The Characteristics of Post-Intensive Care Syndrome to Inform Occupational Therapy Practice During the Post-Intensive Care Period: A Systematic Scoping Review.

Zoe Heiniger (zoe.heiniger@health.qld.gov.au)
Queensland Health https://orcid.org/0000-0002-6096-3090

Susan Brandis
Bond University, Queensland

Research Article

Keywords: Occupational therapy, post-intensive care syndrome, critical illness, intensive care, critical care, rehabilitation

Posted Date: December 13th, 2021

DOI: https://doi.org/10.21203/rs.3.rs-1150667/v1

Abstract

Background**:** As the demand for intensive care treatment increases, so too does the number of people surviving critical illness. Since 2010, the term “post-intensive care syndrome” has been used to describe the constellation of new or worsening physical, cognitive, and psychological impairments that persist after intensive care discharge. This review aimed determine the characteristics of PICS present during the first year following discharge from the ICU to inform occupational therapists working with this population during the post-intensive care period.

Methods**:** A systematic scoping review has been conducted according to the PRISMA-ScR Checklist. Seven key databases were searched from inception to 2020. A single reviewer screened available literature against eligibility criteria then cross-checked by a second reviewer. Data were abstracted from relevant publications and results were narratively synthesised through application of a biopsychosocial model.

Results**:** Twenty-five studies were identified for inclusion. Characteristics were categorised as biological, psychological, or social and contextual. Overarching outcomes were also considered. Results demonstrated that characteristics were complex and interwoven between domains. Results were grouped into four key themes: 1) An increased worldwide demand for intensive care, 2) ADL performance, 3) HRQOL, and 4) Consideration of social and contextual characteristics. No studies were found to detail the role of occupational therapists working with post-intensive care survivors.

Conclusions**:** The complex and interwoven nature of post-intensive care syndrome highlights the need to consider a holistic rehabilitation approach. Considering the COVID-19 pandemic, occupational therapists have the potential to play an increased role during the post-intensive care period to reduce the global healthcare burden and improve patient outcomes. Future research is needed to determine the best model of care to support occupational therapists working with survivors of critical illness.

Trial Registration**:** NA

Background:

Critical care medicine has developed exponentially since its inception in the 1950s [1, 2]. At its core, the intensive care unit (ICU) enables the temporary support of multiple organ systems in the face of critical illness and injury [1]. As a result, medical interventions are often more numerous and more invasive than general hospital treatments. However, in recognising ICU patients’ heightened vulnerability, critical care medicine is beginning to shift towards providing more holistic and more humane care [3].

For over a decade, advances in medical technology, an ageing population, and changes to the prevalence of communicable and lifestyle diseases have seen a rise in the number of patients admitted to the ICU worldwide [4, 5]. The increasing demand for ICU beds is not new. However, the COVID-19 pandemic has highlighted and exacerbated this demand in an unprecedented manner. In some countries, the demand

for ICU treatment and mechanical ventilation has exceeded the current capacity [6, 7]. As reported by the Critical Care Resources registry, the total annual operational cost for ICU care in Australia was $2119 million prior to the COVID-19 pandemic [8]. While the focus has been on patients admitted to the ICU, there is growing interest in the increase in patients surviving critical illness.

In Australia, the ICU mortality rate of COVID-19 patients is 22.2% [9]. The remaining 78% represents a large number of patients who are surviving critical illness. While survival rates are improving, recovery does not end upon discharge from the ICU [10]. Studies have shown that many patients experience persisting functional impairments secondary to their original condition [11, 12, 13]. During the 2002 Brussels Roundtable, “Surviving Intensive Care”, participants described the recovery trajectory of critical illness. They emphasised that critical illness is not limited to the period an individual spends within the ICU but also extends before and well after discharge from hospital [14].

A framework to describe the multidimensional recovery following discharge from the ICU was developed at the 2010 Society of Critical Care Medicine Conference [15]. Collectively referred to as ‘post-intensive care syndrome’ (PICS), many ICU survivors find themselves facing a constellation of new or worsening physical, cognitive, and psychological impairments that persist well after discharge [16]. As such, the use of the term ‘PICS’ subsequently emerges in the literature after 2010.

Since its inception, PICS has been described in terms of physical, cognitive, and psychological factors [10, 12]. The most reported characteristic is f physical deconditioning, documented in approximately 70% of patients discharged from the ICU [17]. Prolonged bed rest, coupled with ICU treatments such as mechanical ventilation, can result in a globalised reduction in muscle strength and physical functioning [18]. This is referred to in the literature as ICU-acquired weakness (ICU-aw) [19].

Often more easily overlooked are the changes patients experience to their cognitive or psychological state. While in the ICU, critically ill patients face high levels of physical and psychological stress [12]. Following discharge, new or worsening cognitive impairments can include impairments in memory, executive function, language, attention, and visual-spatial abilities [17, 20]. Additionally, depression, anxiety, and post-traumatic stress disorder (PTSD) are common during admission and following discharge from the ICU [21, 22]. This constellation of symptoms can significantly impact quality of life and an individual’s ability to reintegrate back into society [10].

Rehabilitation following critical illness has been acknowledged as an area of increasing importance. However, there is limited evidence to underpin practice during the post-acute recovery phase [23]. Schandl et al. [24] identified that multidisciplinary follow-up within 6-months of discharge from the ICU could be of value in identifying untreated physical and psychological problems. However, there remains no consensus on the best model of intervention to use among survivors of critical illness [10].

Physical therapy during ICU admission and following discharge is prominent in the literature [11, 16]. However, the occupational therapy role in working with ICU survivors remains somewhat unexplored. Occupational therapy is concerned with promoting health and well-being through “doing” [25].

Occupational therapists support individuals in performing activities or “occupations” that are needed, wanted, or individually meaningful [26]. Occupational therapy is a holistic profession committed to supporting individuals through addressing a constellation of contextual, environmental, physical, psychological, and social factors that support engagement in desired occupations [27].

The biopsychosocial model aligns with the philosophy of occupational therapy and has been recognised in facilitating a shift towards a more integrated approach to care [28]. Under this model, consideration is given to physical dysfunction, psychological and social factors [29]. A study conducted by Kobylanska et al. [30] considered the efficacy of post-stroke rehabilitation in the context of the biopsychosocial approach. They concluded that external factors play a pivotal role in the rehabilitation journey. The study highlighted the importance of considering biopsychosocial factors, such as acceptance of illness and a sense of self-efficacy, for optimising the recovery trajectory.

Ohtake et al. [16] conducted the most recent systematic review of PICS. They considered only the scope and magnitude of physical characteristics and classified these according to the World Health Organization’s International Classification of Functioning, Disability, and Health (ICF) framework. Limited research considering the holistic management of PICS and increased demand for ICU care highlights an opportunity for occupational therapists to reduce the growing healthcare burden. Therefore, this systematic scoping review aims to determine the characteristics of PICS present during the first year following discharge from the ICU to inform occupational therapists working with this population during the post-intensive care period.

