

Cardio-Pulmonary Resuscitation (CPR) in Children Between 5 and 8 Years Old: Psychometric Properties of Nonide Scale

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Abstract

Background: Early intervention in a cardiorespiratory arrest by a witness significantly increases survival. That is why early training in cardiopulmonary resuscitation (CPR) may be essential. Therefore, the aim of this study is the development and validation of an instrument to assess CPR knowledge and skills for schoolchildren from 5 to 8 years old. **Method:** We used a Spanish sample with 164 children aged between 5 and 8 years old. These children received a workshop called the “CPR from my school” program and their knowledge of CPR was assessed pre- and post-Workshop. We examined the scale through psychometric analyses within the framework of Classical Test Theory. **Results:** The Nonide Scale provided evidence of content validity, revealed an essentially unidimensional internal structure, as well as excellent reliability ($\Omega = .87$). Furthermore, a significant improvement was observed in scores, before and after the CPR Workshop. **Conclusions:** The Nonide Scale, designed to measure CPR knowledge and acquired skills in children from 5 to 8 years old, shows adequate psychometric properties, hence it can be used as professional and research contexts require.

Keywords: Cardiopulmonary resuscitation, Nonide Scale, concept formation, continuing education, psychometric properties, child.

Resumen

Resuscitación Cardio-Pulmonar (RCP) en Niños de 5 A 8 Años: Propiedades Psicométricas de la Escala Nonide. Antecedentes: la intervención precoz en una parada cardiorrespiratoria por el testigo aumenta significativamente la supervivencia. Es por ello que resulta fundamental la formación temprana en reanimación cardiopulmonar (RCP). Por ello, el objetivo del presente estudio es el desarrollo y validación de un instrumento de medida de conocimientos y habilidades en RCP para escolares de 5 a 8 años: Escala Nonide. **Método:** se empleó una muestra de 164 niños de edades comprendidas entre los 5 y los 8 años. A estos niños se les impartió un taller del programa “RCP desde mi cole” y se evaluó sus conocimientos de RCP en el momento pre y post taller, estudiando la escala mediante análisis psicométricos desde el marco de la Teoría Clásica de los Tests. **Resultados:** el instrumento aportó evidencias de validez de contenido, mostró una estructura esencialmente unidimensional, así como una fiabilidad excelente ($\Omega=0,87$). Además, se observó una mejora significativa en las puntuaciones del instrumento, antes y después del taller impartido de RCP. **Conclusiones:** la Escala Nonide diseñada para medir conocimientos y habilidades adquiridos en RCP para niños de 5 a 8 años muestra unas adecuadas propiedades psicométricas, por lo que puede emplearse cuando el contexto profesional y de investigación lo demande.

Palabras clave: reanimación cardiopulmonar, Escala Nonide, formación de concepto, educación continua, propiedades psicométricas, niño.

Cardiopulmonary arrest (CPA) is the sudden cessation and potentially irreversible of cardiac and respiratory functions. A serious problem of public health affecting 76 out of 110 people for every 100,000 inhabitants per year (Loma-Osorio et al., 2018). Given that 2 out of 3 resuscitated patients die before the hospital discharge (Nolan et al., 2007), the mortality rate is high and there is a poor long-term prognosis.

Cardiorespiratory Resuscitation (CPR) is a set of consecutive

measures aimed to reverse a CPA, firstly substituting the circulatory and respiratory functions, then trying to restore them later. When the prevention for CPR includes an adequate treatment of emergency situations, we can refer to life-support.

Shockable rhythms (VF and pulseless VT) are the most important heart rates of CPR and, for ages, it has been known that every minute medical assistance is delayed, the odds of surviving decrease between 7 and 10% (Perkins et al., 2015). Likewise, it is also well known that most CPRs take place outside of health centers such as homes, work places, and public places.

The metaphor developed at the “Chain of Survival”, firstly introduced by Mary Newman in 1987 while a conference held on CPR issues, was published two years later (Newman, 1989) and finally adopted by the American Heart Association in 1991. This metaphor developed the idea of CPA assistance being formed by a

