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Original Article

Assessment of the external construct validity of the Brief International Classification of Functioning, Disability, and Health Core Set for chronic ischemic heart disease in a Turkish population

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ABSTRACT

Objectives: This study aimed to validate the Brief International Classification of Functioning, Disability, and Health (ICF) Core Set for chronic ischemic heart disease (CIHD) in a Turkish patient population, identifying the most common problems in ICF categories and testing its construct validity.

Patients and methods: A total of 85 patients (28 males, 57 females; mean age: 64.4±12.2 years; range, 37 to 88 years) diagnosed with CIHD who were referred to our cardiac rehabilitation outpatient clinic were included in the cross-sectional study between February 2014 and August 2015. Brief ICF Core Set for CIHD, which includes 36 second-level categories, was used to assess the most common impairments. Correlations between these impairments and various clinical assessment scales were analyzed to test construct validity.

Results: The most impaired categories in body functions were heart functions, blood pressure functions, exercise tolerance functions, blood vessel functions, sensations associated with cardiovascular and respiratory functions, and energy and drive functions. In the body structure component, the structure of the cardiovascular system was identified as a problem in 97.6% of patients. The activities and participation component revealed that moving around, remunerative employment, and carrying out daily routines were frequently problematic. All of the environmental factors were identified as both barriers and facilitators. Significant correlations were found between these categories and various clinical assessment scales.

Conclusion: The Brief ICF Core Set for CIHD is a valid tool for assessing the multifaceted impact of CIHD in a Turkish patient population. This validation supports its use for comprehensive, patient-centered evaluations in clinical settings, emphasizing the need for a holistic approach to managing CIHD.

Keywords: Chronic ischemic heart disease, disability, ICF core set, validation.

Ischemic heart disease (IHD), also known as coronary artery disease, results from insufficient myocardial blood flow due to atherosclerosis or functional changes in the coronary arteries, manifesting as acute coronary syndrome or chronic coronary syndrome. Chronic coronary syndrome typically involves stable angina, symptoms persisting over a year after diagnosis or revascularization, or angina linked to vasospastic or microvascular disease.[1-3] Symptoms such as dyspnea, palpitations, and angina often emerge as atherosclerosis progresses, particularly under increased myocardial oxygen demand during exertion or stress.[2] Ischemic heart disease is the leading cause of death worldwide, and due to the long-term impact on functional abilities, it is relevant to the scope of rehabilitation medicine. The rehabilitation process focuses on disability, quality of life, and functional outcomes

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while considering the crucial role of social and environmental factors.[4-6]

In 2001, the International Classification of Functioning, Disability and Health (ICF) was endorsed by the World Health Organization (WHO) as a comprehensive and universally accepted model for defining and classifying functional status, disability, and health in various diseases or conditions.[7-9] The ICF evaluates health status on a biomedical basis and in relation to the individual's environment, activities, and social life. The ICF Core Sets, developed for specific health conditions like musculoskeletal, cardiopulmonary, neurological, and psychiatric diseases, were selected from the entire ICF categories under the guidance of a multidisciplinary expert group.[10-13] For chronic IHD (CIHD), both comprehensive and brief ICF Core Sets were defined by Cieza et al.,[4] based on the ICF framework and classification. The Brief ICF Core Set includes 36 second-level categories related to body functions, body structures, activities and participation, and environmental factors.[14]

In the literature, studies on the application of ICF in cardiac patients, particularly in cardiac rehabilitation units, have predominantly focused on patients with heart failure, post-cardiac surgery, and IHD.[6,15,16] Some of these studies not only evaluated patient functions from the ICF perspective but also examined changes in ICF parameters following cardiac rehabilitation and potential factors affecting ICF evaluations.[15,16] This study aimed to identify the most common problems in the Brief ICF Core Set categories developed for CIHD and assess the external construct validity by comparing these categories with other disease-specific and generic measures.

PATIENTS AND METHODS

This cross-sectional study was conducted between February 2014 and August 2015. We enrolled 85 participants (28 males, 57 females; mean age: 64.4±12.2 years; range: 37 to 88 years) diagnosed with CIHD who were referred to the cardiac rehabilitation outpatient clinic of Ankara Physical Medicine and Rehabilitation Training and Research Hospital. The inclusion criteria were as follows: participants with stable angina pectoris; those who were at least six months post-myocardial infarction (MI) or coronary artery bypass grafting; participants aged 18 years or older; and those with literacy in Turkish. Exclusion criteria were participants with acute coronary syndromes (ST-segment elevation MI, non-ST-segment elevation MI, or unstable angina pectoris); those with post-acute coronary syndrome complications such as cardiac rupture, pericarditis, or reinfarction; participants with New York Heart Association (NYHA) Class IV heart failure; individuals with severe degenerative or inflammatory joint disease, chronic connective tissue disease, or infection; those with a history of malignancy; and individuals with cognitive or psychological impairments that would hinder the completion of the questionnaire. Written informed consent was obtained from all participants. The study protocol was approved by the Ankara Physical Medicine and Rehabilitation Training and Research Hospital Ethics Committee (date: 25.11.2013, no: B.10.1.TKH.5.06.0.02.Z.F1.08-5747). The study was conducted in accordance with the principles of the Declaration of Helsinki.