Methods:

Search strategy:

A systematic scoping review has been conducted in accordance with the PRISMA Extension for Scoping Reviews (PRISMA-ScR): Checklist and Explanation [31]. An unrestricted search of seven electronic databases was conducted (PubMed, Embase, CINAHL, Ovid (Medline), Cochrane Library, Web of Science) and overseen by the University librarian. Articles were included from inception to 20 October 2020.

The search strategy consisted of synonyms and subject headings derived from the following key terms: “post-intensive care syndrome”, “intensive care”, and “occupational therapy”.

Eligibility criteria:

Studies were included if they referred to ‘post-intensive care syndrome’ or reported on one or more of the following outcomes: physical, cognitive, or psychological status following ICU discharge. For inclusion, studies reported on adults over 18-years who had spent at least 48-hours in an ICU. Data collection occurred between ICU discharge and within one year of discharge from the ICU. Studies were required to be published in English, with the full text available. Initially, only systematic reviews and randomised controlled trials were considered for inclusion. However, during the title and abstract screening, the

challenges of randomising the included population became apparent. As such, cohort studies were also included. Qualitative studies, case studies, clinical trials (or pilot studies), protocols, opinion pieces, and conference proceedings were excluded as these constitute a lower level of evidence.

Studies were excluded if participants included individuals with diagnosed cancer, respiratory or neurological pathologies (e.g. stroke, traumatic brain injury, spinal cord injury, amyotrophic lateral sclerosis, or Guillian-barre syndrome). This was done to ensure outcomes were attributable to PICS and not a comorbidity that might also influence recovery.

Study selection and data charting:

Endnote was used to identify duplicate records prior to title and abstract screening. Titles and abstracts were screened by an individual (ZH) reviewer with two reviewers independently screening full-text articles (ZH) (SB). Reference lists of full-text articles were also screened to ensure all relevant papers were included. A non-standardised data extraction form was developed to summarise data from included articles *(see Additional File 1.*). Data were extracted by a single reviewer (ZH) and checked by another (SB). Individual methodological quality appraisal of included articles was not required as per the PRISMA-ScR guidelines however reviewers attempted to exclude poor quality of evidence by following the levels of evidence hierarchy [32].

Collating and summarising results:

Authors deemed that the heterogenous nature of included articles was best to be described through thematic analysis to ensure a thorough and comprehensive review. Given the heterogeneous nature of outcome measures identified across the articles, only primary outcome measures were considered for our analysis. Characteristics were categorised using a biopsychosocial approach, with biological, psychological, and social/contextual characteristics considered [28]. Tables were developed to collate this information then converted into graphs as appropriate as part of the bibliometric analysis.

Results:

The search yielded 3054 articles. Duplicates were removed leaving 2210 articles. Due to the large number of remaining studies, both reviewers agreed to exclude articles published before 2010 (n=440). This decision was based on the knowledge that the term “post intensive care syndrome” was not common until after the 2010 [15]. Titles and abstracts of 1770 articles were screened by a single reviewer (ZH) with 55 full text articles identified for further screening. A quality audit was then conducted by a second reviewer (SB), with agreement to include twenty-five articles in the final analysis *(see* Figure 1.*)*.

Characteristics of included studies:

Of the 25 articles included for analysis, there were six systematic literature reviews, two randomised controlled trials, and seventeen cohort studies. At the time of this review, publications relating to PICS or

ICU survivorship have been dominated by research from the UK (24%) and Germany (24%) *(see* Table 1.*)*, with articles published across 11 countries.

Table 1
Overview of the countries of publication for included articles.

Country of Publication	Number of Publications
UK	6
Germany	6
Japan	3
USA	2
Greece	2
Korea	1
Netherlands	1
Australia	1
Taiwan	1
Switzerland	1
Canada	1

When looking at date of publication, an increasing number of publications is evident (*see* Figure 2.)

Patient factors and characteristics of the patient's condition were commonly considered selection criteria of included studies *(see* Table 2.*)*. Age (>18-years) and ICU discharge status remained consistent between studies. There was, however, considerable variability between studies regarding the patients' length of stay (LOS) in hospital and the ICU, and the duration of mechanical ventilation. Gender, the presence of comorbidities, education level, body mass index (BMI), and additional demographic factors were variables commonly considered. The impact of delirium and the acquisition of ICU-aw on recovery during the post-intensive care period were also considered [33].

Table 2
Variables identified within included studies.

Characteristics of the Condition	Patient Factors
ICU-aw	Age
Illness Severity	Gender
Delirium	Comorbidities
Duration of Mechanical Ventilation*	Demographic Factors
	Education Level
	BMI
*Also considered in Social/Contextual Factors	

Taking a biopsychosocial approach, the characteristics of PICS have been characterised into biological, psychological, and social/contextual characteristics. We identified that overarching the three categories, were ten key outcomes that have been used to describe the recovery trajectory of individuals (*see* Figure 3.).

Biological Characteristics

We defined biological characteristics as those closely resembling the physical characteristics described in previous PICS models [12]. Eleven studies considered biological factors among ICU survivors. These factors were used to report on biopsychosocial outcomes, such as functional status, exercise capacity, physical functioning, participation, and HRQOL.

Muscle strength was commonly measured, either via the Medical Research Council (MRC) scale for muscle strength [34, 35] or dynamometry [34, 35, 36]. Two studies used muscle strength as a determinant of functional status during the post-intensive care period, concluding that improved muscle strength positively correlates with functional status [34, 35]. These two studies also highlighted the impact of ICU-aw on the recovery trajectory, ascertaining that poorer functional outcomes are likely among patients diagnosed with ICU-aw.

Cardiopulmonary exercise testing (CPET) was used to measure peak oxygen consumption (VO2) and anaerobic threshold (AT) in two studies [37, 38]. CPET is considered the gold standard for assessing an individual's exercise capacity [39]. McWilliams et al. [38] concluded that exercise capacity is likely to improve within 12-weeks following discharge from the ICU, regardless of whether rehabilitation is received following discharge from the hospital. However, for patients experiencing more severe illness or requiring mechanical ventilation for more than 14-days, the risk of persistent deficits in exercise capacity is heightened [37].

Considerable variation was evident between methods of data reporting among our included studies. Eggman et al. [40] considered patients' exercise capacity and functional status. However, data were reported via the 6-minute walk test (6MWT) and Functional Independence Measure (FIM). Despite a variation in reporting methodology compared to Benington et al. [37] and McWilliams et al. [38], results remain the same. Patients who experienced moderate-severe muscle weakness also experienced significantly poorer outcomes in the 6MWT (p=0.013), FIM (p=0.001), and hospital LOS (p=0.008). This emphasises the need to consider the characteristics of a patient's condition and social and contextual factors as risk factors for poorer outcomes during the post-intensive care period.

Pain and fatigue are considered primarily biological factors. However, their impact on psychosocial factors should be noted. One included study reported that around two-thirds of ICU survivors report "new" chronic pain during the first 6-months following discharge from the ICU [40]. The interference of pain on everyday life significantly decreased (p=0.04) during the first year following hospital discharge. However, pain remained the most common reason participants reported a reduced "enjoyment of life".