set of consecutive and linked actions which need to be sequentially applied, as soon as possible and in the best way to ensure survival and reduction in aftereffects. These actions described in the “Chain of Survival” (to be used by adults outside of medical centers) are the following: Detection of the CPR and early notification to the emergency number, early basic Cardiopulmonary Resuscitation (CPR), early defibrillation, early and advanced Life-support and effective Post-Resuscitation care. The first three links in the Chain depend on witnesses of the CPR who tend not to be health professionals, thus the importance of expanding the CPR training to the entire population. Studies stating less than 25% of all CPR receive immediate medical treatment carried out by witnesses (Sword et al., 1995; Wissenberg et al., 2013), and in line with this, there have also been improvements in the survival of patients suffering from CPA, after having received CPR by witnesses (Abelairas-Gómez et al., 2020; Homberg et al., 2000; Wissenberg et al., 2003). So, that is the reason for training non-health professionals who might become witnesses of CPR. Moreover, at the stage of identifying and detecting a situation, and activating the system of Emergencies with a basic CPR which includes the early defibrillation with the help of an Automated External Defibrillator (AED).

The CPR training for the population focused on the first three links of the Chain of Survival previously mentioned, proves to be simple and can be performed in some hours. Furthermore, many international scientific societies have been advocating the spread of these programs to the population intending to improve the forecast of patients suffering from a CPA outside of health centers.

It is reasonable to consider that young people at school age are the perfect target for this training due to their learning abilities, absence of prejudices, and the transmitter effect. Also, this method achieves the knowledge gets to the public as a very natural technique so it helps training more solidary and committed citizens (García-Vega et al., 2008).

From the first international conferences on CPR to the one held in 1973 (Washington – USA), recommendations have widely been included in conference report’s conclusions, about school students -starting at the age of 10 years old-, receiving some sort of emergencies annual training at their education centers, which address conducts before accidents and CPR techniques. At the same time, authorities must try and succeed in the shortest time possible (Carveth, 1974). From that moment onwards, according to this recommendation, multiple training programs have been internationally developed and they have shown middle and high school students can learn CPR (Miró et al., 2008; Miró et al., 2012; Ordóñez et al., 2019). What’s more, these programs have also demonstrated middle and high school teachers, with previous training, can be instrumental when teaching CPR and even overcome, thanks to school programs, the persistence of this knowledge before the employment of scientific societies standards in these populations (Jiménez-Fábrega et al., 2009).

Most of these training programs on CPR for students are focused on high school students since traditionally it was considered that younger students neither were strong enough nor had the insight to differentiate these techniques and knowledge. During the last years, programs including middle school students and even some addressed to low school students have been published (Ordóñez et al., 2019). Thanks to them, it arose the question of how to assess these young students trained in CPR knowledge and skills since many students of that age might not know how to correctly read or

write. To this day there is not a standardized literature instrument assessing these aspects and, consequently, the main objective of this study is to develop and validate skills and knowledge instrument of measure about CPR addressed to the school population, between 5 and 8 years old, which allows assessing the effectiveness of training programs and the learning ability to CPR among such young students.

Method

Participants

During this study, it was possible to count on a sample of 164 children from Principado de Asturias (Spain), belonging to 9 different educational centers of this autonomous region. The age of the sample ranged from 5 to 8 years old ($M = 5.8$; $SD = 0.8$). 40% of students were 5 years old, 41% - 6 years old, and 19% - 7 or 8 years old. In agreement with the Spanish education system, 5-year old children study in 3rd of pre-primary or low school, 6-year old children are in 1st primary school, and finally 7 and 8-year old children study in 2nd of primary school. 50% of the participants were girls.

Instruments

Nonide Scale

The idea of teaching the youngest ones on CPR was born in 2013. It started in pre-primary school, shaping the later called “*RCP desde mi cole* [CPR from my school]” which was a training program on CPR. This project is characterized by specific methodology and training materials to teach CPR to young students. Likewise, a scale to measure the knowledge and skills of CPR was designed. Students had to be individually and orally assessed since most of them, being from 5 to 8 years old, cannot correctly read or write. Also, the assessment language used by trainers should be clear and comprehensible. During the assessment of abilities phase, a middle-size teddy bear was arranged so that it became friendly and approachable, and it was used to test the assessed techniques. It consisted of a performance scale structured in 9 items. Every item had a minimum score of 0 and a maximum of 4. The first item dealt with the knowledge of the number in case of Emergencies (112), the second, the acknowledgment of unconsciousness, the third is opening the airway with a maneuver head tilt-chin lift and jaw thrust to the training model (teddy bear), and the fourth assessed the performance of the Recovery Position to an unconsciousness patient who is breathing (teddy bear). Then, the fifth item deals with the performing of chest compression to an unconsciousness patient who does not breathe (teddy bear). The sixth and seventh item value the knowledge and skills related to the attention to serious blockage of airways due to choking or external bodies. In this way, the sixth item could focus on the attitude before choking with, effective cough, seeking the student would encourage the person to cough; whether the seventh item checked the attitude taken when cough becomes inefficient so that the student would apply a series of back blows (interscapular) to the back of the teddy bear. The eighth item was based on the Heimlich Maneuver (classic), and the ninth item focused on a variant of the abdominal Heimlich (Figure 1), out of the official guidelines, which was taught at the Program Workshop “*RCP desde mi cole*” in case of disproportion between

