ARTÍCULO ORIGINAL

Psychometric Properties Of ADHD Rating Scale In School Context

Propiedades Psicométricas de la Escala ADHD en el Contexto Escolar

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Abstract

Background: The ADHD Rating Scale IV (ADHD RS IV) is one of the most commonly used scales in attention deficit hyperactivity disorder (ADHD) assessment. Its psychometric properties have been studied in contexts including Europe and North America, however, in Latin America, there is shortage of empirical evidence about validity or reliability reported by teachers on a scholar context. The aim of the research was to analyze the psychometric properties of the ADHD RS IV based on the behavior of students reported by teachers. **Material/methods**: Three hundred and forty-five students voluntarily participated in this study (162 men and 183 women), aged between 5 and 15 years (Mage = 10.43, SD = 3.61). As instruments of measurement ADHD RS IV, Perception of Differences Test and Go / No-Go experiment were used. Cronbach's alpha, Pearson correlation and confirmatory factor analysis were applied and analyzed. **Results**: In the results it was found that internal consistency coefficient of RS IV ADHD is between .93 and .97. There is a significant statistically correlation between the scale and the number of successes points in the Perception of Differences Test (r = -.55, p = < .001) and mistakes to stimuli no-go (r = .34, p = .002). The classic ADHD model of two factors had good indicators of goodness of fit x2(101) = 321.40, p < .001; CFI = .96; RMSEA = .08 (.07 to .09) and SRMR = .04. **Conclusions**: The article is finalized highlighting the ADHD RS IV has adequate psychometric properties in order to be applied in the school context.

Keywords: ADHD RS IV, attention deficit hyperactivity disorder, Perception of differences Test, Go/No-Go experiment, psychometric properties.

Resumen

Antecedentes: La ADHD Rating Scale IV (ADHD RS IV) es una de las escalas más utilizadas en la evaluación del trastorno por déficit de atención con hiperactividad (ADHD). Sus propiedades psicométricas se han estudiado en contextos que incluyen Europa y América del Norte, sin embargo, en América Latina, hay escasez de evidencia empírica sobre la validez o confiabilidad reportada por los docentes en un contexto académico. El objetivo de la investigación fue analizar las propiedades psicométricas del ADHD RS IV con base en el comportamiento de los estudiantes reportados por los maestros. **Material / métodos**: Trescientos cuarenta y cinco estudiantes participaron voluntariamente en este estudio (162 hombres y 183 mujeres), con edades comprendidas entre 5 y 15 años (Mage = 10.43, SD = 3.61). Como instrumentos de medida ADHD RS IV, se utilizaron la prueba de percepción de diferencias y el experimento Go / No-Go. Alfa de Cronbach, correlación de Pearson y análisis factorial confirmatorio fueron aplicados y analizados. **Resultados**: En los resultados se encontró que el coeficiente de consistencia interna de RS IV ADHD está entre .93 y .97. Existe una correlación estadística significativa entre la escala y el número de puntos de éxito en la Prueba de Percepción de Diferencias (r = -.55, p = <.001) y los errores a los estímulos no-go (r = .34, p =. 002). El modelo clásico de TDAH de dos factores tenía buenos indicadores de bondad de ajuste x2 (101) = 321.40, p <.001; CFI = .96; RMSEA = .08 (.07 a .09) y SRMR = .04. **Conclusiones**: El artículo finaliza destacando que la ADHD RS IV tiene propiedades psicométricas adecuadas para ser aplicado en el contexto escolar.

Palabras clave: ADHD RS IV, trastorno por déficit de atención con hiperactividad, prueba de percepción de diferencias, experimento Go / No-Go, propiedades psicométricas.

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Introduction

ADHD (Attention Deficit/ H yperactivity Disorder) has been classified as a neurodevelopmental disorder, its essential features are an excessive motor pattern, impulsivity, and attentional difficulties. These symptoms interfere in child, adolescent or adult's quality of life.[1]

Diverse studies have reported that this disorder is the most demanded for attention in the mental health context,[2] because its prevalence remains between 3% and 10% of general population,[3,4] and occurs more frequently in males than in females with a ratio of approximately 2:1.[5]

