

Psychometric validation of the short version of the Information Needs in Cardiac Rehabilitation scale through a first global assessment

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Aims

Tailored education is recommended for cardiac patients, yet little is known about information needs in areas of the world where it is most needed. This study aims to assess (i) the measurement properties of the Information Needs in Cardiac Rehabilitation short version (INCR-S) scale and (ii) patient's information needs globally.

Methods and results

In this cross-sectional study, English, simplified Chinese, Portuguese, or Korean versions of the INCR-S were administered to in- or out-patients via Qualtrics (January 2022–November 2023). Members of the International Council of Cardiovascular Prevention and Rehabilitation community facilitated recruitment. Importance and knowledge sufficiency of 36 items were rated. Links to evidence-based lay education were provided where warranted. A total of 1601 patients from 19 middle- and high-income countries across the world participated. Structural validity was supported upon factor analysis, with five subscales extracted: symptom response/

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medication, heart diseases/diagnostic tests/treatments, exercise and return-to-life roles/programmes to support, risk factors, and healthy eating/psychosocial management. Cronbach's alpha was 0.97. Construct validity was supported through significantly higher knowledge sufficiency ratings for all items and information importance ratings for all subscales in cardiac rehabilitation (CR) enrollees vs. non-enrollees (all $P < 0.001$). All items were rated as very important—particularly regarding cardiac events, nutrition, exercise benefits, medications, symptom response, risk factor control, and CR—but more so in high-income countries in the Americas and Western Pacific. Knowledge sufficiency ranged from 30.0 to 67.4%, varying by region and income class. Ratings were highest for medications and lowest for support groups, resistance training, and alternative medicine.

Conclusion

Identification of information needs using the valid and reliable INCR-S can inform educational approaches to optimize patients' health outcomes across the globe.

Lay summary

Patients need information to manage their heart diseases, such as what to do if they have chest pain, what a heart attack is, and how to take their medicine to lower the chances they will have another one, so a study of the information needs of over 1600 heart patients from around the globe was undertaken for the first time. Using the Information Needs in Cardiac Rehabilitation short version (INCR-S) scale—which was shown to be a good measurement tool through the study and hence may improve patient education—patients reported they most wanted information about heart events, heart-healthy eating, exercise benefits, their pills, symptom response, risk factor control, and cardiac rehabilitation—but more so in high-income countries in the Americas and Western Pacific. Knowledge sufficiency ratings for each item ranged from 30.0 to 67.4%, also varying by region and income class; perceived knowledge sufficiency ratings were highest for medications and lowest for support groups, resistance training, and alternative medicine.

Keywords

Cardiac rehabilitation • Global health • Questionnaires and surveys • Patient education

Introduction

The prevalence of cardiovascular disease (CVD) is among the highest of all conditions globally—doubling from 2009 to 2019, with 523 million people affected.¹ Cardiovascular disease is also a leading cause of disability and economic burden worldwide.² Advances in treatment have resulted in increased survival following an initial cardiac event, but these patients remain at increased risk of subsequent mortality and morbidity.³

Patients require information about responding to cardiac symptoms and controlling the many CV risk factors through self-managing their disease to reduce this excess risk.⁴ Indeed, systematic reviews show that patient education leads to not only increased knowledge but also improved heart health behaviour and quality of life and may decrease cardiovascular events.⁵ Accordingly, therapeutic education is recommended for secondary prevention by learned cardiovascular societies.⁶ For these reasons, it is considered a core component of cardiac rehabilitation (CR).^{7,8}

To be effective, guidelines assert that education should be tailored to the needs of individual patients.⁹ Often however, this does not occur in practice.¹⁰ Given this, Ghisi et al.¹¹ developed the Information Needs in Cardiac Rehabilitation (INCR) scale, which assesses patients' top information needs, namely emergency/safety, diagnosis/treatments, medication, and risk factors, among other topics.¹² It is the only available validated and current scale to assess heart patient information needs.¹² The INCR is available in five languages and has been administered in six countries in two World Health Organization (WHO) regions (Americas and Western Pacific), countries of high- and middle-income according to the World Bank.^{12,13} Despite variation in risk factor burden regionally,¹⁴ there has only been one multicountry study of information needs in CVD patients to enable any comparison.¹⁵

Given the global burden of CVD, much more needs to be known about the information needs of CVD patients around the world, particularly those for whom secondary prevention is most needed.² Moreover, through a recent review, INCR items were revisited in light of available evidence, and a short version was proposed (INCR-S).¹² Accordingly, the objectives of this study were to investigate (i) measurement properties of the INCR-S (structural validity, internal reliability, and construct validity) and (ii) CVD patients' information needs globally. The

identification of patients' greatest information needs can inform educational approaches that optimize their health outcomes.

Methods

Design and procedure

This study was cross-sectional in design. York University's Office of Research Ethics (Toronto, Canada) approved the study (e2021-013). Respondents completed the confidential survey after providing informed written consent.

The study was undertaken through the International Council of Cardiovascular Prevention and Rehabilitation (ICCP; globalcardiacrehab.com), a network of ~45 CR-related societies. An invitation to participate was shared through ICCP's programme mailing list, which comprises emails from ~2000 people that work in cardiac care around the globe. Data were collected from January 2022 to November 2023.

