Psychometric Properties of an Instrument to Assess the Barriers to Antiretroviral Treatment Adherence among the Argentinian Population

Propiedades psicométricas de un instrumento de evaluación de barreras para la adherencia al tratamiento antirretroviral en población argentina

Propriedades psicométricas de um instrumento para avaliar as barreiras à adesão ao tratamento antirretroviral na população argentina

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Abstract

Aim: To adapt and validate an existing instrument to assess the barriers to antiretroviral treatment adherence among individuals with HIV in Córdoba, Argentina. *Materials and methods:* The final sample

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population included 180 Argentinian people. The mean age of the participants was 40.61 (SD = 12.032) years and 82.8% were men. Various internal structure and reliability and validity studies with other variables were conducted on the study population (n = 180). *Results:* The results of confirmatory factor analysis were consistent with the factorial structure of the original study. However, to achieve this, items that had low factorial loads and were redundant had to be eliminated. Coefficient ω values of .833 on the Information subscale, .759 on the Motivation subscale, and .888 on the Behavioral Skills subscale were obtained. Significant correlations were determined between the results of adherence and barriers to treatment. *Conclusion:* The results suggest that the instrument can be used to assess the barriers to antiretroviral treatment adherence in Córdoba, Argentina. Although further research is warranted, these results are promising.

Keywords: Treatment adherence; HIV; Acquired immune deficiency syndrome; argentina; highly active antiretroviral therapy.

Resumen

Objetivo: adaptar y validar un instrumento para evaluar barreras a la adherencia antirretroviral en personas que conviven con el VIH en Córdoba (Argentina). *Materiales y métodos:* la muestra final incluyó 180 participantes argentinos. La media de edad fue de 40.61 (DE = 12.032) y el 82.8 % fueron hombres. Sobre la muestra (n = 180) se efectuaron estudios de estructura interna, confiabilidad y validez con otras variables. *Resultados:* el análisis factorial confirmatorio arrojó resultados congruentes con la estructura factorial del estudio original, aunque para ello fue necesario eliminar ciertos ítems que presentaban bajas cargas factoriales y que pueden ser representados por otros ítems, debido a información redundante. Se obtuvieron coeficientes ω = 0.833 en la subescala información; ω = 0.759 en la subescala motivación, y ω = 0.888 en la subescala habilidades comportamentales. Se encontraron correlaciones significativas entre los resultados de adherencia al tratamiento y barreras al tratamiento. *Conclusión:* aunque se requieren de mayores investigaciones, los resultados son promisorios, sugieren que el instrumento puede usarse para evaluar barreras de la adherencia al tratamiento antirretroviral en Córdoba.

Palabras clave: cumplimiento de la medicación; VIH; síndrome de inmunodeficiencia adquirida.

Resumo

Objetivo: adaptar e validar um instrumento de barreiras à adesão anti-retroviral em pessoas vivendo com HIV em Córdoba, Argentina. *Materiais e métodos:* A amostra final incluiu 180 participantes argentinos. A idade média era de 40,61 anos (SD = 12,032) e 82,8% eram homens. Com a amostra (n = 180) foram realizados estudos de estrutura interna, confiabilidade e validade com outras variáveis. *Resultados:* a análise fatorial confirmatória apresentou resultados adequados com a estrutura fatorial do estudo original, embora para isso tenha sido necessário eliminar alguns itens que apresentavam baixas cargas fatoriais e poderiam ser representados por outros itens devido a informações redundantes. Os coeficientes ω = 0,833 foram obtidos na subescala informação; ω = 0,759 na subescala motivação, y ω = 0,888 na subescala competências comportamentais. Correlações significativas foram encontradas entre os resultados do adherencia al tratamiento e do barreiras à adesão ao tratamento. *Conclusão:* embora mais pesquisas sejam necessárias, os resultados são promissores, sugerindo que o instrumento pode ser usado para avaliar as barreiras à adesão ao tratamento anti-retroviral em Córdoba, Argentina.

Palavras-chave: adesão a medicamentos; HIV; síndrome da imunodeficiência adquirida.

