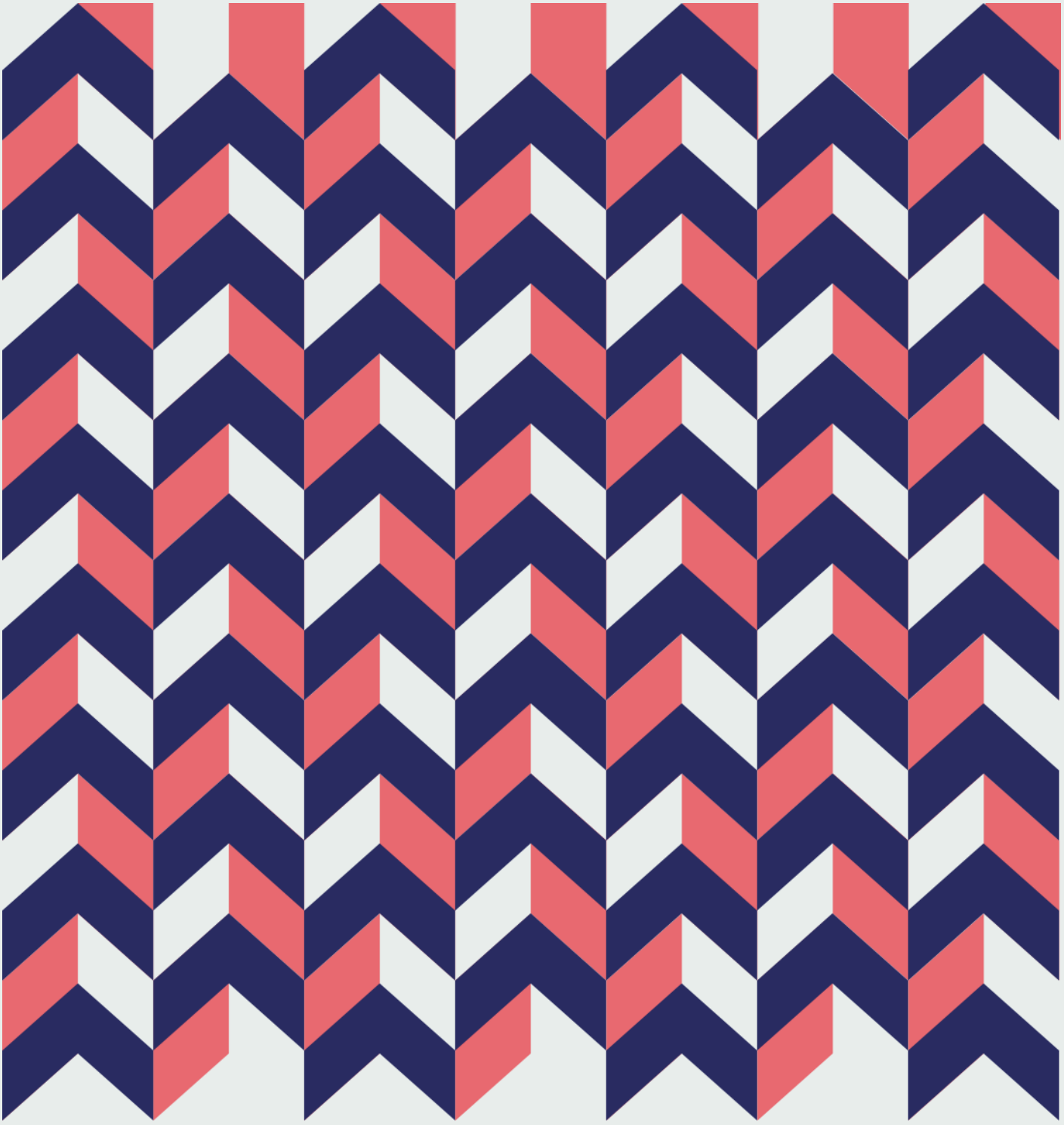

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**XI.** O **JIM** edita números regulares e números especiais, confiados a investigadores/as credenciados/as das respetivas áreas de especialidade (orientações para revisores/as), sob a escrutínio e aprovação da Equipa Editorial. Toda a colaboração é submetida a um exigente processo de seleção e revisão baseado em arbitragem científica e dois modos, cega por pares e por pares aberta.

**XII.** O **JIM** disponibiliza as Normas para apresentação e publicação de artigos e uma lista anual dos/as revisores/as que colaboram na arbitragem científica dos manuscritos, tendo uma política de revisão em que todos os artigos desta publicação científica passam por uma triagem rigorosa, com base na revisão por pares, cega dupla e aberta, assim como pelo crivo dos editores-chefes.

**XIII.** Almejando os mais elevados padrões de ética na publicação, a Equipa Editorial do **JI**M inspira o seu Código de Ética nas orientações estabelecidas pelo

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**XV.** O **JIM** assume o compromisso de assegurar o respeito pelos princípios deontológicos e pela ética profissional dos jornalistas, assim como pela boa-fé dos leitores, nos termos n.º 1 do artigo 17º da Lei de Imprensa.

# ÍNDICE

**EDITORIAL**
***EDITORIAL***

10.29073/jim.v4i2.791

**Cristina Almeida — Editora-Chefe**
Sociedade Portuguesa de Literacia em Saúde; vazdealmeidacristina@gmail.com

## A IMPORTÂNCIA DE REPLICAR MENSAGENS INTEMPORAIS PARA AS ACADEMIAS E INVESTIGADORES: "RESPLANDECER, OUVIR E NÃO TEMER"

Evoco aqui as palavras marcantes do líder da Igreja Católica, Papa Francisco, que nas Jornadas Mundiais da Juventude 2023, em Lisboa, em pleno agosto mais quente dos últimos anos, nos deixou, não apenas para os jovens, mas para o mundo: Resplandecer, Ouvir e Não Temer.

Estas três palavras fizeram eco nos meus ouvidos, sentimentos e análise cognitiva, e permitem-me aqui fazer uma ponte ao trabalho da academia, dos investigadores e de todos aqueles que, através da ciência e de processos baseados em evidência, trazem mais conhecimento ao mundo.

Resplandecer as obras, as pessoas e os trabalhos, que surgem através da análise atenta do mundo que nos rodeia. Para todos os que fazem esforços para relatar de uma forma crítica, científica, organizada o que muitos dizem escrevem e analisaram (as revisões integrativas, sistemáticas, narrativas por exemplo) ou avaliaram no terreno (os experimentos, as intervenções aleatórias ou não aleatórias com grupos experimentais e de controlo, as experiências participativas ou observacionais, entre outras).

E para isso, as publicações científicas, como esta permitem esse resplandecimento dos trabalhos que vão sendo feitos por indivíduos, equipas de maior ou menor dimensão, dentro das organizações de saúde, do social, da educação, da cultura, entre outras, A visibilidade cuidada apoia esse resplandecimento dos indivíduos e das matérias abordadas.

Ouvir melhor, aqui a ponte para a necessária escuta ativa que devemos fazer do que nos é proposto pelo outro. Ouvir, ler, pesquisar, também faz parte da educação no seu todo e fator de melhoria de resultados. Quando ouvimos os outros, as suas necessidades, a sua caminhada e esforços, conseguimos melhores resultados para aquilo que nos propomos fazer. Ouvir é uma ferramenta da educação e da literacia em saúde. Possamos todos ouvir melhor o que os outros têm para nos dizer.

Não temer também se aplica ao esforço científico que tantos fazem e que muitas vezes fica na penumbra. Investigar é dar forças ao desenvolvimento humano para promover uma melhor saúde, um contributo para aquilo que entendemos ser uma "One Health" uma única saúde onde o ecossistema é visto através de uma lente holística e que envolve o ambiente, o ser humano, os animais, as estruturas e o contexto onde vivemos. Não temer investigar, mesmo que o processo seja por vezes penoso, mesmo que não se saiba o que vamos encontrar. Viver uma vida com consciência, com emoção e com a razão. São estas as palavras que me cabem refletir neste momento em que lançamos esta edição do Jornal de Investigação Médica.

Que estes trabalhos agora propostos possam levar a maiores reflexões. São janelas, são passos dados.

Neste número podemos rever análises sobre os riscos do excesso de atividade física combinado com a falta de sono e a probabilidade de aumento dos níveis de lesão celular, queda dos desempenhos físico e cognitivo. Percorremos o caminho das tecnologias da saúde e a avaliação se os profissionais estão recetivos à incorporação dessas ferramentas na sua prática, verificando que a ferramenta UtEQ-B fornece um método confiável e válido para educadores e

investigadores em saúde. Conseguimos compreender melhor o desempenho e a autoeficácia e como o burnout afeta a saúde física e psicológica, já considerado por tantos estudos prévios como uma grande ameaça para a saúde pública. Os autores aqui referem que a palavra-chave "COVID-19" está frequentemente associada a "burnout" nesta ampla revisão feita.

Para obviar e ultrapassar estas questões impactantes como o burnout podemos ler também o artigo que foca na importância do coaching como abordagem importante para apoiar a autogestão de pacientes com doenças não transmissíveis (DNTs) na educação em saúde. A intervenção educacional DigiCare parece ser uma adição de baixo custo útil no desenvolvimento das competências clínicas de coaching dos estudantes.

**Cristina Vaz de Almeida (PhD)**

# ESFORÇO FÍSICO E RESTRIÇÃO DE SONO MODIFICAM MARCADORES BIOQUÍMICOS E COGNITIVOS EM MILITARES: UMA REVISÃO SISTEMÁTICA

## *PHYSICAL EXERTION AND SLEEP RESTRICTION MODIFY BIOCHEMICAL AND COGNITIVE MARKERS IN MILITARY PERSONNEL: A SYSTEMATIC REVIEW*

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## RESUMO

A revisão objetivou descrever os efeitos de treinamentos militares que combinam atividade física intensa e privação de sono em marcadores de estresse oxidativo, lesão celular, desempenho físico e cognitivo. Foi realizada uma revisão sistemática seguindo as recomendações do PRISMA e a pesquisa foi realizada nas bases de dados Pubmed e Google Scholar. A frase de busca foi desenvolvida para identificar estudos experimentais que investigaram momentos pré e pós treinamentos militares, avaliando pelo menos uma das variáveis dependentes: dano oxidativo, capacidade antioxidante, lesão celular, alerta cognitivo e desempenho físico. Vinte e quatro estudos preencheram os critérios de inclusão. As intervenções dos estudos incluídos variaram de 1 a 63 dias, com predominância de atividade física intensa e importante privação de sono. As comparações dos dados pareados convergiram com o aumento dos níveis de lesão celular, queda dos desempenhos físico e cognitivo ($p<0,05$). Houve escassez das avaliações de estresse oxidativo e distinção entre os protocolos dos estudos encontrados. A revisão concluiu que a combinação de atividade física intensa e privação de sono são capazes de provocar aumento nos níveis de lesão celular e queda de performance física e cognitiva. Sugere também que há uma lacuna de informações sobre estresse oxidativo e treinamentos militares.

**Palavras-Chave:** Atividade Física; Dano Celular; Estresse Oxidativo; Função Cognitiva; Privação de Sono.

## ABSTRACT

The review aimed to describe the effects of military training that combine intense physical activity and sleep deprivation on oxidative stress and cellular injury markers, as well as physical and cognitive performance. A systematic review was conducted following PRISMA recommendations, and the search was conducted in Pubmed and Google Scholar databases. The string was developed to identify experimental studies that investigated pre- and post-military training moments, evaluating at least one of the dependent variables: oxidative damage, antioxidant capacity, cellular injury, cognitive alertness, and physical performance. Twenty-four studies met the inclusion criteria. The interventions of the included studies ranged from 1 to 63 days, with a predominance of intense physical activity and significant sleep deprivation. Comparisons of paired data converged with increased levels of cellular injury and decreased physical and cognitive performance ($p<0.05$). There was a paucity of oxidative stress assessments and the distinction between the protocols of the studies found. The review concluded that the combination of intense physical activity and sleep deprivation is capable of causing increased levels of cellular injury and decreased physical and cognitive performance. It also suggests that there is an information gap between oxidative stress and military training.

**Keywords:** Cell Damage; Cognitive Function; Oxidative Stress; Physical Activity; Sleep Deprivation.

## 1. INTRODUÇÃO

Os treinamentos militares, nas mais diversas instituições, guardam algumas semelhanças significativas que permitem a comparação dos seus efeitos nas diferentes amostras avaliadas. Como características basilares entendidas para o desenvolvimento da presente pesquisa bibliográfica, destacam-se o desempenho de atividades físicas intensas e prolongadas (com sobrecarga), a privação parcial ou total de sono, as restrições alimentares e o estresse psicológico. Algumas fases dos exercícios podem não estar relacionadas simultaneamente às três condições, mas pelo menos uma delas está presente (Silva 2019).

Os resultados de pesquisas nessa área apontam que os organismos dos indivíduos são significativamente impactados pelas atividades e condições adversas do curso, exercício ou treinamento (Tanskanen *et al.* 2011; Lieberman *et al.* 2016; Hamarsland *et al.* 2018). Entretanto, em virtude da complexidade e do nível de impacto, ainda não são totalmente compreendidas as alterações ocorridas nestes sujeitos.

Não obstante o avanço nas pesquisas com populações militares, não foi encontrado um grande número de estudos que avaliassem as lesões celulares (Margolis *et al.* 2012; Coutinho *et al.* 2014; Suzuki *et al.* 2014; Domingues *et al.* 2015; Koury *et al.* 2016; Hamarsland *et al.* 2018) e os marcadores de dano oxidativo (Tanskanen *et al.* 2011; Suzuki *et al.* 2014; Koury *et al*. 2016; Varanoske *et al.* 2018). As poucas evidências científicas com estas populações podem dificultar a leitura de quão afetados são estes profissionais pelas atividades laborais, atrapalhando também a adoção de medidas preventivas. Não obstante, a compreensão do impacto dos fatores estressantes dos treinamentos militares pode contribuir para o adequado planejamento de operações semelhantes, buscando os melhores resultados em termos de segurança e eficiência.