The survey was available in English, Portuguese, simplified Chinese, and Korean. All but the Korean surveys were completed online via Qualtrics; the Korean-speaking respondents completed the survey via paper and pencil. When participants were not proficient in any of the above languages and/or had no internet access, staff at participating centres administered the survey via interview and entered their responses online on participant's behalf.

Where respondents who completed any non-Korean survey directly online rated any item as 4 or 5 (indicating the information was 'important' or 'very important' to them) and that they did not yet know enough about the topic (i.e. insufficient knowledge), they were provided with a link to evidence-based lay educational information for that item at the end in the language of the survey. Information responses can be found in the [Appendix](#). In order to facilitate care quality improvement, respondents could elect to provide their institution; this was used to determine respondent's country. At the end of the study, collaborators were provided anonymous responses for their institution in aggregate to support efforts to address top information gaps.

Participants

This study included adult (i.e. age >18 years old) in- or out-patients with a cardiovascular diagnosis indicated for participation in CR (e.g. acute coronary syndromes ± revascularization, heart failure, and peripheral vascular diseases) and hence having information needs in the domains covered in the INCR-S. Patients were excluded if they had completed CR, given many of their information needs would be fulfilled.

Measures

Respondents were first asked to self-report their sociodemographic and other pertinent characteristics through investigator-generated items with forced-choice response options including region of the world (categorized based on WHO region),¹³ age, sex, education, social support (on a 5-point Likert scale from 1 = no to 5 = definitely), and financial insecurity (including in relation to healthcare). Respondents were also asked about CR referral and CR participation (yes/no). For respondents reporting their institution, countries were categorized based on World Bank income classification.

The INCR is a scale created by Ghisi *et al.*¹¹ to assess information needs of CR patients. It originally comprised 55 items across 10 information areas. Each is scored on a 5-point Likert scale from 1 (*really not important*) to 5 (*very important*); higher scores indicate greater information needs. At the end, there is an open-ended item where respondents can add additional information needs. The internal and re-test reliability, responsiveness, and interpretability as well as criterion, content, construct, structural, and cross-cultural validity of the INCR have been established.¹²

In this study, the short version of the INCR-S was administered for the first time.¹² Following a literature review, this version was finalized based on importance ratings in previous studies and the 'other' responses of past respondents, as well as input from healthcare providers involved in the INCR translations and cultural adaptations and CR researchers in the patient education field.^{12,16} The shorter version of the INCR has 36 items covering 9 information areas: the heart (4 items), emergency/safety (2 items), diagnosis/treatment (4 items), risk factors (5 items), medication (5 items), exercise (5 items), nutrition (4 items), psychosocial factors (6 items), and CR (1 item). Furthermore, in addition to the 5-point Likert-type importance rating of each item and the open-ended 'other' information needs item, in this revised version, respondents are also asked to denote whether or not they perceive they already know enough about each topic/item (i.e. knowledge sufficiency).

After reviewing information provided to fulfil their greatest needs, respondents were asked to rate helpfulness of the information provided on a Likert-type scale ranging from 1 = very unhelpful to 5 = very helpful.

Statistical analysis

Data were exported from Qualtrics to SPSS version 28 (IBM), where analyses were performed. For the psychometric validation, after suitability of data was confirmed by Bartlett's test of sphericity and the

Kaiser–Meyer–Olkin (KMO) value, exploratory factor analysis (EFA) was undertaken to assess structural validity. Factor extraction was conducted using the principal component method, with varimax rotation. The number of factors extracted was determined by considering those with eigenvalues ≥ 1.0 , percentage of variance accounted for, and examination of the scree plot. Item factor loadings ≥ 0.3 were considered in finalizing the items for each factor and interpreting them.^{17,18} Internal consistency of resultant factors was then assessed based on Cronbach's alpha; a value >0.70 was considered acceptable.¹⁹ To test construct validity, differences in INCR-S item knowledge sufficiency and importance subscale scores were compared by CR enrolment status using χ^2 and Student's *t*-tests, respectively.

For the second objective, a descriptive examination of INCR-S scores was performed. Analysis of variance was used to examine differences in INCR-S scores by region and income class. A $P < 0.05$ was considered statistically significant.

Results

Overall, 1601 surveys were completed, of which 779 (48.7%) were in English, 583 (36.4%) in Portuguese, 200 (12.5%) in simplified Chinese, and 39 (2.4%) in Korean. The 19 countries from which data were collected are shown in [Figure 1](#). The number of surveys completed per country ranged from 1 to 583. As shown in [Table 1](#), these responses stem from 6/6 WHO regions, in countries of middle- or high-income class ([Figure 1](#)).¹³

Respondent characteristics are shown in [Table 1](#). Overall, 40.1% had not initiated CR.