Prior to enrollment in the cardiac rehabilitation unit, a cardiologist evaluated all participants. Laboratory tests, electrocardiography, and transthoracic echocardiography were performed. Detailed sociodemographic (age, sex, body mass index, education, and marital and employment status) and clinical characteristics (duration of disease, smoking status, cardiac status, peripheral vascular disease, diabetes mellitus, hypertension, dyslipidemia, and pulmonary disease) were recorded. The six-minute walk test (6MWT), a simple submaximal measure of aerobic exercise capacity, was conducted. In this test, participants walk as far as possible on a 30-m flat surface for 6 min.[17] The NYHA Functional Classification was also utilized to categorize congestive heart failure patients based on their symptoms. In this classification, participants are divided into four categories according to their physical activity limitations. While Class I participants have no symptoms, symptoms become increasingly severe towards Class IV and can be felt even at rest.[18]

The brief ICF Core Set for CIHD, consisting of 36 second-level categories, was utilized in this study. It includes 10 categories for body functions, one for body structures, nine for activities and participation, and seven for environmental factors. Severity levels were rated using a 5-point Likert scale (0 to 4) for most components, while environmental factors category employed a dual scale (–4 to +4). This dual scale acknowledges that environmental factors can act as barriers (negative impact, scored between -1 and -4) or facilitators (positive

impact, scored between +1 and +4). When there is insufficient information, "8 (not specified)" is used, and "9 (not applicable)" is chosen if the category cannot be applied; both scores are excluded from final calculations. The ICF qualifiers from 1 to 4 (1=mild, 2=moderate, 3=severe, and 4=complete problem) indicated the presence of a problem, while 0 denoted its absence.[14]

The ICF data were gathered through patient interviews, clinical evaluations, medical records, and laboratory findings. Interviews were conducted by a single physician trained and specialized in ICF practice. The frequency of individuals experiencing problems in each specific category of the brief ICF core set was assessed. Additionally, for the ICF component categories of environmental factors, the frequencies of individuals reporting a specific category as either a barrier or a facilitator were also detailed. A threshold of 10% was utilized to assess content validity, in accordance with the protocol developed by the WHO ICF Research Branch. Construct validity was determined by the level of correlation with clinical assessment scales.

The Fatigue Severity Scale (FSS), a widely used nine-item scale, was employed to assess fatigue levels and its impact on daily functioning. Participants rated the extent of interference on a scale from 1 (no interference) to 7 (extreme interference), with total scores ranging from 9 to 63; higher scores indicate greater fatigue severity.[19]

The Beck Depression Inventory (BDI), a 21-item self-report questionnaire, was used to evaluate depressive symptoms. Each item is scored on a scale from 0 to 3, resulting in a total score between 0 and 63, with higher scores signifying more severe symptoms. The Turkish version was validated by Hisli.[20]

The Berg Balance Scale (BBS) is a widely recognized objective measure for assessing static and dynamic balance abilities in adults. This scale comprises 14 tasks, each rated on a scale from 0 (unable to perform) to 4 (performs independently), with a maximum score of 56 indicating the best possible balance.[21]

Cognitive functioning was assessed using the Mini-Mental State Examination (MMSE), a 30-point questionnaire evaluating orientation to time and place, immediate recall, short-term memory, language abilities, calculation, and construction. Scores range from 0 to 30, with lower scores indicating greater cognitive impairment; a score below 24 typically indicates impairment.[22]

The WHO Disability Assessment Chart (DAS)-II, developed by WHO, evaluates activity limitations and social participation across six categories: understanding and communication, movement, self-care, getting along with people, life activities, and community participation. Using a 5-point Likert scale, it generates a standardized score, with higher scores indicating greater disability.[23]

The 36-item Short-Form Health Survey (SF-36) was employed to assess participants' quality of life. This questionnaire covers eight health dimensions: physical function (10 items), social function (four items), role restrictions due to physical problems (two items), role limitations due to emotional problems (three items), mental health (five items), vitality (four items), pain (two items), and general health (seven items). They can be collected into two summary measures: Physical Component Summary (PCS) scores and Mental Component Summary (MCS) scores. The scores range from 0 to 100, with higher scores denoting better quality of life.[24]

The Duke Activity Status Index (DASI) was used to estimate maximal exercise capacity, encompassing 12 routine activities related to daily life, self-care, housework, sexual function, and recreational activities. The total score ranges from 0 to 58, with higher scores indicating better functional capacity.[25]

Statistical analysis

Data were analyzed using IBM SPSS version 20.0 software (IBM Corp., Armonk, NY, USA). The sample size for this study was calculated based on the primary outcome measure, which was the prevalence of significant impairments in various categories of the ICF Core Set for CIHD. Using a margin of error of 5%, the required sample size was determined to be 85 participants to achieve an 80% confidence level. The Kolmogorov-Smirnov test was used to assess the normality of the distribution of continuous variables. Data were presented as mean ± standard deviation (SD) for continuous variables and as frequency and percentages for categorical variables. The relationships between impairments in ICF categories and clinical assessment scales were assessed using Spearman's correlation coefficients. A p-value <0.05 was considered statistically significant.

