Middle-East Journal of Scientific Research 27 (2): 114-118, 2019
ISSN 1990-9233

DOI: 10.5829/idosi.mejsr.2019.114.118

Structural Equation Model for Studying the Autism Spectrum Disorder

Víctor Daniel Gil Vera and Catalina Quintero López

Universidad Católica Luis Amigó, Transversal 51A # 67B 90. Medellín, Colombia

Abstract: Autism Spectrum Disorder (ASD) is characterized by persistent deficits in social communication, restricted and repetitive patterns of behavior, interests, or activities and often intellectual disabilities. The objective of this paper was to present a structural equation modeling (SEM) to evaluate the variables that most influenced the appearance of this mental disease. Was used a representative sample of 33 adolescents with this disease of the Specialized Attention Center (SAC) "Neuropser IPS", Medellín, Colombia. The sample was selected considering a margin of error of 5 % and a confidence level of 90 %. The results of the Sphericity Kaiser-Meyer-Olkin (KMO) test and Bartlett's test, indicated that the factorial analysis is adequate, all the constructs are statistically significant. The goodness of fit test indicated that the model fits well with the data. This paper concludes that, of all the constructs considered: communication, social behavior, stereotyped behavior and repetitive behavior, the construct that most influences the latent variable "adaptive" is the social behavior and the construct that most influences the latent variable "clinic" is the repetitive behavior.

Key words: Adolescents · ASD · Behavior · Mental Illness · Structural Equation Modeling

INTRODUCTION

Autism spectrum disorders (ASD) are neurodevelopmental disorders in which multiple genetic and environmental factors play roles. Symptoms of deficits in social communication and restrictive, repetitive behavioral patterns emerge early in a child's development [1]. ASD is a term used to describe a constellation of early-appearing social communication deficits and repetitive sensory–motor behaviors associated with a strong genetic component as well as other causes [2].

Diagnoses of ASD have increased considerably over the past 20 years. Because of this rise and the inherent complexity of ASD, there is a need for an increased number of scientifically valid basic and clinical research studies addressing this disorder [3]. The deficient handwriting abilities among children with ASD relate especially to their overall legibility and speed [4]. Symptoms of anxiety and depression are commonly reported by adults diagnosed with an ASD and their presence can exacerbate core autism symptoms and lower quality of life [5]. ASD has a number of prevalent co-morbidities, such as sleep disorders, attention deficit/hyperactivity disorder and epilepsy [6].

Table 1: ASD statistics /per 10.000 children

Country	Rata	Simplified Rate
Poland	3 in 10000	1 in 3, 333
Taiwan	5 in 10000	1 in 2, 000
China	23 in 10000	1 in 435
Germany	38 in 10000	1 in 263
Netherlands	48 in 10000	1 in 208
Norway	51 in 10000	1 in 196
Finland	54 in 10000	1 in 185
Estonia	60 in 10000	1 in 167
Belgium	60 in 10000	1 in 167
Singapore	67 in 10000	1 in 149
Denmark	69 in 10000	1 in 145
Canada	106 in 10000	1 in 94
Switzerland	145 in 10000	1 in 69
Ireland	153 in 10000	1 in 65
Japan	181 in 10000	1 in 55
Usa	222 in 10000	1 in 45
South Korea	263 in 10000	1 in 38
Hong Kong	372 in 10000	1 in 27
Total		

Source: Charron [7]

This paper presents the development of a structural equation model (SEM), which seeks to determine the main variables and factors of this mental disease in adolescents belonging to the Specialized Attention Center (SAC)

Correspondig Author: Víctor Daniel Gil Vera, Universidad Católica Luis Amigó Transversal 51A # 67B 90. Medellin, Colombia.

"Neuropser IPS", institution that provide health and education services in the area of neuropsychology, based on the principles of cognitive neuroscience and inclusion in Medellin, Colombia. Four constructs were considered: communication, social behavior, stereotyped behavior and repetitive behavior and two latent variables were used: adaptive and clinic. It is important to know adolescent's characterization on this mental disease, to make more efficient the psychotherapeutic treatment. Table 1, presents the number of autism diagnoses per 10000 children.

