

Validation of the *Adherencia-CCV* questionnaire for postoperative follow-up in cardiovascular surgery

Validación del cuestionario *Adherencia-CCV* para el seguimiento posoperatorio en cirugía cardiovascular

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ABSTRACT:

Introduction: Adherence to medication, cardiac rehabilitation and healthy lifestyle behaviors is essential for medium- and long-term survival after cardiac surgery; however, there is no standardized instrument that integrates these three domains.

Objectives: To validate the *Adherencia-CCV* questionnaire for the classification of adherence to medication, cardiac rehabilitation, and healthy lifestyle behaviors in patients after cardiac surgery.

Method: An instrumental study was conducted in three phases: development of a nine-item questionnaire, content validation by eight expert judges and a psychometric study involving 212 patients at a tertiary-care hospital in Cuba. Construct validity was assessed using exploratory factor analysis (EFA), and internal consistency was evaluated. Clinical criteria for domain-specific and overall classification were established, and a hybrid scoring approach was developed.

Results: In the content validation the indicators were as follows: overall content validity index = 0.94, Kendall's W = 0.92 and intraclass correlation coefficient = 0.94. The EFA (Kaiser-Meyer-Olkin = 0.75, Bartlett's test, $p < 0.001$) identified a three-dimensional structure explaining 36.8% of the variance. Internal consistency by domain (medication: $\alpha = 0.80$, rehabilitation: $\alpha = 0.19$, lifestyle: $\alpha = 0.15$) supported a hybrid approach consisting of a composite score for medication adherence and a behavioral profile for the other domains. Overall adherence was 11.3%.

Conclusions: The *Adherencia-CCV* questionnaire is a valid and standardized instrument for classifying adherence. Its hybrid approach enables overall quantification of medication adherence while identifying specific behavioral deficits.

Keywords: Questionnaires, Medication Adherence, Lifestyle, Validation Study, Cardiovascular Surgical Procedures, Cardiac Rehabilitation.

RESUMEN

Introducción: La adherencia a la medicación, a la rehabilitación cardíaca y a los estilos de vida saludables son claves para la supervivencia a mediano y largo plazo tras la cirugía cardíaca, pero no existe un instrumento estandarizado que integre los tres dominios. **Objetivos:** Validar el cuestionario *Adherencia-CCV* para

la clasificación de la adherencia terapéutica, rehabilitación cardíaca y estilos de vida en el seguimiento posoperatorio en cirugía cardiovascular. Método: Estudio instrumental en tres fases: construcción del cuestionario, validación del contenido por juicio de expertos y estudio psicométrico en 212 pacientes de un hospital terciario cubano. Se evaluó validez de constructo y consistencia interna. Se definieron criterios clínicos de clasificación por dominio y global, y se diseñó un enfoque híbrido de puntuación. Resultados: En la validación de contenido, se obtuvo un índice de validez global de 0,94; W de Kendall en 0,92; y coeficiente de correlación intraclase de 0,94. La validez del constructo mediante el análisis factorial exploratorio identificó una estructura tridimensional que explicó el 36,8 % de la varianza. La consistencia interna por dominio (medicación: $\alpha = 0,80$; rehabilitación: $\alpha = 0,19$; estilo de vida: $\alpha = 0,15$) justificó un enfoque híbrido: puntuación compuesta para medicación y perfil de conductas para los otros dominios. La adherencia global fue del 11,3 %. Conclusiones: El cuestionario Adherencia-CCV es un instrumento válido y estandarizado para clasificar la adherencia. Su enfoque híbrido permite la cuantificación global de la adherencia farmacológica y la identificación de déficits conductuales específicos.

Palabras clave: Cuestionarios; Cumplimiento de la medicación; Estilo de vida; Estudio de validación; Procedimientos quirúrgicos cardiovasculares; Rehabilitación cardíaca.

INTRODUCCIÓN

Cardiac surgery encompasses a range of technically complex procedures that provide substantial benefits in contemporary medicine. Nevertheless, long-term outcomes depend not only on surgical expertise and perioperative care but, fundamentally, on patients' adherence to three essential pillars: prescribed medication, participation in cardiac rehabilitation programs and adoption of healthy lifestyle behaviors.¹⁻³

Therapeutic adherence, classically defined by the World Health Organization as the extent to which a person's behavior corresponds to the recommendations agreed upon with a healthcare professional,⁴ is a complex and multidimensional construct. Over the past decades, the concept has evolved toward a more dynamic approach that emphasizes collaboration and the therapeutic alliance as central elements in treatment continuity.