TABLE 1
Sociodemographic and clinical characteristics of patients (n=85)

Variables	n	%	Mean±SD	Min-Max
Age (year)			64.4±12.2	37-88
Sex				
Male	28	32.9		
Female	57	67.1		
BMI (kg/m^2)			28.09±5.24	19.11-45.01
Education level				
Low	52	61.1		
High	33	38.9		
Marital status				
Married	68	80		
Single	17	20		
Employment status				
Not working	48	56.5		
Working	39	45.9		
Not working due to illness	18	21.2		
Duration of disease (month)			69.3±57.8	6-240
Comorbidities				
Angina pectoris	68	80		
Past myocardial infarction	35	41.2		
Bypass	17	20		
Peripheral vascular disease	18	21.2		
Heart failure	9	10.6		
Valve disease	5	5.9		
Diabetes mellitus	40	47.1		
Hypertension	74	87.1		
Dyslipidemia	41	48.2		
Pulmonary disease	4	4.7		

SD: Standard deviation; BMI: Body mass index.

TABLE 2
Functional classification and clinical assessment scale results of patients

Variables	n	%	Mean±SD	Min-Max
NYHA				
Class I	13	15.3		
Class II	43	50.6		
Class III	29	34.1		
Fatigue Severity Scale			4.43±1.79	1-7
Beck Depression Inventory			13.47±7.93	1-29
Berg Balance Scale			40.49±15.73	2-56
Mini-mental state examination			25.08±4.83	15-30
WHODAS-II			67.94±31.25	1-3.96
SF-36 PCS			38.02±11.11	20.40-57.60
SF-36 MCS			42.16±9.82	20.20-60.30
Duke Activity Status Index			19.45±12.13	0-42.7
6MWT			390.63±138.89	120-620

SD: Standard deviation; NYHA: New York Heart Association; WHODAS-II: World Health Organization Disability Assessment Chart-II; MCS: Mental Component Summary; PCS: Physical Component Summary; SF-36: 36-Item Short Form Health Survey questionnaire; 6MWT: Six-minute walk test.

TABLE 3
Frequency of impairments in categories of body functions and structures and the correlations with clinical assessment scales

ICF code	Title	n	%	FSS	BDI	BBS	MMSE	WHODAS-II	SF-36 PCS	SF-36 MCS	NYHA	DASI	6MWT
b130	Energy and drive functions	68	80	0.51**	0.60**	−0.42**	−0.43**	0.34**	−0.32**	−0.62**	0.29**	−0.43**	−0.34**
b152	Emotional functions	9	10.6	0.24*	0.44**	−0.23*	−0.28**	0.32**	−0.13	−0,46**	−0.12	−0.33**	0.14
b280	Sensation of pain	62	72.9	0.19	0.24*	−0.04	−0.14	0.16	−0.40**	−0.09	0.35**	−0.10	−0.40**
b410	Heart functions	100	100	0.43**	0.49**	−0.50**	−0.44**	0.54**	−0.37**	−0.50**	0.39**	−0.50**	−0.36**
b415	Blood vessel functions	71	83.5	0.34**	0.35**	−0.21	−0.31**	0.28**	−0.14	−0.44**	0.252	−0.23*	−0.12
b420	Blood pressure functions	80	94.1	0.19	0.29**	−0.25*	−0.28**	0.32**	−0.26*	−0.33**	0.33**	−0.32**	−0.33**
b455	Exercise tolerance functions	74	87.1	0.83**	0.81**	−0.76**	−0.73**	0.78**	−0.79**	−0.66**	0.71**	−0.73**	−0.78**
b460	Sensations associated with cardiovascular and respiratory functions	69	81.2	0.46**	0.36**	−0.36**	−0.30**	0.45**	−0.44**	−0.30**	0.48**	−0.24*	−0.38
b730	Muscle power functions	24	28.2	0.36**	0.39**	−0.56**	−0.35**	0.44**	−0.16	−0.49**	0.06	−0.46**	−0.26*
b740	Muscle endurance functions	32	37.7	0.56**	0.61**	−0.71**	−0.55**	0.61**	−0.38**	−0.63**	0.19	−0.65**	−0.48**
s410	Structure of cardiovascular system	83	97.6	0.25*	0.24*	−.011	−0.19	0.25*	−0.08	−0.16	0.24*	<0.01	−0.08

ICF: International Classification of Functioning, Disability, and Health; FSS: Fatigue Severity Scale; BDI: The Beck Depression Inventory; BBS: The Berg Balance Scale; MMSE: Mini-Mental State Examination; WHODAS-II: World Health Organization Disability Assessment Chart-II; SF-36: 36-Item Short Form Health Survey questionnaire; PCS: Physical component summary; MCS: Mental component summary; 6MWT: Six-minute walk test; NYHA: New York Heart Association; DASI: Duke Activity Status Index; n (%): Number and percentage of patients noting impairments in the relevant ICF category; * p<0.05; ** p<0.01.