Structural validity of the Information Needs in Cardiac Rehabilitation short version and internal reliability

The KMO value of 0.971 indicated a highly acceptable score, with a significant Bartlett's test of sphericity ($P < 0.0001$). Results of the factor analysis are displayed in [Table 2](#). As shown, five factors were extracted, representing 60.1% of the variance and with few item cross-loadings. Cronbach's alpha for the total INCR-S was 0.97. Internal consistency of all factors was also considered acceptable (range 0.85–0.90).¹⁹

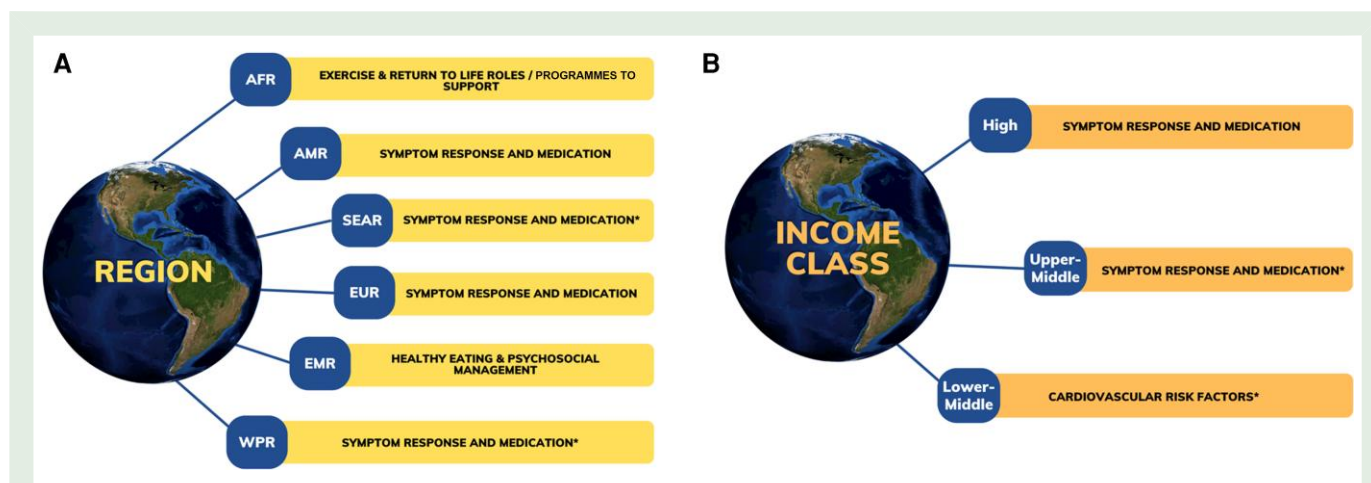


Figure 1 Greatest informational importance areas by (A) region and (B) country income classification. (A) World Health Organization region (countries): AFR, African (Nigeria); AMR, Americas (Brazil, Mexico, and USA); SEAR, Southeast Asian Region (India); EUR, European (Czech Republic, Greece, Italy, Georgia, Serbia, Poland, and UK); EMR, Eastern Mediterranean Region (Iran); and WPR, Western Pacific Region (Australia, Philippines, China, South Korea, Singapore, and Taiwan). (B) World Bank income class (countries): high-income (Australia, Czech Republic, Italy, Greece, Poland, Singapore, South Korea/Republic of Korea, Taiwan, USA, and UK); upper middle-income (Brazil, China, Georgia, Mexico, and Serbia); and lower middle-income countries (India, Iran, Nigeria, and Philippines). *Knowledge sufficiency $<50\%$.

Table 1 Self-reported characteristics of study participants, overall and by total Information Needs in Cardiac Rehabilitation short version scores (*n* = 1601)

Characteristic	<i>n</i> (%) / mean ± standard deviation	Total INCR-S importance score ^a	<i>P</i> ^b	Total INCR-S knowledge sufficiency ^c	<i>P</i> ^d
World region, <i>n</i> (%)			<0.001		<0.001
Africa	68 (4.2%)	3.9 ± 0.4		20 (55.6%)	
Americas	587 (36.7%)	4.4 ± 0.5		16 (44.5%)	
Eastern Mediterranean	4 (0.2%)	4.6 ± 0.4		32 (88.9%)	
Europe	445 (27.8%)	4.1 ± 0.7		22 (61.1%)	
Southeast Asian	137 (8.6%)	4.0 ± 0.5		10 (27.8%)	
Western Pacific	360 (22.5%)	4.3 ± 0.5		14 (38.9%)	
Country income class, <i>n</i> (%)			<0.001		<0.001
Lower middle	293 (18.3%)	4.0 ± 0.5		15 (41.7%)	
Upper middle	893 (55.8%)	4.3 ± 0.5		15 (41.7%)	
High	413 (25.8%)	4.2 ± 0.7		22 (61.1%)	
Age	61.8 ± 13.5		0.40		0.02
<65 years old	817 (51.0%)	4.2 ± 0.6		16 (44.5%)	
65 years old or older	754 (47.1%)	4.3 ± 0.5		18 (50.0%)	
Sex			0.60		0.004
Female	655 (40.9%)	4.3 ± 0.5		15 (41.7%)	
Male	925 (57.8%)	4.2 ± 0.6		18 (50.0%)	
Ethnocultural minority			0.70		0.38
Yes	190 (11.9%)	4.2 ± 0.6		18 (50.0%)	
No	1389 (86.8%)	4.3 ± 0.6		17 (47.2%)	
Work status			0.01		0.001
Retired	816 (51.0%)	4.3 ± 0.5		17 (47.2%)	
Full or part-time work	496 (31.0%)	4.3 ± 0.6		12 (33.3%)	
Unemployed/non-paid labour	112 (7.0%)	4.1 ± 0.6		11 (30.6%)	
Disability/sick leave/modified duties	111 (6.9%)	4.1 ± 0.6		13 (36.1%)	
Seeking work	42 (2.6%)	4.2 ± 0.6		17 (47.2%)	
Social support (/5)	4.3 ± 0.9		<0.001		0.40
Definitely or most of the time	1257 (78.5%)	4.3 ± 0.6		16 (44.5%)	
Sometimes, rarely, or never	282 (17.6%)	4.1 ± 0.6		17 (47.2%)	
Years of formal education	12.7 ± 5.9		0.01		<0.001
12 years or less	595 (37.2%)	4.1 ± 0.5		14 (38.9%)	
>12 years	964 (60.2%)	4.3 ± 0.6		19 (52.8%)	
Worry about money (including for healthcare)			<0.001		0.10
I often worry	518 (32.4%)	4.3 ± 0.6		16 (44.5%)	
I worry sometimes	643 (40.2%)	4.2 ± 0.6		17 (47.2%)	
I never worry	413 (25.8%)	4.1 ± 0.5		18 (50.0%)	
Referral to CR			<0.001		<0.001
Yes	1045 (65.3%)	4.3 ± 0.6		20 (55.6%)	
No/I do not know	535 (33.4%)	4.1 ± 0.5		11 (30.6%)	
Participated in CR			<0.001		<0.001
Yes	933 (58.3%)	4.4 ± 0.5		20 (55.6%)	
No	642 (40.1%)	4.0 ± 0.6		12 (33.3%)	

