were found to show a small improvement in the control group compared to the measurements performed in the first month. However, a statistically insignificant development was seen. There was very little increase in the score. It is thought that this development may have occurred because all the children had to stay at home during COVID-19 and were protected from various allergens or trigger factors. The children included in the study did not experience any adverse effects.

DISCUSSION

In today's world, pediatric asthma negatively affects the physiological, social and psychological quality of life of children when it is not appropriately controlled (GINA, [2019](#); Hockenberry & Wilson, [2018](#); Hsu, Sicrar, Herman, & Garbe, [2018](#); Jenkinson, [2019](#)). The best way to eliminate negative consequences and improve the health of children with asthma is programmatic and systematic education provided by pediatric asthma nurses using appropriate methods. These educational programs should result in a decrease in school absenteeism and presentation at hospital, including unplanned outpatient clinic visits, emergency room visits, nonurgent doctor visits and inpatient admissions, as well as an increase in the quality of life and asthma control.

As this study with a systematic HPPCA program shows, the HPPCA had a large and statistically significant impact on improving PAQLQ, C-ACT scores and on school attendance. With respect to hospital presentation, both groups improved from baseline through follow-up. However, at the beginning of the COVID-19 pandemic, all asthmatic children were required to stay at home unless they had an attack. The improvement of the hospital presentation in both groups can be explained as a result of this.

One of the other important outcomes of our program lies in the absenteeism rates of the two groups. Within the first month following the HPPCA, a significant difference was found in school absenteeism. There was a relative decrease in the control group; however, the main improvement was clearly observed in the experimental group. It can thus be argued that the HPPCA is highly effective with regard to school absenteeism. In a systematic evaluation of 55 studies including asthma control education in school children, Saleh ([2020](#)) reported that systematic education based on up-to-date guidelines had a significant effect on school absenteeism. All school-age children spend most of their time at school. Time spent at school can be a risk factor for children with asthma (Gibson, [2019](#); Ochoa Sangrador & Vazquez Blanco, [2018](#)). According to a CDC report, 53% of children with asthma aged between 5–11 missed at least one day of school due to their asthma (CDC, [2013a](#)). Another study conducted with asthmatic children reported excessive school absenteeism (10% of school days) (Kim, Gee, & Byrd, [2020](#)). Considering that viral or bacterial infections (including, at present, COVID-19) trigger asthma in children, school can sometimes be dangerous for children with asthma in autumn and winter (Jaudes, Bilaver, & Champagne, [2015](#); McClure et al., [2018](#); Ochoa Sangrador & Vazquez Blanco, [2018](#); Walter et al., [2016](#)). The fact that there was a slight decrease in absenteeism due to asthma in the control group in the present study may have been due to the first-month measurement coinciding with the semester break. In the fourth-month measurement, absenteeism from school was found to be 0% in both the experimental and control groups. The reason for this was the cancellation of schools in Turkey due to the COVID-19 pandemic announced by the WHO (Milli Eğitim Bakanlığı, [2020](#); WHO, [2020](#)).

According to Saleh's study one of the important indicators of asthma control is the frequency of hospital presentations (Saleh, [2020](#)). Both outpatient clinic and emergency room presentations were included in the frequency of hospital presentations. In the second post-test administered within the scope of our study 11.1% of all the individual children had presented at hospital despite the COVID 19 pandemic (İçişleri Bakanlığı, 2020). The presentations, which were made despite the lockdown for individuals below 20, suggest that the severity of the attacks could be fatal. The absence of difference in the first- and fourth- month measurements in the study could be explained by the fact that schools were closed due to COVID-19 and children were removed from adverse weather conditions as well as viral/bacterial infections transmitted by their peers. However, McGhan et al. ([2010](#)) reported the reverse of our findings in their study, which investigated an educational program delivered in school. This program, which was called RAP (the Roaring Adventures of Puff), was designed in accordance with social behavioral theory, and the Canadian Asthma Guidelines were used to develop the content. In their study, which was administered to 266 children between the ages of 6 and 13 in a randomized controlled trial design, both the experimental and control groups stated that the frequency of visiting a doctor without an appointment had decreased. This decrease had positively affected the quality of life of the children related to asthma.