Introduction

Recently, treatment of HIV infection has shown remarkable progress. In the 1990s, a combination of drugs exhibiting a high capacity to suppress viral loads was discovered. Reverse transcriptase inhibitors along with protease inhibitors comprise what is now called highly active antiretroviral therapy (HAART). HAART can reduce the viral count to undetectable levels, thus improving the functioning of the immune system, preventing transmissibility, and reducing morbidity and mortality (1–3). However, achieving these effects requires a treatment adherence level of close to 90%–95% (4); therefore, optimal level of treatment adherence is a required to achieve undetectable viral load, which was one of UNAIDS's 90-90-90 goal (5).

A meta-analysis reveal that approximately 60%–70% of patients undergoing treatment in different countries (6) show this level of treatment compliance, particularly those in Latin America and the Caribbean (7). Owing to the problems that may arise from poor treatment adherence, such adherence is one of the main challenges associated with the treatment of HIV infection today. Notably, inadequate adherence can lead to the development of strains that are resistant to the most effective treatment available to date (1). Furthermore, risk behaviors (e.g., sexual intercourse without a condom) expose uninfected individuals to these strains and those with HIV to re-infection, thus limiting treatment options and worsening the situation (1,3).

Different techniques have been proposed to address the lack of long-term treatment adherence, including the Information, Motivation, and Behavioral (IMB) skills model (8). This concept differs from others as it was designed specifically for HIV-infected individuals. The IMB model allows the identification of key intervening factors that can help evaluate and understand the problems associated with HAART adherence as well as determine the target variables to design interventional strategies.

The IMB model uses a simple and dynamic scheme that links different factors that influence HAART adherence. It specifically states that if a person with HIV has enough information about items, including regime and side effects, and the necessary motivation to undergo successful treatment (favorable attitudes towards adherence and perception of social support), then they will put specific behavioral skills into practice to achieve treatment adherence, such as through acquiring the drugs and including the regimen in their daily routine. These skills will result in treatment adherence behavior (8).

The Information factor here refers to aspects including the dose, how and when to take the medication, side effects, degree of treatment adherence required, and interactions with other drugs (9). Different studies have highlighted the impact of this factor on adherence to antiretroviral treatment (10–15).

The individual's attitude towards treatment adherence and perceived social support are included in the Motivation factor. In this sense, Wasti et al. state that not informing

others about their diagnosis increases the probability of non-adherence to treatment (15). Several studies support this hypothesis for antiretroviral treatment as well as for treatment in general (10,13,14,16,17).

Other studies consider Information and Motivation as independent factors that play important roles in preventive behaviors that improve the health status (18), with Information being mandatory for treatment adherence (9).

Behavioral skills in the IMB model include the individual's specific abilities to be adherent and the self-efficacy for all actions related to treatment adherence (9). Several studies refer to the relationship between specific behavioral skills, perceived self-efficacy, and adherence to HAART (10,14,19,20).

To assess the barriers to treatment adherence, an instrument was developed within the framework of the IMB model called the "Life Windows – Information, Motivation, Behavioral Skills–Antiretroviral Treatment Adherence Questionnaire" (LW-IMB-AAQ) (21). This model has been used in different countries including India (22), Romania (23), South Africa (24), and Ethiopia (25). The use of the Motivation subscale has been reported in Argentina as well (26). However, many of these studies do not report the adaptation and validation of the instrument for local use. The original study underestimates the cultural differences that can affect not only the validity of the instrument but also that of the theoretical model; therefore, psychometric investigations of the model have been conducted in populations other than that of the original study (27).

One of the LW-IMB-AAQ adaptation studies was conducted by Peng et al. for application in Shanghai (4). The authors proposed a structure with three sections that corresponded to the three subscales of the original instrument based on the confirmatory factor analysis but with two subscales in each of these sections. Items 1 and 4 of the motivation subscale were eliminated for the model to yield acceptable fit indices. The reliability values (α) were .84 for Information, .81 for Motivation, and .91 for Behavioral Skills.