Several studies have shown that nonadherence among patients recovering from cardiac surgery is common and is associated with an increased risk of recurrent cardiovascular events, hospital readmissions, and mortality.⁴ Cardiac rehabilitation, in particular, has been shown to reduce mortality and hospital readmissions in postsurgical patients; however, participation and adherence rates in these programs remain notably low, making this domain a priority for assessment.

However, most available measurement instruments focus exclusively on medication adherence, such as the Simplified Medication Adher-

ence Questionnaire (SMAQ)⁵ or the Morisky-Green test.⁶ Questionnaires are available to assess adherence to cardiac rehabilitation^{7,8} or lifestyle change,⁹ but none integrates all three domains into a single brief instrument specifically designed for patients undergoing cardiac surgery and capable of classifying overall adherence.

The brevity of the instrument is essential in the postoperative follow-up setting, where available consultation time is limited and patient fatigue—both physical and cognitive—may compromise the quality of the answers when lengthy assessment batteries are presented. It is precisely during this follow-up visit that the questionnaire is applied; therefore, adherence to healthy lifestyle behaviors should be understood not only as compliance with general recommendations but also as systematic participation in cardiac rehabilitation programs, a key behavioral component that the instrument should capture. A brief instrument also facilitates its implementation as a systematic screening tool in outpatient follow-up programs. In the Cuban context, although the Martín-Bayarre-Grau (MBG) questionnaire is widely used to assess adherence in patients with arterial hypertension, it focuses on the pharmacological domain and does not address rehabilitation or lifestyle behaviors. Its unidimensional approach, although valid for its target population, limits its applicability to patients who have undergone cardiac surgery, in whom these three domains are interdependent and determi-

nant for prognosis. Beyond this limitation, the particular characteristics of the Cuban healthcare system —where primary care and family medicine serve as the main pillars of outpatient follow-up— require instruments that can be applied rapidly and integrated into routine consultations without requiring additional personnel for scoring and interpretation. These conditions support the development of an instrument specifically designed for the Cuban population rather than merely adapting international tools cross-culturally, as their items may not adequately reflect local contextual realities. Therefore, the objective of this study was to develop the *Adherencia-CCV* Questionnaire, a standardized instrument that enables patients following cardiac surgery to be classified as adherent or nonadherent across the three domains, with the ultimate goal of facilitating referral for personalized counseling and contributing to improved long-term survival.

METHOD

Study Design and Phases

An instrumental study for questionnaire development and psychometric validation was conducted in three phases: questionnaire development, content validation through expert judgment, and a field study for psychometric validation. The study was approved by the institution's Ethics Committee and conducted in accordance with the Declaration of Helsinki.¹¹ All participants provided written informed consent.

Phase 1: Questionnaire Development

Questionnaire development was based on the logical structure of the SMAQ.⁵ This instrument assesses forgetfulness, omissions, discontinuation due to improvement or worsening, frequency of adherence, and omission on the previous day. Its questions were adapted to the three domains of interest —medication, cardiac rehabilitation and healthy lifestyle behaviors— while maintaining the same answer's structure to ensure the instrument's formal homogeneity. Initially, twelve items were drafted and distributed across three domains, with four items per domain. The domains and initial item wording were agreed upon by a working group comprising two cardiovascular surgeons, two cardiologists, one rehabilitation specialist and one methodologist. None of the members received monetary compensation for their participation.

Phase 2: Content Validation Through Experts Judgment

Eight experts were selected, each with at least five years of experience in their respective fields: four clinical cardiologists, two cardiac rehabilitation specialists and two methodologists with experience in the validation of health-

related instruments. All experts were actively engaged in clinical practice or research in the field of cardiology.

The experts evaluated the clarity, relevance and representativeness of each item using a 5-point likert-type scale (1 = "strongly disagree" to 5 = "strongly agree"), along with open-ended questions for suggestions for improvement. None of the members received monetary compensation for their participation.