ADHD symptoms start in childhood and may continue during an individual's lifetime, originating difficulties in the majority of contexts where he/she develops.[6] For example, it has been reported that people with ADHD show alterations in reading-writing abilities,[7] emotional regulation,[8] psychosocial functioning,[9] among many others, wich are not exclusively present in childhood. They may remain until adulthood, possibly interfering in their occupational performance.[10]

ADHD's diagnostic process must have an integral approach, which includes a clinical interview with parents and teachers, behavioral scales application and experimental tasks that allow to identify the patient's deficits in the social and academic performance and, as long as it is possible, a clinical observation in educational and familiar environments.[6,11]

An important component in the complete ADHD's evaluation is the scales'application on child's behavior by parents and teachers, who observe child's or adolescent's behavior in their daily educational or familiar contexts.[12] Among the main scales used clinically there may be found the next ones: the SNAP – IV,[13] the Conners' scale,[14] the EDAH,[15] and the ADHD RS IV.[16]

It has been reported that these scales' psychometric properties have shown the required reliability and validity standards for the ADHD. That is why these scales could be designated as psychometric reagents, mainly the ADHD RS IV, which represents to serve as a great utility for the clinician in screening, diagnosis and ADHD's treatment evaluation process.[17]

The ADHD RS IV was developed in the United States by Du Paul and his research team,[16] who contextualized the ADHD's symptomatology that was described in the DSM-IV-TR IV,[18] into a behavioral scale assessment. ADHD RS IV's factorial components, as in the actual DSM-5,[5] points out that ADHD integrates two dimensions (a) attentional deficit, which has nine items, and (b) hyperactivity and impulsivity, with nine items as well. All of its items are in concordance with the eighteen symptoms described in the DSM-IV-TR[18] and DSM – 5.[1]

The factorial configuration described before, allow to classify the ADHD into three subtypes: (a) ADHD subtype combined presentation: characterized by inattention and hyperactivity –impulsivity symptomatology; (b) ADHD subtype inattentive presentation: which main and only feature is inattention, and (c) ADHD subtype hyperactive/impulsive presentation: which features are excessive motor activity and difficulties in controlling impulses.[1]

The ADHD RS IV scale was developed in an English linguistic context, and has been translated into a variety of languages, and validated in many countries as Spain,[19] France,[20] Japan,[21] USA, Canada,[17] Chile,[22] among others. In Ecuador, the country where this study has taken place, there exists an ADHD RS IV's previous adaptation proposal with a self-report form for adolescents.[23] In this mentioned study, there were psychometric properties' analyses conducted of the scale in a sample of secondary students aged between 14 and 18 years, belonging to Ecuador's public educational system. Some of the main results of this study describe that the ADHD RS IV scale's application as a self-reported test has an appropriate internal consistency and the goodness of fit parameters for its classical two factors structure.

Although, this previous study is the only one that has been reported in Ecuador and has analyzed ADHD RS IV's reliability and validity, there has not yet been a search of its psychometric properties in a scholar context or through parents or teacher's reports.

In this context, it is vital to mention that the aim of the study is that it looks for the most suitable diagnostic and evaluation methods, which are aspects not solved yet about ADHD investigation lines.[24] On the other hand, this study will contribute to the research development of ADHD in Ecuador, which is a Latin American country with an incipient investigation about this neurodevelopmental disorder.

Therefore, this study's objectives are: (a) to identify the scale's internal consistency through Cronbach's Alpha coefficient, correlation of each item with its scale and getting better the internal consistency coefficient by taking out items; (b) to analyze ADHD RS IV's convergent validity through other assessment processes about ADHD's component factors, and (c) to evaluate the construct validity of the scale through confirmatory factorial analysis process of its one and two factors structure.

Study Scenario

Ecuador is the country where this investigation has taken place, this is a South American country with more of sixteen million people of population, its economic system is capitalism and its currency is USA dollars. In previous investigation of ADHD prevalence in educational context of Ecuador was reported that about 6% of students would present this disorder.[25] These contextual characteristics and disorder peculiarities make the results of the present study possible to be extrapolated to other countries with which similar characteristics to the previous described are shared.

Method

Participants

This sample was recruited from Ecuador's educational system. The total sample (N = 345) consisted of 162 males (47%), and 183 females (53%) students, aged between 5 and 15 years (Mage = 10.43; SD = 3.61). Their scholar level comprehends as following, 53 participants belonging to second grade of basic education (15%), 65 from third grade (19%), 65 from fourth grade (18%), 60 participants belonging to fifth grade (17%), 54 from sixth grade (16%), 11 from seventh grade (4%), 18 from eighth grade (5%) and 19 belonging to ninth grade (6%). Participants' socioeconomic level was middle and high.