Given some missing data, valid percentages are reported.

CR, cardiac rehabilitation; INCR-S, Information Needs in Cardiac Rehabilitation short version.

^aScores range from 1 to 5, with higher scores denoting greater need for information.

^bFor test of differences in total INCR-S importance scores by characteristic, using Pearson's correlation, ANOVA, or *t*-test as applicable.

^c*n* (%) yes.

^dFor test of differences in total INCR-S knowledge sufficiency scores by characteristic, using *t*-tests or χ^2 tests as applicable.

Table 2 Mean Information Needs in Cardiac Rehabilitation short version scores by item, as well as exploratory factor analysis, $n = 1601$

Item	INCR-S scores ^a (mean \pm SD)	Factors ^b				
		1: symptom response and medication	2: heart diseases, diagnostic tests, and treatments	3: exercise and return to life roles/ programmes to support	4: CV risk factors	5: healthy eating and psychosocial management
1: How does a healthy heart work?	4.4 \pm 0.9		0.612			
2: What is 'coronary artery disease'?	4.3 \pm 0.9		0.699			
3: What is angina?	4.2 \pm 0.8		0.672			
4: What happens when someone has a heart attack or other heart event?	4.4 \pm 0.8		0.641			
5: What foods should I eat for a healthy heart?	4.4 \pm 0.7					0.300
6: How can I choose healthy foods at the grocery store?	4.2 \pm 0.8					0.468
7: How can I choose healthy foods when dining out?	4.1 \pm 0.9					0.505
8: How do I read food labels?	4.0 \pm 1.0					0.580
9: How will exercise help my heart condition?	4.4 \pm 0.7			0.543		
10: How do I exercise safely?	4.3 \pm 0.8			0.566		
11: Do I need resistance training (i.e. exercise for strength)?	4.0 \pm 0.9			0.692		
12: What types of exercise equipment are useful and available? (where?)	4.0 \pm 0.9			0.678		
13: Is sexual activity safe for me?	3.8 \pm 1.0			0.539		
14: What medications do I need for my heart?	4.4 \pm 0.7	0.521				
15: How do I take my medications in the right way?	4.4 \pm 0.8	0.466				
16: What side effects are possible with my medications?	4.3 \pm 0.8	0.493				
17: How do I remember to take my medications?	4.2 \pm 1.1	0.374				
18: What roles do complementary and alternative therapies play in my heart recovery?	3.9 \pm 1.0	0.320				
19: When can I return to work and/or to my old activities?	4.1 \pm 0.9			0.479		
20: What feelings are common after a heart attack? How do I get help if I feel down or anxious?	4.2 \pm 0.9					0.303
21: How does stress affect my heart?	4.3 \pm 0.8					0.300
22: How can I manage stress?	4.3 \pm 0.8					0.300
23: How do sleep problems affect my heart?	4.3 \pm 0.8					0.325
24: What services, support organizations and groups are available?	4.0 \pm 0.9			0.433		
25: What should I do if I feel angina or chest pain?	4.4 \pm 0.8	0.567				
26: When should I see the doctor or go to the emergency room?	4.4 \pm 0.8	0.606				

Continued

Table 2 Continued

Item	INCR-S scores ^a (mean ± SD)	Factors ^b				
		1: symptom response and medication	2: heart diseases, diagnostic tests, and treatments	3: exercise and return to life roles/ programmes to support	4: CV risk factors	5: healthy eating and psychosocial management
27: What are the tests used to assess my heart condition?	4.3 ± 0.8		0.300			
28: What other treatments are available for my condition?	4.2 ± 0.9		0.300			
29: What is 'bypass surgery'?	4.1 ± 0.9		0.302			
30: What is an angioplasty or stent?	4.2 ± 0.9		0.372			
31: What can I do to bring my risk factors under control?	4.4 ± 0.8				0.323	
32: How does cholesterol affect my heart?	4.3 ± 0.8				0.415	
33: How does blood pressure affect my heart?	4.4 ± 0.8				0.433	
34: How does being around tobacco affect my heart?	4.2 ± 0.9				0.724	
35: How do alcohol and/or drugs affect my heart?	4.1 ± 0.9				0.708	
36: What is cardiac rehabilitation about?	4.4 ± 0.7			0.499		
Variance explained	NA	15.6%	14.6%	12.5%	9.4%	8.0%
Eigenvalues	NA	16.5	1.7	1.3	1.1	1.0
Internal reliability	NA	0.86	0.88	0.85	0.87	0.90

CV, cardiovascular; INCR-S, Information Needs in Cardiac Rehabilitation short version; NA, not applicable.