TABLE 4

Frequency of impairments in categories of activity and participation and the correlations with clinical assessment scales

ICF code	Title	n	%	FSS	BDI	BBS	MMSE	WHODAS-II	SF-36 PCS	SF-36 MCS	NYHA	DASI	6MWT
d230	Carrying out daily routine	53	62.4	0.64**	0.81**	–0.69**	–0.76**	0.78**	–0.78**	–0.75**	0.55**	0.79**	–0.74**
d240	Handling stress and other psychological demands	30	35.3	0.38**	0.57**	–0.49**	–0.56**	0.50**	–0.43**	–0.59**	0.37**	0.56**	–0.47**
d450	Walking	39	45.0	0.63**	0.68**	–0.73**	–0.71**	0.77**	–0.62**	–0.78**	0.43**	0.79**	–0.67**
d455	Moving around	79	92.9	0.68**	0.71**	–0.65**	–0.71**	0.74**	–0.68**	–0.74**	0.51**	0.76**	–0.66**
d570	Looking after one's health	26	30.6	0.53**	0.49**	–0.32**	–0.41**	0.53**	–0.45**	–0.34**	0.25*	0.35**	–0.22*
d620	Acquisition of goods and services	51	60	0.63**	0.77**	–0.64**	–0.75**	0.76**	–0.69**	–0.65**	0.39**	0.73**	–0.71**
d760	Family relationships	15	17.6	0.05	0.29**	–0.08	–0.38**	0.26*	–0.15	–0.33**	0.18	–0.19	–0.17
d770	Intimate relationships	43	50.6	0.48**	0.71**	–0.65**	–0.69**	0.71**	–0.60**	–0.74**	0.55**	0.77**	–0.69**
d850	Remunerative employment	65	76.5	0.52**	0.54**	–0.56**	–0.66**	0.63**	–0.64**	–0.28**	0.53**	0.56**	–0.74**

ICF: International Classification of Functioning, Disability, and Health; FSS: Fatigue Severity Scale; BDI: The Beck Depression Inventory; BBS: The Berg Balance Scale; MMSE: Mini-Mental State Examination; WHODAS-II: World Health Organization Disability Assessment Chart-II; SF-36: 36-Item Short Form Health Survey questionnaire; PCS: Physical component summary; MCS: Mental component summary; 6MWT: Six-minute walk test; NYHA: New York Heart Association; DASI: Duke Activity Status Index; n (%): Number and percentage of patients noting impairments in the relevant ICF category; * $p<0.05$; ** $p<0.01$.

RESULTS

The mean duration of illness was 69.3±57.8 months. Detailed clinical and demographic characteristics of the participants are delineated in Table 1, while the functional classification and outcomes from clinical assessment scales are detailed in Table 2.

In the body functions component, a significant problem (reported by at least 10% of participants) was observed in all 10 categories. The most impaired categories, with >80% prevalence, were b410 (heart functions), b420 (blood pressure functions), b455 (exercise tolerance functions), b415 (blood vessel functions), b460 (sensations associated with cardiovascular and respiratory functions), and b130 (energy and drive functions), respectively. In this component, FSS, BBS, SF-36 PCS, NYHA, and the 6MWT showed significant correlations with seven categories. The MMSE was significantly correlated with eight categories, while BDI, WHODAS-II, SF-36 MCS, and DASI demonstrated significant correlations with nine categories, as detailed in Table 3.

For the body structure component, only the s410 category (structure of the cardiovascular system) was employed. This category was reported as a significant problem in 97.6% of the participants. Significant correlations for this category were also observed with the FSS, BDI, WHODAS-II, and NYHA, as presented in Table 3.

In the activities and participation component, all nine categories were identified as having a problem. The categories d455 (moving around), d850 (remunerative employment), d230 (carrying out daily routine), and d620 (acquisition of goods and services) exhibited problems most frequently, with a prevalence of 60% or higher. In this component, eight categories showed correlations with FSS, BBS, SF-36 PCS, NYHA, DASI, and 6MWT, while all categories demonstrated statistically significant correlations with BDI, MMSE, WHODAS-II, and SF-36 MCS. (Table 4).

Upon assessing the environmental factors component, it was found that all categories could act as both barriers and facilitators. The most significant barriers were e570 (social security services, systems, and policies), affecting 53 (62.4%) participants, e325 (acquaintances, peers, colleagues, neighbors, and community members), affecting 31 (36.5%) participants, and e355 (health

professionals), affecting 26 (30.6%) participants. The most prevalent facilitators were e310 (immediate family) in 59 (69.4%) participants, e355 (Health professionals) in 59 (69.4%) participants, e110 (Products or substances for personal consumption) in 56 (65.8%) participants, and e410 (Individual attitudes of immediate family members) in 55 (64.7%) participants. Within the environmental factors component, one category (e310) correlated with FSS, four categories (e110, e310, e355, and e410) with BBS, e110 category with SF-36 PCS, three categories (e110, e320, and e410) with NYHA, and two categories (e410 and e570) with 6MWT. None of the categories demonstrated a correlation with BDI, MMSE, WHODAS-II, SF-36 MCS, and DASI (Table 5).