Asthmatic children may feel excluded when their activities are restricted due to attacks. Staying away from certain activities can push them into social isolation. This negatively affects the quality of life of children with asthma (Aktan, Berk, Erdoğan, & Öktem, 2019; Çınar, 2015; Julian et al., 2015; Juniper et al., 1996; Li et al., 2017; McGhan et al., 2010; Walter et al., 2016). One of the most important outcomes of our study is thus quality of life. Similar to the present study, McGhan et al. (2010), who implemented the RAP program, reported higher scores for quality of life compared to the control group in the both follow-up tests. Cicutto, To, and Murphy (2013) compared the RAP education program to a different sampling and a different educational method in 130 different primary schools in the USA. In the first and second follow-ups, a significant difference was determined between the two groups, favoring the RAP education. However, although the quality-of-life scores were still different when the follow-up period approached one year, the difference between the groups was reported to be smaller. Hence, they concluded that the asthma education should be repeated before one year had passed.

Since the quality of life in children is not dependent on a single factor, the PAQLQ and its three subdimensions should also be considered. Similar to our study, McGhan et al. (2010) stated that the symptoms subdimension of the quality-of-life scale was significantly higher compared to the control group in the first six months. However, in the 12th-month follow-up, the mean score decreased to the same levels. In this case, it can be argued that, in accordance with the literature, the HPPCA had a positive effect on the asthma symptoms of children. The inability to participate in certain activities with their school friends creates a feeling of restriction in children with asthma, and may result in anxiety (Juniper et al., 1996; McGhan et al., 2010). The mean score obtained in the activity limitation subdimension of the PAQLQ by the children who participated in our study increased in the first- and fourth-month measurements after the intervention. A significant difference was determined in the activity limitation subdimension in a study on asthma control education carried out by Abdelsalam (2017) with adolescents aged between 12 and 16. Examining the scores in the first and fourth months for the emotional function subdimension of PAQLQ in the present study, the children in the experimental group were observed to have scored significantly higher.

Quality of life improves in children with asthma when they become better at asthma control. A significant difference was found in the present study between the two groups in the first- and fourth-month measurements of the C-ACT, which were performed after the intervention. In the study carried out by Szeffler et al. (2019) on 223 children aged between 5 and 14, it was stated that education provided by school nurses had a 37.4% effect on the asthma control test. Tan, Chen, Soo, Ngoh, and Tai (2013), in their randomized controlled study of 169 children, reported that there was a difference between the asthma control test mean scores of children who created a written action plan for asthma. In the present study, there may have been some specific reasons for the increased scores in the control group at the second follow-up. One of these may have been that the schools were closed in Turkey due to the COVID-19 pandemic, and that the children were thus exposed to fewer triggers. They may have been better monitored at home by their parents and they may have used their medication more appropriately. The frequency of symptoms may also have reduced as a result of decreased physical activity. The warmer weather conditions due to the season may also have contributed to this result. Another reason may have been the standard education provided to both groups by their doctors. This emphasized the vital importance of creating an asthma action plan and providing asthma education to children.

Limitations of the Study

This study had a number of limitations. The first is the Pulmonary Function Test. When beginning to design the trial, one of the outcomes was the Pulmonary function test. Pulmonary Function Tests were administered to the children at the beginning of the study, and PFT data were also an outcome. However, when the COVID-19 pandemic started, the existent healthcare guidelines

placed patients with asthma into the risk group and banned PFTs worldwide in order to prevent the rate of virus spread (AİD, 2020; CDC, 2020; GINA, 2020). We were unable to perform that test and thus had to omit our hypothesis regarding its results. Another limitation is that as a result of the lockdown, the school absenteeism and hospital presentation variables could not be evaluated with second posttest for either group because of the COVID 19 pandemic. In addition, the second post-test of the study should have been administered face-to-face; however, the follow-up was performed on the phone due to COVID 19.