MATERIALS AND METHODS

Structural Equation Models (SEMs) are widely used in biomedical, educational, behavioral, psychological and social sciences [8]. The modeling is a combination of exploratory factor analysis and multiple regressions [9]. These are powerful statistical tools used opinions on the best ways to rear children, as well as to examine the internal reliability of measurements and to different levels of time and effort that parents are willing investigate the theoretical constructs [10]. The main purpose of factor analysis is to obtain the key factor analysis (Most informative) parameters that give an objective [11]. SEMs are often formulated using a pre-specified parametric structural equation and uses latent and estimated variables to determine the relationship of entire networks between variables [12]. We used multivariate statistical techniques; regression and factor analysis in the statistical software STATA 15. The analysis SEM is composed of two models; a measurement model and a structural model in which specifies the relationship between the latent and observable variables [12]. Through a set of statistical tests of goodness of fit (Adjustment index of comparative CIF, Tucker Lewis, RMSEA and coefficient of determination - CD), discusses how well it adapts the model to the data later to assess the direct and indirect effects between the latent variables and independent [12]. In this paper, we analyzed the relationships between four constructs (Communication, social behavior, stereotyped behavior and repetitive behavior) and two latent variables (Adaptive and clinic), which enable you to analyze adolescent's perception about the characteristics of this disease. Was used a database that met the responses from a survey on the autism spectrum disorder (ASD). The survey was applied to a representative sample of 33 adolescents. The sample was selected considering a margin of error of 5 %, confidence level of 90 % and Z value 1.646:

$$n = \frac{Z^2(p*q)}{e^2 + \frac{(Z^2(p*q))}{N}}$$

where:

n: sample size, Z: confidence level, p: proportion of the population with the desired characteristic, q: proportion of the population without the desired characteristic, e: error level willing to commit, N: population size. Fig. 1 and Fig. 2, present the description of each variable used in the development of the model (SEM). These were measured in a Likert scale where 5: strongly agree, 4: something in accordance, 3: neither agree nor disagree, 2: something in disagreement, 1: and 0: strongly disagree [12]. Table 2, presents the observed variables of the model:

Table 2: Observed variables

Question	Variable	Construct
It is difficult for me to understand how other people are feeling when we are talking	ZA1	Communication
I often don't know how to act in social situations	ZA2	
I can chat and make small talk with people	ZA3	
It is difficult to figure out what other people expect of me	ZB1	Social Behavior
How to make friends and socialize is a mystery to me	ZB2	
It is very difficult for me to work and function in groups	ZB3	
When i feel overwhelmed by my senses, i have to isolate myself to shut them down	ZC1	Stereotyped Behavior
Some ordinary textures that do not bother others feel very offensive when they touch my skin	ZC2	
When talking to someone, i have a hard time telling when it is my turn to talk or to listen	ZC3	
Sometimes i have to cover my ears to block out painful noises (like vacuum cleaners or people talking too much or too loudly)	ZC4	
It can be very hard to read someone's face, hand and body movements when we are talking	ZD1	Repetitive Behavior
I focus on details rather than the overall idea	ZD2	
I take things too literally, so i often miss what people are trying to say	ZD3	
I get extremely upset when the way i like to do things is suddenly changed	ZD4	

Source: CAST [14]

Table 3: Latent variables

Question	Variable	Construct
I find it easy to work out what someone is thinking or feeling just by looking at their face	ZE1	Adaptability (ZE)
If there is an interruption, i can switch back to what i was doing very quickly	ZE2	
People often tell me that i keep going on and on about the same thing	ZE3	
I like to play games involving pretending with other children.	ZF1	Clinic (ZF)
I like to collect information about categories of things (e.g., types of cars, birds, trains, plants)	ZF2	
I find it difficult to imagine what it would be like to be someone else	ZF3	

Source: CAST [14]

Table 3, presents the latent variables of the model:

RESULTS AND DISCUSSION

Table 3 and Table 4, presents the results of the Kaiser Meyer Olkin (KMO) test, any KMO is below 0.5, which is why it can be said that factor analysis is valid. The evidence of sphericity rejected at any level of significance considering the results of the Bartlett's sphericity test, the matrix of correlations is not an identity matrix [12].