The psychometric properties of the LW-IMB-AAQ were assessed in another study (28). Exploratory factorial analysis was conducted with a varimax rotation where the original factorial structure was replicated. Further, validity in terms of other variables whose oblique factors were related to measures of treatment adherence was evaluated. Although it is important to acknowledge this effort, it should be noted that there are some limitations to the procedures. Confirmatory factor analysis is currently recommended when starting from a delimited structure (29). Furthermore, varimax rotation assumes that the factors are orthogonal, a condition that is not met in the LW-IMB-AAQ. Therefore, in this case, the use of oblique rotations is suggested as they are more in line with the representation of the constructs studied in psychology (30).

A literature review revealed that no instruments for measuring antiretroviral treatment adherence and/or factors related to it that have been developed, adapted, and/or validated

in Argentina. A questionnaire to evaluate the possible drawbacks in adherence with the appropriate properties and technical requirements is needed to address the challenges posed by the current HIV epidemic (14,13,31). Therefore, this study aimed to validate the instrument for the application in the Argentinian population.

Materials and methods

The sample population comprised 190 people with HIV selected using the nonrandom accidental type who were undergoing antiretroviral treatment at the Córdoba province, Argentina. Ten people were excluded from the study because of missing data, thus exceeding the criteria suggested for the data imputation process (32). The final sample population included 180 people. The mean age of the participants was 40.61 (SD = 12.032) years and 82.8% were men. Regarding ongoing medication, 81% stated that they complied with the schedules but 60% stated that they sometimes forgot.

We included patients aged >18 years who were undergoing antiretroviral treatment and provided their informed consent in compliance with the ethical aspects listed in the Declaration of Helsinki (33). The project was endorsed by the Research Ethics Committee of the College of Psychologists of the Province of Córdoba (File No. 3678).

Two main instruments were used: a self-reported adherence questionnaire and the instrument to be adapted. Data collection was conducted using a questionnaire on sociodemographic variables and others topics related to the positive diagnosis of HIV as a control.

The questionnaire on sociodemographic and other variables was developed ad hoc and it included questions about gender, age, occupation, date of HIV diagnosis, the person(s) the patient lives with, level of education attained, how they found out about the diagnosis, how many people they told about their diagnosis, and their relationship with those individuals.

The Simplified Medication Adherence Questionnaire (SMAQ) (34) was used to asses treatment adherence. The structure of this test is unidimensional and it comprised six items, five with a dichotomous response option and one graded option. Questions were about compliance or noncompliance to drug intake according to the schedule determined for the patient during the past 3 months, the last weekend, and the last week. Forgetfulness, carelessness with the times of the shots, and differential behavior due to discomfort are also explored. This instrument was previously used in a study on an Argentinian population with HIV whose results reported that its validity and reliability were adequate (35).

The LW-IMB-AAQ test comprises 33 items grouped into three subscales: Information, Motivation, and Behavioral skills. The first includes 9 items, the second includes 10 items, and the third includes 14. The psychometric properties are reported together with the publication of the original version of the instrument. The Information subscale had a low index ($\alpha = .59$) of inter-

nal consistency, which was expected because the items were intended to consider aspects of the treatment that were not interrelated. Reliability indices (α) of .70 and .75 were found for the Motivation subscale. Finally, the Behavioral Skills subscale presented reliability indices of .90 in all except the first item (21). A Spanish version was provided by Amico (personal communication, November 16, 2016).

The methodological design of this study meets the criteria established by Montero and León for instrumental studies (36). Participants were invited to participate and informed about the attendance policy for patients regarding the medical appointments of the institution and private offices. Questionnaires were provided after they expressed their agreement and signed the informed consent form. The data were then systematized for the corresponding analyses and tests.

A confirmatory factor analysis was conducted using the MPLUS v.7 program, for the evidence of validity of the internal structure through the weighted least squares means and variance adjusted as a parameter estimation method (36,38). It is more precise when assessing ordinal variables with distributions that do not approach normality and with small samples (39-41); factor loads greater than .40 were considered acceptable (42). The adjustment of the measurement model was assessed following the recommendations of Hu and Bentler, Steiger and DiStefano, Liu, Jiang and Shi where CFI values ≥ .95, RMSEA ≤ .07, TLI ≥ .95, WRMR ≤ .90, are considered as indicators of acceptable fit (43-45). Transverse to this entire process, the modification indices were also analyzed where values >.20 of the Expected Unstandardized Parameter Change (EPC) indicated specifications that had to be performed in the evaluated model (46,47).