^aScores range from 1 to 5, with higher scores denoting greater needs for information.

^bFactor loadings <0.300 are not shown to support interpretation.

Construct validity

In [Table 1](#), INCR-S importance scores are shown by respondents' characteristics. As expected and supporting construct validity, there were significant differences by education. In addition, those that reported having social support, more often worrying about money, and working or previously working rated the information as significantly more important than their counterparts.

[Table 1](#) also displays the association between respondent characteristics and perceived knowledge sufficiency to further consider construct validity. As shown, participants who were older, male, retired or seeking work, and with more education had greater perceived knowledge sufficiency than their counterparts; no other differences were observed.

Finally, to more fully assess construct validity, INCR-S information sufficiency item and importance subscale scores were compared by respondents' CR enrolment status. Perceived knowledge sufficiency was significantly greater among CR enrollees than non-enrollees for all the 36 items. Among non-CR enrolling respondents, the greatest information needs were 'What happens when someone has a heart attack or other heart event?', 'When should I see the doctor or go to the emergency room?', and 'What should I do if I feel angina or chest pain?'. Among enrolling respondents, the greatest information needs were 'How will exercise help my heart condition?', 'What medications do I need for my heart?', and 'What should I do if I feel angina or chest pain?'. There were also significant differences in importance ratings for all subscales by CR enrolment status ([Table 3](#)), with enrollees perceiving each subscale as more important than non-enrollees, also supporting INCR-S validity.

Cardiovascular disease information needs around the globe

The INCR-S item importance scores are shown in [Table 2](#); all items were rated as highly important (i.e. for all but 2 items, the mean scores were above 4/5; the 2 items were sexual activity and complementary and alternative medicine). As shown, respondents perceived as most important the nature of cardiac events, heart-healthy eating, benefits of exercise for the heart, cardiac medications, how to take medications, how to respond to angina and when to seek care, how to control risk factors (particularly blood pressure), and about CR. Total and subscale INCR-S importance scores are shown in [Table 3](#); the subscale rated most important was symptom response and medication.

When asked about any other information needs, most respondents left the item blank or stated 'none' ($n = 1510$), and 16 others responded with a comment related to desired source or mode of information delivery (i.e. not applicable). Of 78 'other' information needs reported, 68 responses related to information were already considered in the scale, such as return to specific activities (e.g. travel, sauna, scuba, bodybuilding, household chores, and social activities), effects of substance abuse on heart health (e.g. marijuana), how to treat dyslipidaemia, information about weight control, and exercise (e.g. using smartwatch to monitor) as well as availability of low-cost CR programmes. Nineteen (1.2%) responses did pertain to topics not included in the scale, such as CPR training, genetics of CVD, activities to avoid

Table 3 Ratings of Information Needs in Cardiac Rehabilitation short version item knowledge sufficiency and Information Needs in Cardiac Rehabilitation short version subscale importance, by CR enrolment status