TABLE 5
Frequency of impairments in categories of environmental factors and the correlations with clinical assessment scales

ICF code	Title	n	%	n	%	FSS	BDI	BBS	MMSE	WHODAS-II	SF-36 PCS	SF-36 MCS	NYHA	DASI	6MWT
e110	Products or substances for personal consumption	19	22.35	56	65.8	0.13	0.01	−0.22*	−0.02	0.13	−0.32**	0.07	0.25*	−0.18	−0.22
e310	Immediate family	22	25.8	59	69.4	0.23*	0.11	−0.37**	−0.15	0.15	−0.21	−0.09	0.16	−0.21	−0.18
e320	Friends	19	22.4	35	41.2	0.14	0.01	−0.14	−0.09	−0.02	−0.08	0.02	0.30**	−0.09	−0.16
e325	Acquaintances, peers, colleagues, neighbors and community members	31	36.5	18	21.2	0.03	−0.13	−0.07	−0.09	0.04	−0.11	0.03	0.21	−0.07	−0.08
e355	Health professionals	26	30.6	59	69.4	0.14	0.04	−0.31**	−0.03	0.09	−0.15	0.00	0.15	−0.16	−0.13
e410	Individual attitudes of immediate family members	14	16.5	55	64.7	0.20	0.10	−0.26*	−0.21	0.10	−0.15	−0.03	0.26*	−0.12	−0.23*
e570	Social security services, systems and policies	53	62.4	27	31.8	0.09	0.01	−0.06	0.02	0.02	−0.15	0.16	0.08	0.02	−0.22*

ICF: International Classification of Functioning, Disability, and Health; FSS: Fatigue Severity Scale; BDI: The Beck Depression Inventory; BBS: The Berg Balance Scale; MMSE: Mini-Mental State Examination; WHODAS-II: World Health Organization Disability Assessment Chart-II; SF-36: 36-Item Short Form Health Survey questionnaire; PCS: Physical component summary; MCS: Mental component summary; 6MWT: Six-minute walk test; NYHA: New York Heart Association; DASI: Duke Activity Status Index; n (%): Number and percentage of patients noting impairments in the relevant ICF category; * $p<0.05$; ** $p<0.01$.

DISCUSSION

This study demonstrated the external validity of the Brief ICF Core Set for CIHD in a Turkish patient population. Our findings showed that in the components of body functions, body structures, and activities and participation, all categories were identified as having problems. Furthermore, in assessing the environmental factors component, we found that all categories could act as both barriers and facilitators in our participants. Significant correlations between the ICF categories and various clinical scales validate its utility as a multidimensional assessment tool. These results support the use of the Brief ICF Core Set for comprehensive evaluation and rehabilitation planning in CIHD.

Chronic IHD significantly impairs various body functions and structures, particularly those associated with cardiovascular and respiratory systems. The most affected categories in the body functions component were heart functions (b410), blood pressure functions (b420), exercise tolerance functions (b455), blood vessel functions (b415), sensations associated with cardiovascular and respiratory functions (b460), and energy and drive functions (b130). Over 80% of participants reported significant problems in these areas. In our study, for the body structure component, only the s410 category (structure of the cardiovascular system) was employed. This category was reported as a significant problem by 97.6% of the participants. This high prevalence is consistent with the extensive structural changes induced by chronic ischemia on the cardiovascular system. In our study, a small subset of participants with CIHD (2.4%) exhibited

normal findings on diagnostic tests. This can be attributed to microvascular disease, ischemia with no obstructive coronary artery disease, transient ischemic episodes, early-stage disease, and the heterogeneous nature of the disease's presentation.[26]

Chronic IHD often leads to left ventricular dysfunction due to mitochondrial dysfunction and oxidative stress, impairing systolic and diastolic functions.[27] This is exacerbated by myocardial remodeling, characterized by hypertrophy, fibrosis, and scar formation, significantly impairing cardiac function.[28,29] Additionally, hypertension, both a cause and consequence of IHD, increases myocardial oxygen demand and accelerates atherosclerosis, leading to endothelial dysfunction and vascular stiffness.[30] Blood vessel functions are further compromised by chronic endothelial injury and inflammation (hallmarks of atherosclerosis), resulting in impaired vasodilation, thrombosis, and vascular remodeling.[31] For these reasons, the categories b410, b420, b415, and s410 were found to be highly problematic in our participants, as expected.

In our study, we also identified a high frequency of issues in the b455, b460, and b130 categories. These findings align with existing literature and are attributed to interrelated mechanisms. Exercise tolerance is impaired due to reduced myocardial capacity to meet oxygen demands during physical activity, stemming from mitochondrial dysfunction and decreased oxidative phosphorylation capacity.[27] Chronic inflammation and elevated proinflammatory cytokines, such as interleukin-6, also contribute to decreased exercise tolerance and increased dyspnea.[32] Sensations of chest pain and breathlessness are exacerbated by ischemia-induced metabolic shifts, increased reactive oxygen species production, and oxidative stress. These altered sensory perceptions significantly impact patients' quality of life. Continuous low-grade ischemia leads to reduced cardiac output and systemic fatigue due to impaired mitochondrial function.[33] Coexisting conditions such as diabetes and hypertension further deplete energy reserves, exacerbating fatigue.[34]

In this study, all nine categories in the activities and participation component were identified as having problems. Chronic IHD significantly limits patients' ability to engage in daily activities and participate in social and professional life. In our study, the most problematic areas identified were moving around (d455), remunerative employment (d850), carrying out daily routine (d230), and acquisition of goods and services (d620), with a prevalence of 60% or higher. These difficulties may stem from interconnected factors such as reduced exercise tolerance and mobility due to persistent fatigue and dyspnea associated with compromised cardiac function. This physical limitation directly impacts patients' ability to engage in physically demanding tasks, maintain employment, and perform daily routines. Additionally, the psychological burden of living with CIHD can exacerbate depression and anxiety, further diminishing the motivation and energy required for daily activities and employment.[4,6,35] Frequent hospital visits and complex medication regimens may also make it difficult to adhere to regular work schedules and routine activities.[36] We believe that these factors contribute to the activity and participation restrictions observed in our paticipants. These multifaceted impacts necessitate comprehensive management strategies to enhance the quality of life for these patients.