the size of the choked and rescuer -the rescuer cannot embrace the abdomen of the choked-, so that it is necessary to place the choked against a wall and, in front of him/her, to apply abdominal compression. The Nonide Scale is shown on Table 1.

Procedure

In order to collect evidence of the content validity, the Nonide Scale was sent to 82 experts via online to the addresses of its organizations, with a deadline of 10 days to willingly respond during February 2020. The message sent explained the objects and developments of the Program “RCP desde mi cole” and encouraged recipients to score the clarity and belonging of each item from the scale designed to measure the knowledge and skills on CPR by young students (5-8 years old). Also, recipients were given access to a video of an assessment on CPR knowledge to a young student of the Program, as a demonstration of the operative. Regarding the Program Workshop of “RCP desde mi cole”, this event was requested by school directors and parents were well-informed before any activity took place. Parents received an informative sheet with a consent form so that children could participate in the Workshop and study Project. Children were evaluated before and after receiving the Workshop “RCP desde mi cole” to observe the effect of this Workshop on the knowledge of CPR, also assessed in the Nonide Scale. The previous evaluation to the Workshop happened the week before with most students, but with a few cases (much reduced group workshops) the evaluation was done immediately before performing the Workshop because of logistic reasons. It was proposed as the goal for the evaluation

after the Workshop, which had to take place in two or three weeks in most of the cases. On the other hand, since the Nonide Scale has to be orally and individually implement by the evaluator due to limitations on students’ level of reading and writing at these ages; the assessment was performed at the same time by evaluators, who independently gave scores the student achieved in the scale. By doing so, it was ensured that the attention of the evaluator would not influence in the scores. The applicators were different health professionals who teach the Workshop. In turn, the sample was divided into three groups according to their age (5, 6, and 7-8 years old). The Project received the authorization by the Committee of Ethics and Investigation of Principality of Asturias.

Data Analysis

To obtain evidence of the validity of the Nonide scale’s contents, the evaluation of the items was requested to 82 experts on CPR (Executives, Directors and Autonomic Regions Coordinators of the CPR Group of the Spanish Society on Emergency Medicine and Emergencies [SEMES-RCP] and the Spanish Group of Pediatric and Neonatal CPR). These groups and societies are in charge of certifying trainers and instructors with knowledge of teaching CPR since they are trained to control the quality, adherence to standards and materials for teaching and assessment. Also, these groups bear the responsibility of establishing criteria for the accreditation of basic and advance CPR courses for adults and the more important pediatricians in Spain with international certification, many of whom belong to the American Heart Association (AHA). A more than a spectacular background to consider these professionals as highly qualified to perform this validation. The scores assigned by these judges were analyzed, both in clarity and belonging aspects, following the Aiken’s V index where 0 means absence of agreement, and 1 was the complete agreement (Penfield & Giacobbi, 2004).

In order to analyze inter-rater reliability, that is, if the scores obtained by the same minor were similar despite the fact that the instrument was applied by a different evaluator, the intraclass correlation and its confidential interval were calculated at a confidence level of 95% , where 0 means no agreement and 1 means absolute agreement.

Descriptive statistics of the items were analyzed. We analysed the item-test correlations (discrimination index) of each item, with them being considered suitable above .20 (Muñiz & Fonseca-Pedrero, 2019). To study the internal structure of the scale, it was performed an Exploratory Factor Analysis (EFA) on the polycorrelations matrix, using Unweighted Least Squares as the method of estimation. Also, KMO and Bartlett tests were applied to study the adequation of the data to the Factor Analysis. The number of factors to be extract was determined by the optimal implementation of the Parallel Analysis (Timmerman & Lorenzo-Seva, 2011). As fit indices, Goodness of Fit Index (GFI) and Root Mean Square Residual (RMSR) were the chosen ones to be more appropriate with independence to the estimation method (Ferrando & Lorenzo-Seva, 2017) -being GFI >.95 y RMSR <.08 (Hu & Bentler, 1999) a good fit. In addition, we used Unidimensional Congruence (UniCo), Explained Common Variance (ECV), and Mean of Item RESidual Absolute Loadings (MIREAL) to examine how well the data fit a single dimension. The following values support treating the data as essentially unidimensional: UniCo >.95; ECV >.85; MIREAL <.30 (Calderón-Garrido et al., 2019). The reliability of the scores was analyzed following McDonald’s Omega Coefficient.