The structural hypothesis initially suggested by the original authors of the instrument was analyzed. According to this model (M1), the 33 items can be grouped into three oblique factors (M1). New models (M2 and M3) were proposed based on the previous one, with the purpose of improving the fit of the measurement model.

The reliability of the scores was then estimated using the omega coefficient (ω) and the correction for correlated errors (ω´), according to the recommendations of Gadermann et al., and Greco et al. (48-52) for interpretation.

We finally sought to provide evidence of validity regarding the other variables. Specifically, a concurrent validity analysis was conducted with the aim of analyzing the relationship between treatment adherence (total SMAQ score) and the three subscales of the LW-IMB-AAQ using linear regression analysis. Statistically significant relationships can be expected based on previous studies (53).

Results

Descriptive analysis of the data was conducted first. As shown in Table 1, 27% of the items have asymmetry and kurtosis values >±2, suggesting that the data does not approximate a normal distribution (42,54).

Table 1. Descriptive analysis of the LW-IMB-AAQ items

	M	SD	Asymmetry	Kurtosis
I1	3.55	1.019	−2.282	4.763
I2	3.37	1.206	−1.911	2.397
I3	1.75	1.654	0.216	−1.611
I4	3.32	1.238	−1.761	1.783
I5	0.43	1.018	2.337	4.263
I6	3.16	1.259	−1.518	1.243
I7	3.36	1.146	−1.852	2.471
I8	3.59	0.855	−2.425	6.068
I9	3.02	1.338	−1.207	0.202
M1	2.63	1.427	−0.685	−0.768
M2	1.71	1.577	0.183	−1.522
M3	0.95	1.389	1.059	−0.396
M4	3.76	0.744	−3.694	14.267
M5	3.48	1.038	−2.015	3.296
M6	0.76	1.493	1.591	0.701
M7	1.60	1.528	0.241	−1.476
M8	1.80	1.565	0.018	−1.605
M9	1.50	1.565	0.378	−1.465
M10	1.93	1.531	−0.030	−1.485
B1	2.17	1.291	−0.066	3.098
B2	3.38	0.079	−1.314	0.983
B3	3.28	1.047	−1.314	0.983
B4	3.07	1.164	−1.053	0.032
B5	3.36	0.909	−1.258	0.714
B6	2.48	1.228	−0.220	−0.846
B7	3.40	0.993	−1.677	1.988
B8	3.08	1.086	−0.768	−0.620
B9	3.17	1.201	−1.326	−0.641
B10	2.36	1.372	−0.123	−1.376

Continue

	M	SD	Asymmetry	Kurtosis
B11	3.05	1.202	−0.934	−0.278
B12	3.56	0.871	−1.788	2.092
B13	3.16	1.093	−0.948	−0.261
B14	3.69	0.712	−2.595	7.002

Further, the fit of the measurement model was assessed. Unacceptable fit indices were obtained for the original model (M1), which were items with factor loads of <.40 and EPC values that suggested adding specifications between the items of the three oblique factors. Considering this, a review was performed based on the content of the items where potentially overlapping reagents were identified. Accordingly, items 3 and 5 (Information), 2, 4, 5, 6, 8, and 9 (Motivation), and 1, 3, and 4 (Behavioral Skills) were removed from this process.

Although the fit indices improve for M2, they do not optimally meet the criteria mentioned in the literature. Furthermore, there are still EPC values >.20 that are related to the correlations between items that can be considered to be under parameterization. As a result, items 2 and 13 (Behavioral Skills) were removed as well.

Finally, for M3, a model of three oblique factors with acceptable fit indices was observed, with factor loads >.40 and without specifications to add or remove from the proposed model (EPC < .20) (Table 2).