INCR-S item	Overall sample (n = 1601)	CR enrolment status		P
		Enrolled, n = 933 (58.3%)	Did not, n = 642 (40.1%)	
1: How does a healthy heart work?	654 (40.8%)	456 (48.9%)	179 (29.5%)	<0.001
2: What is 'coronary artery disease'?	620 (38.7%)	431 (46.2%)	172 (28.4%)	<0.001
3: What is angina?	610 (38.1%)	426 (45.7%)	164 (27.1%)	<0.001
4: What happens when someone has a heart attack or other heart event?	671 (41.9%)	465 (49.8%)	186 (30.7%)	<0.001
5: What foods should I eat for a healthy heart?	831 (51.9%)	593 (63.6%)	209 (34.5%)	<0.001
6: How can I choose healthy foods at the grocery store?	835 (52.2%)	596 (63.9%)	209 (34.5%)	<0.001
7: How can I choose healthy foods when dining out?	785 (49.0%)	555 (59.5%)	206 (34.0%)	<0.001
8: How do I read food labels?	638 (39.9%)	443 (47.5%)	177 (29.2%)	<0.001
9: How will exercise help my heart condition?	857 (53.5%)	631 (67.6%)	199 (32.8%)	<0.001
10: How do I exercise safely?	740 (46.2%)	547 (58.6%)	169 (27.9%)	<0.001
11: Do I need resistance training?	531 (33.2%)	380 (40.7%)	131 (21.6%)	<0.001
12: What types of exercise equipment are useful and available? (where?)	605 (37.8%)	443 (47.5%)	138 (22.8%)	<0.001
13: Is sexual activity safe for me?	802 (50.1%)	573 (61.4%)	201 (33.2%)	<0.001
14: What medications do I need for my heart?	896 (56.0%)	632 (67.7%)	234 (38.6%)	<0.001
15: How do I take my medications in the right way?	1012 (63.2%)	710 (76.1%)	266 (43.9%)	<0.001
16: What side effects are possible with my medications?	659 (41.2%)	467 (50.1%)	168 (27.7%)	<0.001
17: How do I remember to take my medications?	1079 (67.4%)	737 (79.0%)	306 (50.5%)	<0.001
18: What roles do complementary and alternative therapies play in my heart recovery?	503 (31.4%)	360 (38.6%)	129 (21.3%)	<0.001
19: When can I return to work and/or to my old activities?	754 (47.1%)	532 (57.0%)	201 (33.2%)	<0.001
20: What feelings are common after a heart attack? How do I get help if I feel down or anxious?	650 (40.6%)	462 (49.5%)	167 (27.6%)	<0.001
21: How does stress affect my heart?	740 (46.2%)	508 (54.4%)	203 (33.5%)	<0.001
22: How can I manage stress?	608 (38.0%)	412 (44.2%)	169 (27.9%)	<0.001
23: How do sleep problems affect my heart?	669 (41.8%)	457 (49.0%)	185 (30.5%)	<0.001
24: What services, support organizations and groups are available?	481 (30.0%)	344 (36.9%)	122 (20.1%)	<0.001
25: What should I do if I feel angina or chest pain?	779 (48.7%)	538 (57.7%)	211 (34.8%)	<0.001
26: When should I see the doctor or go to the emergency room?	890 (55.6%)	612 (65.6%)	238 (39.3%)	<0.001
27: What are the tests used to assess my heart condition?	740 (46.2%)	513 (55.0%)	199 (32.8%)	<0.001
28: What other treatments are available for my condition?	548 (34.2%)	386 (41.4%)	144 (23.8%)	<0.001
29: What is 'bypass surgery'?	623 (38.9%)	435 (46.6%)	164 (27.1%)	<0.001
30: What is an angioplasty or stent?	727 (45.4%)	518 (55.5%)	184 (30.4%)	<0.001
31: What can I do to bring my risk factors under control?	728 (45.5%)	522 (55.9%)	181 (29.9%)	<0.001
32: How does cholesterol affect my heart?	817 (51.0%)	593 (63.6%)	195 (32.2%)	<0.001
33: How does blood pressure affect my heart?	823 (51.4%)	560 (60.0%)	230 (38.0%)	<0.001
34: How does being around tobacco affect my heart?	948 (59.2%)	658 (70.5%)	263 (43.4%)	<0.001
35: How do alcohol and/or drugs affect my heart?	857 (53.5%)	602 (64.5%)	232 (38.3%)	<0.001
36: What is cardiac rehabilitation about?	691 (43.2%)	570 (61.1%)	103 (17.0%)	<0.001
Factor 1: symptom response and medication	NA	4.5 ± 0.6	4.2 ± 0.7	<0.001
Factor 2: heart diseases, diagnostic tests, and treatments	NA	4.4 ± 0.6	4.1 ± 0.7	<0.001
Factor 3: exercise and return to life roles/programmes to support	NA	4.3 ± 0.5	4.0 ± 0.6	<0.001
Factor 4: CV risk factors	NA	4.4 ± 0.6	4.1 ± 0.7	<0.001
Factor 5: healthy eating and psychosocial management	NA	4.3 ± 0.6	4.1 ± 0.7	<0.001
Total INCR-S	NA	4.4 ± 0.5	4.1 ± 0.6	<0.001

n (%) yes for knowledge sufficiency or mean ± standard deviation for subscale information importance shown.

CR, cardiac rehabilitation; CV, cardiovascular; INCR-S, Information Needs in Cardiac Rehabilitation short version; NA, not applicable.

after surgery or procedures, tests of lung function, relation to other conditions (e.g. kidney and liver diseases), progression of exercise, and probable life span.

The greatest information needs among women were 'What happens when someone has a heart attack or other heart event?', 'What should I do if I feel angina or chest pain?', and 'When should I see the doctor or

Table 4 Information importance by subscale, as well as educational information response helpfulness by WHO region

Region (<i>n</i> countries; <i>n</i> participants)	Mean helpfulness ratings (\pm SD) ^a	Subscales ^a				
		Factor: symptom response and medication	Factor: heart diseases, diagnostic tests, and treatments	Factor: exercise and return to life roles/ programmes to support	Factor: CV risk factors	Factor: healthy eating and psychosocial management
Africa (1 ; 68)	NA	3.8 \pm 0.6	3.9 \pm 0.5	4.0 \pm 0.5	3.9 \pm 0.5	3.9 \pm 0.6
Americas (3 ; 587)	4.3 \pm 0.8	4.5 \pm 0.5	4.4 \pm 0.6	4.3 \pm 0.6	4.4 \pm 0.6	4.4 \pm 0.5
Europe (7 ; 445)	4.5 \pm 0.6	4.3 \pm 0.8	4.2 \pm 0.7	4.1 \pm 0.6	4.2 \pm 0.8	4.1 \pm 0.8
Southeast Asia (1 ; 137)	4.4 \pm 0.5	4.1 \pm 0.5	3.9 \pm 0.6	3.9 \pm 0.6	4.0 \pm 0.6	3.9 \pm 0.6
Western Pacific (6 ; 360)	4.6 \pm 0.6	4.4 \pm 0.5	4.4 \pm 0.5	4.2 \pm 0.6	4.3 \pm 0.6	4.3 \pm 0.5

Eastern Mediterranean not shown due to low sample size ($n = 4$). Values in bold are *n* countries while values in italics are *n* participants.