Conclusion and Recommendations

The HPPCA is an effective program in terms of children's quality of life and asthma control. Children with asthma require education like the HPPCA that uses memorable methods and is prepared according to up-to-date guidelines based on behavioral change and the promotion of health. The provision of this education to children with asthma by an asthma nurse in all allergy and immunology clinics would yield positive results. In order to get their symptoms under control, help children learn to live with asthma, and reinforce their knowledge about the use of medication, children should be followed-up by asthma nurses from the time of diagnosis onwards, and this education should be repeated at three- to six-month intervals at a minimum. It is recommended that asthma control tests be performed at regular intervals and that the quality of life in children with asthma be monitored during their time at school. In addition, it is recommended that the effectiveness of HPPCA be further proven – and improved - by implementing it with children in different populations.

Resources of Support and Approval of the Ethics Committee

No financial support was received for the preparation of the thesis. Ethical approval for the study was obtained from the Clinical Research Ethics Committee of Koc University with the code number 2019.329.IRB1.056. Institutional permission was obtained from the Training and Research Hospital, Health Sciences University Hamidiye Etfal. Booster Shot Media gave contractual permission to use Iggy and the Inhalers.

Registration Number and Name of Trial Registry

The trial was registered at <https://clinicaltrials.gov/>. The trial number is NCT04566835 and it is publicly available.

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Table 1. Comparison between the Groups in Terms of the Socioeconomic and Sociocultural Characteristics and Living Environments of the Children.

Experimental Group (n = 38)	n	%	Control Group (n = 36)	n	%	p
Gender			Gender			
Female	15	39.5	Female	15	41.7	$X^2=0.036$ $p = 0.84$
Male	23	60.5	Male	21	58.3	
Age			Age			
Below 9 Years	17	44.7	Below 9 Years	16	44.4	$X^2=0.79$ $p = 0.34$
9 Years and Above	21	55.3	9 Years and Above	20	55.6	
Perception of the Economic Status of the Family			Perception of the Economic Status of the family			
Low	4	10.5	Low	2	5.6	$X^2=0.97$ $p = 0.53$
Moderate	26	68.4	Moderate	26	72.2	
High	8	21.1	High	8	22.2	
Heating in the House			Heating in the House			
Heating Stove	2	5.3	Heating Stove	5	13.9	$X^2=0.75$ $p = 0.98$
Natural gas	35	92.1	Natural gas	31	86.1	
Other	1	2.6	Other	0	0	
Moisture in the House			Moisture in the House			
There is mold in the house	14	36.8	There is mold in the house	16	44.4	$X^2=0.49$ $p = 0.18$
There is no mold in the house	24	63.2	There is no mold in the house	20	55.6	
Exposure of the House to Sunlight			Exposure of the House to Sunlight			
Gets sunlight	31	81.6	Gets sunlight	30	83.3	$X^2=0.49$ $p = 0.18$
Does not get sunlight	7	18.4	Does not get sunlight	6	16.7	
Smoking in the House			Smoking in the House			
There are smokers	13	34.2	There are smokers	11	30.6	$X^2=1.18$ $p = 0.37$
There are no smokers	25	65.8	There are no smokers	25	69.4	
Total	38	100	Total	36	100	

Table 3. Comparison of PAQLQ Total Scores and Subdimensions by Measurement Period.

Groups	Experimental group (n = 38)		Control group (n = 36)		t*	p
	Mean	SD	Mean	SD		
First Measurement of the PAQOL Total Score (Before the Intervention)	72.130	13.991	73.140	15.166	-0.297	0.767
First-month Measurement of PAQLQ Total Score	91.450	12.839	73.330	11.110	6.474	0.000
Fourth-month Measurement of the PAQLQ Total Score	114.180	12.689	78.420	16.559	10.463	0.000
F	3630.820		9.078			
p	0.000		0.002			
First Measurement of PAQLQ Symptoms (Before the Intervention)	29.370	6.840	30.280	7.284	-0.554	0.581
First Post-test of PAQLQ Symptoms	38.320	6.385	30.500	5.433	5.656	0.000
4th Month Measurement of PAQLQ Symptoms	48.160	6.352	32.720	7.733	9.404	0.000
F	3038.097		8.637			
p	0.000		0.001			
First Measurement of PAQLQ Activity Limitation (Before the Intervention)	15.240	2.676	15.720	2.794	-0.763	0.448
First-month Measurement of PAQLQ Activity Limitation	19.470	2.480	15.970	2.384	6.186	0.000
Fourth-month Measurement of PAQLQ Activity Limitation	24.420	2.456	17.080	3.341	10.804	0.000
F	2459.492		10.825			
p	0.000		0.001			
First Measurement of PAQLQ Emotional Function (Before the Intervention)	24.290	5.188	23.920	5.416	0.302	0.763
First-month Measurement of PAQLQ Emotional Function	29.680	4.592	23.670	3.780	6.136	0.000
Fourth-month Measurement of PAQLQ Emotional Function	41.610	5.027	28.610	6.133	9.991	0.000
F	2648.635		52.730			
p	0.000		0.000			

