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Predictors of participation in, adherence to and outcomes of cardiac rehabilitation in older adults: a scoping review

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Abstract

Background Cardiac rehabilitation lowers mortality and improves function, yet remains underused by older adults. Existing syntheses address access in general populations or frailty alone; none maps predictors across the whole pathway in later life.

Aims To map reported predictors of participation, adherence and outcomes in older adults and identify evidence gaps.

Methods Following JBI methodology and reported with PRISMA-ScR, eligibility used the Population, Concept, Context approach: older adults (mean or median age 65 years or older, or with extractable data for those aged 65 years or older) with a cardiovascular indication; any reported predictor of participation, adherence or outcomes; and any rehabilitation setting. MEDLINE (PubMed), the Cochrane Library, Europe PMC and DOAJ were searched from inception to July 2026, supplemented by grey literature and citation searching. Records were screened and charted in duplicate, with a third reviewer resolving disagreements. Critical appraisal was not undertaken.

Results Of 5250 records screened, 366 studies were included; 356 yielded 1534 predictor associations. Evidence concentrated on outcomes (934) rather than participation (425) or adherence (175). Clinical (426) and sociodemographic (387) predictors predominated; psychosocial predictors were sparsest (173). Female sex and older age were the commonest barriers to participation. Functional and frailty-related predictors fell almost entirely in the outcome domain (209 of 236) and were rarely examined for participation (15) or adherence (12).

Conclusions The evidence is extensive but unevenly distributed. Outcome prediction dominates, adherence is neglected, and frailty is studied as a determinant of outcome rather than access. Future work should address adherence and frailty as a predictor of participation.

Registration Open Science Framework, https://doi.org/10.17605/OSF.IO/63TUK (PROSPERO does not register scoping reviews).

Introduction

Exercise-based cardiac rehabilitation reduces cardiovascular mortality and hospital readmission and improves exercise capacity and health-related quality of life in coronary and other cardiovascular disease [1, 2]. These benefits extend to older patients, in whom supervised rehabilitation after myocardial infarction improves exercise tolerance and quality of life [3], and early rehabilitation after cardiac procedures in patients aged 75 years or older can improve functional recovery and shorten hospital stay [21]. Despite this, cardiac rehabilitation is markedly underused in later life, and referral, enrolment and completion all decline as age advances [4, 5, 6].

The determinants of access to rehabilitation have been synthesised in general adult populations. Systematic reviews have mapped the factors associated with participation and adherence [7], with non-

participation and dropout [8], and with referral to rehabilitation and secondary prevention [9]. These reviews repeatedly identify older age as a barrier, yet they seldom isolate the older population or ask how predictors operate within it.

Ageing brings multimorbidity and frailty, which are common in cardiovascular disease and worsen prognosis [10, 11]. Frailty has become a growing focus in the rehabilitation literature, and recent syntheses have examined its prevalence, its measurement and its relationship with rehabilitation outcomes [12, 13, 14]. Cohort studies in advanced-age patients have begun to identify predictors of exercise-capacity gain during rehabilitation after acute coronary syndromes [22]. This work illuminates individual predictors, but it does not map the wider set of factors that shape participation, adherence and outcomes in older adults.

Two gaps therefore persist. The evidence on predictors of access is concentrated in general populations rather than in older adults, and the evidence that is specific to older adults is largely confined to frailty or is narrative in form. No synthesis maps predictors across the whole pathway, from referral through participation and adherence to functional, clinical and patient-reported outcomes, in older adults, nor does it document how an older adult is defined and how these predictors are measured. A scoping review is the appropriate design to chart this heterogeneous evidence, to clarify concepts and definitions, and to establish whether a systematic review is warranted. In older adults eligible for or undergoing cardiac rehabilitation, the review addresses four questions: first, which factors predict participation and enrolment; second, which factors predict adherence and completion; third, which factors predict outcomes, namely functional capacity, health-related quality of life, mortality, hospitalisation, change in frailty and psychological outcomes; and fourth, how an older adult is operationally defined and how predictors are measured and analysed across the evidence.