The content validity index (CVI) was calculated for each item and for the questionnaire as a whole. Kendall's coefficient of concordance (W) was calculated with a 95% confidence level ($\alpha = 0.05$) to test the null hypothesis of no agreement among the judges. H_0 was rejected when $p \leq \alpha$, assuming the presence of agreement. The degree of agreement was interpreted according to established ranges ($W < 0.1$, very weak; $W \geq 0.9$, unusually high). Additionally, the intraclass correlation coefficient (ICC) was calculated using a two-way mixed-effects model for absolute agreement and interpreted according to the criteria proposed by Koo and Li.¹² An overall $CVI \geq 0.80$ and Kendall's $W \geq 0.70$ were considered acceptable.

Based on the experts' suggestions from the first round, the items were redesigned and submitted to a second round of evaluation by the same eight judges. During the second round, the CVI, Kendall's W, and ICC were recalculated to assess improvement in agreement. The perceived-change items (I7, I8, and I9) showed low correlation with the current-behavior items during the experts' evaluation and were therefore excluded from the final version, resulting in a nine-item questionnaire for the psychometric phase.

Phase 3: Field Study for Psychometric Validation

Participants and Sampling:

A non-probability consecutive sampling method was used, whereby all patients who met the inclusion criteria during the recruitment period were selected. This method was chosen because of its feasibility in the hospital setting and its ability to obtain a sample representative of the population attending the follow-up visit under real conditions.

All patients who had undergone cardiac surgery and attended the follow-up visit at *Hospital Provincial Universitario Cardiocentro Ernesto Guevara* between January and June 2025 were included.

The inclusion criteria were age ≥ 18 years and sufficient cognitive capacity to understand and answer to the questionnaire. Patients with major neurological complications that prevented them from understanding the questionnaire or

those who did not provide informed consent were excluded.

Sample Size

Based on the nine final items and allowing for an additional 20% to account for potential losses, a minimum sample size of 108 patients was estimated.

Application Procedure

The questionnaire was self-applied using an electronic form designed in Google Forms. Patients accessed the form through a link sent to their mobile devices during the follow-up visit. For patients who did not have a mobile device or Internet access, the option of completing the questionnaire in paper-and-pencil format during the same visit was provided, under the supervision of a trained researcher who did not interfere with their answers. This approach was chosen to ensure answers anonymity, reduce social desirability bias, and facilitate data collection and management.

Statistical Analysis

Statistical analyses were performed using Rstudio. Cronbach's alpha was calculated to assess internal consistency, with $\alpha \geq 0.70$ considered acceptable. The EFA was conducted using the maximum likelihood method with Varimax rotation and a Pearson's correlation coefficient. Sampling adequacy was assessed using the Kaiser-Meyer-Olkin (KMO) measure ($KMO \geq 0.70$) and Bartlett's test of sphericity ($p < 0.05$).

Adherence Classification

Cutoff points for classifying adherence in each domain were established by clinical consensus, based on clinical practice guidelines and the literature on adherence among patients who have undergone cardiac surgery. For the medication domain, patients were considered adherent if they met all criteria within the domain. For the rehabilitation domain, patients who answered "Not applicable" to items I3, I4 or I8 were excluded from the analysis of that specific domain but were maintained in the overall adherence analysis. Overall adherence was defined as simultaneous fulfillment of all domains applicable to the patient. A patient without prescribed rehabilitation could be classified as globally adherent if he or she met the criteria for the medication and lifestyle domains.

RESULTS

The validation process is summarized in Figure 1. The results obtained in each phase are presented below.