Portanto, o objetivo dessa revisão sistemática é avaliar o efeito da atividade física intensa e/ou da privação de sono em marcadores de lesão celular, estresse oxidativo, desempenho funcional e alerta cognitivo em estudos com militares.

## 2. MÉTODOS

### 2.1. ESTRATÉGIA DE PESQUISA DA LITERATURA

Esta revisão sistemática foi realizada de acordo com os Principais Itens para Relatar Revisões Sistemáticas e Meta-Análise: A Recomendação PRISMA (*Preferred Reporting Items for Systematic Reviews and Meta-Analyses*) (PRISMA 2009) e foi submetida ao Registro Prospectivo Internacional de Revisões Sistemáticas (PROSPERO), sob o ID 246516. A pesquisa bibliográfica inicial foi feita por um autor (TB) nas bases de dados PubMed (Medline) e Google Scholar, no período de 20 de janeiro a 20 de junho de 2020. A estratégia de busca eletrônica foi desenvolvida para identificar estudos que investigaram modificações em marcadores de lesão celular, estresse oxidativo, desempenho funcional e alerta cognitivo de sujeitos submetidos a treinamento militares. Assim, foram usados os seguintes termos de indexação: *(military) AND ("physical exercise" OR "high intensity exercise" OR "caloric cost" OR "caloric expenditure" OR "energy cost" OR "energy expenditure" OR endurance OR exhaustion OR "sleep restriction" OR "sleep deprivation" OR "sleep shortage" OR "rest deprivation") AND ("cell injury" OR "cell damage" OR "muscle injury" OR "muscle damage" OR biomarker OR "oxidative stress" OR antioxidant OR stress OR oxidant OR cognitive OR "time reaction" OR alert OR performance OR jump OR power OR strength OR muscle OR function).* Inicialmente, todos os títulos e resumos identificados foram baixados e tabulados para que fossem feitas as exclusões das referências cruzadas e duplicadas. Em seguida, foram avaliados os títulos e resumos, com o intuito de elencar os textos enquadrados nos critérios de elegibilidade.

Feita a seleção preliminar, os estudos foram lidos na íntegra sob nova avaliação pelos critérios de inclusão e exclusão. Um segundo autor (FB) atuou na seleção e diante de divergências, um terceiro avaliador (MM) foi consultado.

Com o fito de ampliar o alcance da coleta de dados, neste primeiro momento não foi considerada a avaliação do risco de viés.

### 2.2. CRITÉRIOS DE SELEÇÃO

Foram utilizados os seguintes critérios de inclusão:

1. Textos completos de artigos publicados no idioma inglês, em virtude da ampla superioridade numérica de periódicos bem avaliados que publicam neste idioma;

2. Estudos com militares em atividade, saudáveis, do sexo masculino, com idades entre 18 e 60 anos;

3. Investigações envolvendo marcadores de lesão celular em treinamentos militares com privação de sono e/ou atividade física intensa;

4. Investigações que analisaram marcadores de dano oxidativo em treinamentos militares com privação de sono e/ou atividade física intensa;

5. Investigações que envolviam variáveis de função cognitiva em treinamentos militares com privação de sono e/ou atividade física intensa; e

6. Investigação que envolvia variáveis de desempenho físico em treinamentos militares com privação de sono e/ou atividade física intensa.

Foram utilizados os seguintes critérios de exclusão:

1. Estudos de revisão sistemática, de literatura e estudos de caso;

2. Estudos que não avaliaram pelo menos uma das variáveis propostas no presente estudo; e

3. Estudos que não estão disponíveis para leitura na íntegra, mesmo após contato com os autores.

### 2.3. EXTRAÇÃO E ANÁLISE DOS DADOS

Para a análise sintética dos achados, foi procedida a extração dos seguintes dados de cada estudo elencado: autores, população, tamanho da amostra, dados demográficos (idade, estatura e massa corporal total), delineamento do estudo, duração do treinamento, quantidade diária de sono permitido, nível de intensidade do treinamento desenvolvido e os resultados obtidos da avaliação das variáveis de dano oxidativo, de capacidade antioxidante, de função cognitiva e de desempenho físico. A estratégia utilizada foi a construção de tabelas.

Após a extração dos dados e, de posse de uma visão geral dos resultados, foi realizada a avaliação do risco de viés para verificar a existência de risco que pudesse influenciar as conclusões deste trabalho.

### 2.4. RISCO DE VIÉS

Os estudos foram avaliados em relação ao risco de viés através das orientações da ferramenta Cochrane (Higgis e Altman 2019), que apesar de ter sido criada para avaliar ensaios clínicos randomizados, pode também ser aplicada a outros tipos de estudo, de acordo com os próprios autores. A metodologia sugere cinco tipo de vieses: Viés de seleção — é relacionado ao método de alocação dos participantes e mascaramento da alocação; Viés de desempenho — corresponde ao desconhecimento dos participantes/grupo sobre a alocação; Viés de deteção — corresponde ao desconhecimento da alocação pelos avaliadores; Viés de atrito — relaciona-se com a perda de sujeitos do estudo para determinadas variáveis ou a indisponibilidade de resultados; e Viés de relatório — possibilidade dos pesquisadores relatarem somente dados de maior significância ou conveniência, apesar de terem avaliados outros resultados. As classificações foram atribuídas como incerto (I), baixo (B) ou alto (A) risco e apresentadas em tabela.

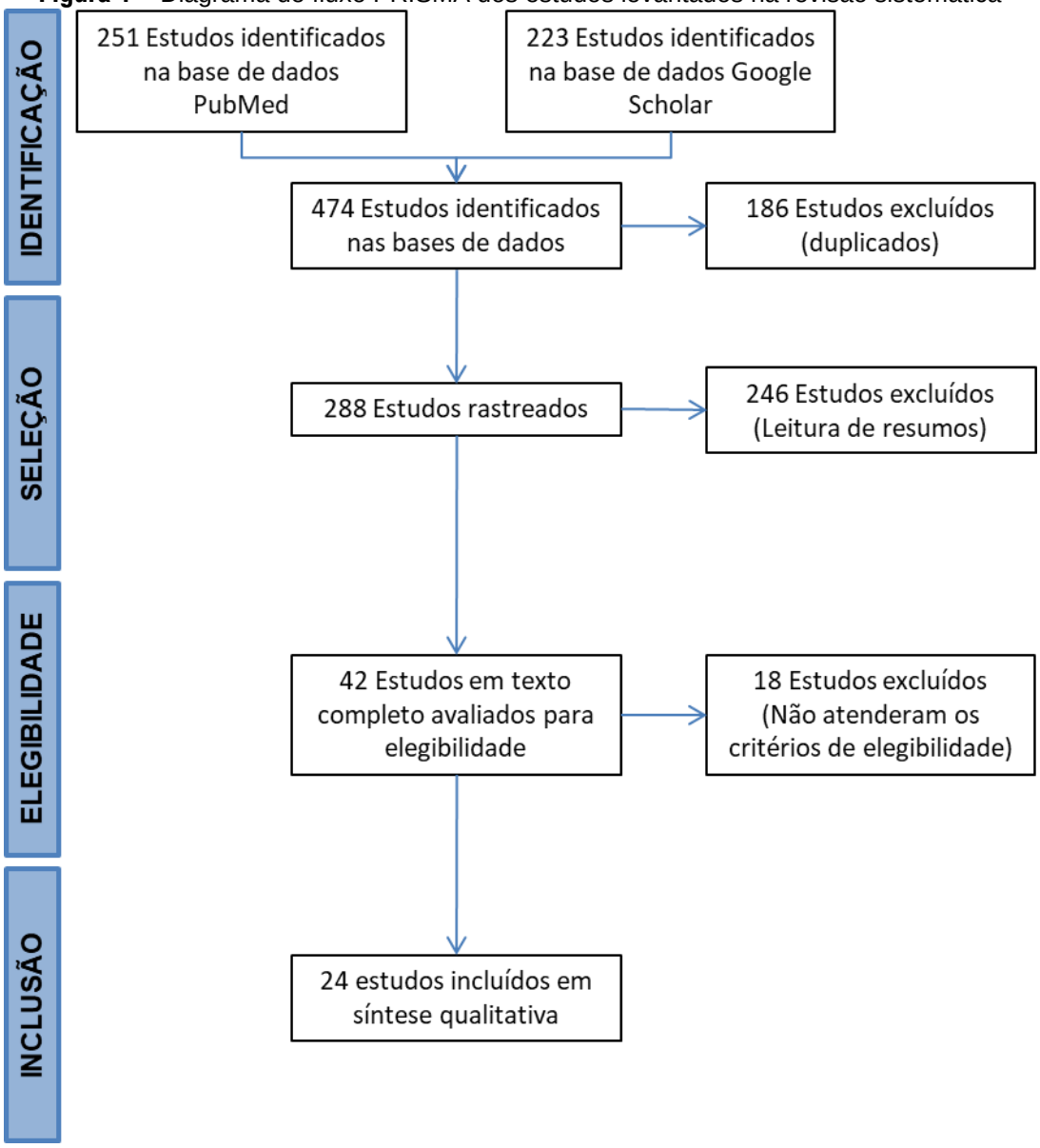
As avaliações foram feitas por dois pesquisadores (TB e FB) cegos um para a decisão do outro e, pela similaridade dos resultados, não foi considerada necessária a análise de um terceiro avaliador.

## 3. RESULTADOS

### 3.1. RESULTADOS DA BUSCA

De um total de 474 artigos identificados provenientes da estratégia de busca, 24 estudos foram incluídos nesta revisão (Figura 1).

**Figura 1 –** Diagrama de fluxo PRISMA dos estudos levantados na revisão sistemática




**Fonte:** Desenvolvida pelo autor

### 3.2. RISCO DE VIÉS

Em linhas gerais, houve predominância de classificações de baixo risco entre os critérios avaliados pelos dois pesquisadores (TB e FB). Para o viés de seleção, 18 estudos (75%) apresentaram baixo risco de viés. Para o desempenho, o número é maior (19 — 79%). Para os riscos de vieses de deteção e de atrito, a maioria dos estudos apresentaram alto risco: 17 (71%) e 14 (58%) respetivamente. E para o risco de viés de relatório, 18 (75%) dos estudos foram avaliados como baixo risco. Os vieses com maiores graus de incerteza foram de atrito e relatório (3 estudos cada). Os resultados estão descritos na Tabela 1.

**Tabela 1 –** Avaliação do risco de viés

| Nr | Autor | Riscos de viés avaliados | | | | |
|---|---|---|---|---|---|---|
| | | VS | VDs | VDt | VA | VR |
| 1 | Legg & Patton (1987) | I | B | A | B | B |
| 2 | Nindl *et al.* (2002) | B | B | B | A | B |
| 3 | Lieberman *et al.* (2006) | B | A | B | A | B |
| 4 | Nindl *et al.* (2007) | B | B | B | A | B |
| 5 | Welsh *et al.* (2008) | B | A | A | B | B |
| 6 | Christensen *et al.* (2008) | B | B | B | A | I |
| 7 | Lieberman *et al.* (2009) | A | B | B | B | B |
| 8 | Tanskanen *et al.* (2011) | A | B | B | A | B |
| 9 | Fortes *et al.* (2011) | A | A | A | I | B |
| 10 | Tomczak *et al.* (2013) | B | A | A | B | B |
| 11 | Tanskanen *et al.* (2012) | B | B | A | A | B |
| 12 | Coutinho *et al.* (2014) | B | B | B | I | B |
| 13 | Margolis *et al.* (2014) | B | B | A | A | I |
| 14 | Suzuki *et al.* (2014) | A | B | A | A | B |
| 15 | Tomczak (2015) | B | B | A | A | B |
| 16 | Domingues *et al.* (2015) | B | B | A | A | B |
| 17 | Lieberman *et al.* (2016) | A | B | A | A | I |
| 18 | Koury *et al.* (2016) | B | B | A | B | B |
| 19 | Tomczak *et al.* (2017) | B | B | A | A | A |
| 20 | Varanoske *et al.* (2018) | B | B | A | I | A |
| 21 | Hamarsland *et al.* (2018) | B | B | A | A | B |
| 22 | Delgado-Moreno *et al.* (2018) | B | B | A | A | B |
| 23 | Santos *et al.* (2018) | B | B | A | B | B |
| 24 | Tomczak & Jówko (2019) | B | A | A | B | A |

**Fonte:** Desenvolvida pelo autor. VS — Viés de Seleção; VDs — Viés de Desempenho; VDt — Viés de Detecção; VA — Viés de Atrito; VR — Viés de Relatório; B — baixo risco; A — alto risco; I — incerto

### 3.3. CARACTERÍSTICAS DOS ESTUDOS INCLUÍDOS

A população incluída nos estudos variou entre jovens e adultos, todos militares e considerados treinados. Dois estudos utilizaram grupos experimentais e grupos controle. O tamanho das amostras oscilou entre 5 e 87 participantes, havendo um estudo com 186 indivíduos (Tabela 2).

Todos os trabalhos fizeram avaliações de pelo menos um momento anterior e um posterior ao período de treinamento militar. O nível de intensidade dos treinamentos foi descrito na maioria como alta ou moderada intensidade. As durações de treinamento relatados variaram de 1 a 63 dias, sendo que um estudo, de Delgado-Moreno *et al.* (2018), não informou o período do exercício. Sobre a quantidade de sono, o período de descanso variou entre zero e o tempo considerado normal (oito horas de sono) e quatro pesquisas (Christensen *et al.* 2008; Welsh *et al.* 2008; Lieberman *et al.* 2009; Delgado-Moreno *et al.* 2018) não relataram os períodos de sono. Considerando a grande variabilidade, as horas de sono relatadas apresentaram valor central de 3,47 horas por dia. O delineamento das pesquisas e as características das variáveis independentes estão descritas na Tabela 2.