Figure 1. Variance of the Heimlich maneuver, out of the official guidelines, taught and assessed in the Program “RCP desde mi cole”

Table 1
Questionnaire of knowledge and skills on CPR for students from 5 to 8 years old: Nonide Scale

1. What is the telephone number of Emergencies? [¿A qué número de teléfono hay que llamar para pedir ayuda?]		
a	4 Points	No help needed to say 112 [cuando dicen 112 sin ayuda]
b	2 Points	Decide between 3 numbers (061, 112, 911) and chose 112 [cuando se les da a elegir entre 3 números (061, 112, 911) y eligen 112]
c	0 Points	Do not know [cuando no lo saben]
2. When a person is on the floor and doesn't answer when being called or moved, is the person ok? [Cuando una persona está en el suelo y la llamamos y la movemos fuertemente pero no contesta ni se mueve, ¿cómo está?]		
a	4 Points	No help needed to say "fainted" [cuando dicen "desmayado" sin ayuda]
b	2 Points	Decide between 3 options (asleep, ill, fainted) and chose "fainted" [cuando se les da a elegir entre 3 opciones (dormido, enfermo, desmayado) y eligen "desmayado"]
c	0 Points	Do not know [cuando no lo saben]
3. When we call 112 to inform someone has fainted, the doctor asks if he/she breathes. How do we know if a person breathes? What do we have to do? [Cuando llamamos al 112 para decir que está desmayada, el médico nos pregunta que si respira. ¿Cómo tenemos que mirar si alguien respira, qué gesto tenemos que hacer?]		
a	4 Points	Tilt the teddy-bear's head backward (head tilt-chin lift maneuver) and then approach his/her face to the teddy-bear's mouth [cuando echan la cabeza del osito hacia atrás (maniobra frente-mentón) y luego acercan su cara a la boca del osito]
b	0 Points	Do not perform the head tilt-chin lift maneuver [cuando no hacen la maniobra frente-mentón]
4. When the person breathes (because the chest and belly are moving, he/she snores, air leaves through the mouth and nose), in which position does the doctor say we should move him/her? Place your teddy-bear. [Cuando respira (porque mueve el pecho y la barriga, ronca, sale aire por su nariz y su boca), ¿cómo nos va a pedir el médico que le pongamos? Coloca tú al osito.]		
a	4 Points	Place the teddy-bear in the Recovery Position (valid as long as the student confuse just one arm or the bent leg) [cuando hacen con el osito la PLS correcta (se da por válido si confunden sólo un brazo o solo la pierna que hay que doblar y lo hacen bien con una pequeña corrección)]
b	3 Points	Express "on one side" or place the teddy-bear on any side [cuando solo dicen "de lado" o ponen al osito de lado de cualquier manera]
c	2 Points	After giving 3 options (face up, face down, or on to the side) they place the teddy-bear into the correct position (valid as long as the student confuse just one arm or the bent leg) [cuando, tras darles 3 opciones (boca arriba, boca abajo o de lado) hacen con el osito la PLS correcta (se da por válido si confunden sólo un brazo o solo la pierna que hay que doblar y lo hacen bien con una pequeña corrección)]
d	1 Point	After giving 3 options (face up, face down, or on to the side), just express "on one side" or place the teddy-bear into any side position [cuando, tras darles 3 opciones (boca arriba, boca abajo o de lado), solo dicen "de lado" o ponen al osito de lado de cualquier manera]
e	0 Points	Do not know [cuando no lo saben]
5. If the person doesn't breathe (because air is not leaving, does not snore, or move the belly), the doctor says: "Heart arrest! We need to help the heart!". How do you do it? [Si no respira (porque no sale aire, no ronca, no mueve la barriga), el médico nos va a decir: "¡Se le está parando el corazón! ¡Hay que ayudar a su corazón!". ¿Cómo se hace?]		
a	4 Points	Correct chest compressions [cuando hacen compresiones torácicas de forma correcta]
b	3 Points	Only express "chest compressions" or place their hands onto the teddy-bear without a real intention or knowledge of where the chest compression area is [cuando solo dicen "apretar en el pecho" o ponen las manos de cualquier manera o en un lugar que claramente no es el pecho]
c	2 Points	After giving 3 options (on the chest, on the belly, on the head), they perform chest compressions in an incorrect way [cuando, tras darles 3 opciones (en el pecho, en la barriga, en la cabeza) hacen compresiones torácicas de forma correcta]
d	1 Point	After giving 3 options (on the chest, on the belly, on the head), they just express "help the heart" place their hands onto the teddy-bear without a real intention or knowledge of where the chest is [cuando, tras darles 3 opciones (en el pecho, en la barriga, en la cabeza), solo dicen "ayudar a su corazón" o ponen las manos de cualquier manera o en un lugar que claramente no es el pecho]
e	0 Points	Do not know [cuando no lo saben]
6. When a person chokes and CAN cough, his/her belly and cough work well, what do we do? [Cuando una persona se atraganta y Sí puede toser, su barriga y su tos funcionan, ¿qué tenemos que hacer?]		
a	4 Points	Express "encourage to cough", "cough, cough, cough" [cuando dicen "animarle a toser", "tose, tose, tose"]
b	2 Points	After giving 2 options ("help or resuscitation?"), they choose "encourage to cough", "cough, cough, cough" [cuando, tras darles 2 opciones ("¿ayudarlo o animarle?") eligen "animarle a toser", "tose, tose, tose"]
c	0 Points	Do not know [cuando no lo saben]
7. In case the person cannot cough because his/her belly and cough do not work well, and move his/her hands to the throat, then we need to help with 5 blows. Where do you perform them? [Y si ya no puede toser, porque su barriga y su tos no funcionan, y se lleva las manos a la garganta, tenemos que ayudarlo con 5 golpes. ¿Dónde se dan?]		
a	4 Points	Perform correct maneuver (with the heel of the hand and "pulling upwards") [cuando hacen la maniobra correcta (con el talón de la mano y "arrastrando hacia arriba")]
b	3 Points	Just express "blows on the back" or give back blows to the teddy-bear any way [cuando solo dicen "dar golpes en la espalda" o dan golpes en la espalda del muñeco de cualquier manera]
c	2 Points	After giving 3 options (on the chest, on the belly, on the back), they perform a correct maneuver (with the heel of the hand and "pulling upwards") [cuando, tras darles 3 opciones (en el pecho, en la barriga, en la espalda) hacen la maniobra correcta (con el talón de la mano y "arrastrando hacia arriba")]
d	1 Point	After giving 3 options (on the chest, on the belly, on the back), they just express "blows on the back" or give back blows to the teddy-bear any way [cuando, tras darles 3 opciones (en el pecho, en la barriga, en la espalda) solo dicen "dar golpes en la espalda" o dan golpes en la espalda del muñeco de cualquier manera]
e	0 Points	Do not know [cuando no lo saben]