Table 4. Differences in the C-ACT Scores by Group.

Group	Experimental Group (<i>n</i> = 38)		Control Group (<i>n</i> = 36)		t*	p
	Mean	SD	Mean	SD		
C-ACT Before the Intervention	13.950	1.999	13.970	2.021	-0.053	0.958
First-month Measurements of C-ACT	20.550	1.704	14.030	2.021	15.044	0.000
Fourth-month Measurement of C-ACT	26.260	1.483	15.860	3.965	15.100	0.000
F	1769.430		11.163			
P	0.000		0.000			
Bonferroni	2.3 > 1		3 > 1			

* Independent Groups T-Test Repeated Measures ANOVA.

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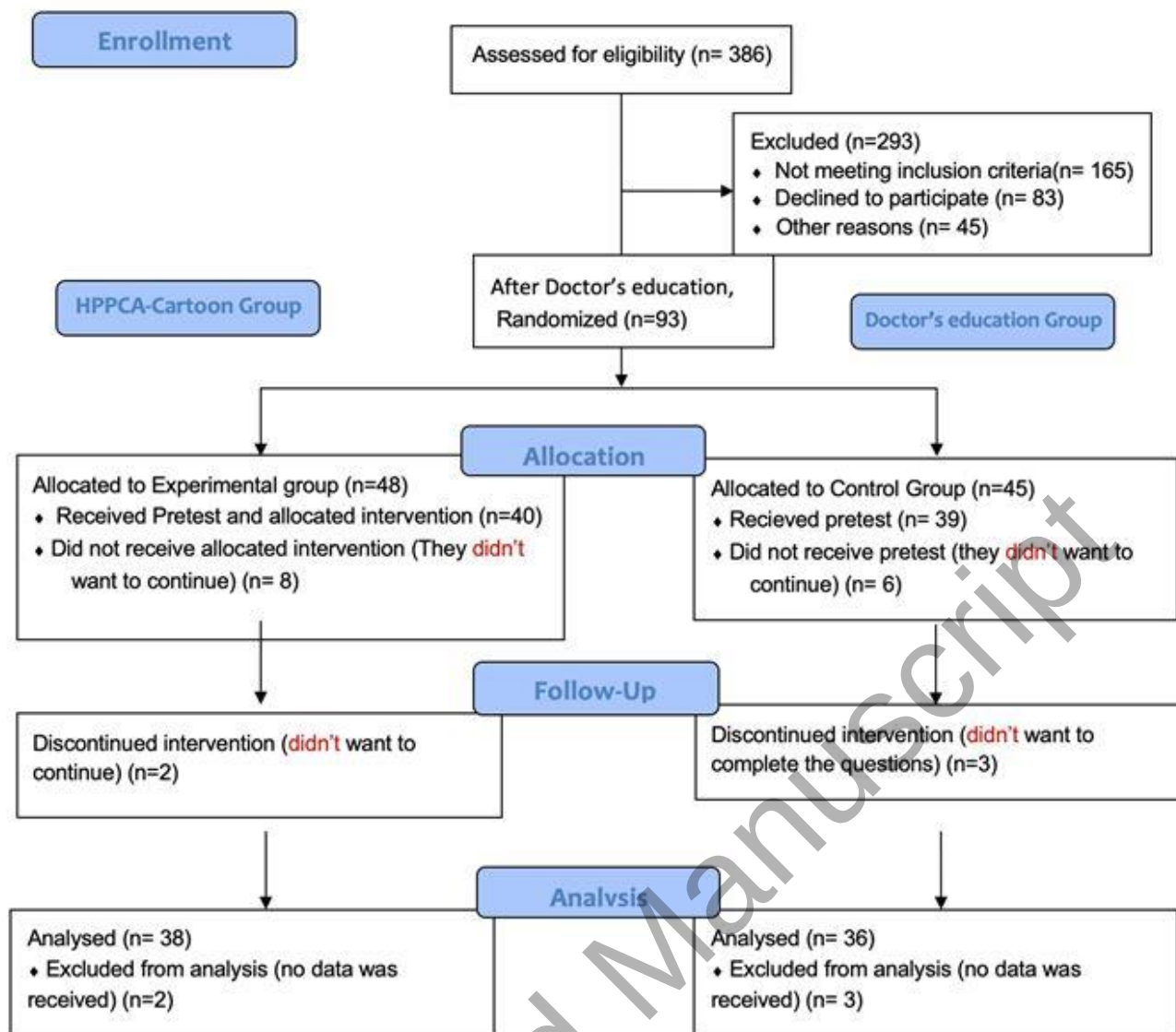