Já as variáveis dependentes elencadas na presente revisão estão apresentadas conforme a Tabela 3. Vale ressaltar que, devido à variedade encontrada nos delineamentos experimentais dos estudos, esta apresentação ateve-se aos momentos pré e pós treinamento militar, bem como

indicou os comportamentos relatados apenas das variáveis de interesse.

A possibilidade do uso de suplementação pelas amostras analisadas nos estudos foi levantada, entretanto os trabalhos elencados não relataram o controle do consumo de suplementos durante os treinamentos.

**Tabela 2 –** Estatística descritiva, delineamento e caracterização das variáveis independentes relatadas

| Nr | Autores | Tamanho amostral (Exp/Con) | Idade média (anos) | Estatura média (m) | MCT média (kg) | Delineamento | Duração do treinamento (dias) | Quantidade de sono | Intensidade do treinamento |
|---|---|---|---|---|---|---|---|---|---|
| 1 | Legg & Patton (1987) | 25 (18 Exp e 7 Con) | Exp: 22,3 ± 2,8 e Con: 23,1 ± 2,7 | Exp: 1,76 ± 0,5 e Con: 1,75 ± 0,4 | Exp: 79,1 ± 14,4 e Con: 73,2 ± 9,2 | Pre e Pós (Grupos Exp e Con) | 8 | 3 a 4 horas por dia | Trabalho manual sustentado (cargas extras de 45 Kg) |
| 2 | Nindl *et al.* (2002) | 10 | 22 ± 3 | 1,83 ± 0,07 | 87,0 ± 8,0 | 3 avaliações: Dia 1 (pré), dia 3 e dia 4 (pós). | 4 | 2 horas por dia | Intensidade moderada a alta |
| 3 | Lieberman *et al.* (2006) | 31 | 31,6 ± 0,4 | 1,78 ± 1,4 | 81,5 ± 1,3 | 3 avaliações: Pré, 24 horas e pós. | 5 | 14,4 ± 1,0 durante os 5 dias | Intensidade moderada a alta |
| 4 | Nindl *et al.* (2007) | 50 | 24,6 ± 4,4 | 1,76 ± 7,8 | 78,4 ± 7,7 | Pré e pós. | 56 | 3,6 horas por dia | Intensidade moderada a alta |
| 5 | Welsh *et al.* (2008) | 29 | 24 ± 1,0 | 1,80 ± 0,06 | 82,5 ± 8,2 | Pré e pós. | 8 | NR | Intensidade alta |
| 6 | Christensen *et al.* (2008) | 5 | 32,2 ± 7,7 | 1,84 ± 1,1 | 85,9 ± 3,7 | 3 avaliações: pré, pós e 3 horas após. | 8 | NR | Intensidade alta |
| 7 | Lieberman *et al.* (2009) | 15 | NR | NR | 67,2 ± 2,1 | 3 avaliações: Pós, 2 dias após e 108 dias após. | 61 | 4 horas por dia | Intensidade alta |
| 8 | Tanskanen *et al.* (2011) | 35 | 19,6 ± 0,3 | 1,78 ± 7,5 | 71,0 ± 7,0 | 3 avaliações: | 56 | Normal | Intensidade |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | Pré, 4 sm e 7 sm. | | | moderada |
| 9 | Fortes *et al.* (2011) | Exp: 15 e Con: 15. | Exp: 24,7 ± 2,8 e Con: 25,3 ± 2,5 | Exp: 1,77 ± 0,04 e Con: 1,79 ± 0,06 | Exp: 80,2 ± 8,8 e Con: 81,6 ± 6,6 | Pré e pós | 56 | Normal | Intensidade de moderada a alta |
| 10 | Tomczak *et al.* (2013) | 8 | 25 a 33 | 1,70 a 1,88 | 71 a 95 | 4 avaliações: Pré, 32 h, 54 h e 72 h (pós) | 3 | 3 horas nos primeiros dias e zero no último | Intensidade de moderada a alta |
| 11 | Tanskanen *et al.* (2012) | 26 | 20,0 ± 0,0 | 1,78 ± 7,5 | 71,0 ± 7,0 | 4 avaliações: 6 dias antes, pré, durante e pós. | 8 | Normal | Intensidade de moderada a alta |
| 12 | Coutinho *et al.* (2014) | 23 | 26,96 ± 4,14 | 1,78 ± 0,06 | 80,74 ± 9,89 | 3 avaliações: Pré, pós e 24 h após. | 4 | 1 a 4 horas por dia | Intensidade alta |
| 13 | Margolis *et al.* (2014) | 21 | 20,0 ± 1,0 | 1,82 ± 0,07 | 82,0 ± 9,0 | 3 avaliações: Pré, pós tarefas militares e pós 5 km de marcha. | 7 | Normal | Intensidade alta |
| 14 | Suzuki *et al.* (2014) | 52 | 26,6 ± 3,1 | NR | NR | 3 avaliações: Pré, 3 sm (durante) e 3–5 dias após o término (pós). | 63 | 5,5 ± 0,68 horas por dia | Intensidade alta |
| 15 | Tomczak (2015) | 13 | 30 a 56 | 1,81 ± 5,6 | 83,4 ± 6,7 | Pré e pós. | 1,5 | Sem sono | NR |
| 16 | Domingues *et al.* (2015) | 17 | 28,7 ± 4,19 | NR | NR | 6 avaliações: Pré, 24 h, 48 h, 72 h, 96 h, 102 h (pós). | 4,25 | 0–2 horas por dia | Intensidade alta |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 17 | Lieberman *et al.* (2016) | 60 | 26,92 ± 0,37 | NR | 85,37 ± 1,03 | Pré e Pós. | 21 | NR | Intensidade alta |
| 18 | Koury *et al.* (2016) | 87 | 20,0 ± 2,0 | NR | 72,8 ± 7,9 | 3 avaliações: 12 h pré, 12 após 30 km de marcha e 48 h pós. | 3 | Normal | Intensidade alta |
| 19 | Tomczak *et al.* (2017) | 15 | 19,6 ± 0,3 | 1,78 ± 1,7 | 72,0 ± 2,1 | 4 avaliações: Pré, 24 h, pós e 24 h após. | 1,5 | Sem dormir | Intensidade alta |
| 20 | Varanoske *et al.* (2018) | 19 | 22,7 ± 3,3 | 1,75 ± 0,04 | 81,8 ± 11,7 | 3 avaliações: pré, 12 h e pós. | 1 | Sem dormir | Intensidade alta |
| 21 | Hamarsland *et al.* (2018) | 15 | 23,0 ± 4,0 | 1,81 ± 0,06 | 78,0 ± 7,0 | 5 avaliações: 3 sm antes, Pré, pós, após 24 h, após 72 horas, após 1 sm e após 2 sm. | 7 | 2–3 horas por dia | Intensidade alta |
| 22 | Delgado-Moreno *et al.* (2018) | 186 | 27,2 ± 4,2 | 1,74 ± 5,7 | 71,6 ± 6,3 | Pré e Pós. | NR | NR | Intensidade alta |
| 23 | Santos *et al.* (2018) | 43 | 19 a 24 | 1,70 ± 0,10 | 74,4 ± 7,7 | 3 avaliações: Pré, pós e 63 h após. | 3 | Sem dormir | Intensidade alta |
| 24 | Tomczak & Jówko (2019) | 14 | 20 a 27 | NR | NR | 4 avaliações: Pré, 24 h, pós e 12 h após. | 1,5 | Sem dormir | Intensidade alta |

**Fonte:** O autor. NR = Não relatado; Exp. = Grupo Experimental; Con. = Grupo Controle; sm = semanas; h = horas; Kg = quilogramas

**Tabela 3 –** Características dos estudos incluídos

| Nr | Autor | Marcadores de estresse oxidativo / Efeito | Marcadores de dano oxidativo / Efeito | Marcadores de lesão celular / Efeito | Desempenho cognitivo / Efeito | Desempenho físico / Efeito |
|---|---|---|---|---|---|---|
| 1 | Legg & Patton (1987) | NR | NR | NR | NR | ↓Potência anaeróbica (Teste de Wingate); ↓Força isométrica de preensão manual. |
| 2 | Nindl *et al.* (2002) | NR | NR | NR | NR | ↓Força de membros superiores (supino); ↓Salto vertical durante o treinamento |
| 3 | Lieberman *et al.* (2006) | NR | NR | NR | ↓Vigilância; ↑Tempo de reação; ↓Reconhecimento de padrões; ↓Substituição de símbolos; ↓ Aprendizado por lista de palavras;↓Raciocínio gramatical. | NR |
| 4 | Nindl *et al.* (2007) | NR | NR | NR | NR | ↓ Altura de salto vertical; ↓Potência de salto vertical. |
| 5 | Welsh *et al.* (2008) | NR | NR | NR | NR | ↓ Altura de salto vertical; ↓Potência de salto vertical. |
| 6 | Christensen *et al.* (2008) | NR | NR | NR | NR | ↓ Altura de salto vertical (Post); ↔ Altura do salto (3 h após) em relação a pré. |
| 7 | Lieberman *et al.* (2009) | NR | NR | NR | ↓Vigilância; ↑Tempo de reação; ↓Reconhecimento de padrões; ↓Substituição de símbolos; ↓ | NR |

| | | | | | | |
|---|---|---|---|---|---|---|
| | | | | | Aprendizado por lista de palavras; e ↓Raciocínio gramatical. | |
| 8 | Tanskanen *et al.* (2011) | ↓TGSH (4sm) e ↑TGSH (7sm); ↑GSSG (4sm) e ↑GSSG (7sm); ↑GSSG/TGSH (4 sm) e ↔GSSG/TGSH (7 sm); ↓ORAC (4 sm) e ↑ ORAC (7 sm). | ↔ PC; ↔ MDA | NR | NR | ↓Força de preensão manual (4 sm) e ↑Força isométrica de preensão (7 sm); ↓Potência de salto vertical (4 sm) e ↑Potência de salto vertical (7 sm) |
| 9 | Fortes *et al.* (2011) | NR | NR | NR | NR | Con: ↓Potência de salto vertical; Exp: ↔ Potência de salto vertical; |
| 10 | Tomczak *et al.* (2013) | NR | NR | NR | ↔ Atenção dividida | ↔ Força de preensão manual; ↓ Velocidade em teste de corrida. |
| 11 | Tanskanen *et al.* (2012) | NR | NR | NR | NR | ↓Força de preensão manual (durante);↑Força isométrica de preensão (pós); ↓Potência de salto vertical (durante);↑Potência de salto vertical (pós). |
| 12 | Coutinho *et al.* (2014) | NR | NR | ↑CK (pós) e ↔ CK (24 k após em relação a pré); ↔ LDH. | NR | ↔ Força de preensão manual. |
| 13 | Margolis *et al.* (2014) | NR | NR | ↑CK e ↑ LDH (pós tarefas militares) e ↑CK e ↑ LDH (pós | NR | ↔ Força máxima de preensão manual. |

| | | | | | | |
|---|---|---|---|---|---|---|
| | | | | 5km de marcha) | | |
| 14 | Suzuki *et al.* (2014) | ↓BDNF (durante) e ↔ BDNF (pós) em relação a pré). | NR | ↑CK (durante) e ↔ CK (pós) em relação a pré); ↑ LDH (durante) e ↑ LDH (pós) em relação a pré); | NR | NR |
| 15 | Tomczak (2015) | NR | NR | NR | ↓ Atenção dividida | ↓ Força máxima de preensão manual; ↓Agilidade; ↓Equilíbrio dinâmico. |
| 16 | Domingues *et al.* (2015) | NR | NR | ↑CK e ↑ LDH (todos os momentos em relação à pré) | ↓Raciocínio verbal, ↓Raciocínio numérico, ↓Raciocínio espacial e ↓Memória de curto prazo (em todos os momentos em relação a pré). | NR |
| 17 | Lieberman *et al.* (2016) | NR | NR | NR | ↓Raciocínio gramatical; ↓Memória de trabalho; ↓Match-to-sample; ↓Alerta cognitivo; ↑Tempo de reação. | NR |
| 18 | Koury *et al.* (2016) | ↑DPPH (após a marcha e 48 h pós, em relação a pré) | NR | ↑CK, ↑LDH e ↑AST (pós em relação a pré) | NR | NR |
| 19 | Tomczak *et al.* (2017) | NR | NR | NR | ↔Tempo de reação (em 24 h, pós e 24 h após) | ↔Força máxima de preensão manual; ↔Corrida de 1600 metros. |

| | | | | | | |
|---|---|---|---|---|---|---|
| 20 | Varanoske *et al.* (2018) | ↑BDNF (12 h e pós, em relação à pré) | NR | NR | ↔Processamento matemático; ↔Tempo de reação motor; ↑Tempo de reação visual; ↔Capacidade de rastreamento visual. | ↔Potência de salto vertical; ↔Pull-ups; ↑Tempo de transporte de vítima; ↔Contrarrelógio de 1 km. |
| 21 | Hamarsland *et al.* (2018) | NR | NR | ↑CK (Pós e após 24 h). | NR | ↓Força máximo de membros superiores (Supino); ↓Força máxima de membros inferiores. ↓Potência de salto vertical |
| 22 | Delgado-Moreno *et al.* (2018) | NR | NR | NR | NR | ↑Potência de salto vertical; e ↔ Coordenação e capacidade de uso de membros superiores. |
| 23 | Santos *et al.* (2018) | NR | NR | ↑CK, ↑LDH e ↑Mb (pós em relação a pré) | NR | NR |
| 24 | Tomczak & Jówko (2019) | NR | NR | NR | ↓ Atenção dividida | ↓Força máxima de preensão manual; ↓Equilíbrio. |

**Fonte:** Desenvolvida pelo autor. NR = Não relatado; kg = quilograma; Pré = Momento anterior; Pós = Momento posterior; N.R. = Não relatado; h = horas; sm = semanas; CK = creatina quinase; LDH = lactato desidrogenase; AST = aspartato transaminase; BDNF = fator neurotrófico derivado do cérebro; DPPH = 1,1-difenil-2-picrilhidrazil; TGSH = glutationa reduzida total; GSSG = glutationa oxidada; ORAC = capacidade de absorção de radicais de oxigênio; PC = proteína carbonilada; MDA = malondialdeído; Mb = mioglobina; ↔ = sem alteração significativa; ↑ = aumento significativo; e ↓ = redução significativa

Os delineamentos experimentais dos estudos foram diversos (Tabela 2), guardando uma característica comum de realizar pelo menos uma avaliação antes e uma após o treinamento, com exceção do estudo conduzido por Lieberman *et al* (2009), que fez análise em condições basais após 102 dias do treinamento. Alguns estudos apresentaram também dados importantes sobre a recuperação dos indivíduos, indicando a possibilidade de efeitos de longo prazo. Entretanto, devido à grande variação na quantidade de dias de intervenção, a comparação entre os estudos pode sinalizar informações inconsistentes. Em consideração ao treinamento de busca e resgate, foco do presente trabalho, seis estudos (Legg & Patto, 1987; Christensen *et al.* 2008; Welsh *et al.* 2008; Tanskanen *et al.* 2012; Tomczac 2013; Margolis *et al*. 2014; Tomczak *et al.* 2017;

Hamarsland *et al.* 2018) tiveram sete ou oito dias de exercício, porém destes, somente Hamarsland *et al* (2018) relataram restrição significativa de sono (2–3 horas por dia).