Methods

Protocol and registration

The review follows the framework of Arksey and O'Malley as refined by Levac and colleagues and the JBI methodology for scoping reviews [15, 16, 17], and is reported using the PRISMA extension for scoping reviews (PRISMA-ScR) [19]; the completed checklist is provided as Online Resource 1. Consistent with the journal's requirement for prospective registration, and because PROSPERO does not accept scoping reviews, the protocol was registered a priori on the Open Science Framework (https://doi.org/10.17605/OSF.IO/63TUK) and developed following best-practice guidance for scoping review protocols [18].

Eligibility criteria

Eligibility followed the Population, Concept, Context approach. Population: adults with a mean or median age of 65 years or older, or studies from which data for participants aged 65 years or older could be extracted, with a cardiovascular indication for rehabilitation (coronary heart disease, post-myocardial

infarction, post-percutaneous coronary intervention or coronary artery bypass grafting, heart failure, valvular disease including post-transcatheter aortic valve implantation or valve surgery, and peripheral artery disease). Concept: any factor reported to be associated, quantitatively or qualitatively, with participation or enrolment, adherence, attendance, completion or dropout, or with outcomes (exercise or functional capacity, health-related quality of life, mortality, hospitalisation or readmission, change in frailty, and psychological outcomes). Context: phase II centre-based, home-based, hybrid or tele-rehabilitation programmes, in any country and any period. Primary quantitative, qualitative and mixed-methods studies were eligible; reviews were used only for reference screening. Eligible reports were in English, with records in other languages logged. Following an amendment to the registered protocol, eligibility was restricted to reports published from 1 January 2005 to the search date and to reports for which the full text could be obtained; the amendment and its justification are documented in the registration record and in the deposited record of deviations [23]. Paediatric populations, non-cardiac rehabilitation, records reporting no predictor, and opinion pieces without data were excluded.

Information sources and search

A two-tier model was used so that the search would be reproducible without subscription databases. The primary sources were freely accessible: MEDLINE via PubMed, the Cochrane Library (CENTRAL), Europe PMC and the Directory of Open Access Journals. Grey literature was sought through Google Scholar, medRxiv, OpenAIRE and the trial registries ClinicalTrials.gov and the WHO International Clinical Trials Registry Platform. The search combined the Population and Concept terms using controlled vocabulary and free-text synonyms, and was developed with an information specialist; the full PubMed strategy is provided as Online Resource 2 and was translated for each database, with reporting following PRISMA-S. The search was executed in July 2026. Backward and forward citation searching complemented the database search, and paywalled full texts were obtained through institutional document delivery, interlibrary loan or author request.

Selection of sources of evidence

Records were deduplicated in a reference manager and screened in Rayyan. Two reviewers (D.S. and M.K.S.) screened titles and abstracts independently, and a third reviewer (D.K.) resolved disagreements. Full-text screening will follow the same duplicate procedure, with reasons for exclusion recorded. Selection is reported in a PRISMA-ScR flow diagram (Fig. 1).

Data charting and synthesis

A charting form was drafted, piloted on a sample of sources and refined by consensus, and charting is performed in duplicate; the completed dataset is openly deposited [23]. Charted items include the citation, country, study design, rehabilitation setting and phase, sample size, the definition of an older adult and the mean or median age, the cardiac indication, the domain or domains addressed, the predictors examined, the direction and strength of association where reported, the outcome measures, and the analytic method. Consistent with scoping review methodology the methodological quality of

sources is not appraised [17, 19]. In a departure from the amended protocol, which restricted inclusion to reports with an obtainable full text, 36 studies whose full text could not be secured at the charting stage were charted from their abstracts rather than excluded; they are identified in the deposited charting dataset [23] and their contribution is quantified in the results and considered in the limitations. Charted data are mapped in tables and summarised narratively, grouped by the three predictor domains (participation, adherence, outcomes) and, within each, by predictor category (sociodemographic, clinical, functional or frailty-related, psychosocial, and system or logistical), with descriptive counts of how often each predictor and category is reported. Gaps are used to frame recommendations for a future systematic review [20].