Figure 1.

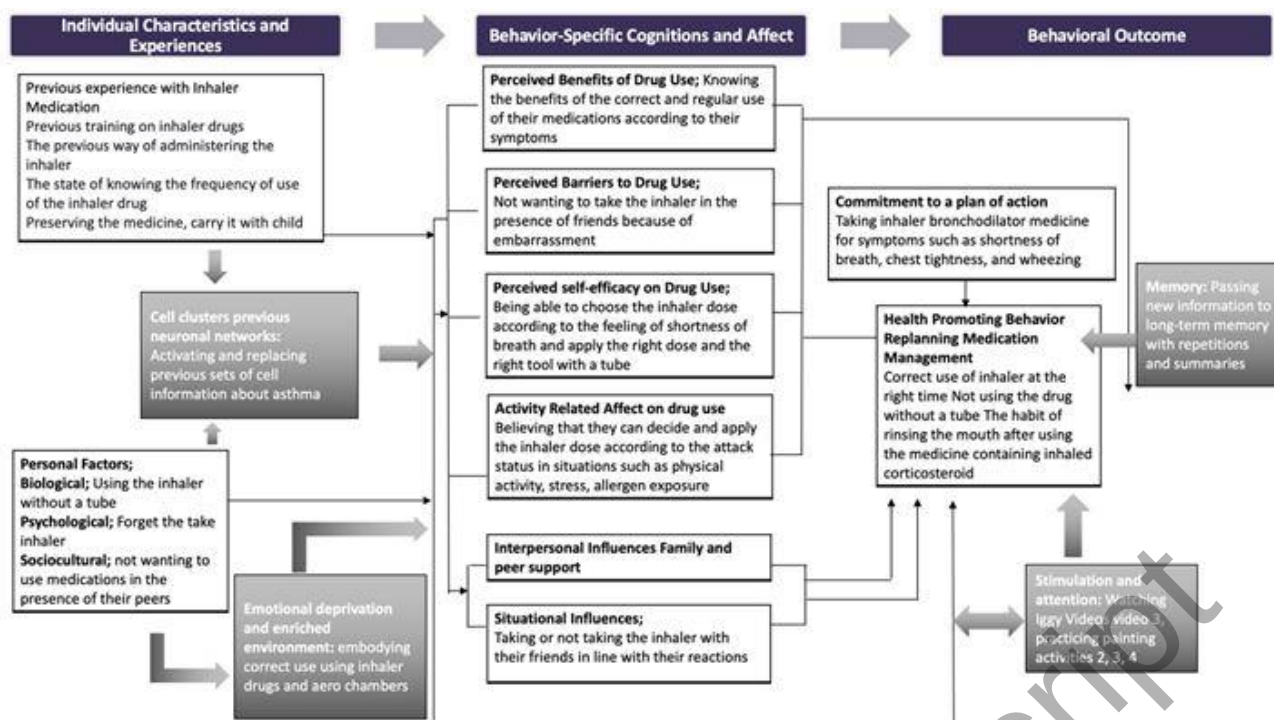


Figure 2.