Dos 24 estudos selecionados, apenas quatro trabalhos (Tankanen *et al.* 2011; Suzuki *et al.* 2014; Koury *et al.* 2016; Varanoske *et al.* 2018) analisaram efeitos oxidativos nos militares. O estudo de Tanskanen *et al.* (2011) apresentou a análise mais abalizada, com dosagens de TGSH, GSSH, ORAC, PC e MDA, sendo o único a avaliar tais marcadores. O trabalho de Suzuki *et al.* (2014) e Varanoske *et al.* (2018) avaliaram o BNDF, enquanto Koury *et al.* (2016) analisaram o DPPH. Dos quatro estudos, tanto as reduções de TGSH, ORAC e DPPH, como o aumento de GSSG verificados em resposta ao treinamento são convergentes, no entanto, os trabalhos envolvendo o BDNF apresentaram resultados divergentes, o que pode ser explicado pela distinção nos delineamentos dos experimentos (1 dia e 63 dias).

Os biomarcadores de lesão celular apareceram em sete estudos (Coutinho *et al.* 2014; Margolis *et al.* 2014; Suzuki *et al.* 2014; Domingues *et al.* 2015; Koury *et al.* 2016; Hamarsland *et al.* 2018; Santos *et al.* 2018], sendo a CK a enzima mais comumente utilizada. A LDH foi dosada nas amostras de seis estudos, enquanto a AST e a Mb apareceram uma única vez cada. A totalidade das avaliações verificou aumento significativo nestes marcadores em resposta aos treinamentos estudados.

Para análise do desempenho cognitivo dos indivíduos, não foi encontrado um consenso nas avaliações que indicassem um padrão mais adequado a ser utilizado. Dentre os diversos protocolos utilizados, o tempo de reação se destaca por estar presente na maioria dos estudos que avaliaram esse tipo de variável (Lieberman *et al.* 2006; Lieberman *et al.* 2009; Lieberman *et al.* 2016; Tomczak *et al.* 2017; Varanoske *et al.* 2018). Os resultados convergem para o aumento no tempo de reação e sugerem maior influência do treinamento militar conforme o aumento da duração do treinamento. Todos os estudos que analisaram as variáveis cognitivas tinham importante privação de sono.

Já para a avaliação de desempenho físico, a medição da força de preensão manual (Legg & Patto, 1987; Tankanen *et al.* 2011; Coutinho *et al.* 2014; Margolis *et al.* 2014; Tomczak *et al.* 2019) e o salto vertical (Christensen *et al.* 2008; Welsh *et al.* 2008; Tanskanen *et al.* 2012; Delgado-Moreno *et al.* 2018; Hamarsland *et al.* 2018; Varanoske *et al.* 2018; Nindl *et al*. 2002; Nindl *et al.* 2007) foram as variáveis mais avaliadas dos 17 estudos que analisaram o desempenho físico, indicando maior consenso na utilização dessas avaliações. Os resultados são semelhantes para o salto vertical, indicando redução neste parâmetro, com exceção de um estudo (Dengado-Moreno *et al.* 2018) que não verificou diferença significativa (estudo com período não relatado) e de outro (Varanoske *et al.* 2018) que verificou melhoria (em um dia de treinamento militar). Já para a preensão manual, houve divergência. Dos artigos analisados, 55% mostraram declínio desta função (Legg *et al.* 1987; Tanskanen *et al.* 2012; Tomczak 2013; Lieberman *et al.* 2016; Tomczak *et al.* 2019), enquanto 45% sinalizando haver declínio, enquanto os restantes sugerem não haver diferenças estatisticamente significativas (Coutinho *et al.* 2014; Margolis *et al.* 2014; Tomczak 2013; Tomczak *et al.* 2017).

## 4. DISCUSSÃO

Esta revisão buscou identificar na literatura os trabalhos com populações militares que avaliassem o efeito de pelo menos uma de duas variáveis independentes peculiares destes exercícios: Atividade física intensa prolongada e privação de sono. Como variáveis dependentes foram elencados os marcadores de dano oxidativo, capacidade antioxidante, lesão celular e de parâmetros de desempenho cognitivo. Em linhas gerais, os efeitos agudos dos treinamentos militares ocasionam aumento significativo no dano oxidativo e na lesão celular, redução significativa na concentração de enzimas antioxidantes e no desempenho cognitivo.

Dos 24 estudos analisados por completo, somente quatro avaliaram aspetos oxidativos.

Destacando o trabalho de Tanskanen *et al.* (2011), os autores relatam que o tempo de atividade aumentou e o tempo de repouso diminuiu nas quatro primeiras semanas de treinamento, com um aumento concomitante no desempenho aeróbico, enquanto a Massa Corporal Total (MCT) permaneceu, havendo redução do estresse oxidativo em repouso. A diminuição do dano oxidativo pode ser explicada pela geração atenuada de EROs ou pelo aprimoramento da proteção tecidual e dos sistemas antioxidantes, devido à adaptação à exposição regular a uma pequena quantidade de EROs provenientes de exercícios (Tanskanen *et al.* 2011). Assim, o fenômeno observado poderia ser uma consequência de um sistema antioxidante aprimorado em resposta a uma carga de treinamento tolerável, convergindo com outros estudos neste sentido (Gomez-Cabrera *et al.* 2008). De acordo ainda com Tanskanen *et al.* (2011) a melhoria de VO2 máx e da capacidade de produzir EROs é acompanhada por alta atividade da glutationa peroxidase eritrocitária e alta concentração de glutationa reduzida, o que pode estar associado a redução da peroxidação lipídica e consequentemente de danos à membrana celular.

Nas avaliações deste mesmo estudo feitas após um exercício aeróbico submáximo de 45 minutos, as quatro semanas de treinamento militar contribuíram com o aumento da suscetibilidade ao estresse oxidativo, coma maior oxidação da glutationa e menor capacidade antioxidante após a intervenção (Tanskanen *et al.* 2011). Na contramão dos resultados apresentados, o ORAC reduziu na quarta semana e o autor atribui esse fato ao consumo de antioxidantes endógenos dietéticos. E, apesar das variações verificadas, não foi registada alteração significativa nas concentrações e proteína carbonilada e de malondialdeído, dois importantes marcadores do dano oxidativo, fato atribuído parcialmente à carga submáxima de exercício não ter sido extenuante o suficiente, considerando ainda que as capacidades antioxidantes foram significativamente ativadas removendo os EROs (Tanskanen *et al.* 2011).

Outro estudo avaliou o DPPH, radical livre comumente presente no plasma sanguíneo, cuja eliminação sinaliza a capacidade antioxidante do organismo e que dependendo da intervenção de treinamento pode ser significativamente impactado (Hammouda *et al.* 2012). No trabalho de Koury *et al.* (2016), houve aumento de DPPH após o treinamento militar de alta intensidade e com privação total de sono. Para os autores, o aumento da capacidade antioxidante pode ser resultado de uma adaptação a longo prazo, visto que eram jovens treinados, e não como uma resposta aguda ao exercício exaustivo (Koury *et al.* 2016).

Em outros estudos com marcador de estresse oxidativo, Suzuki *et al.* (2014) encontraram resultados contrários aos achados anteriores sobre a expressão de BDNF. A literatura sugere que este marcador é aumentado no plasma em homens jovens e saudáveis pós exercício físico (Zoladz *et al.* 2008), além disso, foi relatado que a privação do sono também aumenta a concentração sérica de BDNF (Gorgulu *et al.* 2009). O estudo elencado nesta revisão verificou redução no BDNF como efeito do treinamento militar que envolveu redução na quantidade e qualidade do sono, bem como atividade física intensa. Os autores sugerem então que mais estudos sejam realizados, com maior controle de variáveis, pois muitos parâmetros contribuem para a regulação da concentração plasmática de BDNF e nenhum parâmetro isolado em seu trabalho foi suficiente para regulá-lo (Suzuki *et al.* 2014).

Já Varanoske *et al.* (2018) encontraram aumento de BDNF após um dia de treinamento militar com privação total de sono. Estudos anteriores relatam que períodos agudos de estresse podem aumentar a resposta do BDNF (Huang *et al.* 2013), mas que esse fator neurotrófico tem importante função cognitiva, podendo explicar a manutenção de alguns aspectos cognitivos durante o estudo (Varanoske *et al.* 2018). Em comparação ao trabalho de Suzuki *et al.* (2014), enquanto este avaliou a amostra após 3 semanas de treinamento básico com condições controladas, Varanoske *et al.* (2018) avaliaram os efeitos de apenas um dia de treinamento intenso, sem sono. Essas distinções de

delineamento dos estudos dificultam a realizações de comparações conclusivas.

A convergência encontrada nas avaliações dos biomarcadores de lesão celular corrobora com os estudos na área (Tankanen *et al.* 2011; Coutinho *et al.* 2014; Margolis *et al.* 2014; Suzuki *et al*. 2014; Domingues *et al.* 2015; Koury *et al.* 2016; Hamarsland *et al.* 2018; Santos *et al.* 2018). Entretanto, os níveis de impacto nesses biomarcadores apresentam grande variabilidade, pois além de oferecem respostas bastante distintas individualmente, as diferenças nos delineamentos experimentais também podem exercer influência nos resultados (Brancaccio *et al.* 2007). Adicionalmente, estudos com populações militares sugerem que o aumento de enzimas como a CK seja da ordem de 50 vezes o limite superior basal após o treinamento militar (Kenney *et al.* 2012), e outros marcadores podem obedecer esse mesmo comportamento.

Comparando os achados bioquímicos dos estudos avaliados, é possível perceber possível influência da duração do treinamento nos efeitos em cada biomarcador. Neste sentido, as intervenções mais curtas (menos de sete dias) parecem não ser suficientes para provocar impactos crônicos significativos nos organismos dos indivíduos, enquanto exercícios com mais de quatro semanas parecem oferecer adaptações fisiológicas.

Nos aspectos cognitivos, os protocolos utilizados para avaliação foram bastante diversos. Considerando, no entanto, a variável mais comum (tempo de reação), os achados foram convergentes com o aumento da variável em consequência do treinamento (Lieberman *et al.* 2006; Lieberman *et al.* 2016; Varanoske *et al.* 2018), com exceção dos resultados de Tomczak *et al*. (2017) que não verificaram diferença estatisticamente significativa. Estes últimos autores atribuíram esta manutenção do desempenho ao aumento da motivação dos cadetes durante o exercício.

A maioria dos autores que verificaram reduções nos parâmetros cognitivos sugerem que possa existir maior efeito da privação de sono e/ou da fadiga mental causada pelo estresse ocupacional (Lieberman *et al.* 2016; Domingues *et al.* 2015; Tomczak 2015; Lieberman *et al.* 2016; Varanoske *et al.* 2018).

Acerca do desempenho físico das amostras, as avaliações que utilizaram o salto vertical foram convergentes em relatar resultados deprimidos em relação aos valores basais (Nindl *et al.* 2002; Nindl *et al.* 2007; Welsh *et al*. 2008; Christensen *et al.* 2008; Fortes *et al.* 2011; Tanskanen *et al.* 2011; Tankanen *et al.* 2012), com exceção do trabalho de Delgado-Moreno *et al.* (2018) que não relatou a duração do treinamento e o de Varanoske *et al.* (2018) que analisaram intervenção de apenas um dia. As análises da variação de força de preensão manual são divergentes, sugerindo outras influências nos resultados, não sendo talvez o tempo de treinamento suficiente para provocar alterações (Legg *et al.* 1987; Tanskanen *et al.* 2011; Tanskanen *et al.* 2012; Tomczak 2013; Coutinho *et al.* 2014; Margolis *et al.* 2014; Tomczak 2015; Tomczak *et al.* 2017; Tomczak *et al.* 2019).

Apesar da quantidade de estudos encontrados para a presente análise, não foi possível encontrar nenhum estudo que fizesse análise simultânea de todas as variáveis elencadas, havendo então uma lacuna científica para a compreensão do comportamento destas variáveis e a possível relação entre elas mediante a influência do treinamento militar. É prudente ressaltar, no entanto que a presente busca se limitou a duas bases de dados, sendo talvez possível encontrar mais informações em outras fontes como *SciELO, LiLACS e Scopus*.

## 5. CONCLUSÃO

Os treinamentos militares com atividade física intensa prolongada e/ou privação de sono são capazes de provocar alterações significativas em marcadores bioquímicos e em parâmetros de desempenho cognitivo ou físico. Porém, apesar de guardarem semelhança nas variáveis independentes, os delineamentos dos estudos apresentam grande variação, o que dificulta o consenso entre as considerações acerca das modificações fisiológicas observadas. Intervenções com menos de sete dias parecem não ser suficientes e as com mais de quatro semanas sugerem efeitos crônicos.