Similarly, fatigue is reported to impact nearly half of ICU survivors during the first 6-months of their recovery [41]. Fatigue has been shown to significantly positively correlate with PTSD (p<0.001) and significantly negatively correlate with HRQOL (p<0.001). Additionally, patient factors, including comorbidities and gender (male), were associated with higher perceived fatigue. In contrast, a patient's level of social support provides a salutogenic factor.

Psychological Characteristics

Anxiety, depression, and PTSD are commonly considered psychological characteristics of PICS [12]. For this review, cognition is also considered a psychological factor due to the impact cognitive deficits can have on an individual's level of understanding and ability to participate in their recovery journey [28].

This review found the current literature inconclusive regarding the prevalence of impaired cognitive function following discharge from the ICU. Chung, Yoo, Park & Ryu [42] measured cognitive impairment using the Mini-Cog Test at ICU discharge, reporting that 43% of patients experienced cognitive deficits. However, 12-months following discharge from the ICU, 88% of ICU survivors demonstrate cognitive functioning within a normal range [43].

As with biological factors, characteristics of the condition and patient factors can impact an individual's cognitive recovery trajectory. Sumida et al. [44] conducted an observational cohort study to evaluate cognitive function in patients following discharge from a cardiac intensive care unit. Multiple logistic regression analysis identified that older age (p=0.042), nutritional status (p=0.017), and physical function (p=0.012) are significant and independent factors associated with impaired cognition in ICU survivors [44]. Also emphasising the interwoven nature of characteristics, Thomas & Mehrholz [43] concluded that regaining walking function is the best predictor of normal cognitive function one year following hospital discharge.

Self-report questionnaires, including the EuroQol-5D (EQ-5D) and the Short Form 36 (SF-36) questionnaire, have been used to identify psychological characteristics such as anxiety, depression, and PTSD [43, 45]. These are commonly reflected in an individual's perceived HRQOL. Research suggests that when symptoms of anxiety, depression, or PTSD are experienced, there is a marked reduction in HRQOL [46]. Chung et al. [42] found that 60% of patients exhibited depressive symptoms upon discharge from the ICU, with more than 75% recalling one or more stressful experience from their time within the ICU.

Patient characteristics also appear to contribute to the presence of psychological symptoms. Our review identified that at discharge from the ICU, female patients (88.9%) were significantly more likely to experience depressive symptoms than males (47.6%, p=0.03) [42]. Additionally, it is reported that fatigue is likely to be exacerbated by current or previous anxiety or depression, impacting not only HRQOL but also participation [41].

The recovery of psychological symptoms during the post-intensive care period has also been described by an improvement in HRQOL. However, support for rehabilitation services remains inconclusive. Taito et al. [47] found moderate-quality evidence suggesting that at 6- and 12-months post-ICU discharge, physical rehabilitation provided during the post-intensive care period did not significantly improve HRQOL compared to usual care [physical component scores: (p=0.51); mental component scores: (p=0.61)]. All remaining systematic reviews remained inconclusive as to whether rehabilitation delivered during the post-intensive care period was beneficial in improving HRQOL. In contrast, McWilliams et al. [38] reported a significant improvement in HRQOL following a 7-week outpatient rehabilitation program that included physical rehabilitation and patient education.

Social & Contextual Characteristics

Our strict inclusion criteria did not identify studies that described the characteristics of PICS as "social and contextual". We defined social and contextual characteristics as the factors surrounding an individual externally – for example, the patient's social supports, life stressors, situational characteristics, and their rehabilitation or recovery environment. For occupational therapists, these characteristics align with the "environmental factors" depicted by the Person-Environment-Occupation (PEO) Model [48].

Our review found that contextual factors, such as the duration of mechanical ventilation and the patient's hospital or ICU LOS, were commonly considered. Frequently, these variables were considered in the study's selection criteria, although several studies report considerable impacts of these factors on patient outcomes. A cohort study conducted by Benington et al. [37] identified a positive correlation between more than 14-days on mechanical ventilation and a reduced exercise capacity [peak VO2: (p=0.022); AT: (p=0.009)]. Similarly, a longer duration on mechanical ventilation appears to negatively impact the recovery of sit-to-stand function [49].

The impact of contextual factors on post-intensive care recovery was also highlighted by Chao et al. [50]. Their cohort study considered long-term mortality rates (up to 10-years) and identified that patients at "high risk" of mortality had experienced more severe illness, required a longer stay in hospital or the ICU or

had spent more time on mechanical ventilation. Their study identified that rehabilitation provided during the post-intensive care period is most beneficial for this “high risk” group. They recommend this group of patients should be routinely considered a target population for post-intensive care rehabilitation.

Being surrounded by social supports, such as rehabilitation providers, family, and friends, has been suggested to considerably improve outcome indicators [41]. Occupational therapists have the potential to provide such social support to facilitate holistic recovery during the post-intensive care period. The results of our review suggest that allied health input is currently being underutilised to support PICS recovery during the post-intensive care period. A cohort study conducted by Thomas & Mehrholz [43] reported that during the first 12-months following discharge, 71% of patients received no follow-up from a physiotherapist, and 86% received no follow-up from an occupational therapist.

While the benefits of allied health have been noted, no articles were identified that directly report on the role of occupational therapists working within the post-intensive care period. A single-centre cohort study reported that the time spent engaging in walking practice with a physiotherapist significantly increased the chance of regaining walking ability ($p<0.0001$) [51].

Discussion:

In this systematic scoping review, we have appraised 25 articles, with the aim of answering our research question: what are the characteristics of PICS present within the first year of discharge from the ICU, and how can these characteristics be used to inform occupational therapists working within the post-intensive care period? We applied an occupational therapy lens to our results, utilising the biopsychosocial model to organise PICS characteristics as biological, psychological, and social and contextual. Consideration has also been given to overarching biopsychosocial outcome indicators. Our results highlight the complex and interwoven nature of PICS characteristics during the post-intensive care period. We now turn our attention to the role of occupational therapists in providing a holistic rehabilitation approach to survivors of critical illness.

Theme 1: Worldwide demand for ICU care

Since 2012, the number of articles published relating to the PICS phenomena has steadily increased. This coincides with a gradual increase in demand for ICU treatment and a reduction in mortality as more and more individuals survive their stay in the ICU [52]. Up until the beginning of 2019, these trends have been gradual [52]. However, research is beginning to report on the significant spike in ICU patients seen as a result of the COVID-19 pandemic [53, 54, 55]. Recent Australian data suggests that the potential surge in patients requiring ICU treatment could reach 191% of the current capacity [55]. However, with reported mortality rates between 20-30%, the number of people surviving critical illness is also likely to increase dramatically [9].

While research is still emerging, it is reasonable to assume that the characteristics of PICS will be, to some extent, present in patients recovering from COVID-19. If so, the surge in demand for rehabilitation

services following critical illness is inevitable. We suggest future research aims to determine the correlation between the recovery of PICS and COVID-19. This research should focus on supporting the role of allied health professionals, such as occupational therapists. Despite almost 20% of occupational therapists in Australia reporting rehabilitation as their primary scope of practice, we were unable to identify research supporting the role of occupational therapists during the post-acute phase of recovery from critical illness [56]. In the face of increased global demand, research is needed to provide patients access to occupational therapy services with the goal of improving performance in everyday activities and reducing the strain on healthcare systems globally.