NA, not applicable for Africa because the site could not provide education resources in the patients' first language; WHO, World Health Organization; SD, standard deviation; CR, cardiac rehabilitation; INCR-S, Information Needs in Cardiac Rehabilitation short version.

^aMean scores range from 1 to 5, with higher scores denoting greater information needs or helpfulness.

go to the emergency room?'; among men, the greatest information needs were 'How will exercise help my heart condition?', 'What medications do I need for my heart?', and 'What should I do if I feel angina or chest pain?'. Among patients older than 65, the greatest information needs were 'When should I see the doctor or go to the emergency room?', 'What medications do I need for my heart?', and 'What happens when someone has a heart attack or other heart event?'; among those younger, the greatest information needs were 'How will exercise help my heart condition?', 'What medications do I need for my heart?', and 'What should I do if I feel angina or chest pain?'. Among patients with <12 years of education, the greatest information needs were 'What should I do if I feel angina or chest pain?', 'What medications do I need for my heart?', and 'When should I see the doctor or go to the emergency room?'; among those with more education, the greatest information needs were 'How will exercise help my heart condition?', 'What happens when someone has a heart attack or other heart event?', and 'What should I do if I feel angina or chest pain?'.
Item knowledge sufficiency scores are shown in Table 3; these ranged from 30.0 to 67.4%. Items respondents most often perceived they knew enough about were the following: how to remember to take medications, how to take medications in the right way, and how being around tobacco affects the heart. Items respondents most often perceived they knew least about were as follows: 'What services, support organizations and groups are available?', 'What roles do complementary and alternative therapies play in my heart recovery?', and 'Do I need resistance training?'.
The INCR-S total scores are shown by region and income class in Table 1, with most important information areas by each shown in Figure 1. As shown in Table 1, by region, there was significant variation in importance (rated highest in Americas and lowest in Africa) and knowledge sufficiency (rated highest in Africa and lowest in Southeast Asia). Importance subscale scores are shown by region in Table 4. In Africa, the most important information needs were 'Do I need resistance training?', 'How do alcohol and/or drugs affect my heart?', and 'How do I exercise safely?'. In the Americas, the most important information needs were 'What should I do if I feel angina or chest pain?', 'When should I see the doctor or go to the emergency room?', and 'How will exercise help my heart condition?'. In Europe, the most important information needs were 'What medications do I need for my heart?', 'What happens when someone has a heart attack or other heart event?', and 'What should I do if I feel angina or chest pain?'. In Southeast Asia, the most important information needs were 'What medications do I need for my heart?', 'How do I take my medications in the right way?', and 'When should I see the doctor or go to the emergency room?'. Lastly, in the Western Pacific, the

most important information needs were 'What happens when someone has a heart attack or other heart event?', 'What should I do if I feel angina or chest pain?', and 'When should I see the doctor or go to the emergency room?'.
By income class, there was also significant variation in both, with respondents from lower middle-income countries rating the information as least important and those in high-income countries reporting greatest knowledge sufficiency (Table 1). In lower middle-income countries, the most important information needs were 'What medications do I need for my heart?', 'How will exercise help my heart condition?', and 'How can I manage stress?'. In upper middle-income countries, the most important information needs were 'What should I do if I feel angina or chest pain?', 'When should I see the doctor or go to the emergency room?', and 'What happens when someone has a heart attack or other heart event?'. In high-income countries, the most important information needs were 'How will exercise help my heart condition?', 'What happens when someone has a heart attack or other heart event?', and 'What is cardiac rehabilitation about?'.
Educational information response helpfulness
The mean information helpfulness rating was 4.4 \pm 0.7/5, suggesting the education provided in response to high information needs without knowledge sufficiency was highly satisfactory. Scores are shown by region in Table 4. There was no significant difference in rating by language of survey or CR initiation (both $P > 0.05$).

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Discussion

In this first ever investigation of cardiac patient information needs around the globe, the INCR-S was established as psychometrically valid. Upon assessment in over 1600 patients from almost 20 countries, patient's greatest information needs and areas of knowledge sufficiency were identified, with significant variation by region and country income class shown. This brief scale thus should be used to support optimized and individualized CV patient education internationally.

Through assessment of the reliability and validity of the INCR-S in this study, and along with other measurement properties assessed and established as satisfactory in previous research on the INCR,¹² overall results suggest the brief scale is psychometrically valid. Indeed, mean total importance scores of the INCR-S were consistent with the INCR translations, all slightly above 4/5.¹² Exploratory factor analysis revealed five factors, all

internally consistent and generally consistent with the INCR¹²: symptom response/medication, heart diseases/diagnostic tests/treatments, exercise/return to life roles/programmes to support, cardiovascular risk factors, and healthy eating/psychosocial management. Construct validity was confirmed by significant differences in information importance and knowledge sufficiency ratings by CR enrolment. Despite reducing the number of items, there should not be great concern about failure to identify information needs, given <2% of respondents reported unique 'other' information needs. This brief version will be more usable in clinical settings.

