Noname manuscript No.
(will be inserted by the editor)

Risk assessment of cognitive and behavioral development of early childhood children in quarantine days: An AHP approach

Murat Kirişci · Nihat Topaç · Musa Bardak · Ibrahim Demir

Received: date / Accepted: date

Abstract The world is faced with disasters caused by natural or human effects from time to time. The various political, economic, health, and social consequences of these disasters affect people for different periods of time. In natural disasters and especially in epidemic diseases, some measures are taken to protect people from the negative effects of the situation. One of the measures that can be taken is quarantine. The target audience of this study is children aged 5-6 in early childhood. Children of this age group are in the process of gaining skills in expressing their feelings during this period. In addition, the emotional responses of these children can be noticed by a careful observer or even an expert.The aim of the paper is to evaluate the risks of the impacts of quarantine status related to COVID-19 pandemic on cognition and behavior of children staying at home. Risks of the quarantine process in children in early childhood were evaluated using the Pythagorean fuzzy AHP method.

Keywords COVID-19,early childhood, risk assessment, Pythagorean fuzzy set, analytic hierarchy process, cognitive development, behavioural development

Mathematics Subject Classification (2010) 91C05 · 03E72 · 91B06

M. Kirişci
Istanbul University-Cerrahpasa, Department of Biostatistics and Medical Informatics
Fatih, Istanbul, Turkey. E-mail: mkirisci@hotmail.com ORCID: 0000-0003-4938-5207
N. Topaç
Istanbul University-Cerrahpasa, Department of Early Childhood Education
Buyukcekmece, Istanbul, Turkey. E-mail: ntopac@istanbul.edu.tr ORCID: 0000-0000-0000-0000
Musa Bardak
Istanbul Sabahattin Zaim University, Department of Early Childhood Education
Istanbul, Turkey. E-mail: musa.bardak@izu.edu.tr ORCID: 0000-0000-0000-0000
Ibrahim Demir
Yildiz Technical University, Department of Statistics
Istanbul, Turkey. E-mail: idemir@ytu.edu.tr ORCID: 0000-0000-0000-0000

1 Introduction

Risk is the value determined according to the probability of the damage that dangerous situations can cause. The likelihood and severity of the danger determine the degree of risk. Risk can also be defined as the combination of the probability and violence of the danger, since it has a value determined according to the probability and consequence (severity) of the danger, that is, the potential harm. The risk changes over time. So it is dynamic. Therefore, risk is a manageable phenomenon. Broadly speaking, there are two different approaches to risk: In the first approach, risk means uncertainty. In this case, it can contain both positive and negative consequences. In the second approach, risk means threat/danger. In this case, it contains only negative consequences. It generally has the potential to cause harm. That is, it is dangerous and is often linked to a condition or action that, if left unrestrained, could outcome in undesirable consequences such as illness or injury.

Risk refers to the uncertainty contained in the applied activities. This uncertainty can have positive or negative consequences. The purpose of risk management is to control the consequences of this uncertainty. For this, risk factors must be determined and analysed. Each new unpredictable incident provides valuable experiences for risk executives on how to reply. Corona virus is also no exception, as all other outbreaks are no exception. Based on what is known about the disease so far, some general conclusions can be drawn about how such events should be handled in the future.

Multi-criteria decision making(MCDM) is carried out by modeling the decision process according to the criteria and analyzing it in a way that maximizes the benefit that the decision-maker(DM) will obtain at the end of the continuum. Due to the complexity of the decision-making continuum, the suggestion of a different approach in the literature every day ensures that the MCDM approaches are constantly updated. MCDM approaches consisting of different ad numerous methods have been subjected to different classifications in the literature. Generally, these classes are examined under two groups as MADM(multi-attribute decision making) and MODM(multi-objective decision-making). The AHP (Analytic Hierarchy Process), put forward by Thomas L. Saaty [52], is one of the MADM methods that help the DM. The fact that the criteria can be evaluated analytically by comparison methods without numerical values makes this method more advantageous compared to other methods. This technique speeds up the decision-making process and makes it more systematic. Tuysuz and Kahraman [56] stated that the reliability and accuracy of risks with different dimensions should be evaluated and calculated by taking into account more than one criterion.

Countries or associations generally try to calculate the economic effects of natural disasters first. For example, the European Parliament published a briefing on the economic impacts of the COVID-19 global pandemic in Febru-

ary 2020 [16]. However, people and countries are not only economically affected by disasters. Examples of the sociological effects of COVID-19 can be given from China. The Financial Times reports that courts' demands for divorce have increased dramatically after quarantine in China [66]. An example of the impact of the SARS quarantine on mental health is the study by Hawryluck et al [23]. This study emphasizes that after the virus, the results of the high rate of post-traumatic stress disorder and depression are reached in humans.

In natural disasters and especially in epidemic diseases, some measures are taken to protect people from the negative effects of the situation. One of the measures that can be taken is quarantine. Therefore, Cliff and Smallman-Raynor [14] stated that the quarantine was used to indicate restrictions on the activities of people or animals exposed to infectious diseases during the infectious period. Children, who are members of the society and cannot be isolated from society, should be informed correctly and sufficiently to prevent them from being affected by both the biological effect and the psychological effect of the epidemic. Then, in a study conducted by Lima and Lemos [35] with children, it was emphasized that it was extremely important to inform and raise awareness of children beforehand in order to prevent a pandemic. Because children may face troubles due to the long duration of natural disasters and measures such as quarantine restricting people. Children may face personal losses, collective deaths, and discomfort caused by the diseases caught in natural disasters and outbreaks. These situations can cause adversities such as stress, anxiety, depression, and behavioral disorders in children.

Children's responses to disasters can be examined in three categories: emotion, thought, and behavior. Pfefferbaum et al [49] stated that the behavioral responses of children and adolescents against natural disasters differ from the behavior of adults in the disaster process, however, traces of the reactions of adults to disasters can be seen in the behavior of children. In other words, while children can develop different reactions to disasters than adults, they may show similar responses from time to time. For this reason, it is important to remember that adults should be positive models against children under all conditions.