8. And 5 grips (abdominal thrusts). Where do you perform them? [Y 5 apretones. ¿Dónde se dan?]

a	4 Points	Do the correct Heimlich maneuver (closed fist on the belly of the teddy-bear, the other hand embracing the fist) [cuando hacen la maniobra de Heimlich correcta (puño cerrado sobre la barriga del muñeco, la otra mano abrazando el puño)]
b	3 Points	Just express “on the belly” or they press the belly of the teddy-bear any way [cuando solo dicen “en la barriga” o aprietan la barriga del muñeco de cualquier manera]
c	2 Points	After giving 3 options (on the chest, on the belly, on the back), they do the correct Heimlich maneuver (closed fist on the belly of the teddy-bear, the other hand embracing the fist) [cuando, tras darles 3 opciones (en el pecho, en la barriga, en la espalda) hacen la maniobra de Heimlich correcta (puño cerrado sobre la barriga del muñeco, la otra mano abrazando el puño)]
d	1 Points	After giving 3 options (on the chest, on the belly, on the back), they just express “on the belly” or they press the belly of the teddy-bear any way [cuando, tras darles 3 opciones (en el pecho, en la barriga, en la espalda) solo dicen “en la barriga” o aprietan la barriga del muñeco de cualquier manera]
e	0 Points	Do not know [cuando no lo saben]

9. What if the person is very tall or big and we cannot embrace his/her from behind, how do we perform the Heimlich maneuver? Where do we take the person? [Y si la persona es muy grande o muy gorda, y no podemos darle los apretones por detrás, ¿cómo se los damos? ¿Dónde llevamos a la persona?]