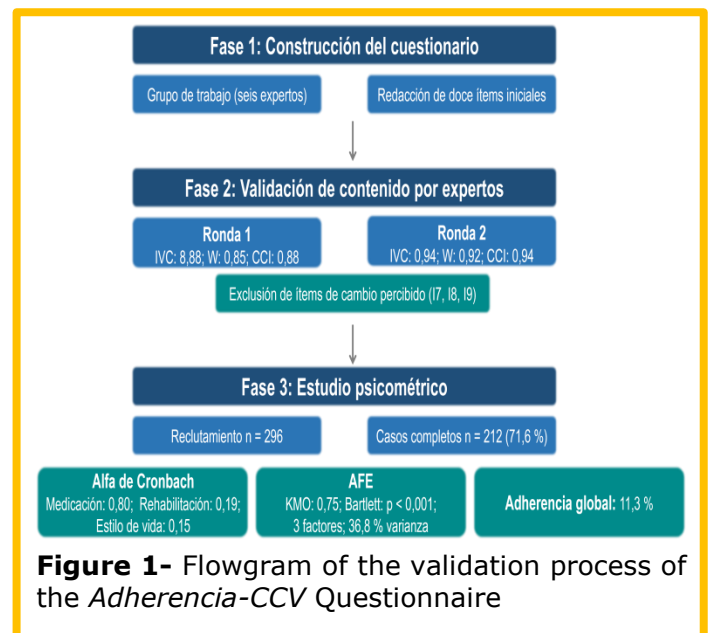


Figure 1- Flowgram of the validation process of the *Adherencia-CCV* Questionnaire

Phase 2

The first round of experts' evaluation yielded a Kendall's W of 0.85 ($p < 0.001$) and an ICC of 0.88 (95% CI: 0.79–0.94), indicating very high agreement and good reliability. After the second round, Kendall's W increased to 0.92 ($p < 0.001$), and the ICC increased to 0.94 (95% CI: 0.89–0.97), indicating unusually high agreement and excellent reliability. The overall CVI was 0.94 (item range: 0.74–1.00). Items I3 and I4 had the lowest CVI values (0.74 each), although both exceeded the established cutoff point of 0.70. The experts' suggestions for these items were incorporated into the final version by adding the phrase "without a justified reason" to item I3. The perceived-change items (I7, I8 and I9 in the initial version) showed low correlation with the current-behavior items and were excluded from the final version.

($\alpha = 0.19$) y estilo de vida ($\alpha = 0.15$) presentaron alfas muy bajos, lo que confirmó la Fase 3

Of the 296 patients recruited, 212 (71.6%) completed all items. The mean age was 64.2 ± 9.7 years and 64.2% ($n = 136$) were men. Regarding the type of surgery, 58.0% underwent valve replacement and 38.7% underwent coronary artery bypass grafting.

Table 1 presents the results of the descriptive analysis of the nine final items. Table 2 presents the alpha coefficients by domain. The medication domain showed an excellent internal consistency ($\alpha = 0.80$). The rehabilitation ($\alpha = 0.19$) and lifestyle ($\alpha = 0.15$) domains showed very low alpha coefficients, confirming the multidimensionality of these constructs and supporting the use of individual indicators for classification.

Table 1. Descriptive statistics of the *Adherencia-CCV* Questionnaire items (n=212)

Ítem	Mean	SD	Median	Range	Asymmetry	Kurtosis
I1	0,49	0,80	0	0-3	1,50	1,25
I2	0,36	0,48	0	0-1	0,56	-1,69
I3	0,48	0,83	0	0-4	1,85	3,13
I4	0,26	0,44	0	0-1	1,09	-0,82
I5	3,13	1,88	3	0-7	0,16	-0,77
I6	2,65	1,01	3	0-4	-0,48	-0,44
I7	0,66	0,97	0	0-3	1,21	0,14
I8	0,63	0,48	1	0-1	-0,54	-1,71
I9	2,50	1,10	3	0-4	-0,52	-0,32

SD: standard deviation.

Table 2. Internal consistency by domain

Domain	Ítems	Cronbach 's Alfa (raw)	Standarized Alfa
Medication	I1, I2, I7	0,80	0,83
Rehabilitation	I3, I4, I8	0,19	0,22
Lifestyle	I5, I6, I9	0,15	0,14

Table 3 Factor loadings of EFA (Varimax rotation)

Ítem	Factor 1	Factor 2	Factor 3	Comunality
I1	0,70	0,56	0,44	0,93
I2	0,65	—	—	0,42
I7	0,91	0,33	—	0,94
I3	—	0,60	—	0,36
I4	—	0,38	—	0,14
I6	-0,31	—	—	0,10
I5	—	—	—	—
I8	—	—	—	—
I9	—	—	—	—
Self-value	1,99	0,96	0,36	
Variance %	22,1	10,7	4,0	
Acummulated %	22,1	32,7	36,8	