Children learn a lot of the information they learn through environmental stimuli. Vygotsky [58] states that the interaction of the child with his environment, social relationships, other people, especially adults, play a very important role in cognitive development. The stimuli that it is exposed to in the pandemic process direct the perception of children to the pandemic. In this case, it is clear that children will pay more attention to the pandemic, quarantine, and related stimuli. In the process, the vast majority of stimuli around children, including parents and digital media, lead their perception of COVID-19. If this perception cannot be controlled properly, a false cognition and belief in children will be inevitable.

The most sensitive and vulnerable groups that are affected by the psychological and behavioural effects of disasters are children [24]. In a survey of 1200 social workers published by the BASW (British Association of Social Workers) on March 25, 2020, participating experts stated that they were particularly concerned about children and their parents in the course of the COVID-19 pandemic process [4]. Corona-virus quarantine, which started on 27 January 2020 in Wuhan, China due to the spread of viruses in December 2019, has been shown as the largest quarantine in human history. Schools, workplaces, meetings, social events, and entry-exit to the city have been stopped [41]. In the following days, similar situations in other cities and countries caused this quarantine to be applied in many parts of the world. In a meta-analysis study by Bish and Michie [5], however, it was emphasized that there were some strategies that could be a guide in combating pandemics, and it was emphasized that the confidence of the state was important in combating pandemics.

Gul [21] has integrated the fuzzy analytical hierarchy process (PFAHP) and fuzzy VIKOR (FVIKOR) into the risk assessment process for the field of OHS. Site safety and decoration, repair, and maintenance projects in skyscrapers are of vital importance. Ilkbahar et al [25] using PF Proportional Risk Assessment (PFPRA), PFAHP, and a fuzzy inference system have developed a new integrated approach. In [28], by using Safety and Critical Effect Analysis and PFSs jointly, a new, more exhaustive, and more accurate risk assessment method has been obtained. In [34], the risk assessment of these issues has been examined with the AHP technique. Mahmudova and Jabrailova [40] developed an algorithm to evaluate the functionality of the software using the analytical hierarchy process (AHP) method. An FMEA-based AHP-MOORA integrated approach in Pythagorean fuzzy environment for a pipeline construction project was first developed by Mete [42]. Yucesan and Kahraman [67] used the PFAHP method for risk assessment in hydroelectric power plants. The risk assessment of a hydroelectric power plant project using the TOPSIS method was studied by Zhang et al. [69]. In [70], new convenient foundations of the PFSs method were determined and the validity of these bases was discussed.

In [65], pandemic control measures are discussed on the negative consequences of coronavirus for children. In addition, results regarding the mental health and well-being of children were expressed. Saurabh and Ranjan [53] selected a group of children and adolescents who were quarantined in India as the target audience and examined their quarantine experiences, their adaptation to the quarantine, and the impact of the quarantine on this group. In [10], the psychological effects of quarantine have been investigated by using electronic databases. In this study, results such as trauma, stress symptoms, confusion, and anger were obtained. In addition, it has been stated that the longer the quarantine period, the more negative situations are encountered. Jiao et al [26] worked on the measures recommended to parents and family members to alleviate the fears and concerns of children in the quarantine process. It has been suggested to produce many facilities such as increasing communication,

playing games, physical activities, and singing as music therapy in order to eliminate the fears and worries in children. There are similar studies prepared recently ([20], [29], [36], [45], [51]).

The target audience of this study is children aged 5-6 at the end of early childhood. Children of this age group are in the process of gaining skills in expressing their feelings during this period. In addition, the emotional responses of these children can be noticed by a careful observer or even an expert. In addition to those mentioned in the literature, most of the studies related to the effects on the adolescents and children of natural disasters in the World and Turkey focused on the symptoms of "Post Traumatic Stress Disorder which is one of the psychological effects of disasters [27]. The aim of the work is to evaluate the risks of the impacts of quarantine status related to COVID-19 pandemic on cognition and behavior of children staying at home.

2 Preliminaries

2.1 Pythagorean Fuzzy Sets

Uncertainty is a crucial concept for decision-making problems. It is not easy to make precise decisions in life since each information contains vagueness, uncertainty, imprecision. Fuzzy Set(FS) Theory, Zadehs [68] pioneering work, proposed a membership function to solve problems such as vagueness, uncertainty, imprecision, and this function took value in the range of [0,1]. FS Theory had solved many problems in practice, but there was no membership function in real life, which only includes acceptances. Rejection is as important as acceptance in real life. Atanassov [3] clarified this problem and posed the Intuitionistic Fuzzy Set(IFS) Theory using the membership function as well as the non-membership function. In IFS, the sum of membership and non-membership grades is 1. This condition is also a limitation for solutions of vagueness, uncertainty, imprecision. Yager [60], [61] has presented a solution to this situation and suggested Pythagorean Fuzzy Sets(PFS). PFS is more comprehensive than IFS because it uses the condition that the sum of the squares of membership and non-membership grades is equal to or less than 1. PFS is also a particular case of the Neutrosophic Set initiated by Smarandache [54].

In this paper, the initial universe, parameters sets will denote U, P, respectively.

The FS has emerged as a generalization of the classical set concept. A function $d_A : U \to [0, 1]$ is called FS on U. This indicated by

$$A = \{(u_i, d_A(u_i)) : d_A(u_i) \in [0, 1]; \forall u_i \in U\}.$$

Consider the set

$$B = \{(u, d_B(u), y_B(u)) : u \in U\}.$$

The set B is called an IFS on U, where, $d_B : U \to [0,1]$ and $y_B : U \to [0,1]$ such that $0 \leq d_B(u) + y_B(u) \leq 1$ for any $u \in U$ [3].

$b_B = 1 - d_B(u) - y_B(u)$ is called the degree of indeterminacy.

An PFS C in U is given by

$$C = \{(u, d_C(u), y_C(u)) : u \in U\},$$

where $d_C : U \to [0,1]$ denotes the degree of membership and $y_C : U \to [0,1]$ denotes the degree of non-membership of the element $u \in \mathcal{U}$ to the set C, respectively, with the condition that $0 \leq [d_C(u)]^2 + [y_C(u)]^2 \leq 1$ [60], [61], [62].

$b_C = \sqrt{1 - [d_C(u)]^2 - [y_C(u)]^2}$ is called the degree of indeterminacy.