a	4 Points	Do correct maneuver (hands on CPR position, and pressing against the belly of the teacher) [cuando hacen la maniobra correcta (manos en posición de RCP, y presionan contra la barriga del profesor)]
b	3 Points	Just express “against the wall” or do Heimlich maneuver against a wall any way [cuando solo dicen “contra la pared” o hacen la maniobra de Heimlich contra la pared de cualquier manera]
c	2 Points	After giving 3 options (the floor, Wall, or a chair), they choose “the wall” and do correct maneuver (hands-on CPR position, and pressing against the belly of the teacher) [cuando, tras darles 3 opciones (al suelo, a una pared o a una silla) eligen “a la pared” y hacen la maniobra correcta (manos en posición de RCP, y presionan contra la barriga del profesor)]
d	1 Points	After giving 3 options (the floor, Wall, or a chair), they just express “against the wall” or do Heimlich maneuver against a wall anyway [cuando, tras darles 3 opciones (al suelo, a una pared o a una silla) eligen “a la pared” o hacen la maniobra de Heimlich contra la pared de cualquier manera]
e	0 Points	Do not know [cuando no lo saben]

Regarding the analysis of the effects of the treatment (the Workshop of CPR taught to students) and the effect on the age, we performed a mixed repeated measure ANOVA with one within-subject factor (treatment; pre and post evaluation) and one between-subject factor (age). Homocedasticity was calculated through the M of Box. The effect size was analysed using Cohen’s *d*, with values between 0.2 and 0.4 indicating a small effect, between 0.5 and 0.7 a moderate effect, and over 0.7 a large effect size (Cohen, 1988). We used Bonferroni’s test to determine differences between the different groups. Also, the *t* test was used to analyze differences in Nonide Scale’s scores based on gender.

Finally, we norm-referenced the scores, based on percentiles to the different groups of age (5, 6, and 7-8 years old).

All analyses were performed on the software SPSS24, safe for AFE, and the coefficient Omega of McDonald, which were assessed with the software FACTOR5.6.1 (Ferrando & Lorenzo-Seva, 2017).

Results

The 9 items of the Nonide Scale were evaluated by a national team of 35 experts, out of the 82 invited, over the adequacy of items in clarity and belonging aspects, on a scale from 1-10 (Table 2). The average score in clarity was 7.46 (*SD* = 2.07), and 7.58 (*SD* = 2.19) in belonging. Item 1 was the best scored by the experts due to its importance over the beginning of this chain of survival, warning 112, and the worst was the controversial item 9, focused on a variant of the abdominal Heimlich, out of the official guidelines, which is included in the program of the Educational Project. The Aiken’s *V* index showed a value of .73 in clarity, and .70 in belonging, indicating an adequate level of agreement (Penfield & Giacobbi, 2004). As a result, the developed scale consisted of 9 items, none of the initial items having been removed thanks to adequate content validity. The complete results of the group of experts’ opinions and evidence of content validity are fully included in Table 2.

The interclass correlation between the assessments performed by each evaluator was analyzed. The interclass correlation result was .96 [.95 - .97 CI 95%], stating a practically perfect agreement among the evaluators.

The descriptive statistics of the items in the Nonide Scale can be observed in Table 3, being the discrimination index adequate on every item (Muñiz & Fonseca-Pedrero, 2019), resulting in between .36 and .61. On the other hand, there was a remarkable item for having high scores on average, as in skewness (negative) and kurtosis. The reason is most of the sample reaches the maximum possible score on the item. Regarding the EFA, both the KMO (.80) and Bartlett’s statistic (*p* < .001) demonstrated that the data was suitable for Factor Analysis. The test is essentially

Table 2
Evidences of the content validity of the Nonide Scale

Item	Clarity			Belonging		
	n	M (SD)	Rank	n	M (SD)	Rank
1	35	8.00 (1.84)	4-10	34	8.53 (1.91)	4-10
2	35	7.69 (2.13)	2-10	34	8.09 (1.99)	4-10
3	35	7.63 (2.09)	3-10	34	7.38 (2.54)	2-10
4	35	7.60 (2.21)	2-10	34	7.62 (2.32)	2-10
5	35	7.57 (2.25)	1-10	34	7.59 (2.56)	1-10
6	35	8.20 (1.91)	4-10	34	8.29 (1.90)	4-10
7	35	7.23 (2.02)	1-10	34	7.18 (2.02)	1-10
8	35	7.43 (2.00)	2-10	34	7.18 (2.08)	2-10
9	34	6.71 (2.22)	1-10	33	6.33 (2.42)	1-10
Average		7.56 (2.07)			7.58 (2.19)	
Aiken’s V index		.73			.70	