In the construction of the SEM model was used the builder tool of the statistical software STATA 15. Was developed an analysis of main components of four constructs (Communication, social behavior, stereotyped behavior and repetitive behavior), which helped reduce its dimensions to only one variable Fig. 3:

The respective equations of the model are:

$$ZA = 0.89\ ZE + 0.28 \quad (1)$$

$$ZB = 0.91\ ZE + 0.18 \quad (2)$$

$$ZC = 33\ ZF + 0.25 \quad (3)$$

$$ZD = 37\ ZF + 0.15 \quad (4)$$

Table 5, presents the results of the goodness of fit test: Comparative Fit Index (CFI) and Tucker Lewis Index (TLI), which take values of 0.901 and 0, 912 respectively, results that indicate a good fit. Finally, the Coefficient of determination was 0.921, is approaching 1 that indicates a good fit. The lower and upper limits of the statistic RMSEA are 0, 038 and 0.25 respectively, which indicates that the setting is good. These results allow us to conclude that, the SEMs model developed is properly adjusted to data and explains the phenomenon.

Table 3: Results of KMO and Bartlett's sphericity test

		ZA	ZB	ZC	ZD	ZE	ZF
Measurement of sample adequacy of Kaiser - Meyer - Olkin (KMO)		,589	,6400	,5100	,642	,600	,500
Approximate Chi square		257,125	31,832	119,521	98,526	32,452	41,541
Bartlett's sphericity test	gl	3	1	1	1	1	1
	sig	,000	,000	,000	,000	,000	,000

Source: Authors' elaboration

Table 5: Goodness of fit statistics of the estimated model

Fit statistic	Value	Description
Population error		
RMSEA	0.079	Root mean squared error of approximation
90 % CI, lower bound	0.038	
Upper bound	0.25	
p close	0.041	Probability RMSEA <= 0, 05
Information criteria		
AIC	16725.525	Akaike's information criterion
BIC	16795.241	Bayesian information criterion
Baseline comparison		
CFI	0.901	Comparative fit index
TLI	0.912	Tucker-Levis index
Size of residuals		
SRMR	0.038	Standardized root mean squared residual
CD	0.921	Coefficient of determination