Example 1 Let $U = \{u_1, u_2, u_3\}$ and $A(u_1) = (0.8, 0.6), A(u_2) = (0.7, 0.7), A(u_3) = (0.5, 0.6)$ be three PFNs of $u_i, (i = 1, 2, 3)$. Then A is called a PFS with

$$A = \{(u_1, 0.8, 0.6), (u_2, 0.7, 0.7), (u_3, 0.5, 0.6)\}. \tag{1}$$

2.2 PFAHP

One of the techniques that gives the best results in Pythagorean fuzzy AHP. Mohd and Abdullah [43] proposed new method(PFAHP) by integrating PFS into AHP for determination of criteria weight.

Weighted scales for PFAHP method are given in Table 1 [**?**], where Linguistic terms Certainly Low Importance, Very Low Importance, Low Importance, Below Average Importance, Average Importance, Above Average Importance, High Importance, Very High Importance, Certainly High Importance, Exactly Equal are shown as α, β, γ, δ, ε, η, θ, λ, μ, φ, respectively.

The algorithm of PFAHP as follows:

Step 1. According to experts' evaluations, the pairwise comparison matrix $E = (e_{ik})_{m\times m}$ is created using Table 1.

Step 2. The upper and lower values of the membership and non-membership functions are calculated using Equations 2 and 3 and the difference matrix $F = (f_{ik})_{m\times m}$ is obtained.

Step 3. The interval multiplicative matrix $G = (g_{ik})_{m\times m}$ is computed using the Equations 4 and 5.

Table 1 Weighted scales for the PFAHP

Linguistic terms	PFN equivalents IVPF numbers			
	m_I	m_J	n_I	n_J
α	0.00	0.00	0.90	1.00
β	0.10	0.20	0.80	0.90
γ	0.20	0.35	0.65	0.80
δ	0.35	0.45	0.55	0.65
ε	0.45	0.55	0.45	0.55
η	0.55	0.65	0.35	0.45
θ	0.65	0.80	0.20	0.35
λ	0.80	0.90	0.10	0.20
μ	0.90	1.00	0.00	0.00
φ	0.195	0.195	0.195	0.195

Step 4. The determinacy value $H = (h_{ik})_{m\times m}$ of the e_{ik} is calculated using the Equation 6.

Step 5. The determinacy values and matrix $G = (g_{ik})_{m\times m}$ are multiplied to find the weight matrix before normalization, and the $T = (t_{ik})_{m\times m}$ matrix is constructed using Equation 7.

Step 6. The normalized priority weights ω_i are obtained with Equation 8.

$$f_{ikI} = d_{ikI}^2 - y_{ikI}^2 \tag{2}$$

$$f_{ikU} = d_{ikJ}^2 - y_{ikJ}^2 \tag{3}$$

$$g_{ikI} = \sqrt{1000^{f_{ikI}}} \tag{4}$$

$$g_{ikJ} = \sqrt{1000^{f_{ikJ}}} \tag{5}$$

$$h_{ik} = 1 - \left(d_{ikJ}^2 - d_{ikI}^2\right) - \left(y_{ikJ}^2 - y_{ikI}^2\right) \tag{6}$$

$$t_{ik} = \left\{\frac{g_{ikI} + g_{ikJ}}{2}\right\} h_{ik} \tag{7}$$

$$\omega_i = \frac{\sum_{k=1}^{m} t_{ik}}{\sum_{i=1}^{m}\sum_{k=1}^{m} t_{ik}} \tag{8}$$

3 COVID-19 Quarantine Implementation

According to identify the criteria to be measured, the cognitive and behavioral status of children should be taken into account when doing risk analysis with respect to their attitudes in quarantine practice. For the weighting procedure, an aggregate of expert opinions consisting of evaluations of Early Childhood experts will be taken. After this stage, the sub-criteria and their weights will be used as entries for the AHP technique to prioritize the objectives and take the final decision. The experts in this study are people working on Early Childhood. Experts cross-check the criteria identified in accordance with the

cognitive and behavioral attitudes of these age children and express their evaluations.

The linguistic terms and their numeric labels are:
For Questions to be asked to the child: Yes (1), maybe/some (2), no (3).
For Questions to be asked to parents: too much (1), much (2), some (3), too little (4), none (5).
The survey was prepared to be answered on the internet. Survey questions were asked to children aged 5-6 and their families. The survey includes the following questions:

Questions to be asked to the child:

E1 Do you know Corona-virus?
E2 Does Corona-virus harm people?
E3 Does Corona-virus harm animals?
E4 Can Corona-virus be prevented?
E5 Are you afraid of Corona-virus?
E6 Do you think it's nice not to go to school?
E7 Are you upset that you can't go to school?
E8 Is the obligation to stay home boring?
E9 Can we be protected from Corona-virus by staying at home?
E10 Do you think you can go to school from now on?

Questions to be asked to parents:

P1 Does your child pay more attention to cleaning after Corona-virus?
P2 Has your child's sleep pattern been impaired after Corona-virus?
P3 Have there been changes in your child's nutritional habits after Corona-virus?
P4 Does your child behave anxiously after Corona-virus?
P5 Is your child afraid when a conversation about Corona-virus has passed?
P6 Does your child ask about Corona-virus?
P7 Did your child develop undesirable behaviour after Corona-virus?
P8 Is your child happy because she/he can't go to school?
P9 Has the time your child spent on the Internet after Corona-virus increased?
P10 Has the time your child spent in front of the TV increased after Corona-virus?