Theme 2: ADL Performance

Occupational therapy is defined by the World Federation of Occupational Therapy (WFOT) [57] as: “a client-centred health profession concerned with promoting health and well-being through occupation”. WFOT [57] describes the primary goal of occupational therapy as “enabling people to participate in activities of daily living (ADLs)”. ADLs include the fundamental tasks oriented toward taking care of one’s own body and are considered essential to living in a social world [58].

Various biological characteristics, such as muscle strength and fatigue, are reported in the literature to directly correlate with ADL performance [59, 60]. In our analysis however, the only paper to directly link PICS to ADL performance was a systematic review conducted by Ohtake et al. [16]. They found that at 3-months following critical illness, 35% of patients had dependence in at least one ADL (including bathing, dressing, toileting, transferring, continence, or feeding) compared to 25% prior to their critical illness. Three additional systematic reviews reported limited or no research reporting on ADL performance in the context of PICS [47, 61, 62].

The impact of PICS on ADL performance has been identified as an area requiring future research. Based on our analysis, we predict that ADL performance is likely to be negatively impacted in patients with PICS during the post-intensive care period. Occupational therapists frequently use assessment tools specifically designed to measure ADL performance – such as the Barthel Index and the Functional Independence Measure (FIM) [63]. We suggest that utilising such assessment tools will assist occupational therapists to lead the way in developing research to support the link between PICS and ADL performance. In doing so, an opportunity is created for occupational therapists to engage in post-intensive care rehabilitation to facilitate positive patient outcomes.

Theme 3: HRQOL

The complex presentation of PICS characteristics highlights a prominent need for rehabilitation to occur across all domains of the biopsychosocial model. Our analysis suggests that HRQOL is undeniably linked to psychological characteristics. When symptoms of anxiety, depression, or PTSD are experienced, there is a marked reduction in HRQOL [46]. However, it is impossible to separate HRQOL from biological and social and contextual factors as well. Fatigue has been linked to a significant reduction in HRQOL, with fatigue also likely to exacerbate psychological symptoms such as PTSD [41]. Additionally, HRQOL is improved when patients feel supported by their social connections [41, 46].

We identified that research to date has focused on physical rehabilitation and is not reflective of the potential benefits of a holistic rehabilitation approach. The occupational therapy scope of practice encompasses more than just physical or biological rehabilitation [64]. Models, such as the PEO model, guide occupational therapists to consider the person and their ability to engage in meaningful occupations or life roles in the context of their broader environment [48]. Research suggests that when a person's abilities fit well with the demands and opportunities in their environment, they experience improved quality of life and overall occupational performance [65]. Therefore, taking a holistic approach and utilising engagement in day-to-day tasks, occupational therapists working within the post-intensive care period have the potential to improve patient outcomes.

Theme 4: Social and contextual characteristics

As with HRQOL, the PEO model highlights the inability to separate a person's occupational performance from social and contextual influences [48]. However, we found no direct reference made to the biopsychosocial model in facilitating recovery during the post-intensive care period. As such, the importance of considering social and contextual factors as unique characteristics was of high importance to our review.

The length of stay in the hospital or the ICU and the duration of mechanical ventilation can be considered uncontrollable contextual characteristics that can impact post-intensive care recovery [37, 49, 50]. Research regarding occupational therapy intervention within the ICU is emerging. A recent systematic review suggested that occupational therapists are well-equipped to facilitate environmental interventions within the ICU, such as physical setup, noise, and organisational structure [26]. These findings support the opportunity for occupational therapists to transfer their skills in environmental modifications into the ICU environment, potentially reducing the severity of PICS.

Our results indicate that allied health professionals remain underutilised within the post-intensive care period. Thomas and Mehrholz [43] reported that only 14% of patients received occupational therapy input following discharge from the ICU. Emerging research has predicted that social isolation and loneliness are likely to be significantly impacted by the COVID-19 pandemic [66]. From our analysis, we know that patient outcomes are favourable when patients feel they have access to a strong social support network [41]. Utilising digital platforms such as telehealth, occupational therapists can connect with patients and provide rehabilitation services despite growing social isolation.

Strengths and Limitations:

To our knowledge, this is the first systematic scoping review explicitly focused on the role of occupational therapy in the management of PICS. We used a robust study design to determine the characteristics of PICS as they relate to occupational therapy practice and applied a biopsychosocial model to highlight how these characteristics are intertwined.

Scoping reviews have inherent limitations as they focus on breadth rather than depth [31]. Rapid growth in ICU demand and the COVID-19 pandemic means that new and emerging literature will likely have been

published following our literature search. Additionally, we only considered data following discharge from the ICU, with there likely to be research available that considers rehabilitation interventions commencing within the ICU. Data were extracted and processed by a single reviewer only. A secondary reviewer then completed cross-referencing to reduce the risk of bias. Our robust study design meant our eligibility criteria could have excluded valuable data. For example, qualitative studies reporting on patients' or health professionals' perspectives could have supported the occupational therapy role in PICS management. This should be considered when conducting future research.

We acknowledge there are likely articles published since the completion of this review given the constantly changing COVID-19 situation globally. It is noted that these articles appear to focus on the impacts of COVID-19 whereas the current paper did not specifically seek to identify articles relating to COVID-19.

Conclusion:

Our systematic scoping review found the characteristics of PICS to be complex and include biological, psychological, and social and contextual factors. We have highlighted the need to consider a holistic rehabilitation approach to facilitate the recovery trajectory during the post-intensive care period. We identified the characteristics of PICS amenable to occupational therapy intervention given their ability to provide a holistic approach to care, considering the person, their environment, and activities that provide them with meaning.

The COVID-19 pandemic increases the need for healthcare systems to utilise available resources to ensure optimal patient outcomes. Currently underutilised, occupational therapists have the potential to reduce the global healthcare burden and improve patient outcomes by providing client-centred care. Future research is needed to determine the best model of care to support occupational therapists in promoting recovery following critical illness.

Abbreviations

6MWT
6-minute walk test
ADLs
Activities of daily living
EQ-5D
EuroQol-5D questionnaire
HRQOL
Health-related quality of life
ICF
World Health Organization's International Classification of Functioning, Disability, and Health
ICU

Intensive care unit
ICU-aw
Intensive care unit acquired weakness
LOS
Length of stay
PEO
Person-environment-occupation model
PICS
Post-intensive care syndrome
PRISMA-ScR
PRISMA Extension for Scoping Reviews
PTSD
Post-traumatic stress disorder
SF-36
Short Form 36 questionnaire

Declarations

Ethics approval and consent to participate: Not applicable

Consent for publication: Not applicable

Availability of data and materials: Data sharing is not applicable to this article as no datasets were generated or analysed during the current study.

Competing interests: The authors declare that they have no competing interests.

Funding: Not applicable

Authors' contributions: All those designated as authors have met all four ICMJE criteria for authorship: 1. Substantial contributions to the conception or design of the work; or the acquisition, analysis, or interpretation of data for the work; and 2. Drafting the work or revising it critically for important intellectual content; and 3. Final approval of the version to be published; and 4. Agreement to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.