As dosagens das concentrações de creatina quinase apareceram em todos os estudos com avaliações de lesão celular e tiveram resultados convergentes, sugerindo ser um bom parâmetro para esta análise. O mesmo ocorreu com o salto vertical para o desempenho físico e o tempo de reação para a resposta cognitiva.

Os estudos com marcadores de estresse oxidativo, dano oxidativo e capacidade antioxidante foram mais escassos na presente revisão, sugerindo a necessidade do desenvolvimento de mais pesquisas com essas variáveis. As evidências encontradas em relação ao treinamento militar ainda são divergentes e a compreensão desta influência ainda não parece estabelecida.

Adicionalmente, esta revisão sugere a realização de pesquisa com duração do treinamento superior a sete dias, com o controle de variáveis como a intensidade do esforço físico e a quantidade/qualidade de sono. Este controle de variáveis deve oferecer maior compreensão da relação com as variáveis dependentes.

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## PROCEDIMENTOS ÉTICOS

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# HOW DO MEDICAL AND NURSING STUDENTS VIEW HEALTHCARE TECHNOLOGY? A PSYCHOMETRIC VALIDATION STUDY OF THE USABILITY EVALUATION QUESTIONNAIRE IN BANGLADESH

## *COMO É QUE OS ESTUDANTES DE MEDICINA E ENFERMAGEM VEEM A TECNOLOGIA DE SAÚDE? UM ESTUDO DE VALIDAÇÃO PSICOMÉTRICA DO QUESTIONÁRIO DE AVALIAÇÃO DE USABILIDADE EM BANGLADESH*

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## ABSTRACT

The modernization of healthcare delivery is a reality in various international settings. To ensure efficient and safe use of the diverse forms of healthcare technology available, professionals and students must be receptive to incorporating such tools into their practice. Currently, there is no instrument in Bangladesh to assess healthcare students' technology acceptance.
**Objective:** To translate, culturally adapt, and validate the Usability Evaluation Questionnaire (UtEQ) among Bangladeshi healthcare students.
**Method:** A cross-sectional study with a methodological approach was conducted in two phases. The first phase involved the translation of the UtEQ questionnaire to Bengali, following the six stages proposed by Beaton et al. In the second phase, the psychometric properties of the questionnaire were evaluated using a non-probability sample of 486 undergraduate

healthcare students from three higher education institutions in Bangladesh. Confirmatory factor analysis was performed, and the Cronbach's alpha coefficient was estimated to find out the internal consistency.
**Results:** Internal consistency was found to be excellent for all scale dimensions, ranging from 0.88 to 0.92, while confirmatory factor analysis showed adequate goodness-of-fit indicators.
**Conclusion**: The UtEQ-B provides a reliable and valid method for healthcare educators and researchers to assess technology acceptance among healthcare students during clinical training in Bangladesh.
**Keywords:** Technology Acceptance; Medical Students; Nursing Students; Scale; Bangladesh

**RESUMO**

A modernização da prestação de cuidados de saúde é uma realidade em vários contextos internacionais. Para garantir a utilização eficiente e segura das diversas formas de tecnologia em saúde disponíveis, os profissionais e estudantes devem estar receptivos à incorporação dessas ferramentas na sua prática. Atualmente, não existe em Bangladesh um instrumento para avaliar a aceitação da tecnologia pelos estudantes de saúde.
**Objetivo:** Traduzir, adaptar culturalmente e validar o Questionário de Avaliação da Usabilidade (UtEQ) entre estudantes de saúde de Bangladesh.
**Método:** Foi realizado um estudo transversal com uma abordagem metodológica em duas fases. A primeira fase envolveu a tradução do questionário UtEQ para bengali, seguindo as seis etapas propostas por Beaton et al. Na segunda fase, foram avaliadas as propriedades psicométricas do questionário usando uma amostra não probabilística de 486 estudantes de graduação em saúde de três instituições de ensino superior em Bangladesh. Foi realizada uma análise fatorial confirmatória e estimou-se o coeficiente alfa de Cronbach para verificar a consistência interna.
**Resultados:** Foi encontrada uma consistência interna excelente para todas as dimensões da escala, variando de 0,88 a 0,92, enquanto a análise fatorial confirmatória mostrou indicadores adequados de ajuste.
**Conclusão:** O UtEQ-B fornece um método confiável e válido para educadores e pesquisadores em saúde avaliarem a aceitação da tecnologia entre estudantes de saúde durante o treinamento clínico em Bangladesh.
**Palavras-Chave:** Aceitação de Tecnologia; Estudantes de Medicina; Estudantes de Enfermagem; Escala; Bangladesh.

## 1. INTRODUCTION

In recent years, Bangladesh has made significant strides in healthcare outcomes. However, the country is currently undergoing sociodemographic and epidemiological transitions characterized by increasing longevity, decreasing fertility, and a shift in disease epidemiology [1]. Non-communicable diseases (NCDs) have been on the rise across different geographic locations (both rural and urban settings), age groups, sexes, and ethnicities [1]. A national study conducted in Bangladesh on NCD risk factors revealed that a majority of adults aged 18–69 (70.9%) had at least one risk factor, while 26.2% had three or more risk factors [2]. These risk factors included inadequate fruit and vegetable intake, tobacco use, low physical activity, obesity (particularly central obesity), high blood pressure, diabetes mellitus, excessive salt intake, dyslipidemia, and binge drinking. Recognizing the importance of addressing this situation, the Country Office for Bangladesh of the World Health Organization emphasized the need for effective strategies to enhance accessibility to healthcare services [2]. Therefore, it is crucial to proactively take steps to tackle this emerging health challenge and ensure that comprehensive care delivery is accessible to all.

The increasing adoption of information and communication technology (ICT) in private and public healthcare settings is playing a crucial role in bridging the gap between citizens and healthcare providers in Bangladesh [3–5], mirroring efforts made in the recent years by other countries [6]. However, progress in Bangladesh lags behind that of other countries in Southeast Asia [7,8]. In a scoping review

conducted by Ahmed et al. [9] on eHealth and mHealth initiatives in Bangladesh, the authors emphasized the absence of fundamental medical training, specifically hands-on sessions focusing on the utilization of technical materials and technological platforms. A similar viewpoint was shared by Islam [10], who conducted interviews with 68 healthcare professionals in Bangladesh. The study findings suggested that healthcare staff should receive technology training to enhance service efficiency and promote transparency in health services [10].

The use of such technologies is crucial to increase the work efficiency and effectiveness of healthcare professionals and students, leading to better care outcomes for patients and their families [3–5,11]. Electronic patient health records, internet-based health websites, digital applications, and telemedicine software are some of the information technologies and applications that healthcare professionals and students will use in their daily clinical work. Before deciding to use a specific technological device, users evaluate its advantages and limitations. It is, therefore, essential to understand how these individuals react to new technologies [12].

Low levels of technology acceptance can lead to failure or delay in implementing a specific technology in daily clinical practice, which can negatively impact healthcare objectives and hinder the quality and safety of care delivery [13,14]. Technology acceptance refers to users' willingness to use technology for the tasks it is designed to support [15]. Healthcare professionals and students' knowledge and beliefs influence the evaluation process and contribute to their adoption, not just during its design phase or immediately after its implementation in a clinical setting [16]. Changes are expected to occur in information systems, their designs, working environments, potential users, and social and cultural factors, which can affect healthcare professionals and students' needs and acceptance of technology [15,17].

Current literature references the existence of several technology acceptance models and theories which can assist researchers understand users' behaviors towards technology by examining the underlying factors [17]. Identifying these factors can improve the effectiveness of healthcare technologies by allowing researchers to investigate technical, social, and cultural aspects and understand the correlation between those factors and users' readiness to use such innovation [12,18,19]. The Technology Acceptance Model (TAM) is widely accepted in literature for understanding predictors of user intention towards technology usage [19]. It is considered the common ground theory in this field. According to TAM, an individual's intention to use new technology is influenced by two primary factors: perceived ease of use and perceived usefulness. Building on the TAM model, a group of researchers developed the Usability Evaluation Questionnaire (UtEQ) to assess end-users' assessment of medical devices and technology efficacy, performance, and safety [20]. The UtEQ has been adapted by healthcare educators and researchers in various countries, including Portugal, Belgium, Finland, Slovenia, and Vietnam, to assess healthcare students' acceptance of different technologies during their clinical training, with positive results [21,22].

As there is currently no such instrument available in Bangladesh, we aim to culturally adapt and validate the psychometric properties of the UtEQ among Bangladeshi undergraduate medical and nursing students.

## 2. MATERIALS AND METHODS

This study is part of the DigiCare Project, an international research initiative supported by the Erasmus+ Agency through its Strategic Partnerships for Higher Education Programme (grant number 598267-EPP-1-2018-1-FI-EPPKA2-CBHE-JP). The project aims to address the specific needs and challenges of healthcare education in the Asian region and facilitate the effective integration of digital technologies to enhance learning outcomes and prepare students for the evolving healthcare landscape.

### 2.1 STUDY DESIGN

This study consisted of two main phases. The first phase involved the translation and adaptation of the UtEQ questionnaire into

Bengali, as well as the assessment of its psychometric properties among undergraduate healthcare students in three universities in Bangladesh. The second phase focused on the validation of the translated and culturally adapted version of the UtEQ-B in three higher education institutions in Bangladesh.

During the initial phase, in stage I, the questionnaire was translated from English to Bengali through a rigorous process following the methodology proposed by Beaton et al. [23]. Two independent healthcare reviewers proficient in both English and Bengali performed the forward translation. In the synthesis stage (stage II), the translations were thoroughly analyzed and discussed by the research team and reviewers, resulting in the development of the Bengali version of the UtEQ (UtEQ-B). In stage III, two official translators with native English proficiency back-translated the initial Bengali version into English. The back-translations were then reviewed by the research team and translators to ensure linguistic correspondence between the original UtEQ and the Bengali version.

During stage IV, an Expert Committee ($n$ = 6) consisting of PhD researchers and professors from three medical colleges and hospitals in Bangladesh was formed to review the UtEQ-B. After several rounds of discussion, a final consensus was reached, and the experts unanimously approved the questionnaire as a valuable tool for the assessment of technology acceptance by medical and nursing students in Bangladesh. A pre-test involving 78 students from the three institutions was conducted to assess the suitability and average response time of the instrument, with a predetermined average response time of 20 minutes. The original authors of the questionnaire reviewed the results from the previous phases and approved the process.

In the second phase of the study, the UtEQ-B was administered to a convenience sample of students from three higher education institutions in Bangladesh. The participants were asked to complete the questionnaire, and their responses were collected between November 2021 and February 2022. The collected data were then subjected to statistical analysis to evaluate the psychometric properties of the UtEQ-B.

### 2.2 SAMPLE SIZE, STUDY RECRUITMENT AND DATA COLLECTION

The participants of the study were recruited among the healthcare students from City Medical College and Hospital, Gazipur (CIMCH), Khulna City Medical College, Khulna (KCMCH), and Universal Medical College, Dhaka (UMCH). To be included in the study, a participant was required to be a bachelor in nursing or a medical student interested in participating and available during data collection. Students who were not available nor interested in participating during data collection time were excluded from the study.

The sample size was defined ensuring a minimum of 10 individuals per questionnaire item according to Terwee and collaborators [24]. A sample of 486 students participated in the study, considering the number of parameters and dimensions present in the questionnaire, to ensure an adequate stability of the variance/covariance matrix when performing a Confirmatory Factor Analysis (CFA).

### 2.3. INSTRUMENTS AND VARIABLES

Parreira et al. [20] developed the UtEQ questionnaire based on the TAM model, which originally comprises 45 items divided into four factors: Utility Performance (UP), Utility Empowerment (UE), Utility Relationship (UR), and Ease of Use (EU). The UR factor of the scale evaluates students' perceptions regarding how technology aligns with their workflow, integrates with existing clinical processes, and enhances communication and collaboration with patients and healthcare professionals [20]. This factor comprises 10 items that specifically assess the role of technology in facilitating a positive and effective relationship between healthcare professionals and patients [20]. These items, such as "Facilitates an empathic relationship with a patient" (item 20), "Enhances my understanding of a patient's experience" (item 21), "Establishes a true relationship with the patient" (item 23), and "Builds an effective relationship with the patient" (item 32), collectively measure the extent to which

technology is perceived to support meaningful interactions, empathy, and rapport in the context of patient care [20].

The UP factor within the scale assesses the perceived performance-enhancing aspects of technology in healthcare settings [20]. This factor consists of nine items, including examples such as "Supports my recordkeeping" (item 5), "Allows me to complete task(s) quickly" (item 9), and "Allows me to control the task(s) to be performed" (item 14). These items collectively capture students' perceptions of how technology contributes to their efficiency, effectiveness, and control in performing various tasks related to patient care [20]. By evaluating the utility of technology in terms of performance, this factor provides insights into the extent to which technology enables students to streamline their workflow, manage tasks efficiently, and have greater control over their work processes [20].

The UE factor in the scale consists of six items that assess the role of technology in empowering patients to take an active role in managing their own health. These items, including "Supports the patient's self-management skills" (item 33), "Motivates the patient to take control of his/her own health" (item 35), and "Motivates the patient's interest in his/her own health" (item 38), capture the perceived utility of technology in promoting patient empowerment and engagement in their healthcare journey. This factor emphasizes the potential of technology to support patients in developing self-management skills, fostering motivation, and encouraging a proactive approach towards their own health [20].

The EU factor focuses on the perceived ease of use and user-friendliness of technology in the clinical care of patients. It evaluates students' perceptions of the simplicity of learning and navigating the technology, as well as the intuitiveness of its interface and features [20]. The factor's eight items assess various aspects, such as the requirement of a short learning period (e.g., item 17), the need for previous knowledge (e.g., item 19), and the demand for minimal mental effort (e.g., item 3).

