Research competencies for undergraduate rehabilitation students: A scoping review

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Background. Research training is important for all health science professions and interlinks with evidence-based practice (EBP). Previous studies that investigated research competencies for undergraduates predominantly focused on medical and nursing professions. However, specific competencies may be more relevant to certain professions than others. A set of minimum core research competencies has not been defined for research methods (RM) training in the undergraduate rehabilitation curriculum.

Objectives. To review available evidence and identify a set of research competencies for undergraduate rehabilitation students.

Method. A scoping review was done of studies published between January 2009 and December 2018. Five databases were searched (November - December 2018). Articles were included if they contained statements referring to knowledge, skills, attitudes and tasks related to research or research-related EBP for rehabilitation undergraduates. Competencies were categorised into 6 research domains using thematic analysis.

Results. Forty-five competencies were identified from research-related statements in 26 studies. No studies explicitly investigated the most important research competencies for rehabilitation. Research competencies were often derived directly from the EBP framework (n=19 studies), resulting in poor representation of competencies related to conducting research. Overall, domains related to research methodology and inquiry were best represented, while soft skills, dissemination, professional attitudes and ethics were poorly represented.

Conclusion. We identified a set of research competencies that may be important for rehabilitation undergraduates. It remains unclear which of these should be prioritised in the rehabilitation curriculum. However, this preliminary set may guide future consensus statements and allow educators to identify and address gaps in current curricula.

Afr J Health Professions Educ 2021;13(1):52-58. https://doi.org/10.7196/AJHPE.2021.v13i1.1229

Research training has been identified as the foundation for all programmes in the health science professions.[1] Undergraduate exposure is associated with improved scholarship[2] – a key competency that is promoted by the Health Professions Council of South Africa (HPCSA).[3] Familiarity with doing or using research fosters analytical thinking and develops skills for informed decision-making in patient service delivery and care.[4] Although not all rehabilitation students may become primary researchers, all practitioners will need to evaluate, interpret and use research for evidence-based practice (EBP).[5]

Previous studies investigating research competencies for undergraduates predominantly focused on the medical and nursing professions.[6-8] However, certain competencies may be more relevant to rehabilitation.[9,10] Rehabilitation students should be equipped with knowledge, skills, attitudes and tasks that are relevant to the current clinical context and professional research needs. For example, knowledge of pretrial studies or alternative designs to traditional randomised controlled trials (e.g. practice-based evidence trials[10] and health services research[11]) may be particularly important for rehabilitation research.[10]

Although not synonymous, EBP and research are closely related concepts.[4] Educators in rehabilitation are increasingly restructuring research curricula towards EBP.[12,13] Research training may be used to cover EBP, and vice versa.[1,14] The Sicily Statement on EBP provides a five-step framework to use when developing curricula: (*i*) research question formulation; (*ii*) searching for best evidence; (*iii*) critically evaluating the evidence; (*iv*) applying the evidence to clinical practice; and (*v*) monitoring performance.[15] However, an investigation of existing physiotherapy coursework and EBP coverage[14] indicated that some research competencies are poorly defined in the learning outcomes, while others are not addressed at all. A standardised set of minimum core research competencies needs to be defined more explicitly to benchmark standards for research methods (RM) training in the undergraduate rehabilitation curriculum.

Recently, 86 EBP competencies were identified in a systematic review involving health professionals, regardless of the discipline or level of training.[16] The findings were generalised to all health professions, leaving it to educators to 'advance competencies depending on the needs and desires of learners'.[16] No similar reviews exist that focus on research competencies or rehabilitation. This review aimed to provide a comprehensive overview of the existing literature regarding core research competencies that may be required by rehabilitation undergraduates. As a secondary outcome, a list of recommendations regarding the implementation of such competencies was compiled.