The cognitive and behavioral distributions of questions are as follows:

For children's cognition;

C1 Do children know about the current situation? (4 questions)
C2 Does the current situation affect children's emotions? (4 questions)
C3 Does the current situation affect children's thoughts? (2 questions)

For children's behavioral;

B1 Has Corona-virus changed the basic habits of children? (3 questions)

Table 2 Classifications of hazards about children's cognition

Current status information(CSI)	Children's COVID-19 knowledge	E1
	The idea of COVID-19 harming people	E2
	The idea of COVID-19 harming animals	E3
	Knowledge of to prevent COVID-19	E4
Affecting children's emotions(ACE)	Children's fear of COVID-19	E5
	Nice not to go to school	E6
	It's sad to not go to school	E7
	The boringness of staying in the compulsory home	E8
Affecting children's thoughts(ACT)	Being protected from COVID-19 by staying at home	E9
	To think that schools can be reopened	E10

Table 3 Classifications of hazards about children's behaviour

Change of basic habits of children(CBHC) in the quarantine period	Change in cleaning habits after COVID-19	P1
	Disruption in sleep pattern after COVID-19	P2
	Change in nutritional habits after COVID-19	P3
Change in behavioural after COVID-19(CB)	Anxiety increase after COVID-19	P4
	The emergence of fear when COVID-19 is spoken	P5
	Asking questions about COVID-19	P6
	Development of undesirable behavior after COVID-19	P7
	The idea that it is good not to go to school	P8
Change in behavior related to Information Technologies(CBIT)	increase in time spent on the internet	P9
	Increase in time spent in front of TV	P10

Table 4 Linguistic evaluations for CSI

	E1	**E2**	**E3**	**E4**
E1	$< 0.195, 0.195, 0.195, 0.195 >$	$< 0.90, 1.00, 0.00, 0.00 >$	$< 0.65, 0.80, 0.20, 0.35 >$	$< 0.80, 0.90, 0.10, 0.20 >$
E2	$< 0.80, 0.90, 0.10, 0.20 >$	$< 0.195, 0.195, 0.195, 0.195 >$	$< 0.54, 0.64, 0.36, 0.46 >$	$< 0.91, 1.00, 0.05, 0.03 >$
E3	$< 0.65, 0.80, 0.20, 0.35 >$	$< 0.81, 0.91, 0.09, 0.13 >$	$< 0.195, 0.195, 0.195, 0.195 >$	$< 0.24, 0.33, 0.65, 0.76 >$
E4	$< 0.90, 1.00, 0.00, 0.00 >$	$< 0.81, 0.91, 0.09, 0.13 >$	$< 0.48, 0.59, 0.41, 0.52 >$	$< 0.195, 0.195, 0.195, 0.195 >$

B2 Did behavior change occur in children after quarantine? (5 questions)
B3 Did children's behavior regarding information technologies increase after quarantine? (2 questions)

In this study, from Turkey, 201 children ages 5-6 units and 201 parents were the participants. Opinions of each child and each parent about the questions asked were got. The effect of quarantine on their own cognition in line with the answers given by the children and the effect of the behaviour of their children in line with the observations of the parents have been revealed.

Risk factors were identified as a result of interviews and evaluations with Early Childhood experts. Basic problem and sub-problems related to this problem were created and data were obtained. The evaluations of early childhood experts were obtained for the weights with the acquired data. The risk analysis structure of children's and parents' evaluations is given in Figure 1. Cognitive and behavioral risks that can be classified in children are

Table 5 Linguistic evaluations for CB

	P4	**P5**	**P6**	**P7**	**P8**
P4	$< 0.195, 0.195, 0.195, 0.195 >$	$< 0.45, 0.55, 0.45, 0.55 >$	$< 0.91, 1.00, 0.02, 0.01 >$	$< 0.90, 1.00, 0.00, 0.00 >$	$< 0.68, 0.78, 0.22, 0.32 >$
P5	$< 0.90, 1.00, 0.00, 0.00 >$	$< 0.195, 0.195, 0.195, 0.195 >$	$< 0.78, 0.89, 0.11, 0.16 >$	$< 0.92, 1.00, 0.04, 0.02 >$	$< 0.47, 0.59, 0.41, 0.53 >$
P6	$< 0.55, 0.65, 0.35, 0.45 >$	$< 0.68, 0.78, 0.22, 0.32 >$	$< 0.195, 0.195, 0.195, 0.195 >$	$< 0.47, 0.59, 0.41, 0.53 >$	$< 0.24, 0.30, 0.66, 0.76 >$
P7	$< 0.90, 1.00, 0.00, 0.00 >$	$< 0.83, 0.91, 0.09, 0.15 >$	$< 0.66, 0.76, 0.24, 0.30 >$	$< 0.195, 0.195, 0.195, 0.195 >$	$< 0.45, 0.55, 0.45, 0.55 >$
P8	$< 0.10, 0.20, 0.80, 0.90 >$	$< 0.20, 0.35, 0.65, 0.80 >$	$< 0.00, 0.00, 0.90, 1.00 >$	$< 0.19, 0.30, 0.68, 0.81 >$	$< 0.195, 0.195, 0.195, 0.195 >$

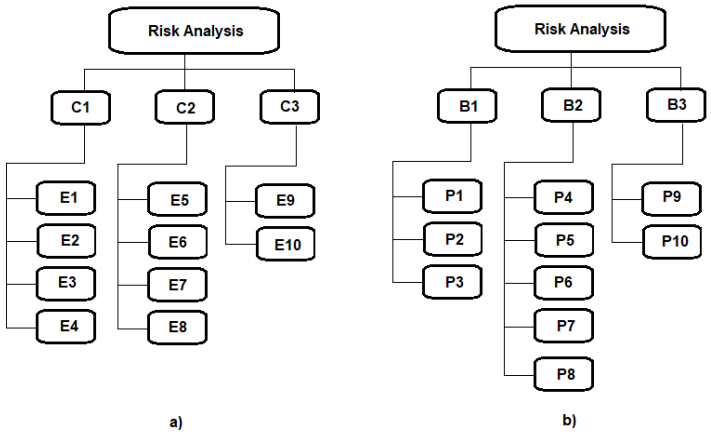

Fig. 1 Risk analysis a) for children's cognition, b) for children's behavioural

classified in Table 2 and Table 3. In Table 4, Table 5, compromised pairwise comparison tables for CSI and CB are given, respectively. These tables were created according to the evaluations given by the experts by using the values in Table 1. Pythagorean fuzzy numbers are denoted by $<$ *degree of membership*, *degree of non-membership* $>=< \mu_L, \mu_U, \upsilon_L, \upsilon_U >$ in Table 4, Table 5.