Use of a large language model

A large language model (Claude, Anthropic) was used to support data management. It assisted with translating the search strategy across databases, reconciling and de-duplicating the exported records, constructing the screening and charting workbooks. All eligibility decisions, all data charting and all interpretation were made by the named authors, who checked the outputs against the source records and take full responsibility for the content of this article.

Results

Selection of sources of evidence

The database searches identified 7655 records: 4685 in MEDLINE (PubMed), 1168 in the Cochrane Library (CENTRAL), 1233 in Europe PMC and 569 in DOAJ. After 2373 duplicate records were removed, 5250 records were screened at title and abstract, of which 4432 were excluded and 818 were sought for full-text assessment. 818 reports were sought for full-text assessment. Full texts were obtained through open access and automated open-access retrieval (Unpaywall, OpenAlex and Semantic Scholar); reports whose full text could not be obtained were excluded and recorded as full text unavailable. Under the amended eligibility criteria (published 2005 to 2026, with an obtainable full text), 386 reports proceeded to charting; during charting a further 20 were excluded because the reported mean or median age proved to be below 65 years, leaving 366 included studies. A further 146 reports that were eligible on title and abstract were excluded because the full text could not be obtained, and three were excluded as outside the timeframe. The flow of sources, with reasons for exclusion at full text, is shown in the PRISMA-ScR flow diagram (Fig. 1).

Characteristics of included sources

The 386 included studies were published between 2005 and 2026, and the volume of eligible research has risen over time, with most studies appearing in the past decade (Fig. 2). They were published most frequently in the European Journal of Preventive Cardiology, the Journal of the American Heart Association, the Journal of Cardiopulmonary Rehabilitation and Prevention and PLoS One. All four searched databases contributed to the final set. The countries, study designs, rehabilitation settings,

cardiac indications and operational definitions of an older adult are charted from the full texts and reported in Table 1.

Studies originated in 33 countries or multinational collaborations. Japan (99 studies) and the United States (92) together accounted for just over half of the evidence, followed by Italy (31), the United Kingdom (28), multinational collaborations (13), Denmark (12) and the Netherlands (12). Cohort designs predominated (190 studies), with registry or administrative analyses (69), cross-sectional studies (48), randomised controlled trials (28) and qualitative studies (18) making up most of the remainder. Centre-based phase II programmes were the commonest setting (185 studies), followed by inpatient rehabilitation (89); home-based (18), hybrid (9) and tele-rehabilitation (8) programmes were comparatively rare, and the setting was not reported in 35 studies. Most studies enrolled mixed cardiac populations (161); heart failure (71), coronary heart disease (47) and post-myocardial infarction cohorts (43) were the commonest single indications, while valvular disease including transcatheter aortic valve implantation was addressed by 16.

The operational definition of an older adult was heterogeneous. A fixed age threshold was used in 155 studies, a reported mean age in 131 and a median age in 45, while 31 studies reported no usable age definition and only 4 defined the population by frailty. Among the 162 studies reporting a single unambiguous mean or median age, the median of those values was 71.8 years (range 65.0 to 86.9). Full characteristics are given in Table 1.

Table 1 Characteristics of the 366 included studies

Characteristic	Studies, n (%)
Country or region (33 distinct)	
Japan	99 (27.0)
United States	92 (25.1)
Italy	31 (8.5)
United Kingdom	28 (7.7)
Multinational	13 (3.6)
Denmark	12 (3.3)
Netherlands	12 (3.3)
Germany	8 (2.2)
China	8 (2.2)
South Korea	7 (1.9)
Other countries	56 (15.3)
Study design	
Cohort	190 (51.9)
Registry / administrative	69 (18.9)
Cross-sectional	48 (13.1)
RCT	28 (7.7)
Qualitative	18 (4.9)
Mixed-methods	7 (1.9)
Other	4 (1.1)
Case-control	2 (0.5)
Cardiac rehabilitation setting	
Centre-based phase II	185 (50.5)
Inpatient	89 (24.3)
Not reported	35 (9.6)
Other	22 (6.0)
Home-based	18 (4.9)
Hybrid	9 (2.5)