Methods

A scoping review was conducted according to the methodological framework developed by Arksey and O'Malley[17] and refined by Levac *et al.*[18] The six-step process includes: (*i*) identifying a research question; (*ii*) identifying relevant studies using an effective search strategy; (*iii*) selecting studies fulfilling inclusion criteria; (*iv*) charting the data involving numeric and

thematic analysis; (*v*) collating, summarising and reporting results; and, optionally (*vi*) consulting with key stakeholders. Reporting followed the PRISMA Extension for Scoping Reviews checklist (Supplementary Table 1 (http://ajhpe.org.za/public/files/1229-table.pdf)).[19]

Search strategy

A comprehensive search of published research reports was conducted (November - December 2018) in 5 computerised databases (PubMed, ScienceDirect, Africa-Wide Information (EBSCO), Scopus and CINAHL (EBSCO)). Database-specific search strategies were developed, including Medical Subject Headings and Boolean operators. A date limit (January 2009 - December 2018) was applied to access up-to-date evidence. The search was repeated in March 2019 and reference lists of articles that were identified in the primary search were explored. Table 1 lists the main search terms. Consensus was reached to include the term 'evidence-based practice', considering the potential overlap in coursework.

Eligibility criteria

Articles were eligible if they contained statements regarding research-related knowledge, skills, tasks or attitudes (i.e. competencies[16]) required by undergraduate students in the rehabilitation health professions of physiotherapy, occupational therapy and speech and language therapy. Articles that included these professions were considered, regardless of whether other medical or allied health professionals were included. Publications were excluded if the sample included postgraduate students or qualified rehabilitation health professionals. Only studies written in English or available in translation were eligible for inclusion.

Data charting

A data extraction sheet was developed in Excel (Microsoft Corp., USA) and studies were grouped by design. Extracted data included first author, publication year, country, sample health profession and characteristics, aim and main construct addressed in study (EBP v. RM), statements relating to research competencies, and recommendations regarding research competency training or evaluation. Extracted data were discussed by all reviewers for consistency and consensus. As this was a scoping review, risk of bias was not assessed.

Data analysis

Competency-related statements retrieved from all study designs were combined. Overlapping or duplicate statements were collated to produce a comprehensive list of unique statements. Thematic analysis was done using categories previously identified in the literature. We identified 6 categories using a combination of research domains described by the Research Competencies Framework (RCF)[20] and the Research Competencies Scale.[21] Analysis and grouping of competencies were discussed between the authors to reach consensus. The findings from the included studies were presented narratively.

Results

Search results

The initial search yielded 1 374 hits, of which 1 211 articles were excluded because titles clearly did not conform to the objective of this review or were duplicates. Subsequently, we screened 106 abstracts, of which 57 did not include rehabilitation undergraduate students and were therefore excluded. Two more articles were retrieved via PEARLing; hence 59 full texts were obtained for review. Of these, 26 proved eligible for analysis (Fig. 1).

Study characteristics

Studies were mostly from high-income countries (*n*=20; 76.9%). More than half (*n*=16; 61.5%) were published in the past 5 years. No studies included a description of research competencies among their objectives, although competencies were included in the article content. Ten studies (34.5%) reflected research or research-related EBP competencies in physiotherapy,[12-14,22-28] 2 (7.7%) in occupational therapy[29,30] and 2 (7.7%) in speech and language therapy.[31,32] Seven studies (26.9%) reported on mixed rehabilitation professions,[29,33-38] while 5 (19.2%) were on unspecified allied health professions.[1,39-42]

Eight studies (30.8%) were surveys, with students being the most frequently surveyed population in 6 of these. Self-reported questionnaires were used to establish, e.g. students' perceptions of their research or EBP competency levels in a rehabilitation undergraduate programme. In one of the studies[14] academic staff were surveyed to ascertain which competencies are covered in their curricula and which competencies are deemed appropriate at undergraduate or postgraduate level of learning. Another study appraised student projects, part of which ascertained evidence of students' fulfilment of listed research competencies.[23] Three pretest-post-test studies (11.5%) evaluated students' knowledge, skills and attitudes toward EBP after exposure to EBP or RM training courses.[1,26,33]