Environmental factors play a crucial role in the management and outcome of CIHD. In our study, all categories in the environmental factors component were identified as both barriers and facilitators. The most frequently encountered barriers were social security services, systems, and policies (e570) and acquaintances, peers, colleagues, neighbors, and community members (e325). Conversely, immediate family (e310) and health professionals (e355) were identified as significant facilitators, both with a prevalence of 69.4%. Social security services systems and policies may fail to provide adequate support for patients with CIHD. These patients frequently require long-term medical care, and deficiencies in the healthcare system can exacerbate the challenges they face. In this study, the most common barrier observed among our participants, with a prevalence of 62.4%, was the e570 category, which can be attributed to factors such as difficulties in scheduling doctor appointments, waiting for complex tests and hospital admissions for treatment, and challenges in accessing cardiac rehabilitation. Despite being recognized as facilitators by the majority of participants, 30.6% of participants identified healthcare professionals as barriers. We consider that systemic healthcare inefficiencies, which result in limited time allocated to patients, may significantly contribute to the potential barrier posed by healthcare professionals.

Another important result of this study is that individuals other than the immediate family are mostly perceived as barriers by patients in terms of social support networks. The stigma and lack of understanding about the disease may contribute to the perception of e325 mostly as a barrier, with a prevalence of 36.5%. This situation, which can lead to social isolation, should not be overlooked, and solution strategies should be developed. In our study, the identification of the immediate family as a facilitator is also not surprising, considering the supportive and protective nature of the Turkish family structure towards its members. Immediate family members' emotional and practical assistance can improve adherence to treatment regimens and overall disease management. In the literature, the significant role of environmental factors in disease management has been well-documented, emphasizing the need for supportive social and healthcare networks to improve patient outcomes.[37-39]

Our findings elucidate the multifaceted nature of CIHD and its extensive impact on health. Significant correlations were observed between multiple categories of body functions, body structures, activities and participation, and environmental factors with a range of assessment scales. These scales included the FSS, BBS, SF-36 PCS and MCS, NYHA classification, 6MWT, MMSE, BDI, WHODAS-II, and DASI. Notably, the body functions and activities and participation components showed widespread correlations with various scales, highlighting IHD's pervasive impact on physical and psychological health. The body structure component also demonstrated significant correlations, emphasizing the interconnectedness of structural and functional impairments in IHD. In contrast, since traditional scales cannot measure environmental factors, we found a low correlation with the environmental factors component of the ICF. This demonstrates that, unlike traditional disease scales, the ICF can measure IHD in a multidimensional manner, considering biopsychosocial aspects.

Our findings indicate that the ICF Core Set for CIHD, as a single assessment method, can identify restrictions, problematic areas, and the severity of these issues and special needs in IHD, providing optimal data in creating rehabilitation plans. Assessments based on ICF into routine clinical practice provides a structured approach to evaluate the broader impacts of CIHD, guiding patient-centered care planning. This approach ensures that interventions target not only clinical outcomes but also the broader determinants of health, such as social inclusion and quality of life.

The limitations of this study included the cross-sectional design, which restricts the ability to draw causal inferences between CIHD and the identified impairments. Additionally, the study population was limited to Turkish participants, potentially impacting the generalizability of the findings to other populations and cultural contexts. Another limitation was that in the statistical analysis of ICF categories, the assessment focused on the presence or absence of a problem, without reflecting the severity of these issues in the results.

In conclusion, this study demonstrated the external construct validity of the brief ICF Core Set for CIHD and underscored the need for its widespread adoption in rehabilitation medicine. Overall, our findings illustrate the multifaceted impact of CIHD on individuals' health, emphasizing the need for a holistic assessment and management approach that addresses both physical and psychological dimensions. Unlike disease-specific or generic scales that focus on specific issues, the ICF Core Set captures the wide-ranging effects of IHD on body functions, body structure, activities and participation, and environmental factors. This multidimensional approach enables healthcare professionals to tailor patient-specific interventions, ultimately contributing to improved patient care and quality of life. Future research should aim to validate the ICF Core Set for CIHD in diverse populations to enhance its applicability. Longitudinal studies are also needed to assess the progression of disabilities and the impact of interventions over time.

Data Sharing Statement: The data that support the findings of this study are available from the corresponding author upon reasonable request.