Tele-rehabilitation	8 (2.2)
Cardiac indication	
Mixed	161 (44.0)
Heart failure	71 (19.4)
Coronary heart disease	47 (12.8)
Post-MI	43 (11.7)
Valvular incl. TAVI	16 (4.4)
Post-PCI	11 (3.0)
Post-CABG	9 (2.5)
Other	8 (2.2)
Definition of an older adult	
Age threshold	155 (42.3)
Mean age	131 (35.8)
Median age	45 (12.3)
Not reported	31 (8.5)
Frailty-based	4 (1.1)
Reported mean or median age	
Median of reported values, years (range)	71.8 (65.0-86.9); reported by 162 studies
Full text used for charting	
Full text obtained	330 (90.2)
Charted from abstract only	36 (9.8)
Charted associations	
Studies contributing at least one association	356 (97.3)
Studies with no chartable predictor	10 (2.7)
Total predictor associations charted	1534
Participation	425
Adherence	175
Outcome	934
Adjusted estimates	961 (62.6)

Unadjusted estimates	459 (29.9)
Adjustment not reported	114 (7.4)

Percentages for associations are of the 1534 charted associations; all other percentages are of the 366 included studies. Country values are normalised, and multi-country studies are grouped as Multinational

Predictors of participation and enrolment

425 associations were charted in this domain (Fig. 3). Sociodemographic predictors dominated (179 associations), followed by clinical (130), system or logistical (69), psychosocial (32) and functional or frailty-related predictors (15). Negative associations outnumbered positive ones (247 versus 148, with 24 null), reflecting the barrier-oriented framing of this literature. The most frequently charted predictor was female sex (20 associations, negative in 17), followed by older age (14 associations, negative in 12). Ethnicity was consistently reported as a barrier, with Black race relative to White (6 associations) and Hispanic ethnicity relative to White (5) uniformly negative. Living alone (4 associations) and pre-existing mild cognitive impairment (4) were also charted as barriers. Functional and frailty-related characteristics were examined in only 15 associations across the whole domain.

Predictors of adherence and completion

This was the sparsest domain, with 175 associations, under one fifth of the outcome literature. Psychosocial predictors were relatively more prominent here than elsewhere (53 associations), followed by system or logistical (44), sociodemographic (41), clinical (25) and functional or frailty-related predictors (12). Directions were more evenly balanced than for participation (74 positive, 71 negative, 28 null), and no single predictor was charted more than four times, indicating a fragmented evidence base. Female sex (4 associations), social support (3), peer-mentor interventions (3, all positive) and referral to cardiac rehabilitation (3, all positive) recurred most often.

Predictors of outcomes

Outcomes accounted for the largest share of the evidence, with 934 associations. Clinical predictors led (271 associations), followed by functional or frailty-related (209), system or logistical (199), sociodemographic (167) and psychosocial predictors (88). Positive associations slightly outnumbered negative ones (407 versus 354), with a substantial null fraction (168). Age was the most frequently charted predictor, whether as a continuous variable (23 associations, negative in 14) or dichotomised at 65 years (22 associations, of which 11 were null and 10 negative). Participation in cardiac rehabilitation itself was charted as a predictor of better outcome in 19 associations (positive in 14). Frailty measured with the Clinical Frailty Scale was uniformly negative (6 associations).

Adjustment and reporting

Of the 1534 charted associations, 961 derived from adjusted analyses, 459 from unadjusted analyses and 114 from reports in which the adjustment status could not be determined. Ten studies met the eligibility criteria but yielded no chartable predictor association, most often because they were feasibility, descriptive or measurement studies, and these are recorded in the deposited charting dataset [23] with the reason. Thirty-six studies (114 associations, 7.4 per cent) were charted from the abstract because the full text could not be secured at the charting stage; this is a departure from the amended protocol and is examined in the limitations.