Instruments

As it was pointed out before, the ADHD RS IV is a scale that allows assessing ADHD in concordance with the 18 symptoms described to diagnose this disorder (Du Paul & Stoner, 2014). This is a liker-type scale, where 1 means there has never been this symptom; 2 means sometimes, 3 means often, and 4 means very often. The first step was the scale´s linguistic contextualization in Ecuador. For this purpose, there were 3 stages, the first consisted of preparing the instrument, in the second stage the instrument was revised by the judgment of an expert professional group in ADHD evaluation, their suggestions were taken into account and the third stage consisted in the implementation of a pilot study. Once the instrument had the optimal conditions, the application process was conducted. In the present research was taken into consideration the teacher´s report format. From the scale, there were obtained three measurements: (a) attentional deficit, from the items numbered 1 to 9; (b) hyperactivity and impulsivity, from the items 10 to 18, and (c) ADHD total, from the items 1 to 18.

Accessing the convergent validity was necessary to conduct two experimental tasks. In the first place, the Perception of Differences Test[26] was used; it is a task that allows assessing perceptive visual and attentional process. The procedure for this test consists in giving to each participant a booklet which has four columns, each of those with fifteen rows with three faces as visual stimuli, where two of them are the same and one is different, this last one has to be identified by the participant. The application time is three minutes. From this task, measurements obtained were: (a) total successes; (b) total mistakes; (c) total omissions.

The second experimental task consisted in a computerized assignment called Go/No-Go, which is a response's n inhibitory activity.[27] During this task, participants must respond to a stimulus Go (P in the first phase and R in the second phase) and to inhibit the answer to a stimulus No-Go (R in the first phase y P in the second phase).[28] It has 362 tries, with a total duration of 9 minutes approximately. The stimuli (R-P) are presented in a 2 by 2 matrix which has four stars where are the mentioned letters (See figure 1). For entering participant's answers a button box was used. From this experiment it was quantified the number of mistakes over non-answer stimuli (No-Go).

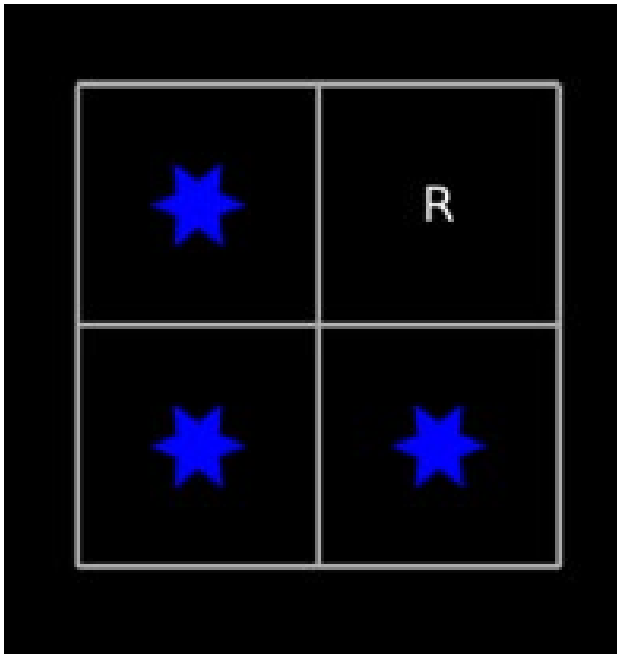

Figure 1. Go/No-Go Task.

Procedure

This study began with the signature in the informed consent and voluntary participation agreement. Throughout the procedure, according to Helsinki's declaration about ethical research with human beings, standards were respected.[29] The instruments were responded by participant's teachers. The scale and experiments were applied individually and in a distraction free environment.

Data Analyses

For the descriptive analysis, measures of central tendency and dispersion were used. For the analysis of internal consistency of the scale, the Cronbach's Alpha procedures, total scale item correlation and calculation of the coefficient were used. In the analysis of convergent validity, the Pearson correlation process was used. To confirm the validity of the construct, a confirmatory factorial analysis was used. Statistical analyzes were performed in the SPSS version 20 and AMOS version 23 package.