Source: Authors' elaboration

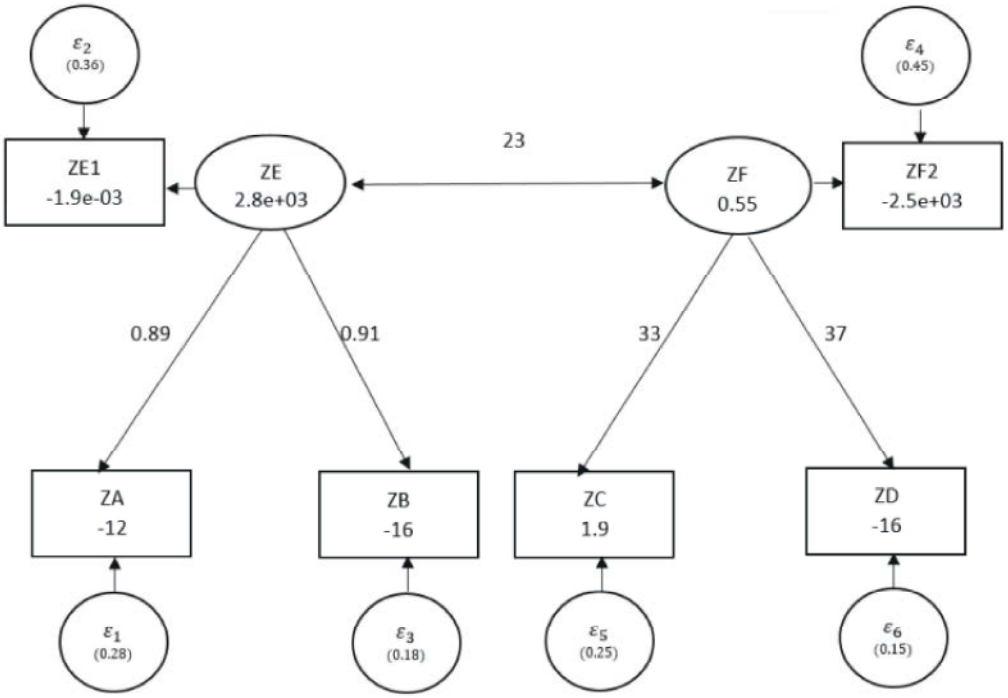

Fig. 3: SEMs– Renewable energy acceptation

All the signs of the coefficients of the slopes are positive, indicating a strong and direct correlation between the latent variables and constructs [12]. On the latent variable adaptive, the construct that has greater influence is the social behavior, whose coefficient is 0.91. For its part, the construct that affects most on the latent variable clinic is the repetitive behavior with a coefficient of 37. There is a direct relationship between the two latent variables (adaptive and clinic), which was estimated with a covariance of 39, indicating that both variables are strongly correlated.

CONCLUSIONS

The structural equation model developed allows to identify the main variables and factors that influence the ASD appearance; communication, social behavior, stereotyped behavior and repetitive behavior. The model identified a positive relationship and direct link between the four constructs and the two latent variables considered (adaptive and clinic). It has also identified a strong correlation and direct link between the two latent variables, for which an increase or decrease in any of them, will generate the same effect in the other.

REFERENCES

1. Crowell, J.A., J. Keluskar and A. Gorecki, 2019. Parenting behavior and the development of children with autism spectrum disorder. Compr. Psychiatry, 90: 21-29.
2. Lord, C., M. Elsabbagh, G. Baird and J. Veenstra-Vanderweele, 2018. Autism spectrum disorder, Lancet, 392: 508-520.
3. Urbano, M.R., C. Teal Raffaele, N.L. Kreiser, J.M. Flaherty and K. Hartmann, 2019. Clinical considerations for the inclusion of individuals with autism spectrum disorder in clinical trials, Prog. Neuro-Psychopharmacology Biol. Psychiatry, 89: 295-302.
4. Rosenblum, S., H. Amit Ben-Simhon, S. Meyer and E. Gal, 2019. Predictors of handwriting performance among children with autism spectrum disorder, Res. Autism Spectr. Disord., 60: 16-24.
5. Murray, C., H. Kovshoff, A. Brown, P. Abbott and J.A. Hadwin, 2019. Exploring the anxiety and depression profile in individuals diagnosed with an autism spectrum disorder in adulthood, Res. Autism Spectr. Disord, 58: 1-8.

6. Poleg, S., P. Golubchik, D. Offen and A. Weizman, 2019. Cannabidiol as a suggested candidate for treatment of autism spectrum disorder, Prog. Neuro-Psychopharmacology Biol. Psychiatry, 89: 90-96.
7. Charron, R., 2017. Autism Rates across the Developed World. Available from: https://www.focusforhealth.org/autism-rates-across-the-developed-world/
8. Xue, Z., G. Shen, J. Li, Q. Xu, Y. Zhang and J. Shao, 2012. Compression-aware I/O Performance Analysis for Big Data Clustering. In Proceedings of the 1st International Workshop on Big Data, Streams and Heterogeneous Source Mining: Algorithms, Systems, Programming Models and Applications, pp: 45-52.
9. Zakaria, R., N. Jaafar and S. Marican, 2012. Financial behavior and financial position: a structural equation modelling approach. Middle-East Journal of Scientific Research, 12(10): 1396-1402.
10. Chand, S., A.A. Farooqi and M.F. Munir,2013. Factor model of parenting style using exploratory and confirmatory factor analysis. Middle-East Journal of Scientific Research, 15(7): 1028-1034.
11. Filatov, E. A. and L.G. Rudykh, 2014. Factor Analysis of Financial Profitability According to the Author ' Methods, 29: 908-914.
12. Valencia Arias, A., G. Gonzalez Uribe and M. Castaneda Riascos, 2016. Structural equation model for studying the mobile-learning acceptance, IEEE Lat. Am. Trans., 14: 1988-1992.
13. Duncan, O.D. and M. Stenbeck, 1987. Are Likert scales unidimensional?, Soc. Sci. Res., 16: 245-259.
14. CAST, 2019. Childhood Autism Spectrum Test. Available from: http://espectroautista.info/CAST-es.html#P1.