All authors read and approved the final manuscript.

Acknowledgements: We would like to acknowledge Sarah Bateup for assisting in the development of search strategies.

Authors' information (optional)

Zoe Heiniger - Corresponding author.

BExSc. MOccTherapy.

Occupational Therapist

Gold Coast Health Service

Queensland Health

ORCID ID 0000-0002-6096-3090

Professor Susan Brandis

Bond University, Queensland

ORCID ID 0000-0003-2613-4114

References

1. Kelly F, Fong K, Hirsch N, Nolan J. Intensive care medicine is 60 years old: the history and future of the intensive care unit. Clin Med. 2014;14(4):376–79.
2. Vincent J. Critical care - where have we been and where are we going? Crit Care. 2014;17 Suppl 1:S2.
3. Vincent J, Creteur J. Paradigm shifts in critical care medicine: the progress we have made. Crit Care. 2015;19 Suppl 3:S10.
4. Lange D, Soares M, Pilcher D. ICU beds: less is more? No. Intensive Care Med. 2020;46:1597–99.
5. Sjoding MW, Prescott HC, Wunsch H, Iwashyna TJ, Cooke CR. Longitudinal changes in intensive care unit admissions among elderly patients in the United States. Crit Care Medicine. 2016;44(7):1353–60.
6. Emanuel E, Persad G, Upshur R, Thome B, Parker M, Glickmann A, et al. Fair allocation of scarce medical resources in the time of COVID-19. N Engl J Med. 2020;382:2049–55.
7. Li R, Rivers C, Tan Q, Murray M, Toner E, Lipsitch M. The demand for inpatient and ICU beds for COVID-19 in the US: lessons from Chinese cities. MedRxiv [Preprint]. 2020 [cited 2020 Dec 5]. Available from: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7239072/
8. Hicks P, Huckson S, Fenney E, Leggett I, Pilcher D, Litton D. The financial cost of intensive care in Australia: a multicentre registry study. Med J Aust. 2019;211(7):324–25.
9. Burrell A, Pellegrini B, Salimi F, Begum H, Broadley T, Campbell L et al. Outcomes of COVID-19 patients admitted to Australian intensive care units during the early phase of the pandemic. Med J Aust [Preprint]. 2020 [cited 2020 Dec 5]. Available from: https://www.mja.com.au/journal/2020/outcomes-covid-19-patients-admitted-australian-intensive-care-units-during-early-phase.

10. Svenningsen H, Langhorn L, Agard A, Dreyer P. Post-ICU symptoms, consequences, and follow-up: an integrative review. Nurs Crit Care. 2015;22(4):212–20.
11. Bemis-Dougherty A, Smith J. What follows survival of critical illness? Physical therapists' management of patients with post-intensive care syndrome. Phys Ther. 2013;93:179–85.
12. Inoue S, Hatakeyama J, Kondo Y, Hifumi T, Sakuramoto H, Kawasaki T, et al. Post-intensive care syndrome: its pathophysiology, prevention, and future directions. Acute Med Surg. 2019;6(3):233–46.
13. Needham D, Davidson J, Cohen H, Hopkins R, Weinert C, Wunsch H, et al. Improving long-term outcomes after discharge from the intensive care unit: report from a stakeholders' conference. Crit Care Med. 2012;40:502-9.
14. Angus D, Carlet J. Surviving intensive care: a report from the 2002 Brussels Roundtable. Intensive Care Med. 2013;29:368–77.
15. Elliot D, Davidson J, Harvey M, Bemis-Dougherty A, Hopkins R, Iwashyna T, et al. Exploring the scope of post-intensive care syndrome therapy and care: engagement of non-critical care providers and survivors in a second stakeholders meeting. Crit Care Med. 2014;42(12):2518–26.
16. Ohtake P, Lee A, Coffey Scott J, Hinman R, Ali N, Hinkson C, et al. Physical impairments associated with post-intensive care syndrome: systematic review based on the World Health Organization's international classification of functioning, disability and health framework. Phys Ther. 2018;98(8):631–45.
17. Smith J, Lee A, Zeleznik H, Coffey Scott J, Fatima A, Needham D, Ohtake P. Home and community-based physical therapist management of adults with post-intensive care syndrome. Phys Ther. 2020;100(7):1062–73.
18. Appleton R, Kinsella J, Quasim T. The incidence of intensive care unit-acquired weakness syndromes: a systematic review. J Intensive Care Soc. 2015;16(2):126–36.
19. Vanhorebeek I, Latronico N, Van den Berghe G. ICU-acquired weakness. Intensive Care Med. 2020;46:637–53.
20. Merbitz N, Westie K, Dammeyer J, Butt L, Schneider J. After critical care: challenges in the transition to inpatient rehabilitation. Rehabil Psychol. 2016;61(2):186–200.
21. Nikayin S, Rabiee A, Hashem M, Huang M, Bienvenu J, Turnbull A, Needham D. Anxiety symptoms in survivors of critical illness: a systematic review and meta-analysis. Gen Hosp Psychiatry. 2016;43:23–29.
22. Righy C, Rosa R, da Silva R, Kochhann R, Migliavaca C, Robinson C, et al. Prevalence of post-traumatic stress disorder symptoms in adult critical care survivors: a systematic review and meta-analysis. Crit Care. 2019;23:213.
23. Connolly B, Denehy L, Brett S, Elliot D, Hart N. Exercise rehabilitation following hospital discharge in survivors of critical illness: an integrative review. Crit Care. 2012;16:226.
24. Schandl A, Brattstrom O, Svensson-Raskh A, Hellgren E, Falkenhav M, Sackey P. Screening and treatment of problems after intensive care: a descriptive study of multidisciplinary follow-up. Intensive Crit Care Nurs. 2011;27(2):94–101.