Results

Internal Consistency Analysis

In the total ADHD scale it was found a Cronbach's Alpha coefficient of $\alpha = .97$; on deficit attention's scale $\alpha = .95$; on hyperactivity and impulsivity's scale $\alpha = .93$ showing and excellent reliability in the three of them.

Table 1 shows scale's correlational parameters total item and scale's Alpha's coefficient if there is an elimination of any item.

Table 1. ADHD RS IV Scale item's internal consistency.

Ítems	r_{jx}	α-j
Attention Deficit		
1. Fails to give close attention to details or makes careless mistakes in schoolwork.	.66	.92
2. Has difficulty sustaining attention in tasks or play activities.	.73	.92
3. Does not seem to listen when spoken directly.	.77	.92
4. Does not follow through on instructions and fails to finish work.	.79	.91
5. Has difficulty organizing tasks and activities.	.78	.91
6. Avoids tasks (eg, schoolwork, homework) that require sustained mental effort.	.79	.91
7. Loses things necessary for tasks or activities.	.74	.92
8. Is easily distracted.	.63	.92
9. Is forgetful in daily activities.	.68	.92
Hyperactivity and Impulsivity		
10. Fidgets with hands or feet or squirms in seat.	.58	.93
11. Leaves seat in classroom or in other situations in which remaining seated is expected.	.75	.92
12. Runs about or climbs excessively in situations in which it is inappropriate.	.77	.92
13. Has difficulty playing or engaging in leisure activities quietly.	.75	.92
14. Is "on the go" or acts as if "driven by a motor".	.79	.92
15. Talks excessively.	.74	.92
16. Blurts out answers before questions have been completed.	.74	.92
17. Has difficulty awaiting turn.	.77	.92
18. Interrupts or intrudes on others.	.72	.92

Correlation item-total (rjx) and Cronbach's Alpha if element was removed (α-j)

Convergent Validity

Correlational analysis among ADHD RS IV scale and Perception of Differences Test it was found that the total successes in this scale are significantly correlated with the three ADHD RS IV's subscales that means, with hyperactivity and impulsivity r = -.49, p < .001; attentional deficit r = -.54, p= < .001 and total ADHD r = -.55, p = < .001.

Total mistakes in Perception of Differences Test is significantly correlated with every ADHD RS IV subscales, with hyperactivity and impulsivity r = .36, p <.001, attentional deficit r = .46, p < .001 and total TDAH r = .45, p = < .001.

Total omissions in Perception of Differences Test is significantly correlated with every ADHD RS IV subscales, with hyperactivity and impulsivity r = .44, p < .001, attentional deficit r = .43, p < .001 and total TDAH r = .48, p < .001.

Analysis among the experiment Go/No-Go and ADHD RS IV scale showed that attentional deficit was significantly correlated with No-Go mistakes r = .38, p < .001; hyperactivity and impulsivity significantly correlated with mistakes No-Go r = .34, p = .002.

Between ADHD RS IV subscales existed a significant correlation among attentional deficit and hyperactivity and impulsivity r = .69; p < .001; hyperactivity and impulsivity with the total ADHD r = .93; p < .001 and attentional deficit with total ADHD r = .91, p < .001.

Construct's Validity

To accomplish this point, scale's confirmatory factor analysis was used, taking into account its one factor configuration and two factors classic structure (see figures 2 and 3). As goodness of fit parameters it was found that,