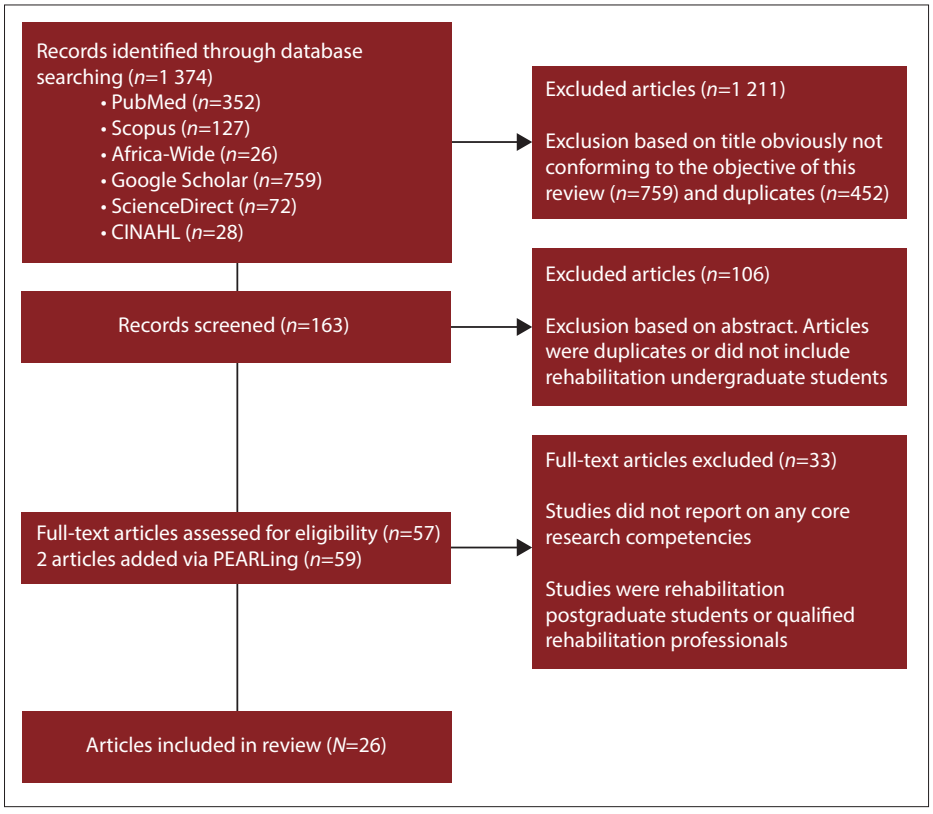

Fig. 1. Prisma flowchart showing selection of studies for inclusion in review.

Four studies (15.4%) described curriculum development.[12,29,36,39] Research competencies were identified from the learning outcomes of these curricula. Other designs included qualitative studies (*n*=2; 7.6%), mixed-method studies (*n*=4; 15.4%), systematic reviews (*n*=2), a scoping review (*n*=1), a narrative review (*n*=1) and an opinion paper (*n*=1).

Most studies (*n*=19; 73.1%) had EBP as main construct (6 surveys,[14,25,28,30,32,38] 4 reviews,[34,40,42,43] 3 mixed-method studies,[24,27,37] 3 studies describing curriculum development[29,36,39] 2 pretest-post-test studies[26,33] and 1 qualitative study[31]). Four studies (15.4%; 2 surveys,[23,41] 1 qualitative[35] and 1 opinion paper[22]) had RM as main construct, with direct reference to research competencies. The remaining 3 studies (pretest-post-test,[1] mixed methods,[13] curriculum development[12]) addressed both EBP and RM as main constructs. Appendix A (http://ajhpe.org.za/public/files/1229-a.pdf) presents study characteristics according to design, including research-related statements (listed according to corresponding item numbers from the research competencies (Table 2)).

Table 1. Search terms

Key areas	#	Keywords
Rehabilitation students	1	Students, allied health
	2	Students, rehabilitation
	3	Students, physiotherapy or physical therapy
	4	Students, occupational therapy
	5	Student, speech and language therapy or student, speech and language pathology
	6	#1 or #2 or #3 or #4 or #5
Learning outcomes	7	Education, health, undergraduates
	8	Teaching or training
	9	Curriculum
	10	#7 or #8 or #9
Research	11	Research competencies
	12	Research skills
	13	Core competencies
	14	#11 or #12 or #13
Evidence-based practice	15	Evidence-based practice
Combined terms	16	#6 and #10 and #14
	17	#6 and #10 and #15

Competencies

We initially identified 58 research competencies after synthesis of the research competency-related statements from all 26 studies. This initial set was reviewed for duplication, overlap and clarity, leaving 45 competencies. All 6 research domains were represented: research methodology/processes (*n*=20); research inquiry/literature review (*n*=14); soft skills (*n*=5); dissemination (*n*=3); professional attitudes (*n*=2); and ethics (*n*=1) (Table 2). Fig. 2 shows overlap between competencies (grouped into the 6 domains) derived from studies with EBP, RM or both as main constructs (Appendix A).