Note: n = number of experts on the CPR; M = mean; SD = standard deviation

unidimensional (Calderón-Garrido et al., 2019), based on the optimal implementation of Parallel Analysis suggested a single dimension, the first factor explains 49% of the total variance, and the UniCo (.96) and MIREAL (.28) indices that also support a unidimensional structure, being ECV very closed to the suggested value (.83). The fit of the EFA was adequate (GFI = .97; RMSR = .09), being RMSR a bit high. The factorial loadings were all very high, ranging from .48 and .76 (see Table 3). Likewise, the instrument also presented an excellent reliability ($\omega = .87$).

The complete descriptive statistics and factorial loadings for the items in the Nonide Scale are shown in Table 3.

To study the effect of the treatment (the Workshop of CPR taught to students) and the effect of age, we performed a mixed repeated measure ANOVA with one within-subject factor (treatment) and one between-subject factor (age; $N_{5 \text{ years old}} = 66$; $N_{6 \text{ years old}} = 68$; $N_{7,8 \text{ years old}} = 30$). The assumption of the homoscedasticity of variances was satisfied since the M of Box was not statistically significant ($p = .09$). The interaction was not statistically significant ($p = .73$), so that we proceeded to main effects. In reference to the effect of the treatment, the F of the Trace of Pillai was 501.71_{1,161}, being the differences statistically significant between both evaluations ($p < .001$), with a very big size effect ($d = 3.88$). Regarding the age, the F of the Trace of Pillai was 12.18, being the differences statistically significant between groups of age ($p < .001$), with a big size effect ($d = 0.86$; Cohen, 1988). Bonferroni's post-hoc test shows that there are statistically significant differences between all age groups ($p < .001$) in favor of the oldest age group. In Figure 2, there are graphic representations of the difference in the Nonide Scale according to the age and having received the Workshop on CPR. In line with the differences in terms of gender, boys ($M = 23.48$) and girls ($M = 25.34$), with a t of -1.63, do not show statistically significant differences ($p = .11$) on the Nonide Scale scores, once they received the Workshop on CPR.

Lastly, we norm-referenced the scores based on percentiles for the Nonide Scale. As there were differences based on age, it was performed an assessment both for 5, 6, and 7-8 years old (Table 4).

Discussion

The perception of the scientific and education community about the possibility of applying CPR to the knowledge and training of our youngest, it has been developing over the last decade. Although

there are not either any standardized programs, specific to the youngest students, nor theoretical teaching materials or practice models adapted to these individuals. Also, there are not any instruments to assess the knowledge and skills on CPR of young individuals, being our case of 5 to 8 years old, thus, it is impossible to know what the students may learn with a training program in CPR (its efficacy).

The only standard that does exist is the evaluation “exams” of the official courses on CPR, generally for adults and mostly addressed to health professionals, being necessary to “pass” -achieving a minimum required score- to get the accreditation of the promoting entities. These exams use to include a basic theoretical knowledge test and a practice test over approved dummies to perform the CPR with the assessed technique and the received practical skills. This method does not apply to young students who have not learned to correctly read or write yet and are not strong enough to use the techniques over standard approved dummies -apart from the probable shock for their appearance-. Thus, in the event of developing a training program in CPR for young students from 5 to 8 years old (“RCP desde mi Cole”), the need arose to implement specific teaching methods (simple and comprehensive language, friendly but rigorous environment, song for the resuscitation part...), and the use of appropriate materials (teddy bears as practice models). With the birth of the Program, the necessity of an instrument of measure appeared, being a specific and adapted test, to assess the learning and the efficacy of the Program.

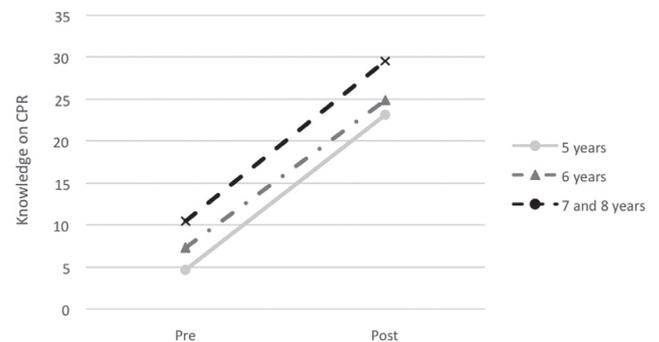


Figure 2. Differences in the Nonide Scale based on having received the Workshop on CPR and age