For the weighting procedure, the sum of the assessments of the three experts was taken. As a result of expert evaluations, 10 critical criteria for cognitive development, and 10 critical criteria for behavioral development were determined. After this step, in order to identify the priorities of the aims and make final decision, the sub-problems and their weights as PFAHP inputs are studied. Experts are early childhood employees and can compare specified problems, report results, and indicate their evaluations. Using pairwise comparison with the PFAHP method, 10 different hazards and associated risks identified for each development situation are weighted. Pairwise comparisons were given by experts for the importance weight of each evaluation criterion. Experts were asked to implement the linguistic variables indicated in Table 1. Here, the linguistic variables are transformed into the corresponding interval-valued PFNs. Since the evaluation degrees of each expert are subjective and will differ from each other, these subjective values are given as compromised pairwise comparison matrices in Table 4 for CSI and Table 5 for CB, respectively. The D matrices and S matrices for CSI and CB are given Tables 6, 7, 8 and 9, respectively. After h_{ik} determinacy values were calculated with Equation 6, T matrices (Tables 10 and 11) for CSI and CB were established with Equation 7. Further, the importance weights for CSI and CB are indicated in Tables 12 and 13.

Analysis and Discussion

These tables will be calculated in ACT and ACE for the cognitive development category, CBIT and CBC for behavioral development category. Then, the risk factors in each category will be determined. According to the results obtained with the calculated tables, E2 for CSI and P5 for CB were determined as the most important risk factors. The evaluation here will be made for E2 and P5.

Quarantine, which is one of the most important ways to prevent epidemic diseases, requires conscious participation. However, in this process, it is also an important issue to direct the cognition and behaviour of more sensitive and disadvantaged groups such as children. Although the World Health Organization (WHO) states that quarantine increases the capacity of people to control the spread of infectious diseases [7], this may have negative repercussions on people. In addition to the restrictions that may be experienced during the quarantine process, fear, anxiety, etc. related to basic needs and habits can threaten the individual's well-being, especially in terms of mental aspects.

The fact that the stimuli in the environment are intensely related to the virus causes children to learn about the virus. It is possible to be exposed to such an intense flow of information in a short time, to limit life in an instant, to create a perception of danger by talking about unpredictability and death news unnecessarily. According to the results obtained for CSI, the riskiest factor is E2. During the quarantine process, the child is exposed to the flow of information from many sources, from her/his immediate environment to her distant environment. When evaluated within the framework of ecological theory [8], it can be said that sensitivity to interaction between different environments will increase during the quarantine process. The diversity of information reaching the child through family and media-communication technologies reinforces this situation. However, if this information is not suitable for the child's level, misunderstanding and wrong cognition may develop. According to Piaget [50], it is possible that the child who is still in the pre-operational period does not understand the information that contains abstract elements. This situation can cause emotional problems in the child.

Misunderstanding and wrong cognition can disrupt the emotional balance of preschool children. According to the results obtained for CB, the riskiest factor is P5. Piaget [50] stated that newly learned information creates an imbalance in mental processes and that balance will occur with correct experiences. The child may develop fear, anxiety, and panic as a result of the imbalance caused by the information he receives from the environment. However, the exaggerated application of control measures may also increase children's fears.

Gagne [18] stated that learning is a cumulative process. The individual can make sense of the stimuli coming from the environment in her/his mind,

Table 6 Difference matrix for CSI

	E1	**E2**	**E3**	**E4**
E1	$< 0.00, 0.00 >$	$< -0.19, 0.00 >$	$< 0.30, 0.48 >$	$< 0.48, 0.80 >$
E2	$< 0.48, 0.80 >$	$< 0.00, 0.00 >$	$< 0.08, 0.28 >$	$< 0.8272, 0.9975 >$
E3	$< 0.30, 0.48 >$	$< 0.6392, 0.82 >$	$< 0.00, 0.00 >$	$< -0.52, -0.3136 >$
E4	$< 0.81, 1.00 >$	$< 0.6392, 0.82 >$	$< -0.04, 0.18 >$	$< 0.00, 0.00 >$

associate that information with new situations and use it in solving problems [9], [57]. The beliefs that the Corona-virus harms people, guides the children's other cognitions and behaviours on this issue. In particular, the negative behaviours of one or more of the family members related to the virus also affect the children. Because children imitate adult responses. Even if there are different reasons for children to be affected cognitively, when these and similar triggering factors are combined with the effect of the current period, it is possible to leave permanent problems in children. This situation may negatively affect the healthy preparation of children for adulthood.

Every new experience means new knowledge. Especially children should get the correct information with correct experiences in natural disasters such as epidemics. The information must be coded correctly and transformed into behaviour. For this, administrators should inform the public with correct information and thinking about the psychology of society.

As children model adult reactions, parents should pay attention to their own behaviour and their own discourse in the home. It is also important not to overreact to stimuli received from the media. However, messages sent by the media to children should be filtered. When considered as a whole, it is recommended that parents and adults take a controlled approach without exaggerating their way of interacting with the child. Considering the cognitive and behavioral development of children, parents should not allow children to be exposed to too many news, notifications, and stimuli. However, it is not healthy also to act as if nothing happened or will not happen by moving away from the usual situation.

At this point, as experts [55] have stated, it is important that adults have enough knowledge about the new coronavirus and try to find a balance in order to answer their children's questions well enough without increasing the severity of their anxiety. All possible situations that cause anxiety and fear should be discussed in accordance with the developmental levels of children in this period. Again, the questions of children on these issues should be tried to be answered. The message that children will be safe and that the situation is controllable, especially when necessary precautions are taken, should be given in an age-appropriate manner.