Competencies from articles with EBP as main construct

Seven of the 45 identified competencies were not alluded to in any of the EBP-focused studies. Although these studies commonly referred to 'EBP competencies' rather than 'research competencies', research-related competencies were evident as part of the EBP framework. Research-related competencies were mostly derived from the first three steps of the EBP framework, i.e. research question formulation, searching for best evidence available (both related to the domain of research inquiry/literature review) and critical evidence evaluation (domain of research methodology/processes). Consequently, these were the 3 most commonly cited research competencies overall (Table 2). Consistent with the EBP context, all but one[40] of the 19 studies with EBP as main construct emphasised the need for students to learn to identify articles that are creditable evidence sources. Bozzolan *et al.*[24] reported students' satisfaction with journal clubs as a medium for learning critical appraisal skills. However, in 2 studies, lecturers felt that critical appraisal skills should be taught at postgraduate level, with curricular time constraints[37] and students' inability to grasp the concepts at undergraduate level[14] cited as reasons. Another study[40] acknowledged that learning biostatistics in an EBP context is different from learning to do original research, but that it is nonetheless important, as students learn to be proficient research consumers.

Seventeen competencies were described exclusively in the EBP-focused studies, with most of these (*n*=8; 47.1% (Fig. 2)) falling under the research inquiry/literature review domain. None of these studies cited research skills, which involve generating new research, such as biostatistics application, data collection, identifying graduate funding and publishing. Three studies (15.8%) cited competencies spanning across at least 4 of the 6 research domains considered in this review. Seven studies (26.9%) addressed the development of information literacy skills interlinked with EBP. These articles focused on accessing and retrieving information efficiently and effectively.

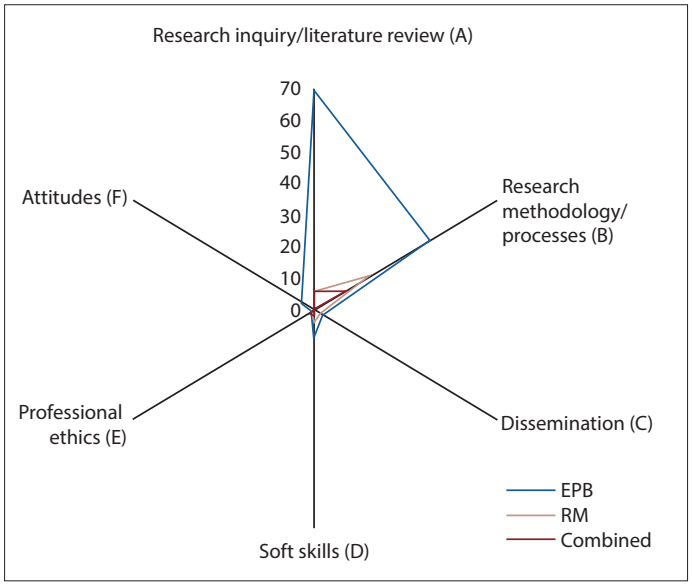

Fig. 2. Radar chart showing overlap between competencies identified from studies, with main constructs of evidence-based practice (EBP), research methodology (RM) or both (combined). (See Table 2 for corresponding domains.)

Many authors (*n*=12; 63.2%) mentioned knowledge of research designs, without explicitly stating which designs needed to be taught. One study[14] cited that students need only be equipped with knowledge of 'commonly used' designs, whereas no studies indicated which are the most commonly used designs in rehabilitation science.