Discussion

This review maps a large but unevenly distributed body of evidence. The central finding is one of imbalance. Almost two thirds of the charted associations concern outcomes, while adherence, the stage at which the benefits of rehabilitation are consolidated, accounts for barely one in nine. The asymmetry matters clinically, because an older patient who enrols but withdraws derives little of the mortality and functional benefit that the outcome literature documents so thoroughly.

A second imbalance concerns the characteristics that define geriatric practice. Functional and frailty-related predictors were charted 236 times, but 209 of these fell in the outcome domain and only 15 in participation and 12 in adherence. In other words, frailty and physical performance are studied overwhelmingly as determinants of how much a patient gains from rehabilitation, and hardly at all as determinants of whether the patient enters or remains in it. This is the reverse of the clinical intuition that frailty, gait speed and cognitive impairment shape access most strongly. Existing syntheses of frailty within rehabilitation have concentrated on the same outcome-facing question, so the gap identified here is not an artefact of our eligibility criteria but a genuine feature of the field.

Where participation is studied, the framing is predominantly demographic and negative. Female sex and older age were the most frequently charted predictors, almost always as barriers, and disparities by ethnicity were reported consistently. These findings agree with syntheses conducted in general adult populations, which likewise identify age, female sex and socioeconomic disadvantage as barriers. Our contribution is to show that, in populations that are already old, chronological age continues to be charted as a barrier, while the functional heterogeneity that actually distinguishes one older patient from another is rarely examined at the point of access.

The heterogeneity of definitions compounds the problem. Only a minority of studies applied an explicit age threshold, many relied on a reported mean age, 31 reported no usable definition, and just 5 defined their population by frailty. Comparability across studies is therefore limited, and pooling would be hazardous without harmonised definitions. This observation reinforces the case for a future systematic review with tightly specified population criteria rather than a broader mapping exercise.

Implications follow directly. For practice, referral decisions in older adults should not rest on chronological age, which the outcome literature charts as frequently null as negative when dichotomised at 65 years, whereas participation itself was consistently charted as a positive predictor of outcome. For

research, the priorities are adherence in older adults and frailty as a determinant of participation and persistence, together with consistent reporting of how an older adult is defined and whether estimates are adjusted.

This review has strengths and limitations. It was registered prospectively, the search relied on freely accessible databases and is therefore reproducible without subscription access, and screening and charting were performed in duplicate with third-reviewer arbitration. Against this, the review was restricted to English-language reports, no critical appraisal was undertaken, consistent with scoping review methodology, and the counts reported here are counts of reported associations rather than of independent effects, so a study reporting many predictors contributes more weight than one reporting a single predictor. Two protocol amendments, made after the yield of the search had been observed and documented in the registration, further shape the map: eligibility was restricted to reports published from 2005 onwards and to reports with an obtainable full text, which excluded 146 otherwise-eligible records and probably biases the included set towards open-access journals and more recent years. A further departure requires disclosure: although the amended protocol restricted inclusion to reports with an obtainable full text, 36 studies were ultimately charted from their abstracts because the full text could not be secured at the charting stage. These contributed 114 associations, 7.4 per cent of the total, and abstracts report predictors selectively, so the direction and adjustment status recorded for them are less reliable than for the remaining studies. Twenty reports were also excluded during charting when the reported mean or median age proved to be below 65 years, three of them identified only when the age field was parsed for the deposited dataset. Finally, the evidence is geographically concentrated, with Japan and the United States contributing just over half of the included studies, which limits transferability to health systems with different referral pathways and rehabilitation provision.

Conclusion

The literature on cardiac rehabilitation in older adults is extensive but unevenly distributed. Prediction of outcomes dominates, participation is studied mainly through demographic barriers, and adherence remains comparatively neglected. Functional and frailty-related characteristics, which are central to geriatric assessment, are examined almost exclusively as determinants of outcome rather than of access or persistence, and definitions of an older adult are inconsistent. Priorities for future work are a systematic review of adherence in older adults, primary studies of frailty and physical performance as predictors of participation, and harmonised reporting of age and frailty definitions.