Table 2. Confirmatory factor analysis, interfactorial correlations, and adjustment indices of the structural hypotheses

	M1				M2				M3			
	F1	F2	F3	R^2	F1	F2	F3	R^2	F1	F2	F3	R^2
I1	.737			.544	.746			.556	.751			.563
I2	.752			.566	.792			.628	.789			.662
I3	−.174			.030	-			-	-			-
I4	.545			.298	.599			.359	.613			.376
I5	.313			.098	-			-	-			-
I6	.643			.413	.642			.413	.619			.383
I7	.505			.255	.557			.310	.558			.312
I8	.581			.338	.593			.351	.598			.358
I9	.572			.327	.570			.325	.575			.331
M1		.476		.227		.553		.305		.569		.324
M2		.752		.565		-		-		-		-
M3		.700		.490		.762		.580		.765		.585
M4		-.339		.115		-		-		-		-
M5		-.277		.077		-		-		-		-

Continue

	M1				M2				M3			
	F1	F2	F3	R^2	F1	F2	F3	R^2	F1	F2	F3	R^2
M6		.367		.135		-		-		-		-
M7		.820		.673		.776		.602		.762		.581
M8		.722		.521		-		-		-		-
M9		.722		.521		-		-		-		-
M10		.743		.552		.548		.300		.547		.299
B1			.205	.042			-	-			-	-
B2			.447	.200			.446	.199			-	-
B3			.333	.111			-	-			-	-
B4			.286	.082			-	-			-	-
B5			.502	.252			.500	.250			.518	.269
B6			.502	.252			.492	.242			.505	.255
B7			.733	.538			.739	.546			.761	.580
B8			.572	.327			.575	.330			.590	.348
B9			.843	.710			.848	.719			.881	.776
B10			.714	.510			.703	.494			.734	.539
B11			.831	.691			.838	.702			.770	.593
B12			.847	.717			.851	.725			.790	.624
B13			.841	.707			.848	.719			-	-
B14			.600	.360			.859	.347			.576	.332
F1	1				1				1			
F2	−.256	1			−.126	1			-.124	1		
F3	.389	-.558	1		.321	−.629	1		.299	-.657	1	
cfi			.862		.946				.956			
tli			.852		.939				.950			
RMSEA (90%)	.063 (.055–.070)				.055 (.043–.067)				.047 (.032–.061)			
wrmr	1.271				.977				.888			

F1 = Information; F2 = Motivation; F3 = Behavioral skills.

Third, the internal consistency was analyzed considering the different models. The reliability of the M1 scores were as follows: ω_{F1} = .765/ω'_{F1} = .757; ω_{F2} = .781/ω'_{F2} = .702 and ω_{F3} = .889/ω'_{F3} = .886; for model M2: ω_{F1} = .832/ω'_{F1} = .767; ω_{F2} = .759 and ω_{F3} = .917/ω'_{F3} = .873; and for model M3: ω_{F1} = .833; ω_{F2} = .759 and ω_{F3} = .888. In all cases, it can be inferred that the values are acceptable.

As a last step, evidence on the validity in terms of other variables was collected. As shown in Table 3, there is a statistically significant relationship between the scores of the Information and Behavior subdimensions of the LW-IMB-AAQ with treatment adherence. The evaluated model

presents a value of R^2 = .134, which is considered mid-level (53). The Motivation subdimension did not provide statistically significant values.

Table 3. Linear regression analysis between treatment adherence and subscales of the LW-IMB-AAQ

	B	β	t	r_s
Information	.032	.179*	2.48	.602
Motivation	.018	.082	0.995	.596
Behavior	.035	.246*	2.952	.85

β = beta coefficient; r_s = coefficient of determination.

Discussion

The objective of this study was to evaluate the psychometric properties of the LW-IMB-AAQ in a sample population including individuals diagnosed with HIV in Córdoba, Argentina. This study was needed in the absence of other studies, specifically those on the internal structure validity, relationship with other variables, and analysis of the reliability of the scores. All this was performed as per the recommendations of the Standards for Educational and Psychological Testing (55). The final version of the instrument included 20 items in the Information, Motivation, and Behavioral Skills subscales, with significant associations with treatment adherence and acceptable reliability results for application in the Argentinian population.

The results indicated that the original factorial structure is not replicated in terms of the evidence of validity of the internal structure. There were specifications in M1 that suggested adding relationship parameters between items, allowing us to infer a possible factorial complexity because of the poorly differentiated factorial loads of some items and because there were high interfactorial correlations between the Motivation and Behavioral Skills subscales (43,56). This evidence is supported by the high correlations between the same subscales by Santillán-Torres-Torrija et al. (28). For this reason, in view of the previous issues and the representation of the construct through the theoretically proposed components, we decided to remove items with redundant content and low factor loading so we could obtain a robust version of three oblique factors that continues to represent what was proposed by Fisher et al. (9).