Table 2. Research competencies for undergraduate rehabilitation students

Domain	Research competency-related items	Studies, *n*
Research inquiry/ literature review (A)	A1. Enquiring mind/curiosity	2
	A2. Exploring general information sources to increase familiarity with topic	1
	A3. Recognising gaps in the literature	5
	A4. Formulating a structured answerable question using PICO format	22
	A5. Identifying key concepts and terms that describe information need	1
	A6. Successfully searching for and locating relevant literature	19
	A7. Searching for literature when off campus	1
	A8. Knowledge of evidence sources and types, including their strengths and weaknesses	4
	A9. Choosing an appropriate database	6
	A10. Constructing a systematic and comprehensive search strategy that reflects the purpose of the study	10
	A11. Applying a search strategy: narrowing a search, use of keywords, Boolean, truncation, search filters and MeSH	6
	A12. Managing references/software	2
	A13. Strategies to obtain full texts of relevant articles	1
	A14. Reading and understanding scientific articles, including research terminology	4
Research methodology/ processes (B)	B15. Knowledge of research design (differentiating and defining)	13
	B16. Knowing strength and weaknesses of each study design	2
	B17. Understanding hierarchy of levels of evidence	5
	B18. Knowing the best type of design to answer question (matching)	6
	B19. Critical appraisal of different study designs using CAT	23
	B20. Basic knowledge of biostatistics	5
	B21. Evaluating statistical tests and principles	1
	B22. Reporting statistics	1
	B23. Sample size determination	3
	B24. Data collection skills	2
	B25. Data analysis skills	4
	B26. Using data analysis techniques consistent with research question/hypotheses	2
	B27. Using statistical software package	1
	B28. Interpretation/synthesis of findings	5
	B29. Implications for future research and practice for each discipline	2
	B30. Interpreting the certainty in evidence and strength of recommendation in healthcare	1
	Other research processes	
	B31. Writing a grant application	2
	B32. Identifying graduate funding	1
	B33. Identifying mentors	1
	B34. Knowing the authorship process	1
Dissemination (C)	C35. Scientific writing: understanding rules for citations, referencing, writing style, formatting, plagiarism	2
	C36. Publishing research	3
	C37. Oral presentation	1
Soft skills (D)	D38. Communication skills	4
	D39. Independent and critical thinking skills	6
	D40. Problem-solving skills	2
	D41. Team-working skills/working in groups	3
	D42. Reflective skills	2
Professional ethics (E)	E43. Addressing ethical and legal issues	6
Attitudes (F)	F44. Evidence-based practice essential to clinical work	3
	F45. Learning by doing	2

PICO = patient/population, intervention, comparison and outcomes; MeSH = medical subject headings; CAT = critical appraisal tools.

Competencies from articles involving RM as main construct

Although 21 of the 45 identified competencies were not mentioned in any of the 4 studies with RM as main construct, the competencies that were addressed spanned across all 6 research domains. Two of the 4 studies (50%) cited competencies spanning at least 4 of the 6 research domains. One study[41] had the highest number of research competencies listed in a single article (n=13; Appendix A). The domain of research methodology/processes was covered most extensively among studies with RM as main construct

(Fig. 2), with competencies particular to this group of studies including biostatistics and epidemiology, evaluating statistical tests and principles,[13] using statistical software packages,[41] and using data-analysis techniques consistent with research questions.[41] Within this category, only 1 study highlighted the specific processes that students need to become familiar with to carry out research, such as seeking project funding and knowing the authorship process.[41] Research inquiry/literature review was the second-best represented domain; the ability to search and retrieve literature even when off campus[35] was specifically mentioned. Publishing research (dissemination domain) was reported as providing a scholarly contribution to the scientific body of knowledge and giving students motivation for doing research.[22] Problem-solving (soft skills domain) was cited by 2 studies.[22,41]

Recommendations for research/EBP competency training or evaluation

Recommendations pertaining to competency training or evaluation could be grouped into 5 categories: (*i*) collaboration; (*ii*) teaching methods/curriculum design; (*iii*) supervision; (*iv*) assessment; and (*v*) translation of research evidence. Recommendations from systematic reviews were the constructing of curricula into manageable sessions;[42] assessing prior knowledge to identify