Table 7 Difference matrix for CB

	P4	**P5**	**P6**	**P7**	**P8**
P4	$< 0.00, 0.00 >$	$< -0.10, -0.10 >$	$< 0.828, 0.9996 >$	$< 0.81, 1.00 >$	$< 0.36, 0.56 >$
P5	$< 0.81, 1.00 >$	$< 0.00, 0.00 >$	$< 0.5828, 0.78 >$	$< 0.846, 0.9984 >$	$< -0.06, 0.18 >$
P6	$< 0.10, 0.30 >$	$< 0.36, 0.56 >$	$< 0.00, 0.00 >$	$< -0.06, 0.18 >$	$< -0.52, -0.3456 >$
P7	$< 0.81, 1.00 >$	$< 0.6664, 0.82 >$	$< 0.3456, 0.52 >$	$< 0.00, 0.00 >$	$< -0.10, 0.10 >$
P8	$< -0.80, -0.60 >$	$< -0.60, -0.30 >$	$< -1.00, -0.81 >$	$< -0.62, -0.3724 >$	$< 0.00, 0.00 >$

Table 8 The interval multiplicative matrix for CSI

	E1	**E2**	**E3**	**E4**
E1	$< 1.00, 1.00 >$	$< 0.52, 1.00 >$	$< 2.81, 5.25 >$	$< 5.25, 15.85 >$
E2	$< 5.25, 15.85 >$	$< 1.00, 1.00 >$	$< 1.32, 2.63 >$	$< 17.41, 31.35 >$
E3	$< 2.82, 5.25 >$	$< 9.42, 17.00 >$	$< 1.00, 1.00 >$	$< 0.17, 0.30 >$
E4	$< 16.40, 31.62 >$	$< 9.1, 17.00 >$	$< 0.79, 1.86 >$	$< 1.00, 1.00 >$

Table 9 The interval multiplicative matrix for CB

	P4	**P5**	**P6**	**P7**	**P8**
P4	$< 1.00, 1.00 >$	$< 0.70, 0.70 >$	$< 17.46, 31.58 >$	$< 16.40, 31.62 >$	$< 3.47, 6.92 >$
P5	$< 16.40, 31.62 >$	$< 1.00, 1.00 >$	$< 7.49, 14.80 >$	$< 18.58, 31.44 >$	$< 0.81, 1.86 >$
P6	$< 2.00, 2.82 >$	$< 3.47, 6.92 >$	$< 1.00, 1.00 >$	$< 0.81, 1.86 >$	$< 0.17, 0.303 >$
P7	$< 16.40, 31.62 >$	$< 10.00, 17.00 >$	$< 3.30, 6.02 >$	$< 1.00, 1.00 >$	$< 0.707, 1.41 >$
P8	$< 0.063, 0.13 >$	$< 0.13, 0.35 >$	$< 0.031, 0.060 >$	$< 0.117, 0.276 >$	$< 1.00, 1.00 >$

Table 10 The weights before normalization for CSI

	E1	**E2**	**E3**	**E4**
E1	1.00	0.152	2.82	8.44
E2	8.44	1.00	1.58	19.80
E3	2.82	10.83	1.00	0.19
E4	4.80	10.70	1.03	1.00

Table 11 The weights before normalization for CB

	P4	**P5**	**P6**	**P7**	**P8**
P4	1.00	0.70	20.35	4.80	4.16
P5	4.80	1.00	8.92	21.26	1.015
P6	1.93	4.16	1.00	1.015	0.20
P7	4.80	11.48	3.87	1.00	1.06
P8	0.08	0.17	0.01	0.15	1.00

Table 12 Importance weights of evaluation for CSI

Criteria	Weight
E1	0.17
E2	0.40
E3	0.20
E4	0.23

Table 13 Importance weights of evaluation for CB

Criteria	Weight
P4	0.31
P5	0.37
P6	0.08
P7	0.22
P8	0.01

4 Conclusion

The quarantine measures carried out as a result of COVID-19 and the protective / preventive decisions taken in connection with this process are very important for the psychological conditions of early childhood children. Risk assessments related to the negative effects of the cognitive and behavioral development of children in this period have an important effect on decision-making processes. In this study, 10 risk factors for cognitive development and 10 risk factors for behavioral development were determined and evaluated with PFAHP. For this evaluation, the opinions of early childhood experts were taken. Preventive measures have been expressed in order to minimize the most important risk factors identified.

References

1. M. Agarwal, K.K. Biswas, M. Hanmandlu, *Generalized intuitionistic fuzzy sets with applications in decision making*, Appl. Soft Compt., **13**, (2013), 3552–3566.
2. M. Irfan Ali, Feng Feng, Xiaoyan Liu, Won Keun Min, M. Shabir, *On some new operations in soft set theory*, Comput. Math. Appl., **57**, (2009), 1547–1553.
3. K. Atanassov, *Intuitionistic fuzzy sets*, Fuzzy Sets Syst., **20**, (1986), 87–96.
4. British Association of Social Workers. Voices of 1200 social workers through BASW Covid-19 survey set agenda for safety and effective practice during pandemic. https://www.basw.co.uk/media/news/2020/mar/voices-1200-social-workers-through-basw-covid-19-survey-set-agenda-safety-and (Date of access: 04.04.2020).
5. Bish, A., Michie, S. Demographic and attitudinal determinants of protective behaviours during a pandemic: a review. Br J Health Psychol, 2010;15:797-824.
6. Bolturk E, Kahraman C. A novel interval-valued neutrosophic AHP with cosine similarity measure. Soft Comput 2018;22: 4941–58.
7. Bonita R, Beaglehole R, Kjellstrm T, *Basic Epidemiology* (2nd edition). Geneva: World Health Organization, (2006).
8. Bronfenbrenner U, *The ecology of human development: Experiments by nature and design*, Cambridge, MA: Harvard University Press, (1979).
9. Brooks JM, Brooks MG, *In Search of Understanding: The Case for Constructivist Classroom*, Virginia: Associating for Supervision and Curriculum Development, (1999).
10. Brooks SK, Webster RK, Smith LE, Woodland L, Wessely S, Greenberg N, Rubin GJ, *The psychological impact of quarantine and how to reduce it: rapid review of the evidence*, The Lancet, Volume 395(10227), 2020, 912–920, DOI: 10.1016/S0140-6736(20)30460-8
11. N. Çağman, F. Erdoğan, S. Enginoğlu, *Fuzzy parametrized soft set theory and its applications*, Ann. Fuzzy Math. Inform., **2**(2), (2011), 219–226.
12. C.L. Chang, *Fuzzy Topological Spaces*, J. Math. Anal. Appl., **24**, (1968), 182–190.
13. S.M. Chen, J.M. Tan, *Handling multicriteria fuzzy decision-making problems based on vague set theory*, Fuzzy Sets Syst., **67**, (1994), 163-172.