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REFERENCES

1. Jensen RV, Hjortbak MV, Bøtker HE. Ischemic heart disease: An update. Semin Nucl Med 2020;50:195-207. doi: 10.1053/j.semnuclmed.2020.02.007.
2. Institute of Medicine (US) Committee on Social Security Cardiovascular Disability Criteria. Cardiovascular Disability: Updating the Social Security Listings. Washington (DC): National Academies Press (US); 2010.
3. Ambrosetti M, Abreu A, Corrà U, Davos CH, Hansen D, Frederix I, et al. Secondary prevention through comprehensive cardiovascular rehabilitation: From knowledge to implementation. 2020 update. A position paper from the Secondary Prevention and Rehabilitation Section of the European Association of Preventive Cardiology. Eur J Prev Cardiol 2021;28:460-95. doi: 10.1177/2047487320913379.
4. Cieza A, Stucki A, Geyh S, Berteanu M, Quittan M, Simon A, et al. ICF core sets for chronic ischaemic heart disease. J Rehabil Med 2004;(44):94-9. doi: 10.1080/16501960410016785.
5. Kaski JC, Crea F, Gersh BJ, Camici PG. Reappraisal of ischemic heart disease. Circulation 2018;138:1463-80. doi: 10.1161/CIRCULATIONAHA.118.031373.
6. Racca V, Spezzaferri R, Modica M, Mazzini P, Jonsdottir J, De Maria R, et al. Functioning and disability in ischaemic heart disease. Disabil Rehabil 2010;32 Suppl 1:S42-9. doi: 10.3109/09638288.2010.511691.
7. Stucki G, Kostanjsek N, Ustün B, Cieza A. ICF-based classification and measurement of functioning. Eur J Phys Rehabil Med 2008;44:315-28.
8. Rauch A, Cieza A, Stucki G. How to apply the International Classification of Functioning, Disability and Health (ICF) for rehabilitation management in clinical practice. Eur J Phys Rehabil Med 2008;44:329-42.
9. World Health Organization. International classification of functioning, disability and health. Geneva: ICF; 2001. p. 3-207.
10. Wildner M, Quittan M, Portenier L, Wilke S, Boldt C, Stucki G, et al. ICF Core Set for patients with cardiopulmonary conditions in early post-acute rehabilitation facilities. Disabil Rehabil 2005;27:397-404. doi: 10.1080/09638280400013958.
11. Ustün B, Chatterji S, Kostanjsek N. Comments from WHO for the Journal of Rehabilitation Medicine Special Supplement on ICF Core Sets. J Rehabil Med 2004;(44):7-8. doi: 10.1080/16501960410015344.
12. Cieza A, Ewert T, Ustün TB, Chatterji S, Kostanjsek N, Stucki G. Development of ICF Core Sets for patients with chronic conditions. J Rehabil Med 2004;(44):9-11. doi: 10.1080/16501960410015353.
13. ICF core sets in clinical practice. ICF-based documentation tool. Available at: https://www.icf-core-sets.org.
14. ICF Core Set for Chronic Ischaemic Heart Disease. Available at: https://www.icf-research-branch.org/icf-core-sets-projects2/cardiovascular-and-respiratory-conditions/icf-core-set-for-chronic-ischaemic-heart-disease.
15. Racca V, Di Rienzo M, Mazzini P, Ripamonti V, Gasti G, Spezzaferri R, et al. ICF-based approach to evaluating functionality in cardiac rehabilitation patients after heart surgery. Eur J Phys Rehabil Med 2015;51:457-68.
16. Scalvini S, Olivares A, Giardini A, Comini L, Zanelli E, Corica G, et al. ICF framework in cardiac rehabilitation: A real-life implementation in post-cardiac surgery and chronic heart failure patients. Eur J Phys Rehabil Med 2023;59:605-14. doi: 10.23736/S1973-9087.23.07666-9.
17. Giannitsi S, Bougiakli M, Bechlioulis A, Kotsia A, Michalis LK, Naka KK. 6-Minute walking test: A useful tool in the management of heart failure patients. Ther Adv Cardiovasc Dis 2019;13:1753944719870084. doi: 10.1177/1753944719870084.
18. Caraballo C, Desai NR, Mulder H, Alhanti B, Wilson FP, Fiuzat M, et al. Clinical implications of the New York Heart Association Classification. J Am Heart Assoc 2019;8:e014240. doi: 10.1161/JAHA.119.014240.
19. Armutlu K, Korkmaz NC, Keser I, Sumbuloglu V, Akbiyik DI, Guney Z, et al. The validity and reliability of the Fatigue Severity Scale in Turkish multiple sclerosis patients. Int J Rehabil Res 2007;30:81-5. doi: 10.1097/MRR.0b013e3280146ec4.
20. Hisli N. Beck depresyon envanterinin geçerliği üzerine bir çalışma. Psikoloji Dergisi 1988;22:118-26.
21. Sahin F, Yilmaz F, Ozmaden A, Kotevolu N, Sahin T, Kuran B. Reliability and validity of the Turkish version of the Berg Balance Scale. J Geriatr Phys Ther 2008;31:32-7. doi: 10.1519/00139143-200831010-00006.
22. Küçükdeveci AA, Kutlay S, Elhan AH, Tennant A. Preliminary study to evaluate the validity of the mini-mental state examination in a normal population in Turkey. Int J Rehabil Res 2005;28:77-9. doi: 10.1097/00004356-200503000-00011.
23. Akyurek G., Bumin G. The World Health Organization Disability Assessment Scale: Reliability and validity in people with disabilities. Arch Phys Med Rehabil 2018;99:E21.
24. Koçyiğit H, Aydemir Ö, Fişek G, Ölmez N, Kısa Memiş A. Form-36 (KF-36)'nın Türkçe versiyonunun güvenilirliği ve geçerliliği. İlaç ve Tedavi Dergisi 1999;12:102-6.
25. Hlatky MA, Boineau RE, Higginbotham MB, Lee KL, Mark DB, Califf RM, et al. A brief self-administered questionnaire to determine functional capacity (the Duke Activity Status Index). Am J Cardiol 1989;64:651-4. doi: 10.1016/0002-9149(89)90496-7.
26. Kunadian V, Chieffo A, Camici PG, Berry C, Escaned J, Maas AHEM, et al. An EAPCI Expert Consensus Document on Ischaemia with Non-Obstructive Coronary Arteries in Collaboration with European Society of Cardiology Working Group on Coronary Pathophysiology & Microcirculation Endorsed by Coronary Vasomotor Disorders International Study Group. Eur Heart J 2020;41:3504-20. doi: 10.1093/eurheartj/ehaa503.
27. Stride N, Larsen S, Hey-Mogensen M, Hansen CN, Prats C, Steinbrüchel D, et al. Impaired mitochondrial function in chronically ischemic human heart. Am J Physiol Heart Circ Physiol 2013;304:H1407-14. doi: 10.1152/ajpheart.00991.2012.