Respondents rate each item on a scale of 1 (Strongly disagree) to 7 (Strongly agree), with higher scores indicating a greater inclination to incorporate technology into their clinical practice due to its perceived benefits [14]. Additionally, the data collection instrument includes a brief section that asks about participants' sociodemographic characteristics (e.g., age, gender) and academic information (e.g., course year, enrollment status).

### 2.4. STATISTICAL ANALYSIS

We employed the AMOS software (SPSS Inc., Chicago IL) to conduct CFA and estimate the structural model. Internal consistency of the constructs in the study was assessed using Cronbach's alpha (α), where a value of greater than 0.70 was considered to indicate adequate reliability [25].

To evaluate the goodness of fit of the data to the model, we employed a range of goodness-of-fit indexes, along with their acceptable thresholds. These thresholds were derived from Hu and Bentler [26]. The evaluation of the proposed structures' goodness of fit to the correlational structure of the data was based on measures such as $\chi^2$/df, comparative fit index (CFI), Tucker-Lewis index (TLI), Standardized Root Mean Squared Residual (SRMR), Root Mean Square Error of Approximation (RMSEA), and the 90% confidence interval for RMSEA.

To determine a good fit, we set the threshold of chi-square/degrees of freedom to be less than 5.0. A CFI greater than .97 was considered a good adjustment, and a CFI between .95 and < .97 was considered an acceptable fit. Concerning the goodness-of-fit (GFI) index, we regarded a value greater than .95 as indicative of a good fit, and a value between .90 and < .95 as acceptable. We deemed a Root Mean Square Error of Approximation (RMSEA) value of less than .05 as indicative of a good fit, and a value between .05 and .08 as acceptable. We assumed a statistical significance level of .05.

### 2.5. ETHICAL CONSIDERATIONS

The research proposal bearing number P781-5/2021 was authorized by the Ethics Committee of the Health Sciences Research Unit of the Nursing School of Coimbra. Prior to participating in the study, participants voluntarily provided informed consent. Participants were provided with

comprehensive information about the study's objectives as well as data collection and analysis methods. To ensure participant confidentiality and anonymity, the data collection instruments used in the study were coded randomly. This coding process was designed to prevent the research team from accessing any personal identification details of the participants, promoting a secure and ethical research environment. Additionally, they were informed of their right to withdraw from the study at any time without fear of academic or personal repercussions.

## 3. RESULTS

A total of 486 nursing (*n* = 274, 61.2%) and medical (*n* = 174, 38.8%) students from three higher education institutions in Bangladesh participated in the study. These institutions were CIMCH (*n* = 172, 38.4%), KCMCH (*n* = 140, 31.3%), and UMCH (*n* = 136, 30.4%). Female students (*n* = 349, 77.9%) outnumbered male students (*n* = 99, 22.1%) by almost four to one. Most participants *(n* = 418, 93.3%) were full-time students, with only a small proportion (*n* = 30, 6.7%) being part-time students. In terms of age, most students were between 19 and 25 years *(n* = 404, 90.2%), followed by students ages 26 to 30 *(n* = 36, 8%) and ages between 31 and 36 years *(n* = 8, 1.8%). Concerning their academic course year, most participants were in their third year (*n* = 206, 46%), followed by second *(n* = 200, 44.6%), fourth (*n* = 37, 8.3%), and first-year students (*n* = 5, 1.1%).

In terms of the results of phase two, the descriptive statistics of the UtEQ-B can be found in Table 1.

**Table 1 –** Descriptive statistical analysis of UtEQ-B factors (*n* = 486)

| ***Factor*** | ***Min.*** | ***Max.*** | ***Mean*** | ***SD*** |
|---|---|---|---|---|
| *Utility Relationship (UR)* | *1* | *7* | *5.34* | *1.18* |
| *Utility Performance (UP)* | *2.11* | *7* | *5.50* | *1.05* |
| *Utility Empowerment (UE)* | *1* | *7* | *5.40* | *1.15* |
| *Ease of Use (EU)* | *1* | *7* | *5.40* | *1.15* |

Min. = Minimum value; Max. = Maximum value; SD = Standard deviation

Reliability analysis revealed that the EU factor of the UtEQ-B had an α value of 0.88, indicating adequate reliability. Similarly, the UR factor with 10 items presented an α value of 0.92, indicating good reliability. The UP factor with 9 items (α = 0.90) was deemed good. The UE factor with 6 items was also deemed adequate (α = 0.88).

Concerning the EU factor, we first explored its confirmatory structure analysis as a single model (Table 2). All the eight items of EU factor showed positive and significant impact with $p < .001$.

**Table 2 –** Confirmatory structure analysis of the UtEQ-B's EU factor

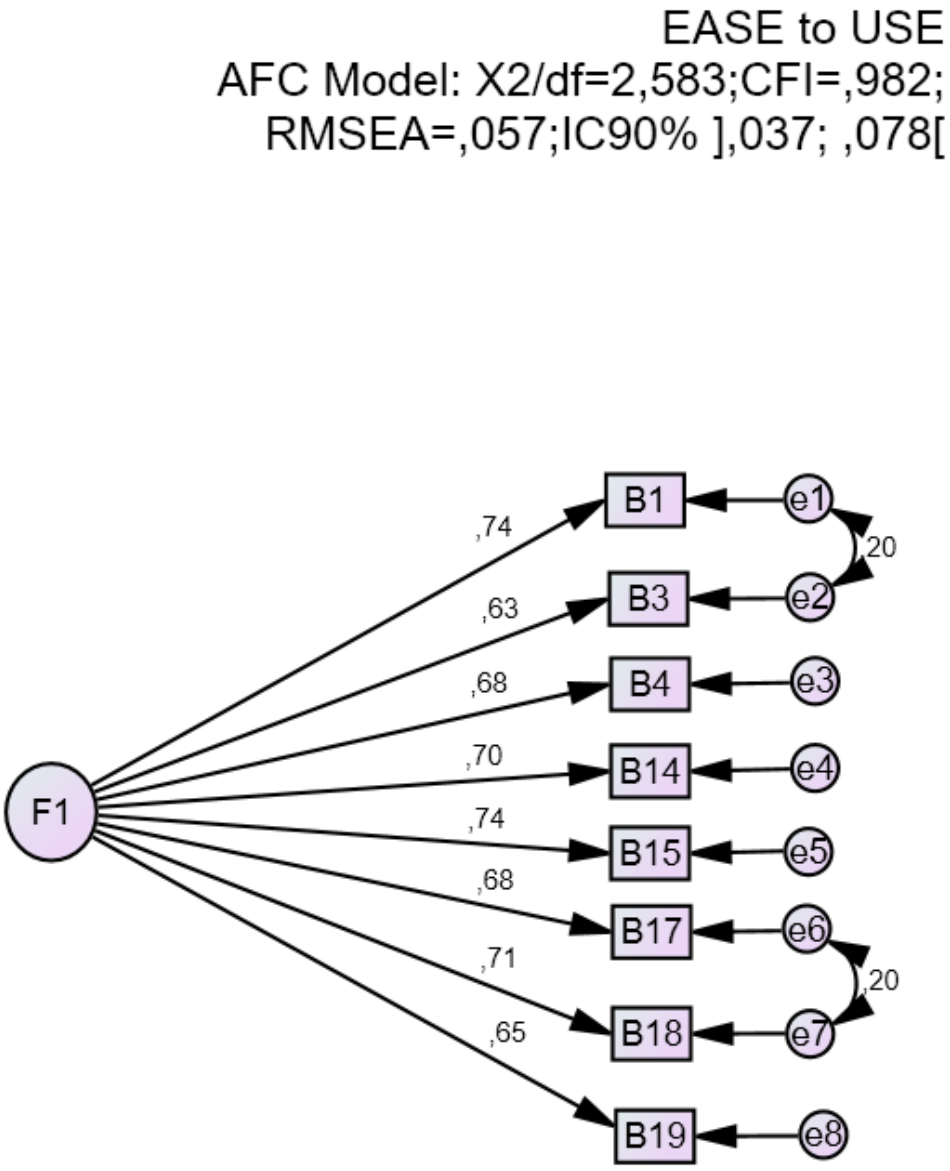
| **Item** | **Estimates** | **SE** | **t-value** | **Sig.** |
|---|---|---|---|---|
| 1. Is intuitive | 1.000 | .053 | | .000 |
| 3. Requires minimal mental effort | .781 | .057 | 14.77 | .000 |
| 4. Meets my expectations | .819 | .054 | 14.31 | .000 |

| | | | | |
|---|---|---|---|---|
| 14. Allows me to control the task(s) to be performed | .794 | .058 | 14.67 | .000 |
| 15. Requires formal instructions to use them | .896 | .057 | 15.55 | .000 |
| 17. Requires a short learning period to use them | .808 | .055 | 14.18 | .000 |
| 18. Allows me to complete the task(s) according to the patient's needs | .803 | .055 | 14.69 | .000 |
| 19. Requires previous knowledge (e.g., computer science) to use them | .741 | .053 | 13.54 | .000 |

SE = Standard Error; Sig. = Statistical significance ($p \leq .05$)

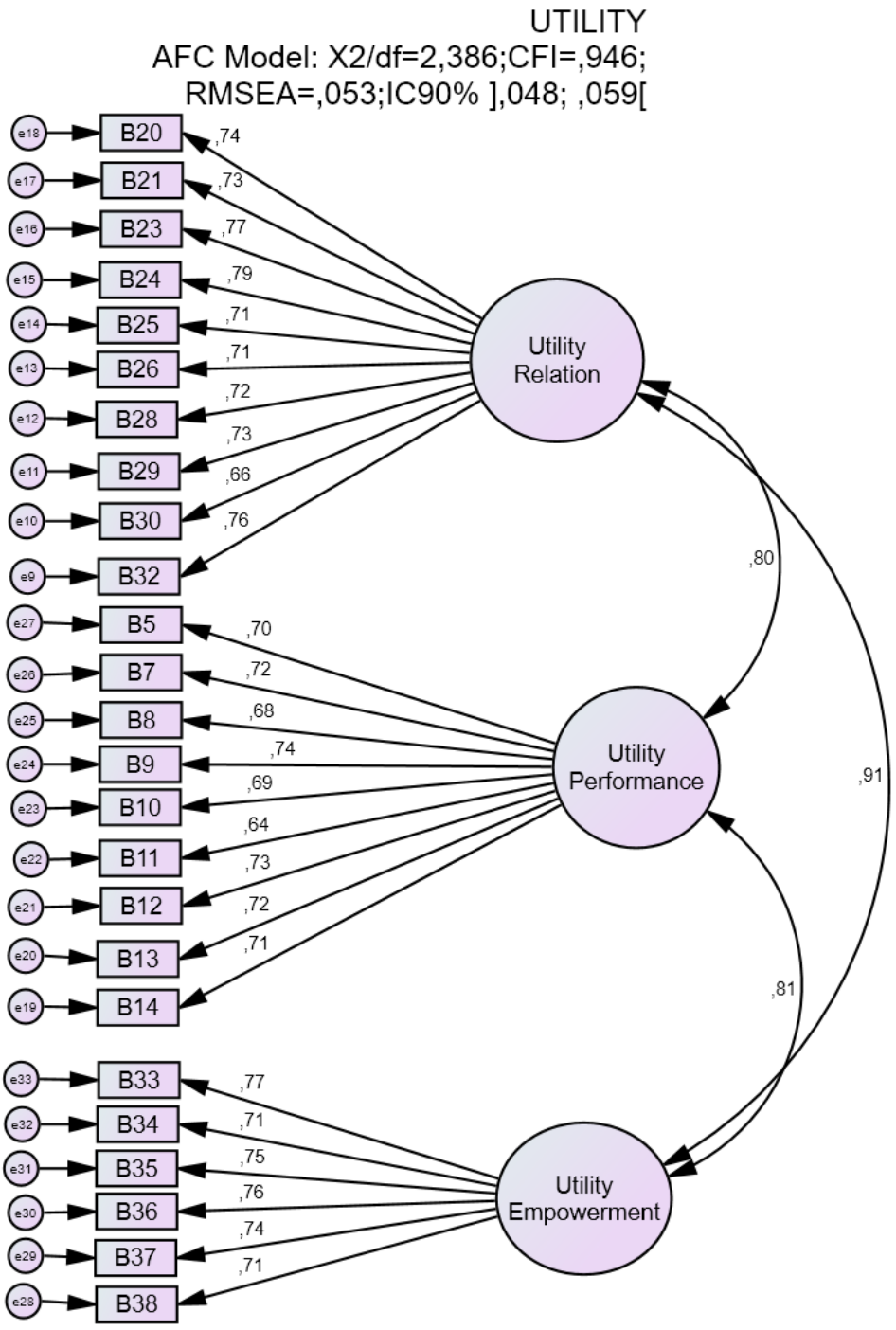
The fit indexes for the EU factor fell within the acceptable range (Figure 1), considering the found results for CMIN/df = 2.583, GFI = .977, CFI= .982, RMSEA = .057 [LO90 = .037; HI90 = .078], and a TLI = .973.

**Figure 1 –** Confirmation factor analysis of the EU factor (UtEQ-B)




We performed CFA on a joint model that combines all utility-related aspects of professional performance, relationship, and empowerment. The fit indexes for the model focusing on “Utility” (Figure 2), with CMIN/df = 2.386, GFI = .902, TLI = .940, CFI = .982, and RMSEA = .053 [LO90 = .048; HI90 = .059], were also considered acceptable.