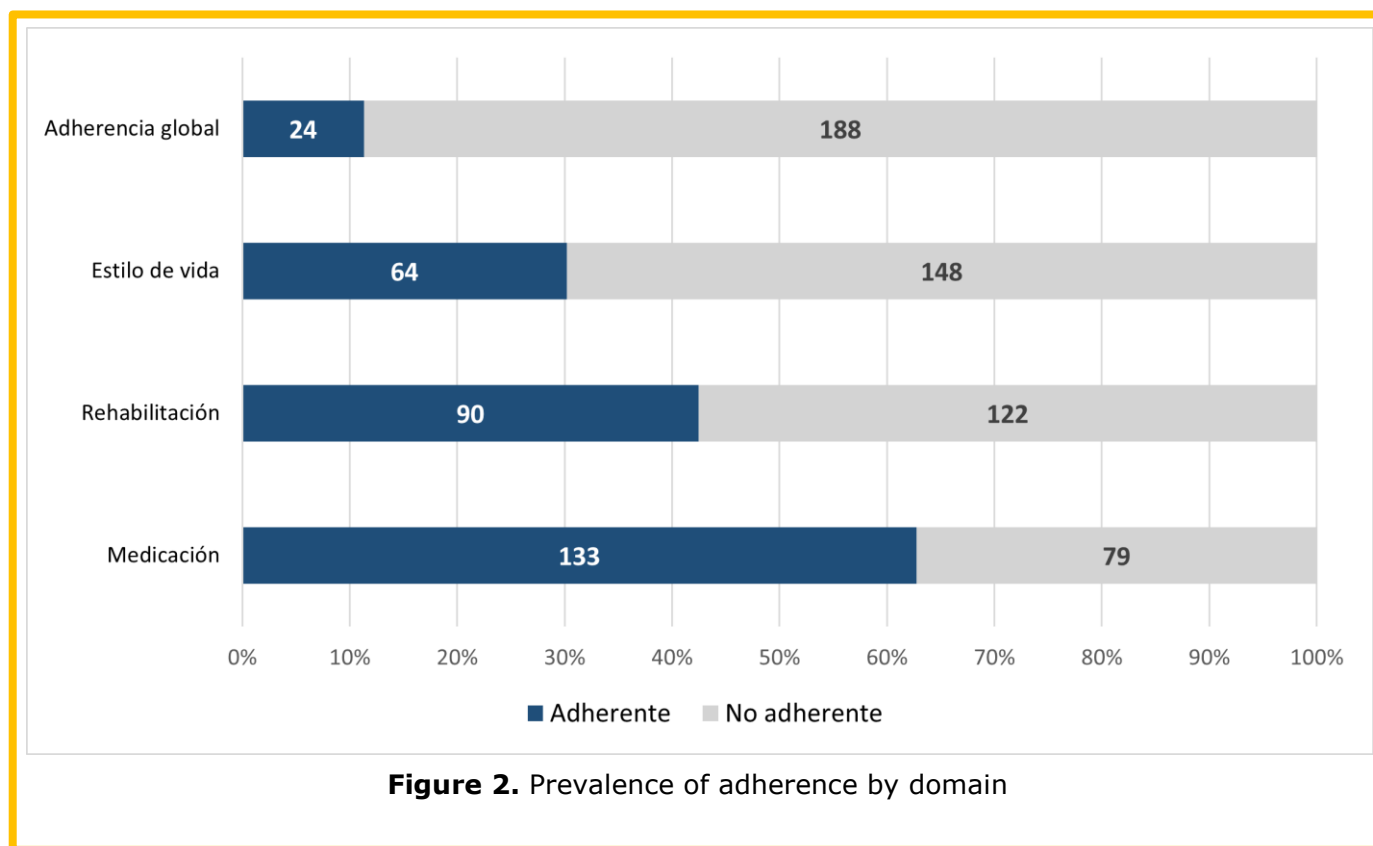
Estadistics: KMO = 0,75; Bartlett $\chi^2 = 407,97$ gl = 36 p < 0,001. Cargas $\geq 0,30$ mostradas.