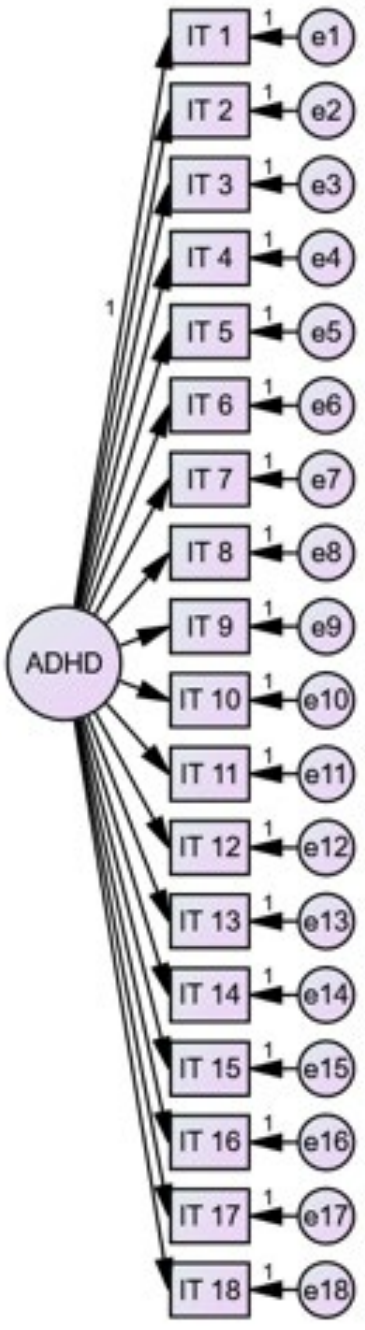

Figure 2. Model of one factor of ADHD

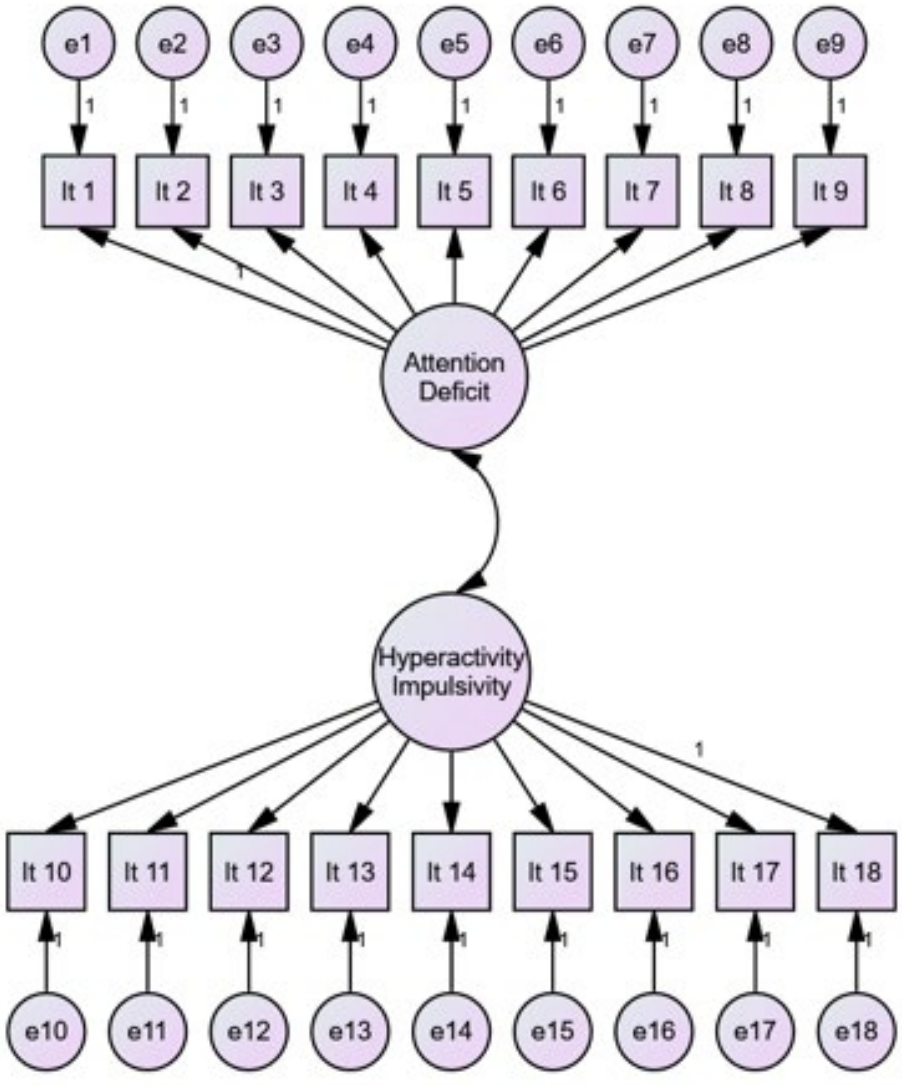

Figure 3. Model of two factors of ADHD

one factor model shows x2(135) = 1270.39; p < .001, CFI = .68; RMSEA = .18 (.17 – .19); SRMR = .10; meanwhile two factors model shows x2 (101) = 321.40, p < .001; CFI = .96; RMSEA = .08 (.07 - .09), SRMR = .04.