Declarations

Funding: The authors received no specific funding for this work.

Competing interests: The authors have no competing interests to declare that are relevant to the content of this article.

Ethics approval: Not applicable. The review uses previously published data and involves no human participants or animals.

Consent to participate and consent to publish: Not applicable.

Data availability: The datasets generated and analysed during this review are openly available in the RepOD repository at https://doi.org/10.18150/W2JRFA. The deposit comprises the list of included studies with their identifiers, the complete data-charting dataset of 1534 predictor associations together with its normalisation log, the reports excluded at full text with the reasons for exclusion, the full electronic search strategy, the completed PRISMA-ScR checklist, the amended protocol and a complete record of deviations from the registered protocol. The registered protocol and its documented amendments are also available in the Open Science Framework repository (https://doi.org/10.17605/OSF.IO/63TUK). No individual participant data were used, because the review synthesises previously published aggregate findings.

Author contributions: D.S. had the idea for the review and designed it. D.S. and M.K.S. performed the literature search and study selection; D.S., A.S.-S. and M.K.S. performed data charting; D.K. acted as third reviewer and arbitrated disagreements. D.S. drafted the manuscript and all authors revised it critically and approved the submitted version. D.S. is the guarantor.

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Figures

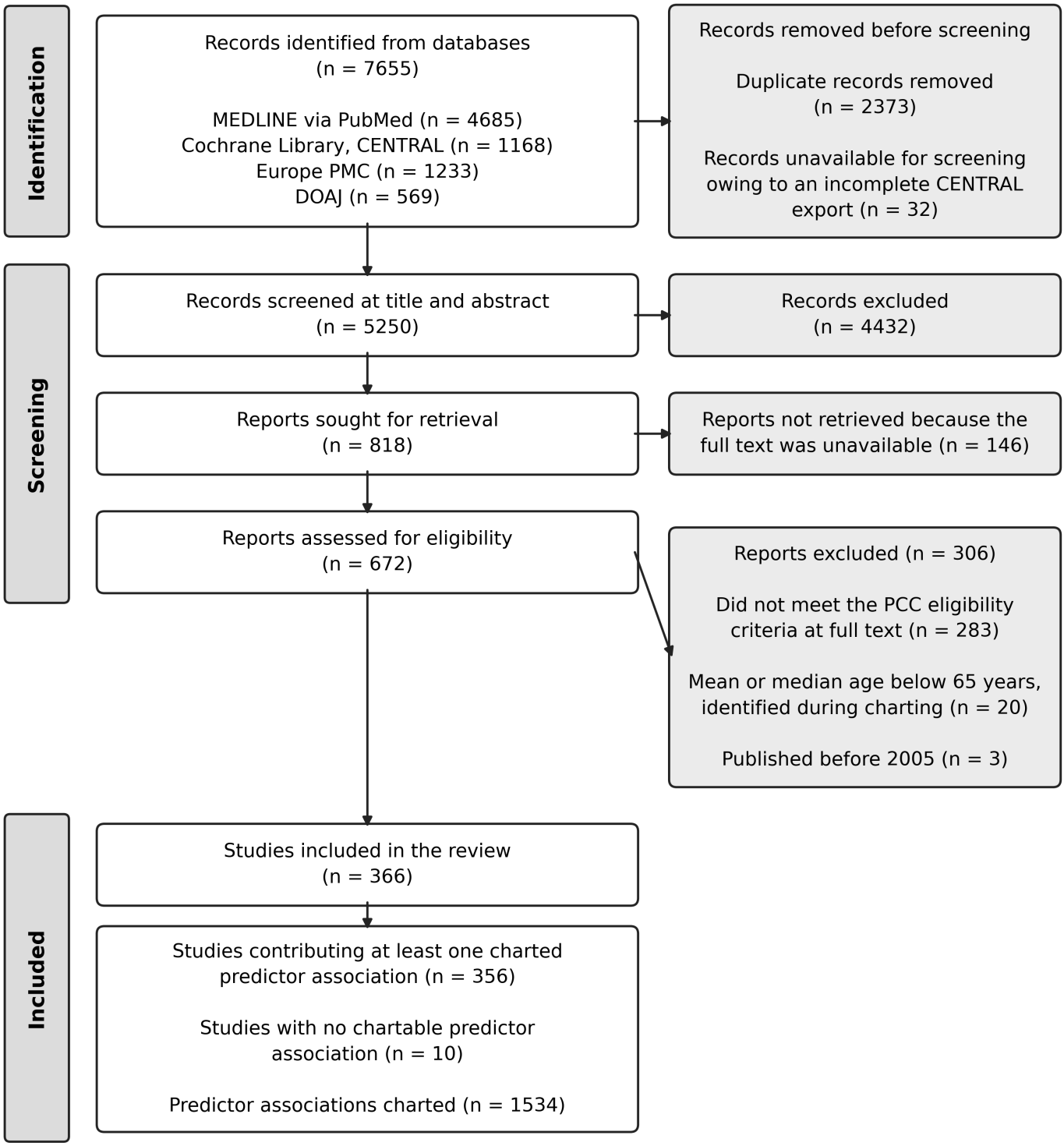


Figure 1

PRISMA-ScR flow diagram showing the identification, screening and inclusion of sources of evidence. PCC Population, Concept, Context

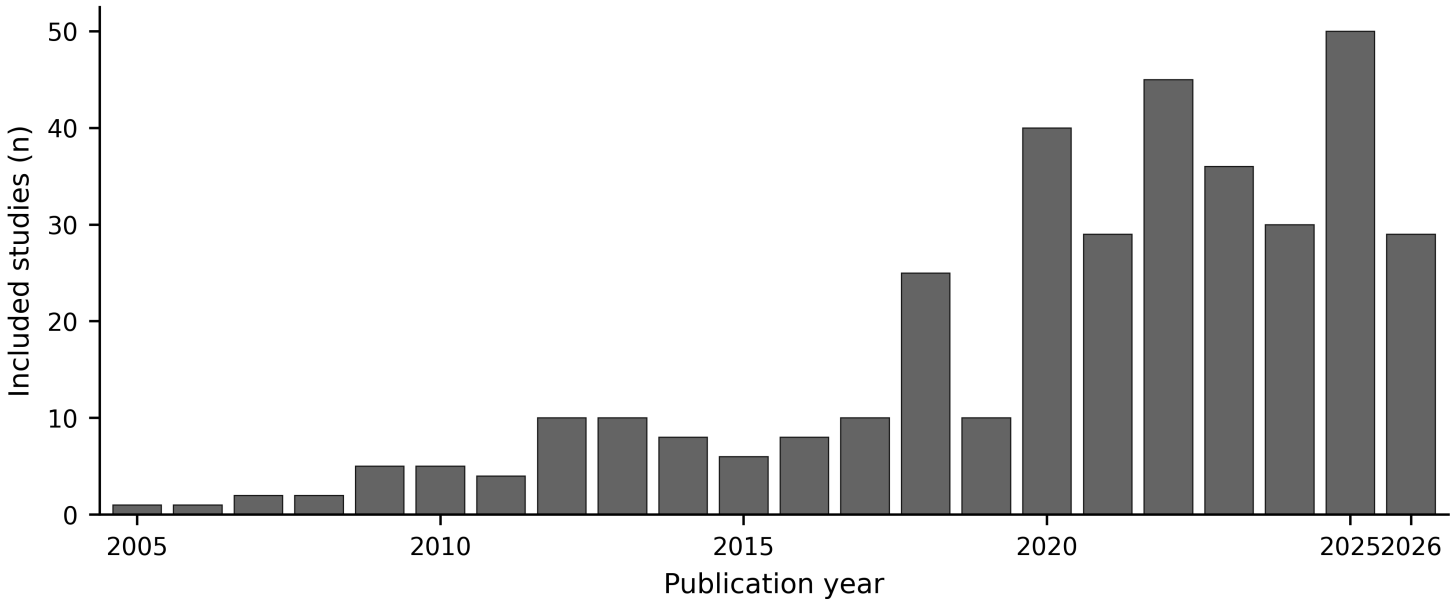


Figure 2

Included studies by year of publication (n = 366)