**Figure 2 –** Confirmation factor analysis of the utility combined factors (UtEQ-B)




## 4. DISCUSSION

In Bangladesh, a country with a low socio-economic status, patients encounter significant obstacles in accessing essential healthcare services, both in community settings and hospitals [27]. The country's population-nurse ratio of 5000:1, bed-nurse ratio of 13:1, and doctor-nurse ratio of 2.5:1 are significantly lower than international standards [28,29]. Consequently, doctors and nurses struggle to deliver quality care and improve patient's experience. To address this issue, the Ministry of Health and Family Welfare (MOHFW), supported by WHO Bangladesh, has launched the development of a national digital health strategy. The primary aim of this strategy is to

improve the accessibility, quality, and affordability of health services, considering the low access to healthcare services in Bangladesh and the potential of technological advances to enhance people's health [27]. Digital health technology provides an opportunity to transform inadequate healthcare systems into more appropriate ones by offering cost-effective, faster, and more effective solutions for treating chronic diseases [30].

Additionally, digital technology can level the playing field between patients and healthcare professionals, allowing patients to access healthcare services more efficiently and enable healthcare professionals to deliver care more effectively. However, there is a risk that care quality may be compromised due to poor technology acceptance by both patients and healthcare professionals. In a recent multicenter study conducted in Swiss psychiatric hospitals, it was found that physicians and nurses who have greater interaction with digital technologies tend to report higher levels of stress and lower levels of digital competence compared to individuals in other professions [31]. Another multicenter cross-sectional study conducted by Kasemi et al. [32] examined the relationship between technology-related stress and various outcomes among Egyptian medical staff members and students. The study revealed that participants reported moderate-to-high levels of stress, which were associated with increased burnout, strain, and cortisol levels. Additionally, high levels of technology-related stress were found to be associated with decreased work engagement and lower CoQ10 enzyme levels [32]. To address this, targeted interventions should be conducted during formal education to enhance students' perceptions of the role and utility of technology in care delivery [16].

However, a valid measurement scale is necessary to predict user technology acceptance in Bangladeshi healthcare education. Our findings suggest that the UtEQ-B is a reliable and well-suited tool for assessing technology acceptance among healthcare students in Bangladesh. Its "Easy to Use" factor, composed of eight items, showed a positive and significant impact ($p < .001$) on overall technology acceptance. These results are a surprising addition to the ones by Hoque and Bao [8], who found that perceived usefulness was a significant indicator of e-health adoption decisions, whereas Perceived Ease of Use was an insignificant predictor of e-health adoption among 146 respondents from private and public hospitals in Dhaka.

Overall, the Cronbach's alpha values were within normal limits, confirming the reliability of the questionnaire. The goodness-of-fit indexes of the final model proposal were found to be adequate, indicating that the original model proposed by Parreira and colleagues [9] is appropriate for evaluating technology acceptance among healthcare students in Bangladesh. Therefore, the UtEQ-B is a valid and comprehensive measurement tool that can be utilized by healthcare educators and researchers in Bangladesh to accurately assess students' technology acceptance during their academic journey, prior to their entry into the job market. Utilizing such measurement tool is vital in addressing existing challenges in Bangladesh, where healthcare staff are often considered ill-prepared to navigate technologically advanced care environments [33].

Our study findings show that medical and nursing students in Bangladesh exhibit a moderate level of acceptance towards the technology utilized in patient care. This is evident from the average scores ranging from 5.34 (Utility Relationship factor) to 5.50 (Utility Performance factor) across the different factors of the UtEQ-B scale. While young adults are generally proficient in technology, our findings indicate that there is still room for improvement and further acceptance among medical and nursing students.

The understanding of this moderate level of acceptance among students holds significance for the development of educational curricula and policymaking in Bangladesh. Medical and nurse educators should consider incorporating electronic health records (EHRs), wearable technologies, big data and data analytics, and increased patient engagement as crucial areas in curriculum development [39,40]. Additionally, clinical supervisors and tutors

involved in student training should be mindful of the potential impact of technology on students' professional development during clinical placements. This includes areas where technology is employed in care delivery, such as communication with patients and their families, and updating patients' healthcare plans in EHRs. Such unpreparedness can lead to unfavorable outcomes for both students and professionals (e.g., technostress [34,35]), as well as patients (e.g., occurrence of adverse events, low-quality care experience [36,37]).

To equip both current and future medical and nursing professionals with a comprehensive set of technological and informatics skills, ongoing educational opportunities should be made available [13,16,38]. As the healthcare landscape evolves, it is imperative for clinicians in Bangladesh to be well-prepared for the prominent role technology will play in transforming healthcare practices. Therefore, medical and nurse educators need to proactively prepare themselves to guide these practitioners into the future [39,40]. By recognizing the current acceptance level and addressing the evolving technological needs of medical and nursing students, we can foster a more adept national healthcare workforce that embraces and effectively utilizes technology to enhance patient care and outcomes.

While our study provides valuable insights into technology acceptance among medical and nursing students in Bangladesh, it is important to acknowledge its limitations. Although we followed established recommendations for sample size in initial validation studies, the total number of participants ($n$ = 486) may not provide a comprehensive representation of the entire student population in Bangladesh. In addition, our sample selection process did not include defining the students' course year as an inclusion criterion, which may introduce potential biases. Clinical practice and experience can vary significantly throughout course completion, and this variability was not accounted for in our study. To address these limitations, future research should aim to include specific inclusion criteria related to the students' course year or level, as well as more representative samples that can better capture the diversity of the undergraduate and postgraduate healthcare student population in Bangladesh. Such efforts would enhance the generalizability of our findings and provide a more complete understanding of technology acceptance among medical and nursing students in the country.

Another significant limitation of our study is that it did not specifically focus on doctors and nurses, who are key populations within the context of technology acceptance in healthcare. While our research provides valuable insights into the perceptions of medical and nursing students, it does not fully capture the experiences and perspectives of practicing healthcare professionals in Bangladesh. Including both clinicians and students in future studies would have several advantages. Firstly, incorporating clinicians in the study would allow for a more comprehensive understanding of technology acceptance across different professional roles and levels of experience. Clinicians bring their unique perspectives, practical insights, and real-world challenges to the table. Their involvement would provide a deeper understanding of how technology impacts clinical workflows, patient care, and outcomes. Secondly, having a sample that includes both clinicians and students would enable a more robust evaluation of the psychometric properties of the UtEQ-B. By including a diverse range of participants, we could gather a broader range of responses, allowing for a thorough examination of its reliability, validity, and factor structure. This would further refine the questionnaire and enhance its applicability across various healthcare contexts in the country.

## 5. CONCLUSIONS

The UtEQ-B showed semantic and idiomatic equivalence to the original version and was well-received by academic experts and undergraduate healthcare students in Bangladesh. The questionnaire demonstrated satisfactory reliability properties, indicating that it is a useful tool for assessing healthcare students' technology acceptance during their formal education. A structured evaluation of this domain could be advantageous for higher education teachers and researchers in Bangladesh, enabling targeted interventions to

enhance students' perceptions of the role of technology in care delivery, as well as its ease of use and utility. Nevertheless, future research endeavors should consider expanding the sample size to include students and professionals from various healthcare disciplines to further validate these findings and ensure the instrument's applicability across a broader context.

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# CULTURAL ADAPTATION AND PSYCHOMETRIC VALIDATION OF THE SELF EFFICIENCY AND PERFORMANCE IN SELF-MANAGEMENT SUPPORT (SEPSS) QUESTIONNAIRE IN UNDERGRADUATE NURSING AND MEDICAL STUDENTS OF BANGLADESH

## *ADAPTAÇÃO CULTURAL E VALIDAÇÃO PSICOMÉTRICA DO QUESTIONÁRIO SELF EFFICIENCY AND PERFORMANCE IN SELF-MANAGEMENT SUPPORT (SEPSS) EM ESTUDANTES DE GRADUAÇÃO EM ENFERMAGEM E MEDICINA DE BANGLADESH*

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## ABSTRACT

In an aging society, healthcare professionals and students face increasing demands to actively involve patients in the decision-making process regarding their health conditions and lifestyles. Self-management support is considered a best practice that aligns with the patient-centered care paradigm in Bangladesh. However, there is currently no instrument available to assess healthcare professionals' competencies in this field, particularly during their early education and training period. The aim of this study was to translate the Self Efficiency and Performance in Self-management Support (SEPSS) instrument into Bangla and validate its psychometric properties in a sample of undergraduate healthcare students in Bangladeshi higher education institutions. A cross-sectional study was conducted to assess the reliability, validity, and cultural appropriateness of the Bangla version of SEPSS-36 among 486 nursing and medical students. Confirmatory factor analysis was carried out using the chi-square model fit index (CMIN), comparative fit index (CFI), and Root Mean Square Error of Approximation (RMSEA) as fit indices. The internal consistency was estimated by the Cronbach alpha coefficient. The results

indicate that the CMIN (2.658) and RMSEA (.058) values suggest that the sample data and hypothetical model are an acceptable fit in the analysis, with satisfactory CFI values (.895). The reliability for all SEPSS dimensions was acceptable. The Bangla version of the SEPSS questionnaire is a valid and reliable instrument that can assist healthcare educators and researchers in determining students' competencies within this domain.
**Keywords:** Self-Management; Nursing Students; Medical Students; Self-Efficacy; Performance; Scale

**RESUMO**

Numa sociedade envelhecida, os profissionais de saúde e os estudantes enfrentam exigências cada vez maiores para envolver ativamente os pacientes no processo de tomada de decisão em relação às suas condições de saúde e estilos de vida. O apoio à autogestão é considerado uma prática recomendada que está alinhada com o paradigma de cuidados centrados no paciente em Bangladesh. No entanto, atualmente não existe um instrumento disponível para avaliar as competências dos profissionais de saúde nesse campo, especialmente durante o período inicial de educação e formação. O objetivo deste estudo foi traduzir o instrumento Self Efficiency and Performance in Self-management Support (SEPSS) para o bengali e validar as suas propriedades psicométricas numa amostra de estudantes de saúde de graduação em instituições de ensino superior de Bangladesh. Foi realizado um estudo transversal para avaliar a confiabilidade, validade e adequação cultural da versão em bengali do SEPSS-36 entre 486 estudantes de enfermagem e medicina. A análise fatorial confirmatória foi conduzida utilizando o índice de ajustamento do modelo qui-quadrado (CMIN), o índice de ajustamento comparativo (CFI) e o erro quadrado médio de aproximação (RMSEA) como índices de ajustamento. A consistência interna foi estimada pelo coeficiente alfa de Cronbach. Os resultados indicam que os valores de CMIN (2,658) e RMSEA (0,058) sugerem que os dados da amostra e o modelo hipotético têm um ajustamento aceitável na análise, com valores de CFI satisfatórios (0,895). A confiabilidade de todas as dimensões do SEPSS foi aceitável. A versão em bengali do questionário SEPSS é um instrumento válido e fiável que pode ajudar os educadores e investigadores em saúde a determinar as competências dos estudantes nesta área.
**Palavras-Chave:** Autogestão; Estudantes de Enfermagem; Estudantes de Medicina; Autoeficácia; Desempenho; Escala.

## 1. INTRODUCTION

In the current era, there is a rapid expansion of new interventions for the management of noncommunicable diseases (NCDs) [1]. The Centers for Disease Control and Prevention report that about 85% of elderly people have at least one NCD and around 60% have at least two [2]. NCDs pose a significant global health burden and represent a substantial threat to public health. These diseases not only hinder social and economic development worldwide but also contribute to growing inequalities between nations and within populations [3], particularly in Low- and Middle-Income Countries (LMICs) [4].

Bangladesh, a densely populated developing nation in South Asia, is undergoing significant economic transition and experiencing rapid demographic shifts. The current population of Bangladesh stands at approximately 167.4 million people [5]. Over the years, there has been an improvement in life expectancy at birth, rising from 65.6 years in 2000 to 74.3 years in 2019 [5]. However, the healthy life expectancy at birth remains around 64.3 years, posing significant challenges for both the citizens of Bangladesh and the country's healthcare and social systems [5]. Notably, recent studies have revealed that the escalating rates of non-communicable diseases (NCDs) in the country can be attributed to prevailing lifestyle practices among both adults and children [6,7]. Factors such as inadequate diet, poor sleeping patterns, tobacco consumption, and low levels of physical activity have been identified as contributing to the exponential growth of NCDs in Bangladesh [6,7]. These findings underscore the urgent need for interventions and preventive measures to address these

lifestyle-related issues and mitigate the burden on public health and society at large.

To tackle this challenge, the World Health Organization encourages self-management support as a worldwide preference to improve population health and sustain healthcare systems in response to the increasing number of individuals with NCDs [8] across high-, middle-, and low-income countries. Self-management education should be an integral part of high-quality health care as it aims to manage NCDs individually [9]. In a systematic review of 157 studies, Reynolds et al. [10] found that self-management support interventions most frequently resulted in improvements in patient-level outcomes compared to others. Thus, healthcare professionals must take on a new role and develop new skills to support their patients' self-management, establishing a proactive, personalized and dynamic partnership with their patients, families and communities [11,12].

The most commonly reported framework in the literature is the Five A's model, which outlines the five essential stages to support patients in managing their NCDs by identifying, planning, and taking action towards new healthy lifestyle goals (Assess, Advise, Agree, Assist, and Arrange)[13]. Healthcare professionals must evaluate patients' motivation and beliefs about living with NCDs to personalize the support provided. The advise phase's crucial component is information regarding the health condition and its impact on the patients' health and well-being. Education is necessary to make evidence-based decisions about new health and lifestyle goals [13]. During the agree phase, healthcare professionals and patients should jointly decide on the goals to pursue, guided by positive experiences. The assist phase requires healthcare professionals to have the necessary skills to help patients implement and maintain their new lifestyle routines. The arrange phase involves healthcare professionals and patients comparing initial expectations with actual achievements and discussing the need for any changes, initiating a new cycle [13].