The KMO measure was 0.75, and Bartlett's test of sphericity was significant ($\chi^2 = 407.97$, gl = 36, p < 0.001). EFA, with three factors, yielded a structure explaining 36.8% of the total variance. Table 3 presents the factor loadings. Fac-

tor 1 comprised the medication items. Factor 2 partially comprised the rehabilitation items. The lifestyle items did not achieve significant loadings on any factor, supporting their independence.

Figure 2 shows the prevalence of adherence according to the predefined clinical criteria. Medication adherence was 62.7%, rehabilitation adherence was 42.5% among patients for

whom rehabilitation had been prescribed, and adherence to healthy lifestyle behaviors was 30.2%. Overall adherence was 11.3%.



DISCUSSION

The *Adherencia-CCV* Questionnaire demonstrated excellent content validity, with an overall CVI of 0.94 and unusually high agreement among experts ($W = 0.92$; $ICC = 0.94$). Internal consistency was excellent for the medication domain ($\alpha = 0.80$) but low for the rehabilitation ($\alpha = 0.19$) and lifestyle ($\alpha = 0.15$) domains, confirming the multidimensional nature of these constructs and supporting the use of individual indicators. The factor structure grouped the medication items into a single factor, whereas the rehabilitation and lifestyle items showed more complex patterns. Overall adherence prevalence was low (11.3%), with the lifestyle domain showing the lowest adherence (30.2%). The *Adherencia-CCV* Questionnaire differs from other available instruments in that it integrates the three key domains of adherence into a single brief questionnaire. Most existing instruments are unidimensional. The *Adherencia-CCV* Questionnaire offers a distinctive advantage by allowing patients to be classified within each domain and referred for personalized counseling according to the specific item on which they failed to meet the adherence criterion. This approach avoids the loss of information that may

occur when items assessing different behaviors are grouped into a single score.

The adherence prevalence observed in this study is consistent with previous literature. Medication adherence was 62.7%, a figure similar to the 65% reported in a cohort of patients who underwent coronary artery bypass grafting.⁴ Adherence to cardiac rehabilitation was 42.5%, comparable to that reported by Lyapina et al.¹³ in a remote rehabilitation program (52%). The lifestyle domain showed the lowest adherence rate, at 30.2%, consistent with the literature indicating that lifestyle changes are among the most difficult behaviors to maintain over the long term.^{14,15} Finally, the overall adherence rate of 11.3% is a relevant finding: only one in ten patients met the criteria across all three domains simultaneously, underscoring the need for personalized and multidisciplinary interventions.

The low internal consistency observed in the rehabilitation and lifestyle domains should not be interpreted as a deficiency of the instrument, but rather as a reflection of the multidimensional nature of these constructs. Adherence to rehabilitation is not a homogeneous behavior: attending supervised sessions, not discontinu-

ing rehabilitation because of fear, and performing exercises at home are behaviors influenced by different determinants. The exploratory factor analysis supported this interpretation, thereby justifying the methodological decision to use individual indicators for classification within these domains.

The *Adherencia-CCV* Questionnaire has relevant clinical implications. Its brief applying time (<5 minutes) and self-applied format facilitate its integration into follow-up consultations without placing an additional burden on healthcare staff. Early identification of patients with specific adherence deficits enables referral for personalized counseling before adverse events occur.

This study has several limitations. First, the non-probability consecutive sampling method may have introduced selection bias. Second, the sample was predominantly male and was largely composed of patients who underwent coronary artery bypass grafting or valve surgery, which limits the generalizability of the findings. Third, the questionnaire's temporal stability was not assessed. Fourth, no objective gold-standard measure was available to validate the cutoff points using receiver operating characteristic (ROC) curves; therefore, these thresholds were established by clinical consensus. Future research should address these limitations by evaluating the questionnaire's predictive validity in relation to long-term clinical outcomes.

CONCLUSIONS

The *Adherencia-CCV* Questionnaire is a valid, standardized, and clinically useful instrument for classifying postoperative cardiac surgical patients as adherent or nonadherent across the three key domains for survival: medication, cardiac rehabilitation and healthy lifestyle behaviors. Its hybrid approach enables a comprehensive assessment that facilitates clinical decision-making and the personalization of interventions. Its implementation is recommended in the cardiology and cardiac rehabilitation units of Cuba.

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