Table 3. Recommendations for development of research competencies

Area	Recommendations regarding strategies to develop research/EBP competencies in undergraduates	Study design
Collaboration	Utilise librarians' expertise in joint teaching of IL skills in rehabilitation curricula[25,29,31,33,36]	Survey Qualitative Describing curriculum development
	Support collaborative learning, which helps students develop social networking skills[43]	Review
	Use journal clubs as a means of collaborative learning and invite students from other disciplines[24]	Mixed methods
Teaching methods/ curriculum design	Ensure effective coverage of all competencies via curriculum mapping in terms of content, timing and type of training[28,36]	Survey Describing curriculum development
	Prioritise areas of research by identifying those that are heavily subscribed to in past student projects[23]	Survey
	Assess prior knowledge to identify what needs to be taught[40,43]	Review
	Construct curricula into manageable sessions[42]	Review
	Include explicit learning outcomes related to EBP/research in module guides and evaluate curricula on a regular basis[37]	Mixed methods
	Repeat EBP concepts throughout curricula to allow for consolidation and application of knowledge[27-29,37]	Survey Mixed methods Describing curriculum development
	Include teaching methods such as didactic lectures, computer practice sessions, journal clubs and group work[14,31,37,40,42,43]	Survey Qualitative Mixed methods Review
	Incorporate instruction modes, such as audio-visuals and online teaching[33,35]	Pretest-post-test Qualitative
Supervision	Upskill faculty members adequately to consolidate their ability to supervise students in research and EBP[14]	Survey
	Regularly evaluate quality of teaching instruction using validated assessment tools[39]	Describing curriculum development
	Give regular constructive feedback to encourage reflection skills[24]	Mixed methods
Assessment	Use formal assessment as a stimulus for learning[26,37]	Pretest-post-test Mixed methods
	Incorporate assessment methods, such as poster presentations, research project/thesis, peer review, tests and assignments[14,37,43]	Survey Mixed methods Review
Translation of research evidence	Evidence synthesis in the form of systematic reviews and meta-analyses is a time-efficient and sustainable way of increasing undergraduate physiotherapy publication outputs[12]	Describing curriculum development
	Early exposure to EBP training facilitates development of skills and knowledge, which students can build during their remaining years[24,29]	Mixed methods Describing curriculum development
	Encourage publishing of manuscripts/research projects[22]	Review
	Implement EBP in rehabilitation education by incorporating it into the clinical setting[13]	Mixed methods

EBP = evidence-based practice; IL = information literacy.

what needs to be taught;[40] and including teaching methods such as didactic lectures, computer practice sessions, journal clubs and group work;[40,42] other recommendations were from various designs (Table 3).

Discussion

We derived 45 core competencies that rehabilitation undergraduates may require to be effective research consumers or conductors. To our knowledge, this is the first review to focus on rehabilitation professions. These competencies may serve as a starting point for developing research training curricula, after considering opinions of students, curriculum experts and rehabilitation clinicians.

The identified competencies are largely similar to those reported for nursing and medical undergraduates.[6-8,44] Most competencies fell within 2 research domains: inquiry/literature review and methodology/processes. The most commonly cited competency was critical evidence appraisal, followed by research question formulation, searching, retrieving literature efficiently and effectively, and knowledge of research designs. These are considered important foundational skills in the continuum of undergraduate research training in healthcare education[4] and mostly relate to being informed research consumers. However, competencies lacked considerable detail in their description, making it difficult to clearly assess their relevance specifically to rehabilitation. For example, despite research design knowledge being among the most commonly occurring competencies, no studies explicitly indicated which designs should be taught to rehabilitation students. Only teaching the 'most common' designs may not be the best approach in rehabilitation research, given the trend towards innovative alternatives (which balance internal and external validity) to traditional effectiveness research.[45]