28. Boudina S, Laclau MN, Tariosse L, Daret D, Gouverneur G, Bonoron-Adèle S, et al. Alteration of mitochondrial function in a model of chronic ischemia in vivo in rat heart. Am J Physiol Heart Circ Physiol 2002;282:H821-31. doi: 10.1152/ajpheart.00471.2001.
29. Frangogiannis NG, Kovacic JC. Extracellular Matrix in Ischemic Heart Disease, Part 4/4: JACC Focus Seminar. J Am Coll Cardiol 2020;75:2219-35. doi: 10.1016/j.jacc.2020.03.020.
30. Rosendorff C, Black HR, Cannon CP, Gersh BJ, Gore J, Izzo JL Jr, et al. Treatment of hypertension in the prevention and management of ischemic heart disease: A scientific statement from the American Heart Association Council for High Blood Pressure Research and the Councils on Clinical Cardiology and Epidemiology and Prevention. Circulation 2007;115:2761-88. doi: 10.1161/CIRCULATIONAHA.107.183885.
31. Canty JM Jr, Suzuki G. Myocardial perfusion and contraction in acute ischemia and chronic ischemic heart disease. J Mol Cell Cardiol 2012;52:822-31. doi: 10.1016/j.yjmcc.2011.08.019.
32. Lietava J, Vohnout B, Penz P, Kuka P, Bucova M, Kosmalova V, et al. Relationship of self-reported exercise tolerance with inflammatory markers in women with stable ischemic heart disease. Neuro Endocrinol Lett 2012;33 Suppl 2:50-4.
33. Lesnefsky EJ, Moghaddas S, Tandler B, Kerner J, Hoppel CL. Mitochondrial dysfunction in cardiac disease: Ischemia--reperfusion, aging, and heart failure. J Mol Cell Cardiol 2001;33:1065-89. doi: 10.1006/jmcc.2001.1378.
34. Guazzi M, Brambilla R, Pontone G, Agostoni P, Guazzi MD. Effect of non-insulin-dependent diabetes mellitus on pulmonary function and exercise tolerance in chronic congestive heart failure. Am J Cardiol 2002;89:191-7. doi: 10.1016/s0002-9149(01)02199-3.
35. Askin L, Uzel KE, Tanrıverdi O, Kavalcı V, Yavcin O, Turkmen S. The relationship between coronary artery disease and depression and anxiety scores. North Clin Istanb 2020;7:523-6. doi: 10.14744/nci.2020.72602.
36. Marzilli M, Merz CN, Boden WE, Bonow RO, Capozza PG, Chilian WM, et al. Obstructive coronary atherosclerosis and ischemic heart disease: An elusive link! J Am Coll Cardiol 2012;60:951-6. doi: 10.1016/j.jacc.2012.02.082.
37. Barefoot JC, Grønbaek M, Jensen G, Schnohr P, Prescott E. Social network diversity and risks of ischemic heart disease and total mortality: Findings from the Copenhagen City Heart Study. Am J Epidemiol 2005;161:960-7. doi: 10.1093/aje/kwi128.
38. You M, Fang W, Wang X, Yang T. Modelling of the ICF core sets for chronic ischemic heart disease using the LASSO model in Chinese patients. Health Qual Life Outcomes 2018;16:139. doi: 10.1186/s12955-018-0957-0.
39. Czajkowski SM, Arteaga SS, Burg MM. Social Support and Cardiovascular Disease. In: Waldstein SR, Kop WJ, Suarez EC, Lovallo WR, Katzel L, editors. Handbook of Cardiovascular Behavioral Medicine. New York: Springer; 2022.