25. Townsend EA, Polatajko HJ. Enabling occupation II: Advancing an occupational therapy vision for health, well-being, & justice through occupation. Ottawa: CAOT Publications ACE; 2013.
26. Costigan F, Duffet M, Harris J, Baptiste S, Kho M. Occupational therapy in the ICU: a scoping review of 221 documents. Crit Care Med. 2019 Dec;47(12):1014–21. doi: 10.1097/CCM.0000000000003999. Epu. [cited 2020 Oct 18]
27. American Occupational Therapy Association. Occupational therapy services in the promotion of mental health and well-being. Am J Occup Ther. 2016;70:1–15.
28. Gentry K, Snyder K, Barstow B, Hamson-Utley J. The biopsychosocial model: application to occupational therapy practice. Open J Occup Ther. 2018;6(4).
29. Engel G. The need for a new medical model: a challenge for biomedicine. Science. 1977;196(4286):129–36.
30. Kobylańska M, Kowalska J, Neustein J, Mazurek J, Wójcik B, Bełza M, et al. The role of biopsychosocial factors in the rehabilitation process of individuals with a stroke. Work. 2018;61(4):523–35.
31. Tricco A, Lillie E, Zarin W, O'Brien K, Colquhoun H, Kastner K, et al. A scoping review on the conduct and reporting of scoping reviews. BMC Med Res. 2016;16(15).
32. Burns PB, Rohrich RJ, Chung KC. The levels of evidence and their role in evidence-based medicine. Plast Reconstr Surg. 2021;128(1):305–10.
33. Watanabe S, Kotani T, Taito S, Ota K, Ishii K, Ono M, et al. Determinants of gait independence after mechanical ventilation in the intensive care unit: a Japanese multicentre retrospective exploratory cohort study. J Intensive Care. 2019;7(53):1–9.
34. Patsaki I, Gerovasili V, Sidiras G, Karatzanos E, Mitsiou G, Papadopoulos E, et al. Effect of neuromuscular stimulation and individualised rehabilitation on muscle strength in intensive care unit survivors: a randomised trial. J Crit Care. 2017;40: 76–82.
35. Sidiras G, Patsaki I, Karatzanos E, Dakoutrou M, Kouvarakos A, Mitsiou RC, et al. Long-term follow-up of quality of life and functional ability in patients with ICU acquired weakness - a post hoc analysis. J Crit Care. 2019;53:223–30.
36. Kiriella J, Araujo T, Vergara M, Lopez-Hernandez L, Cameron J, Herridge M, et al. Quantitative evaluation of muscle function, gait and postural control in people experiencing critical illness after discharge from the intensive care unit. Phys Ther. 2018;98(1):8–15.
37. Benington S, McWilliams D, Eddleston J, Atkinson D. Exercise testing in survivors of intensive care - is there a role for cardiopulmonary exercise testing? J Crit Care. 2012;27(1):89–94.
38. McWilliams D, Benington S, Atkinson D. Outpatient-based physical rehabilitation for survivors of prolonged critical illness: a randomised controlled trial. Physiother Theory Pract. 2016;32(3):179–90.
39. Tran D. Cardiopulmonary Exercise Testing. Methods Mol Biol. 2018;1735:285–95.
40. Eggman S, Luder G, Verra M, Irincheeva I, Bastiaenen C, Jakob S. Functional ability and quality of life in critical illness survivors with intensive care unit acquired weakness: a secondary analysis of a

randomised controlled trial. Plos One. 2020 March 4;15(3):0229725. doi: 10.1371/journal.pone.0229725. Epu. [cited 2020 Oct 18]

41. Wintermann G, Rosendahl J, Weidner K, Straub B, Hinz A, Petrowski K. Self-reported fatigue following intensive care of chronically critically ill patients: a prospective cohort study. Journal of Intensive Care. 2018;6(27):1–12.
42. Chung C, Yoo H, Park J, Ryu S. Cognitive impairment and psychological distress at discharge from an intensive care unit. Psychiatry Investigations. 2017;14(3):376–79.
43. Thomas S, Mehrholz J. Health-related quality of life, participation, and physical and cognitive function of patients with intensive care unit-acquired muscle weakness one year after rehabilitation in Germany: the GYMNAST cohort study. BMJ Open. 2018 Jul 13;8:020163. doi: 10.1136/bmjopen-2017-020163. Epu. [cited 2020 Oct 17]
44. Sumida H, Yasunaga Y, Takasawa K, Tanaka A, Ida A, Saito T, et al. Cognitive function in post-cardiac intensive care: patient characteristics and impact of multidisciplinary cardiac rehabilitation. Heart and Vessels. 2020;35:946–56.
45. Kerckhoffs M, Kosasi F, Soliman I, van Delden J, Cremer O, de Lange D, et al. Determinants of self-reported unacceptable outcome of intensive care treatment one year after discharge. Intensive Care Medicine. 2019;45(6):806–14.
46. Farley K, Eastwood G, Bellomo R. A feasibility study of functional status and follow-up clinic preferences of patients at high risk of post-intensive care syndrome. Anesthesia and Intensive Care. 2016;44(3):413–19.
47. Taito S, Yamauchi K, Tsujimoto Y, Banno M, Tsujimoto H, Kataoka U. Does enhanced physical rehabilitation following intensive care unit discharge improve outcomes in patients who received mechanical ventilation? A systematic review and meta-analysis. BMJ Open. 2019 June 9;9:026075. doi: 10.1136/bmjopen-2018-026075. Epu. [cited 2020 Oct 17]
48. Law M, Cooper B, Strong S, Stewart D, Ridgy P, Letts L. The person-environment-occupation model: A transactive approach to occupational performance. Canadian Journal of Occupational Therapy. 1996;63(1):9–23.
49. Thomas S, Burridge J, Pohl M, Oechmichen F, Mehrholz J. Recovery of sit-to-stand function in patients with intensive-care-unit-acquired muscle weakness: results from the general weakness syndrome therapy cohort study. Journal of Rehabilitation Medicine. 2016;48:793–8.
50. Chao P, Shih C, Lee Y, Tseng C, Kuo S, Shih Y, et al. Association of post-discharge rehabilitation with mortality in intensive care unit survivors of sepsis. American Journal of Respiratory and Critical Care Medicine. 2014;190(9):1003–11.
51. Thomas S, Mehrholz J, Bodechtel U, Elsner B. Effect of physiotherapy on regaining independent walking in patients with intensive-care-unit-acquired muscle weakness: a cohort study. Journal of Rehabilitation Medicine. 2019;51(10):797–804.
52. Warrillow S, Raper R. The evolving role of intensive care in health care and society. Medical Journal of Australia. 2019;211(7):294–7.

53. Cohen J, Korevaar D, Matczak S, Chalumeau M, Allali S, Toubiana J. COVID-19–related fatalities and intensive-care-unit admissions by age groups in Europe: a meta-analysis. Frontiers in Medicine. 2021;7:1097.
54. Litton E, Bucci T, Chavan S, Ho Y, Holley A, Howard G, et al. Surge capacity of Australian intensive care units associated with COVID-19 admissions. Medical Journal of Australia. 2020;212(10):463–467.
55. Tyrrell C, Mytton O, Gentry S, Thomas-Meyer M, Allen J, Narula A, et al. Managing intensive care admissions when there are not enough beds during the COVID-19 pandemic: a systematic review. Thorax. 2021;76:302–12.
56. Department of Health. Occupational therapy: 2016 factsheet. Canberra: Australian Government; 2018.
57. World Federation of Occupational Therapy (WFOT). About occupational therapy [Internet]. London: WFOT; 2012 [cited 2021 Jan 8]. Available from https://wfot.org/about/about-occupational-therapy
58. American Occupational Therapy Association. Occupational therapy practice framework: domain and process. American Journal of Occupational Therapy. 2017;68 (Suppl 1):1–14.
59. Lerdal A, Bakken L, Kouwenhoven S, Pedersen G, Kirkevold M, Cand A, Kim H. Poststroke fatigue - a review. Journal of Pain and Symptom Management. 2009;38(6):928–49.
60. Legrand D, Vaes B, Matheï C, Adriaensen W, Van Pottelbergh G, Degryse J. Muscle strength and physical performance as predictors of mortality, hospitalization, and disability in the oldest old. Journal of the American Geriatrics Society. 2014;62(6):1030–8.
61. Mehlhorn J, Freytag A, Schmidt K, Brunkhorst F, Graf J, Troitzsch U, et al. Rehabilitation interventions for post-intensive care syndrome: a systematic review. Critical Care Medicine. 2014;42(5):1263–71.
62. Mehrholz J, Pohl M, Kugler J, Burridge J, Muckel S, Elsner B. Physical rehabilitation for critical illness myopathy and neuropathy. Cochrane Database of Systematic Reviews. 2015;11:1–22.
63. Pashmdarfard M, Azad A. Assessment tools to evaluate activities of daily living (ADL) and instrumental activities of daily living (IADL) in older adults: a systematic review. Medical Journal of the Islamic Republic of Iran. 2020;34:33.
64. Occupational Therapy Australia. Occupational therapy scope of practice framework. Fitzroy: Occupational Therapy Australia; 2017.
65. Dooley N, Hinojosa J. Improving quality of life for persons with Alzheimer's disease and their family caregivers: brief occupational therapy intervention. American Journal of Occupational Therapy. 2004;58(5):561–9.
66. Wu B. Social isolation and loneliness among older adults in the context of COVID-19: a global challenge. Global Health Research and Policy. 2020;5(27).
67. Chan K, Mourtzakis M, Friedman L, Dinglas V, Hough C, Ely E, et al. Evaluating muscle mass in survivors of acute respiratory distress syndrome: a 1-year multicentre longitudinal study. Critical Care Medicine. 2018;46(8):1238–46.