Other domains (dissemination, soft skills, ethics and professional attitudes) and even specific competencies within the abovementioned 2 domains (e.g. reading and understanding scientific articles, skills related to statistics, interpreting evidence certainty) were less represented. This does not imply that these competencies are less important; indeed, some of these were identified as areas in need of specific attention in rehabilitation. For example, 2 surveys[14,27] revealed that rehabilitation undergraduates specifically lacked confidence in statistics, reading scientific journals and understanding the relevance of EBP. Similar concerns have been raised among medical undergraduates[46] and practising rehabilitation clinicians.[47] It has been suggested that applying a scientist-practitioner model (where clinicians have sound research training) to rehabilitation education may overcome the disconnect between academic research/EBP knowledge and actual clinical practice.[5] Such disconnect may result from training that is mostly focused on the first 3 domains of EBP.[1]

The order or count of the competencies listed in this review therefore does not reflect their relative importance or teaching sequence. Rather, the distribution reflects that the EBP framework may often overtake research training (Fig. 2) as a separate but related entity, with many research-related competencies derived exclusively from this framework. Although research and EBP processes inform each other, the concepts differ in important areas.[48,49] Exclusively relying on the EBP framework to identify a set of research-specific competencies is not sufficient and results in omittance of potentially important skills, such as those required for generating and publishing new research.

Inconsistencies were noted regarding the teaching sequence of some competencies. In one study,[37] lecturers indicated that formal critical appraisal should only be taught at postgraduate level owing to full undergraduate curricula. However, in another study,[13] students reported not being confident in appraising literature and requiring more training. The timing of introducing various competencies requires careful consideration and input of different stakeholders. A multi-tiered research competency model that progresses along a continuum of under- and postgraduate training has been proposed in the medical sciences.[4] While there is great merit in such an approach, the specific competencies (and their sequence) defining each tier need to be tailored to rehabilitation undergraduates. For example, whereas research publication was listed under the most advanced (postgraduate) tier of training in medical education,[4] introduction of this skill may be needed earlier for rehabilitation students, given the rising focus on publishing undergraduate rehabilitation articles.[12]

Core research competencies need to be taught and evaluated using valid methods. Unfortunately, there is a paucity of evidence regarding effective instructional methods in EBP, including research orientation and skills development.[1,40] Although not a primary aim of our review, we extrapolated a list of recommendations regarding the development of research-related competencies, which may be subjected to input from educators and students in future. Teaching and assessment methods need careful and contextualised consideration and may need to be tailored to suit each competency. For example, group work, while fostering positive qualities such as respect and encouraging (interdisciplinary) teamwork,[24,50] has also been reported by rehabilitation students as a potential barrier to acquiring individual skills.[27] In this case, educators need to identify effective methods of developing and assessing individual competencies that have been taught in a group setting and the competencies that may not be appropriate for this method. Such considerations and linkages to specific competencies should be applied to each recommendation.

The absence of methodological quality appraisal limits the strength of this review to recommend the identified competency set as the 'gold standard' for undergraduate rehabilitation research training. Much of the evidence came from self-reported surveys, which are prone to recall and response biases, and cross-sectional studies (level III evidence). However, we provided a comprehensive map of the current state of information and demonstrated a scarcity of high-level evidence, along with insufficient detail, regarding research competencies for rehabilitation students. This provides grounds for future high-quality research and preliminary material for further investigation among stakeholders.

The next steps towards forming a general framework for effective curriculum mapping involve following up on this preliminary evidence using a Delphi survey or stakeholder consensus forum to prioritise and gain consensus on the most essential research competencies.[16] This will also inform decision-making regarding the optimal timing and depth of content of each research competency. In addition to a clear articulation of each research competency in the outcomes of research curricula, effective methods of instruction and evaluation need to be outlined and linked with relevant competencies.

Conclusions

This scoping review identified knowledge, skills and attributes that may be important for rehabilitation undergraduates to attain throughout their research training. It remains unclear which of these should be prioritised within the rehabilitation curriculum, or how to time their introduction along the continuum of training. However, this set offers a preliminary

guide for future consensus statements, may allow educators to identify gaps in current curricula and may create opportunities for addressing these competencies. This is a first step in addressing inconsistencies in the quality and content of research training courses within rehabilitation curricula.

Declaration. None.

Acknowledgements. None.

Author contributions. All authors contributed substantially to manuscript conceptualisation, development and outline; revised draft versions for intellectual content; and approved the final version submitted for publication.

Funding. None.

Conflicts of interest. None.

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Accepted 9 March 2020.