Discussion

This study has examined ADHD RS IV Scale's psychometric properties on an Ecuadorian student's sample. In relationship with the first objective (a) to analyze the scale's internal consistency through Cronbach's Alpha coefficient, correlation of each item within its scale and getting better the internal consistency coefficient by taking out items. It was found that internal consistence is excellent, because its Cronbach's Alpha coefficients are greater than 0.90, which is concordant with previous researches where AHDH RS IV has been reported by participant's teachers. For example, in a study realized in Spain coefficients were found greater than .94;[19] in Japan its coefficients were between .85 and .93;[21] in USA between .87 and .93;[17] in France between .93 and .94;[30] in Denmark between .86 y .94;[31] and in Chile between .76 y .92.[22] These previous results together with the ones in the present article (coefficients between .93 and .97), contribute with important evidence about ADHD RS IV Scale's good reliability qualities in the variety of contexts it was applied.

On the other hand, in Ecuador there exists a previous study, where ADHD RS IV was adapted through a self-report format and it was reported an internal consistency between .77 and .83.[23] This suggests that when this scale is applied with a teacher's report, it would be more reliable than when the patient does it by him/herself. This is because, as mentioned before, a patient's subjectivity would exist in the construction about his/her own behavior and its report.

According to this study's second objective (b) to analyze ADHD RS IV's convergent validity through other assessment processes about ADHD's component factors, results suggest that there is a statistically significant relationship among both ADHD's evaluation methods.

Findings of correlation among Perception of Differences Test and ADHD RS IV scale suggest that greater severe behavioral symptomatology of attentional deficit, hyperactivity and impulsivity, less will be the efficiency in the Perception of Differences Test. The relationship among experiment Go/No-Go and ADHD RS IV scale suggests that, patients with greater scores in the scale will present a major number of mistakes to stimuli in which they must stop a response that has a tendency to continue.

These results could be explained by Barkley's theory,[32] who affirms that patients who show ADHD's clinical features would present a deficit in the inhibitory control (frontal lobe's inherent function). This would produce in participants who scored higher in the ADHD RS IV scale to present a higher number of mistakes to No-Go stimuli and a low performance in the Perception of Differences Test.

Mentioned results have relationship with previous studies, that have reported that children who scored higher in ADHD's evaluation scales, present higher difficulties in experiments that assess motor control, which is different with children with typical development, to whom this function is preserved.[33,34,35]

The third objective (c) was looking to test the scale's construct validity through a confirmatory factorial analysis process about its structure bases in one and two factors. Following Steiger,[36] Hu and Bentler[37] proposed guidelines, the adequate goodness of fit parameters are based in (a) RMSEA less than .07 or .06; (b) CFI greater than .90 and (c) SRMR less than .05. Therefore, one factor's model did not present the adequate parameters. Meanwhile, ADHD's two classic factors fulfill the indicators, except for the RMSEA which shows .08; however, its interval is between .07 and .09. These results suggest that ADHD RS IV scale's reported by teachers in Ecuador maintains its classical configuration that has been described in the last two DSM versions.[1,18]

The accomplished confirmatory factor analysis process has concordance with previous studies. For example, in Japan's study, the goodness of fit found was x2 (90) = 305.21, $p < .001$, RMSEA = .05, CFI = .98, SRMR = .02, and a study conducted in France reported the next indicators CFI = .90 y RMSEA = .07 (.06 - .09); which allows guiding these confirmatory factor analysis' results pro the ADHD RS IV scale's construct validity previously reported in other social contexts and nowadays in Ecuador.

Finally, per the conclusion, it is possible to affirm that ADHD RS IV scale possesses suitable reliability and validity properties to be applied to students belonging to scholar Ecuadorian system under teacher's report. Further, being this the first study reporting these psychometric parameters in an Ecuadorian context, it constitutes an important contribution to the ADHD's research line in this country.

As limitations of the present study, they could be limited to the following points: the sample's size may be too small to be representative of Ecuador's national level and participants' geographic localization does not take in account every city. Even though, these two factors could be taken as motivations for future studies. For example, to make a replication based in this study into a national level with a statistically representative sample and where selected participants would belong to every Ecuadorian regions.

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