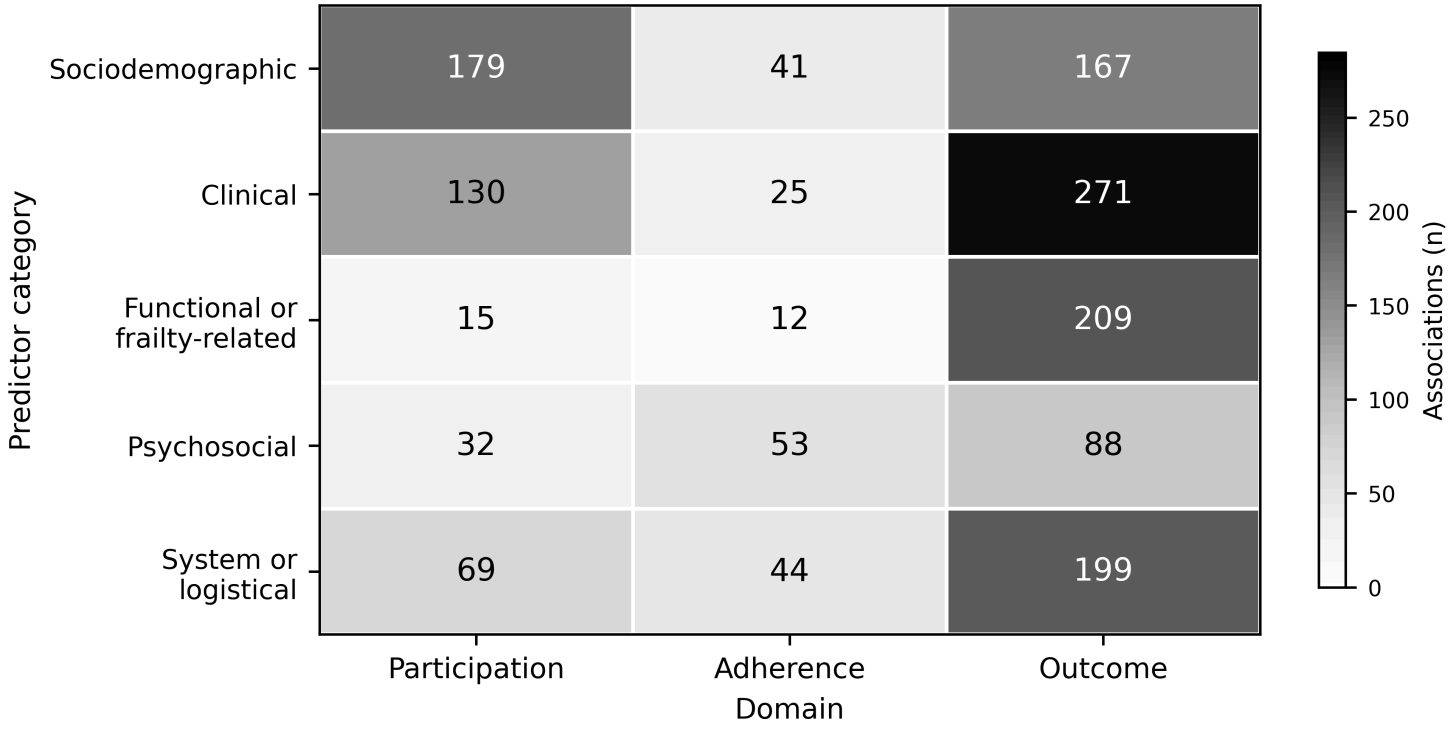


Figure 3

Evidence map of the charted predictor associations (n = 1534) by predictor category and domain. Darker shading indicates a greater number of associations

Supplementary Files

This is a list of supplementary files associated with this preprint. Click to download.

- ESM1PRISMAScRchecklist.docx
- ESM2searchstrategy.docx