14. Cliff A. D., Smallman-Raynor M. R. (2013). Quarantine: Spatial Strategies. In A. D. Cliff & M. R. Smallman-Raynor (Eds.), Oxford Textbook of Infectious Disease Control: A Geographical Analysis from Medieval Quarantine to Global Eradication (pp.64-97). Oxford: Oxford University Press.
15. I. Deli, N. Çağman, *Intuitionistic fuzzy parameterized soft set theory and its decision making*, Appl. Soft Comp., **28**, (2015), 109–113.
16. Delivorias, A, Scholz, N (2020). Economic impact of epidemics and pandemics. European Parliamentary Research Service. *https* : *//www.europarl.europa.eu/RegData/etudes/BRIE/*2020/646195/$EPRS_BRI$(2020)646195$_EN.pdf$
17. Feng Feng, Hamido Fujita, Muhammad Irfan Ali, Ronald R. Yager, Xiaoyan Liu, *Another View on Generalized Intuitionistic Fuzzy Soft Sets and Related Multiattribute Decision Making Methods*, IEEE Transactions on Fuzzy Systems, DOI: 10.1109/TFUZZ.2018.2860967.
18. Gagn RM, *The conditions of learning and theory of instruction*, 4th edition. New York: Holt, Rinehart, and Winston, (1985).
19. H. Garg, *A New Generalized Pythagorean Fuzzy Information Aggregation Using Einstein Operations and Its Application to Decision Making*, Int J Intell Syst, **31**, (2016), 886-920.
20. Green P, *Risks to children and young people during COVID-19 pandemic*, BMJ, 369, 2020, m1669.
21. Gul M, *Application of Pythagorean fuzzy AHP and VIKOR methods in occupational health and safety risk assessment: the case of a gun and rifle barrel external surface oxidation and colouring unit*, Int. J. Occup. Saf. Ergon., 2018 , 1–26, DOI: 10.1080/10803548.2018.1492251
22. A. Guleria, R. K. Bajaj, *On Pythagorean fuzzy soft matrices, operations and their applications in decision making and medical diagnosis*, Soft Computing, https://doi.org/10.1007/s00500-018-3419-z
23. Hawryluck, L., Gold, W. L., Robinson, S., Pogorski, S., Galea, S., Styra, R. (2004). SARS control and psychological effects of quarantine, Toronto, Canada. Emerging Infectious Diseases, 2004;10(7), 1206–1212.
24. Houston, J. B., First, J., Spialek, M. L., Sorenson, M. E., Koch, M. Public disaster communication and child and family disaster mental health: A review of theoretical frameworks and empirical evidence. Current Psychiatry Reports, 2016;18:1–9.
25. Ilkbahar E, Karasan A, Cebi S, Kahraman C, *A novel approach to risk assessment for occupational health and safety using Pythagorean fuzzy AHP & fuzzy inference system*, Safety Science 103 (2018) 124–136. https://doi.org/10.1016/j.ssci.2017.10.025
26. Jiao WY, Wang, LN, Liu J, Fang SF, Jiao FY, PettoelloMantovani M, Somekh E, *Behavioral and emotional disorders in children during the COVID19 epidemic*, The Journal of Pediatrics, 221, 2020, 264–266.e1, DOI:10.1016/j.jpeds.2020.03.013
27. Karabulut, D., Bekler, T. Effects of Natural Disasters on Children and Adolescents. Artvin oruh University Journal of Natural Hazards and Environment, 2019;5:368–376.
28. Karasan A, Ilkbahar E, Cebi S, Kahraman C, *A new risk assessment approach: Safety and Critical Effect Analysis (SCEA) and its extension with Pythagorean fuzzy sets*, Safety Science, 108, 2018, 173–187, DOI: 10.1016/j.ssci.2018.04.031
29. King DL, Delfabbro PH, Billieux J, Potenza MN *Problematic online gaming and the COVID-19 pandemic*, J Behav Addict., 2020 April 29 [Epub ahead of print].
30. M. Kirişci, *Comparison the medical decision-making with Intuitionistic fuzzy parameterized fuzzy soft set and Riesz Summability*, New Mathematics and Natural Computation, 15, 2019, 351–359, DOI: 10.1142/S1793005719500194.
31. M. Kirişci, *Medical decision making with respect to the fuzzy soft sets*, Journal of interdisciplinary mathematics, 23, 2020, 767–776, DOI: 10.1080/09720502.2020.1715577.
32. M. Kirişci, *A Case Study for medical decision making with the fuzzy soft sets* Afrika Matematika, 31, 2020, 557–564, DOI: 10.1007/s13370-019-00741-9.
33. M. Kirişci, *Integrated and differentiated spaces of triangular fuzzy number*, Fasc. Math., **59**, (2017), 75-89, DOI:10.1515/fascmath-2017-0018.
34. Li, RYM, Chau, KW, Zeng, FF, *Ranking of Risks for Existing and New Building Works*, Sustainability, 11, 2019, 2863, DOI:10.3390/su11102863