The working hypothesis was that the subscales measured through the SMAQ are important predictors of treatment adherence for the evidence of validity regarding other variables of the final version of the LW-IMB-AAQ. The results of the linear regression analysis indicated that the factors of Information and Behavioral Skills are the most important predictors of

the variance associated with taking medications. However, when analyzing the proportion of variance predicted by each factor, this is considered high for all subscales. This result is consistent with that reported by Fisher et al., who suggest that information is a necessary condition and the most important factor for engaging in behaviors involved in treatment adherence (9). Another reason for this is that there are people who have the information but low levels of motivation and vice versa (18). This result is consistent with those obtained by Botempi et al., Miller et al., Jones et al., Varela-Arévalo et al., Wasti et al., Simoni et al., Horvath et al., Ladero-Martín et al., and Fisher et al. (9-12,14-16,19,20).

The evaluated models can be considered acceptable according to the standards of Gadermann et al. and Greco et al. in terms of score reliability (51,52). However, there is a difference between the values of the omega coefficient and the correction for correlated errors as it has been reported that the under-parameterization of correlated errors in statistical models causes reliability to be a biased estimator (57). One of the causes is the presence of redundant items, as seen in the case of the LW-IMB-AAQ, and can lead false positives and false negatives that have a possible direct effect on decision making (58-60). These values suggest that the LW-IMB-AAQ can be applied for group description purposes and not for individual decision-making considering that values around .90 are needed in the three subscales.

In short, the findings of this study coincide with that of the original study in terms of factors as well as internal structure (21). The factorial structure confirms the presence of three main factors, coinciding with the Information, Motivation, and Behavioral Skills subscales, which was also reported by Santillán-Torres-Torrija et al. (28). After removing two items, Peng et al. (4) identified three sections that coincide with the abovementioned factors but with two subscales each. Moreover, the analysis of the internal consistency of the subscales also yielded acceptable values both in this study and in the research by Peng et al. (4). However, in the original study and in the one conducted by Santillán-Torres-Torrija et al. the Information subscale showed a α of .70 (21,28).

There are certain limitations to this study. The sample mainly comprised patients from the same institution, and the majority included patients who adhered to treatment; this could influence the results of the study. Therefore, future studies should include sample populations including participants from both public and private health institutions. Likewise, we recommend increasing the number of cases to obtain greater variability and to conduct more complex analyses, such as structural equations.

This is an initial study on LW-IMB-AAQ; therefore, we recommend evaluating the factor structure through confirmatory analysis of measurement invariance to corroborate its equivalence in different populations, thus contributing to the generalization of its use. This is especially considering that the removal of the items in the final structure of this version of the instrument should be confirmed with other samples for consolidation (61).

In conclusion, this research constitutes a significant theoretical and practical contribution to the approximation of adherence to antiretroviral treatment, because information was obtained on the best representation of the constitutive definition of the construct among the Argentinian population, and because this study can be a precedent for the LW-IMB-AAQ to be most widely supported, and to be used by health professionals as evidence for the design of specific intervention strategies.

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Author contributions

Elena Lucía Colasanti was responsible for conceptualization, data curation, formal analysis (statistical techniques, data analysis), fundraising, the research process, design and development of the methodology, project administration (management and coordination), software (programming, design and implementation), drafting of the document, and its subsequent revision and edition. Jhonatan Navarro-Loli worked on data curation, formal analysis (statistical techniques, data analysis), design and development of the methodology, data visualization and presentation, document writing, and review and editing. Marcos Marino performed the conceptualization, research process, project administration (management and coordination), software (programming, design and implementation), and review and edition of the text. Leonardo Adrián Medrano worked on the conceptualization, data curation, formal analysis (statistical techniques, data analysis), the research process, design and development of the methodology, project administration (management and coordination), drafting of the document, and its revision and edition.

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Conflicts of interest

None declared.

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