68. Devine H, Quasim T, McPeake J, Shaw M, McCallum L, Mactavish P. Chronic pain in intensive care unit survivors: incidence, characteristics, and side effects up to one year post-discharge. Journal of Rehabilitation Medicine. 2019;51(6):451–5.
69. Khalil H, Peters M, Godfrey C, McInerney P, Soares C, Parker D. An evidence-based approach to scoping reviews. Worldviews on Evidence-Based Nursing. 2016;13(2):118–23.
70. Puthucheary Z, Gensichen J, Cakiroglu A, Cashmore R, Edbrooke L, Heintze C, et al. Implications for post critical illness trial design: sub-phenotyping trajectories of functional recovery among sepsis survivors. Crit Care. 2020;24:577–89.
71. Schofield-Robinson O, Lewis S, Smith A, McPeake J, Alderson P. Follow-up services for improving long-term outcomes in intensive care unit (ICU) survivors. Cochrane Database of Systematic Reviews. 2018;11:1–69.

Figures

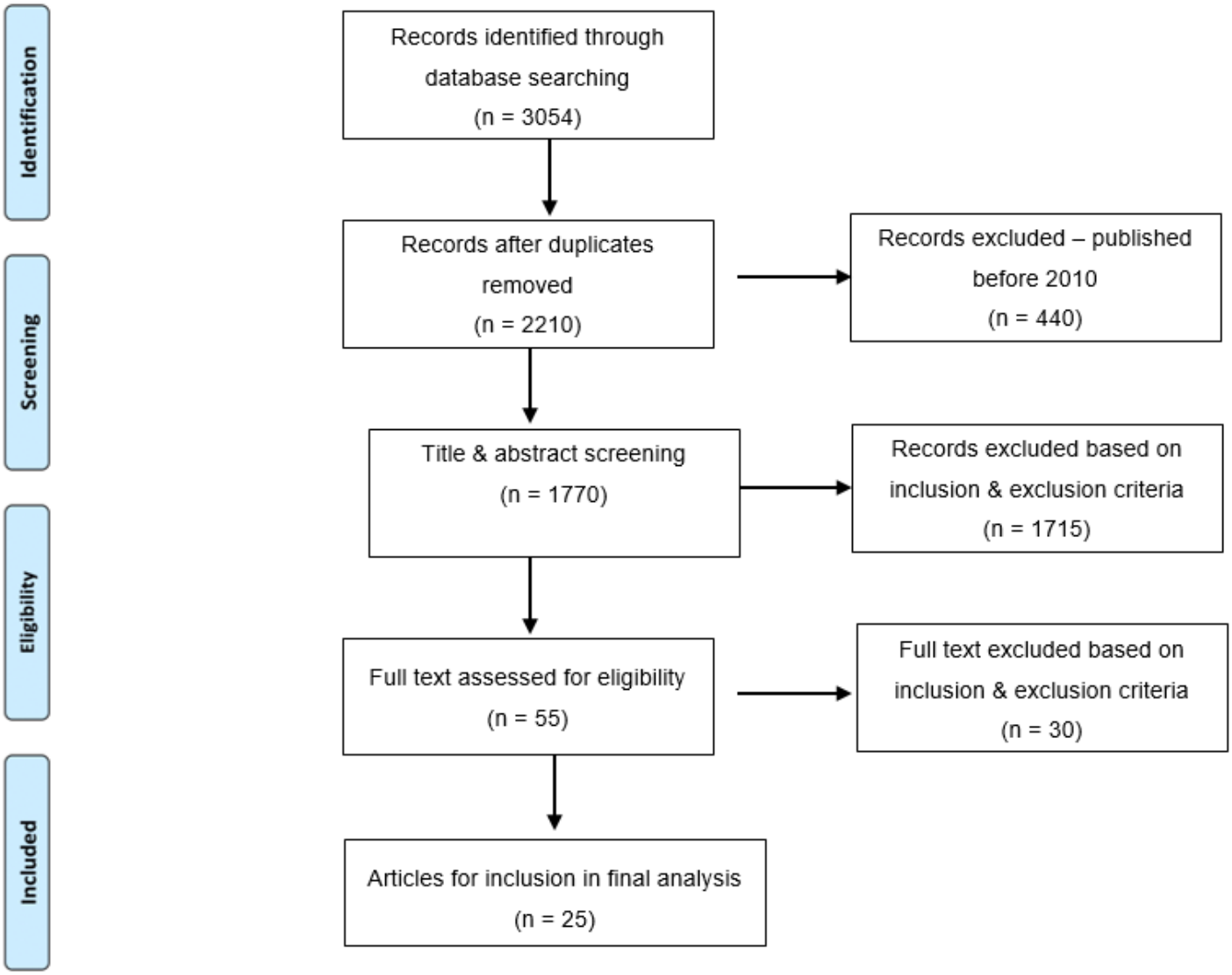

Figure 1

PRISMA flow diagram of included studies.