35. Lima, L., Lemos, M. S. (2011). How children made sense of the flu pandemic. In M. Deng, F. Raia, & M. M. Vaccarella (Eds.), Relational Concepts in Medicine (pp. 181-191). Oxfordshire, United Kingdom: Inter-disciplinary Press.
36. Liu JJ, Bao Y, Huang X, Shi J, Lu L, *Mental health considerations for children quarantined because of COVID-19*, Lancet Child Adolesc Health. 4, 2020, 347–349.
37. P.K. Maji, R. Bismas, A.R. Roy, *Fuzzy soft set*, The Journal of Fuzzy Mathematics, **9**(3), (2001), 589–602.
38. P.K. Maji, R. Bismas, A.R. Roy, *Intuitionistic fuzzy soft sets*, The Journal of Fuzzy Mathematics, **9**(3), (2001), 677–692.
39. P.K. Maji, R. Bismas, A.R. Roy, *Soft set theory*, Comp. Math. Appl., **45**(1), (2003), 555–562.
40. Mahmudova S, Jabrailova Z, *Development of an algorithm using the AHP method for selecting software according to its functionality*, Soft Computing, 44, 2020, 8495–8502, DOI:10.1007/s00500-020-04902-y
41. Markel, H. (2020, January 27). Will the Largest Quarantine in History Just Make Things Worse? The New York Times, 27.01.2020. https://www.nytimes.com/2020/01/27/opinion/china-wuhan-virus-quarantine.html?auth=link-dismiss-google1tap (Date of access: 04.04.2020)
42. Mete S, *Assessing occupational risks in pipeline construction using FMEA based AHP-MOORA integrated approach under Pythagorean fuzzy environment*, Human.Ecol. Risk Assess.Int. J., 2018, https://doi.org/10.1080/10807039.2018.1546115.
43. Mohd WRW, Abdullah L, *Pythagorean fuzzy analytic hierarchy process to multi-criteria decision-making*, AIP Conference Proceedings, 1905, 2017. DOI: 10.1063/1.5012208
44. D. Molodtsov, *Soft Set Theory-First Results*, Comput. Math. Appl., **37**, (1999), 19–31.
45. Oh DL, Jerman P, Silvrio Marques S, et al. *Systematic review of pediatric health outcomes associated with childhood adversity*, BMC Pediatr., 18, 2018, 83.
46. X. Peng, Y. Yang, J. Song, Y. Jiang, *Pythagorean fuzzy soft set and its application*, Computer Engineering, **41**(7), (2015), 224–229.
47. X. Peng, Y. Yang, *Some results for Pythagorean fuzzy sets*, Int. J. Intelligent Systems, **30**, (2015), 1133–1160.
48. X. Peng, Y. Yang, *Multiple attribute group decision making methods based on pythagorean fuzzy linguistic set*, Comput Eng Appl, **52**(3), (2016), 50–54.
49. Pfefferbaum, B., Houston, J.B., North, C.S., Regens, J.L. (2008). Child reactions to disasters and the factors that influence their response. The Prevention Researcher, 2008;15:3-6.
50. Piaget J, *The Origin of Intelligence in Children*, New York: International University Press Inc., (1952).
51. Purewal Boparai SK, Au V, Koita K, et al., *Ameliorating the biological impacts of childhood adversity: a review of intervention programs*, Child Abuse Negl., 81, 2018, 82–105.
52. Saaty, T.L., The analytical hierarchy process, planning, priority. Resource Allocation. RWS Publications, USA, 1980.
53. Saurabh K, S. Ranjan S, *Compliance and Psychological Impact of Quarantine in Children and Adolescents due to Covid-19 Pandemic*, The Indian Journal of Pediatrics, 87(7), 2020, 532–536, DOI: 10.1007/s12098-020-03347-3
54. Smarandache F, Neutrosophic Set is a Generalization of Intuitionistic Fuzzy Set, Inconsistent Intuitionistic Fuzzy Set (Picture Fuzzy Set, Ternary Fuzzy Set), Pythagorean Fuzzy Set (Atanassovs Intuitionistic Fuzzy Set of second type), q-Rung Orthopair Fuzzy Set, Spherical Fuzzy Set, and n-HyperSpherical Fuzzy Set, while Neutrosophication is a Generalization of Regret Theory, Grey System Theory, and Three-Ways Decision (revisited) Journal of New Theory 29, 2019, 0131.
55. Sperling J, *How to talk to children about the coronavirus*, Harvard Health Blog.(2020). Accessed April 15, 2020. https://www.health.harvard.edu/blog/how-to-talk-to-children-about-the-coronavirus-2020030719111
56. Tuysuz, F., Kahraman, C., 2006. Project risk evaluation using a fuzzy analytic hierarchy process: an application to information technology projects. Int. J. Intell. Syst. 21 (6), 559584.

57. Von Glasersfeld E, *Introduction: Aspect of Constructivism*, C.T. Fosnot,(Ed.). Constructivism: Theory, Perspectives, And Pracrice.(3-7). USA: Teacher College Press, (1996).
58. Vygotsky, L. (1962). Thought and language. In Studies in communication. (E. Hanfmann & G. Vakar, Eds.). Cambridge: MIT Press.
59. Z.S. Xu, *Intuitionistic fuzzy aggregation operator*, IEEE Trans. Fuzzy Syst., **15**, (2007), 1179–1187.
60. R. R. Yager, *Pythagorean fuzzy subsets*, In: Proc Joint IFSA World Congress and NAFIPS Annual M eeting, Edmonton, Canada; (2013), 57-61.
61. R. R. Yager, *Pythagorean membership grades in multicriteria decision making* IEEE Trans Fuzzy Syst., **22**, (2014), 958-965.
62. R. R. Yager, A. M. Abbasov, *Pythagorean membership grades, complex numbers, and decision makin*, Int J Intell Syst. **28**, (2013), 436-452.
63. R.R. Yager, *Multicriteria decision making with ordinal linguistic intuitionistic fuzzy sets for mobile apps*, IEEE Trans. Fuzzy Syst., **24**, (2016), 590-599.
64. R.R. Yager, *Properties and applications of Pyhagorean fuzzy sets*, in Imprecision and Uncertainty in Information Representation and Processing, 119–136, Springer, Berlin, 2016.
65. Ye J. *Pediatric mental and behavioral health in the period of quarantine and social distancing (COVID19)*, JMIR Pediatr. Parent., 3, 2020, e19867, doi: 10.2196/19867
66. Yu, S., Liu, X. (2020). Strain of life under lockdown sparks divorce surge in China. Financial Times, 04.04.2020, Beijing. https://www.ft.com/content/11990ff0-c8f5-4f60-9b0a-be06324a4ddb
67. Yucesan M, Kahraman G, *Risk evaluation and prevention in hydropower plant operations: A model based on Pythagorean fuzzy AHP*, Energy Policy, 126, 2019, 343–351, DOI:10.1016/j.enpol.2018.11.039
68. L. A. Zadeh, *Fuzzy sets*, Inf. Comp. **8**, (1965), 338–353.
69. Zhang S, Sun B, Yan L, Wang C, *Risk identification on hydropower project using the IAHP and extension of TOPSIS methods under interval-valued fuzzy environment*, Nat. Hazards, 65(1), 2013, 359–373.
70. Zhang XL, Xu ZS, *Extension of TOPSIS to multi-criteria decision making with Pythagorean fuzzy sets*, Int. J. Intell. Syst., **29**, (2014), 1061-1078.