Table 3
Descriptive statistics and factorial loadings for the items of the Nonide Scale

Item	Mean	SD	Sk	K	D.I	Factorial loading
1	3.94	0.41	-7.48	60.77	.38	.76
2	3.61	0.94	-2.41	5.21	.37	.59
3	1.61	1.97	0.40	-1.86	.36	.48
4	2.88	1.31	-0.86	-0.67	.46	.58
5	3.31	1.18	-1.69	1.69	.54	.73
6	2.18	1.39	-0.13	-0.92	.52	.64
7	2.87	1.24	-0.97	-0.27	.48	.68
8	2.37	1.49	-0.34	-1.41	.61	.72
9	2.30	1.54	-0.28	-1.45	.54	.68
Total	25.07	7.14	-0.72	0.33	-	-

Note: SD = standard deviation; Sk = skewness; K = kurtosis; D.I = discrimination index

Table 4
Norm-referenced scores for Nonide Scale

Scoring on 5 years	Scoring on 6 years	Scoring on 7-8 years	Percentile
0 - 10	0 - 16	0 - 21	5
11 - 17	17	22 - 23	10
18	18 - 20	24 - 25	20
19 - 20	21	26	30
21 - 22	22 - 23	27	40
23 - 25	24	29	50
26	25 - 26	30 - 31	60
27	27 - 29	32	70
28	30 - 31	33	80
29 - 30	32 - 33	34	90
31 - 34	34	35	95
35 - 36	35 - 36	36	99

This study represents the development and validation of the Nonide Scale consisting of 9 items that assess the knowledge on CPR for students from 5 to 8 years old. The items included in the scale, showed evidence of content validity through the assessment of 35 national experts on CPR, both in clarity and belonging. Due to the target sample was between 5 to 8 years old, and many of them could not read or write correctly, the evaluator had to apply the test to the students. To confirm this effect of the evaluator did not interfere with the results, the instrument was applied to the student by a different evaluator, analyzing its inter-rater reliability, with excellent results ($r = .96$), which meant the results of a participant with a different evaluator are similar.

Regarding the structure of the instrument, it was highlighted that essentially unidimensional internal structure (Calderón-Garrido et al., 2019), assessing the only denominated factor -knowledge- on CPR. Also, the Nonide Scale demonstrated excellent reliability ($\omega = .87$). In terms of the items analysis, the 9 items are adequate when discerning the results of higher or lower knowledge on CPR, since the discrimination index swung between .36 and .61. The Nonide Scale consists of 9 items, so the reduced number of items should not fatigue the child, without affecting their scores in this sense, in benefit both to the environment of research, and the professional (Blanca et al., 2020; Postigo et al., 2020).

Concerning the training workshop on CPR of the Program “RCP desde mi cole”, different and several conclusions may be extracted. Firstly, the effect of the Workshop was enormous ($d = 3.86$), where it can be observed a significant acquisition of knowledge on CPR thanks to the evaluation after the Workshop, measured with the Nonide Scale, resulting also this improvement of knowledge for all the age groups (Figure 2). On the other side, there were also some results evidencing the difference according to the age, both in the previous moment to the Workshop, as well as after it, being always in favor of the older ones, thus a norm-referenced based on percentiles different in function to the age was calculated. In future studies, it would be advisable to use a bigger sample, especially with 7-8-year-old students, to increase the reliability of the norm-referenced

exposed in this study, which has to be carefully used. In addition, differences in the youngest ones (4 to 6 years old) have been found in variables such as inhibitory control (Cueli et al., 2020), reason why future research with larger samples could study the measurement invariance of the Nonide Scale, among other psychometric aspects. It is relevant to notice that the program “RCP desde mi cole” has been developed in other countries with very good reception and the only methodological adaptation was the telephone number in case of emergency (item 1 and 3), so future adaptations and validations of the Nonide Scale should also contemplate the telephone number of the emergency health service of the country.

The Nonide Scale, unfortunately, cannot be compared with any other instrument since there is no specific piece of literature about knowledge and skills on CPR for young students from 5 to 8 years old.

For all this information, with this study, the Nonide Scale gets validated to evaluate knowledge and skills on CPR for young students. This is the first validated instrument for school students from 5 to 8 years old, and it will be able to serve to evaluate the efficacy of any training program on CPR for students of low and middle school. It also establishes a standard and a starting point with which future instruments designed for the same purpose and population can be compared to find the easiest to apply and with the best psychometric properties.

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