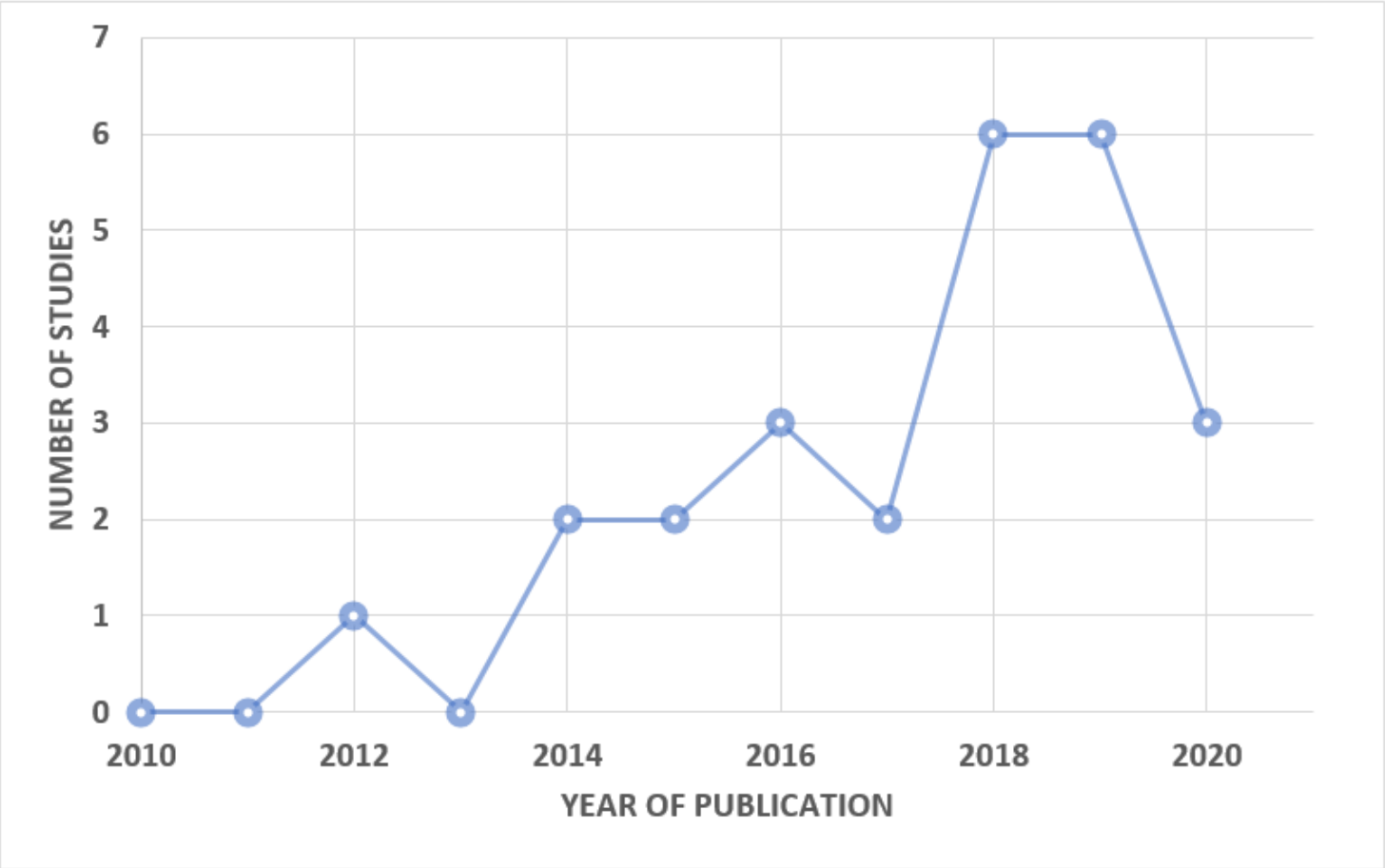

Figure 2

Number of articles published by year of publication from 2010 to 20 October 2020.

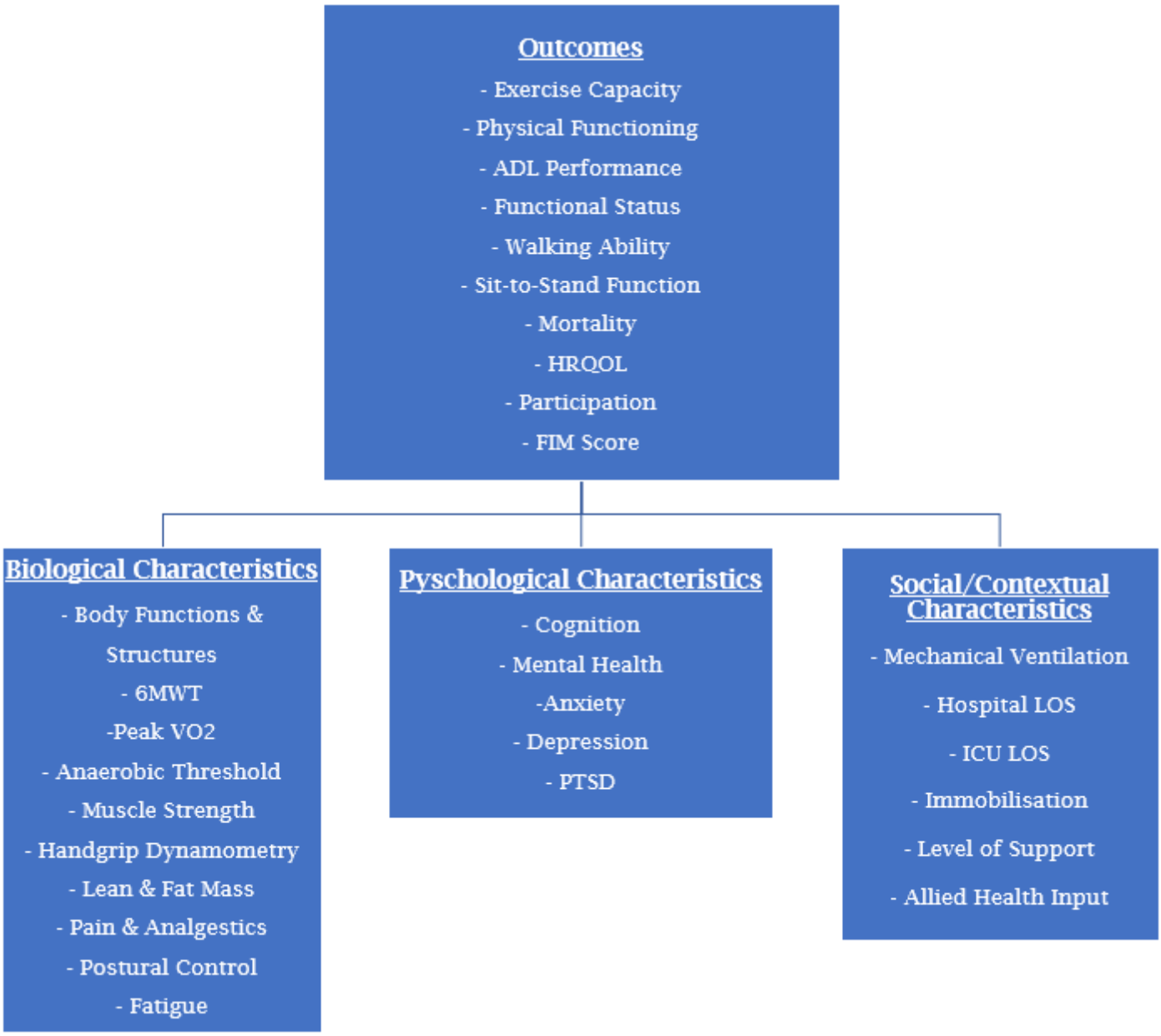

Figure 3

Application of the biopsychosocial model to the characteristics of PICS.

Supplementary Files

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

- AdditionalFile1.docx