Of interest was the lack of sex difference in ratings of information importance but significant sex difference in knowledge sufficiency. There are few studies of sex differences in cardiac patient information needs,²⁰ despite that it is known women who develop CVD have lower awareness of their risk²¹ and that women with CVD receive less patient education.²² Therefore, this study adds to our understanding. But given current understanding, the dearth of studies on sex differences in disease management knowledge in cardiac patients is a glaring omission.²³ Whether women cardiac patients generally have lower knowledge than men warrants study, as the higher knowledge sufficiency ratings in men may be explained by their documented over-confidence in many areas.²⁴

Implications for cardiac rehabilitation programmes

Arguably, patient information needs can best be met within CR, given the multidisciplinary team who have knowledge across all areas of secondary prevention,²⁵ delivering care over time and hence providing the context to support patient implementation of knowledge gained.²⁶ Indeed, therapeutic education is a core component of CR.^{27,28} The ICCPR's global audit established 97% of programmes deliver education as a standard of care (median 4.5 h per patient).²⁹

Nevertheless, CR programmes report barriers to providing comprehensive education.³⁰ For instance, while programmes are generally staffed by a multidisciplinary team³¹ as per best practice recommendations,⁷ staff desire further training and time to assess knowledge and cover all needed areas for fulsome secondary prevention.⁹ Moreover, as demonstrated herein and in previous research,³² patient information needs change over the course of their disease trajectory.

For these reasons, the INCR-S is a valuable tool to support identification of key information needs in CR participants, enabling prioritization of education content over time to optimize comprehensive delivery, minimizing burden on patients and staff. To support CR programmes, ICCPR hosts the INCR-S in English, Portuguese, and simplified Chinese for patient self-report on its website at <https://globalcardiacrehab.com/For-Patients>.

It would be prudent for CR programmes to concomitantly assess patient health literacy also using a validated tool³³ to ensure it is sufficient, so education provided can be tailored not only in terms of information needs but also level of difficulty. Moreover, no patient knows what they do not or need to know, and hence, a corresponding assessment of actual knowledge to ensure patients do have all the information needed to successfully self-manage their heart disease would also be prudent, such as with the Coronary Artery Disease Education Questionnaire (CADE-Q).³⁴ This is particularly true given that some patients seek information about their heart on the internet, and the information may be erroneous or out of date.^{35,36} In sum, CR programmes are advised to assess patient health literacy, information needs (using potentially the now validated INCR-S), and knowledge *a priori* to inform delivery of individualized education plans for their patients.

Areas to target for patient education given their high importance combined with low knowledge sufficiency ratings regard understanding their condition (i.e. CVD and angina), managing stress, and treatment options (e.g. bypass surgery). Interestingly, knowledge sufficiency was rated highest for medication adherence tools, yet patient adherence to medications remains grossly suboptimal.³⁷ Knowledge sufficiency

around tobacco was also very high, suggesting awareness campaigns have been successful,³⁸ but again there was wide regional variation observed in this international study, and hence, this may remain an important education topic in several regions. Moreover, in Southeast Asia, the Western Pacific, and middle-income countries overall, patients reported low knowledge sufficiency in the areas where they most desired information, most commonly related to symptom response and medication (Figure 1).

Limitations

Results of this study should be interpreted with caution. First, generalizability is limited. There were very few responses in the Eastern Mediterranean, so conclusions for that region should not be extrapolated from these findings. Moreover, the survey was not administered in some commonly spoken languages around the world. Information needs of those speaking Spanish, Hindi, and Arabic for example should be assessed in the future, and indeed, a Spanish translation of INCR is available.¹⁵ Additionally, this was a convenience sample, so those that did not complete the survey may have different information needs. However, previously, the INCR had only been administered in Canada, South Korea, Brazil, Costa Rica, Colombia, and Peru, so for the first time, it has been administered in four new WHO regions. Given general consistency in findings, major concerns should be assuaged.

Second, regarding statistical analyses, multiple comparisons were made, inflating the potential for error. Readers are hence cautioned in over-interpreting associations observed without replication research. But given the novel nature of these data, these associations can be considered hypothesis generating. Finally, causal conclusions cannot be drawn due to the design of this study. For example, patients with greater awareness of the importance of disease-related knowledge may advocate for their CR referral.

Conclusions

The identification of patient information needs can guide healthcare providers in the development of tailored therapeutic education to support increases in patient's disease-related knowledge, which should result in behaviour changes and ultimately improved health outcomes. The INCR-S is established as reliable and valid for this purpose; while more research is needed, overall results confirmed satisfactory measurement properties and supported its administration across many global contexts. Cardiac care providers are urged to assess patient's health literacy, their perceptions of information importance, and knowledge and/or perceived knowledge sufficiency to inform delivery of prioritized, brief, and individualized education. Based on results of this study, education regarding the nature of their cardiac conditions, managing stress, and treatment options should be prioritized around the globe.

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Author contributions

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Data availability

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

Appendix

Links to evidence-based lay educational information as responses for each INCR-S item patients rate highly. Note: translations available at <https://cadeq.wordpress.com/related-tools/>.

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