Self-management support should involve an interdisciplinary personalized approach to care delivery, where each member of the healthcare team displays core competencies in recognizing ethical quandaries, reflecting on their own behavior, and respecting patients' autonomy in shared decision-making [9]. Therefore, it is essential to have standardized and reliable tools to assess healthcare professionals' competencies that can enhance their role in this domain, particularly during their formal education and training stages [14]. The emphasis on students as the healthcare professionals of tomorrow is particularly crucial, considering the growing body of evidence highlighting their challenges in applying theoretical knowledge to practical settings [15]. Moreover, students often encounter conflicting values between their formal education and clinical internships, further underscoring the importance of addressing their needs and concerns. [16–19]. In alignment with this requirement, the Self-Efficacy and Performance in Self-management Support (SEPSS) instrument [20] emerges as a promising tool to measure healthcare professionals and students' self-efficacy and performance in providing self-management support to patients with NCDs.

In Bangladesh, an instrument that can validly and reliably measure healthcare professionals' performance and their perceived capacity to perform self-management support is needed to evaluate the current practice and training in this field. Thus, we aimed to translate the SEPSS instrument into Bangla, culturally adapt it, and validate its psychometric properties in a sample of undergraduate nursing and medical students from Bangladesh.

## 2. MATERIALS AND METHODS

### 2.1. STUDY DESIGN

This study was conducted in two main phases: i) translation and cross-cultural adaptation of the SEPSS questionnaire to Bangla; ii) assessment of the scale's psychometric properties with a sample of undergraduate healthcare students from Bangladesh.

During phase one, the original version of the SEPSS questionnaire (in English) was translated and adapted to Bangla during phase

one (April to September 2021) using the six stages proposed by Beaton et al. [21]. Stage I involved two independent reviewers who were fluent in written and spoken English and performed the forward translation of the questionnaire. The resulting translations were analyzed and discussed by the research team and reviewers, and a Bangla α version of the SEPSS questionnaire [20] was developed in stage II.

In stage III, two official translators with native English proficiency back-translated the α version into English. The research team and translators reviewed the back-translations, and the original SEPSS questionnaire and the Bangla α version were deemed linguistically equivalent.

An Expert Committee consisting of one member from Khulna City Medical College Hospital (Khulna, Bangladesh), two members from City Medical College & Hospital (Khulna, Bangladesh), and two members from Universal Medical College and Hospital (Dhaka, Bangladesh) was formed in stage IV to review the Bangla version of the SEPSS questionnaire. After rounds of discussion and synthesis of individual contributions, a final consensus on each component of the scale was achieved. In a final round, the experts unanimously deemed the scale as a valuable contribution to the current undergraduate training of healthcare professionals in Bangladesh.

In the final stage, a pre-test of the pre-final version was conducted, and nursing and medical students ($n$ = 38) found the items of the SEPSS questionnaire (Bangla version) clear and easily scored. The research team deemed the average response time of 30 minutes appropriate based on their experience with previous instruments. The original authors of the questionnaire approved the conducted process after reviewing the results gathered from the previous phases (stage VI).

Concerning phase two, the psychometric validation of the SEPSS questionnaire (Bangla version) was conducted between September and November 2021, in the three higher education institutions of Bangladesh.

### 2.2. SETTING AND PARTICIPANTS

Three higher education institutions in Bangladesh, namely City Medical College and Hospital, Gazipur, Bangladesh (CIMCH), Khulna City Medical College, Khulna, Bangladesh (KCMCH), and Universal Medical College, Dhaka, Bangladesh (UMCH), were selected for the initial validation process of the SEPSS questionnaire due to their role as partner institutions of the Erasmus+ project titled “DIGICARE—Educating students for digitalized health care and coaching of their patients” (ref. 598267-EPP-1-2018-1-FI-EPPKA2-CBHE-JP).

During phase two of the study, student recruitment followed a non-probability, consecutive sampling approach [22], with senior researchers approaching students between classes and informing them about the study goals. Interested students who were age 18 years or above, enrolled in a bachelor of nursing or medicine degree at one of the institutions and willing to participate in the study, were asked to sign an informed consent form. Students who had previous formal training on clinical self-management support or were enrolled in these institutions as part of a short-term mobility action were excluded from the study. After signing the consent form, students were instructed to independently score the SEPSS questionnaire and place it in a sealed box when finished to be considered eligible for study inclusion.

### 2.3. INSTRUMENTS AND VARIABLES

Data were collected using the translated and culturally adapted version of the SEPSS to Bangla. The SEPSS questionnaire is based on the Five A’s models and includes an additional category for “generic” self-management support skills that are not covered by the model [20]. The questionnaire comprises six dimensions, each containing six items: (i) Assessment, (ii) Advise, (iii) Agree, (iv) Assist, (v) Arrange, and (vi) Overall Competency. Respondents score their self-efficacy and performance on a five-point Likert scale, with 0 representing the lowest score and 4 representing the highest score. The six subscales allow for a more detailed analysis of specific aspects of self-management support, while the total score provides an overall view

[20]. Scores range from 0 to 4 for the subscales and from 0 to 24 for the total score, with higher scores indicating better self-efficacy and performance in self-management support. Mean scores need to be calculated for each subscale (range 0–4).

### 2.4. STATISTICAL ANALYSIS

A two-step maximum likelihood structural equation modeling procedure was conducted using AMOS 23.0 (SPSS Inc., Chicago, IL). Firstly, a confirmatory factor analysis (CFA) was performed to validate the measurement model. The reliability of the constructs was evaluated using Cronbach's α coefficients, and values above the 0.70 criterion were considered reliable [23]. Secondly, the structural model estimation was carried out to test the research hypothesis. The suitability of the data for both the measurement and structural models was assessed using a variety of Goodness-of-Fit indices (GFIs). In particular, a good model fit was considered when the chi-square (x2) was less than 3.0, and the comparative fit index (CFI) and GFI were greater than 0.90 [23]. A Root Mean Square Error of Approximation (RMSEA) value less than 0.06 indicated a good fit, while values between 0.08 and 0.10 were deemed acceptable [23].

### 2.5. ETHICAL CONSIDERATIONS

The research proposal was approved by the Ethics Committee of the Health Sciences Research Unit: Nursing of the Nursing School of Coimbra with number P781-5/2021. Informed consent was obtained to ensure that the subjects voluntarily participated in this study. The students participating in the study were provided with full information about the study, including the purpose, research methods, and rights when participating in the study. Students were informed of their right to withdraw from the study at any time without consequences.

## 3. RESULTS

A total of 486 nursing (*n* = 312, 64.2%) and medical (*n* = 174, 35.8%) students from three higher education institutions in Bangladesh voluntarily participated in the study. These institutions were CIMCH (*n* = 184, 37.9%), KCMCH (*n* = 152, 31.2%), and UMCH (*n* = 150, 30.9%). Female students (*n* = 371, 76.3%) outnumbered male students (*n* = 115, 23.7%) by three to one. Most participants *(n* = 457, 94%) were full-time students, with only a small proportion (n = 29, 6%) being part-time students. The students' mean age was 22.4 years (±2.35), with the youngest student being 19 and the oldest 36 years old. In terms of the results of phase two, healthcare students scored their potential performance higher than their self-efficacy perception (Table 1).

**Table 1 –** Total and subscale mean and SD in self-efficiency and performance of the SEPSS instrument

| ***SEPSS dimension*** | ***Self-efficacy (min and max)*** | ***Performance (min and max)*** |
|---|---|---|
| ***Assess*** | *2.83 ± 0.83 (0 and 4)* | *2.99 ± 0.77 (0 and 4)* |
| ***Advise*** | *2.85 ± 0.74 (0 and 4)* | *2.99 ± 0.74 (0 and 4)* |
| ***Agree*** | *2.84 ± 0.80 (0 and 4)* | *2.97 ± 0.76 (0 and 4)* |
| ***Assist*** | *2.87 ± 0.78 (0 and 4)* | *2.99 ± 0.70 (0 and 4)* |
| ***Arrange*** | *2.82 ± 0.82 (0 and 4)* | *2.88 ± 0.86 (0 and 4)* |
| ***Overall competency*** | *2.87 ± 0.78 (0 and 4)* | *3.00 ± 0.78 (0 and 4)* |
| ***Total score (0–24)*** | *17.08* | *17.82* |

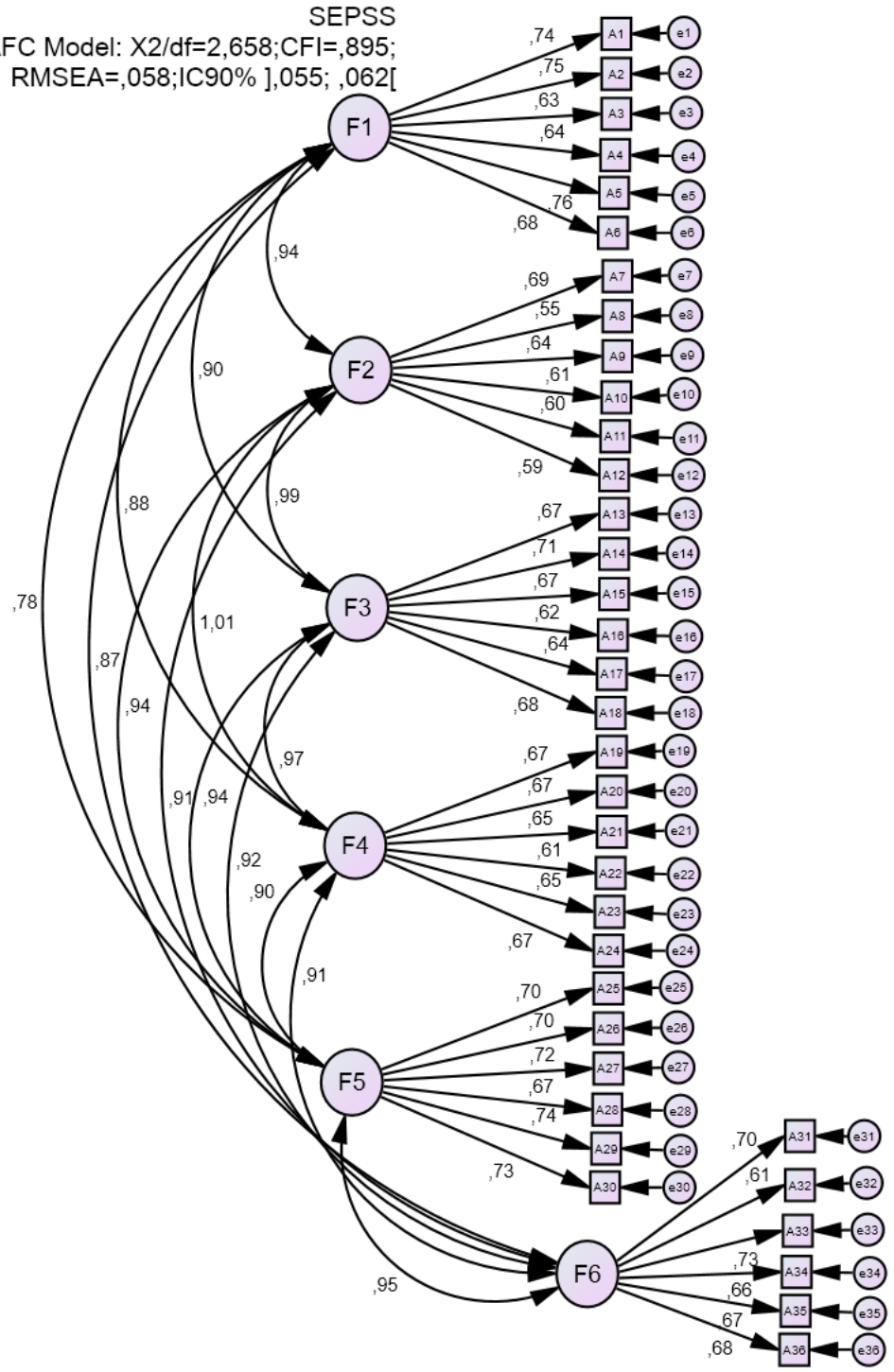
The reliability of the SEPSS dimensions for self-efficacy and performance was estimated using Cronbach's alpha (Table 2). All values for self-efficacy and performance were equal to or greater than 0.75, indicating acceptable reliability.

**Table 2 –** Cronbach alpha values of 6 dimensions of SEPSS

| ***SEPSS dimensions*** | ***Self-efficacy subscale*** | ***Performance subscale*** | ***SEPSS scale (global)*** |
|---|---|---|---|
| ***Assess*** | *0.84* | *0.82* | *0.85* |
| ***Advise*** | *0.76* | *0.75* | *0.78* |
| ***Agree*** | *0.82* | *0.78* | *0.83* |
| ***Assist*** | *0.83* | *0.75* | *0.82* |
| ***Arrange*** | *0.83* | *0.84* | *0.86* |
| ***Overall competency*** | *0.82* | *0.80* | *0.83* |

Regarding the CFA performed on the final model (Figure 1), the results showed a good fit according to the normal fit index (NFI), which had a value of .842. The comparative fit index (CFI) also indicated an adequate fit, with a value of .895. The Root Mean Square Error of Approximation (RMSEA) was .058 (with a 90% confidence interval between .055 and .062), suggesting that the observed data and the proposed model fit reasonably well. Additionally, the CMIN/DF fit index for the default model was 2.658, which is less than 3, indicating an acceptable fit according to Kline [24].

**Figure 1 –** SEPSS model and goodness-of-fit indexes obtained by confirmatory factor analysis.




| | |
|---|---|
| F1 | ASESS |
| F2 | ADVISE |
| F3 | AGREE |
| F4 | ASSIST |
| F5 | ARRANGE |
| F6 | OVERALL COMPETENCY |

## 4. DISCUSSION

Self-management is the dominant paradigm for delivering care for NCDs in many countries. Developing and implementing educational interventions to enhance self-management support competencies for future healthcare professionals is therefore critical [25–27]. In this study, we aimed to evaluate the construct validity of the SEPSS instrument using CFA. The proposed structural equation model evidenced satisfactory goodness-of-fit indices. The CMIN/DF value for the default model was 2.658, indicating a reasonable fit. The sample data and hypothetical model were an acceptable fit, as indicated by RMSEA values ≤ 0.05. The instrument and its subscales demonstrated strong internal consistency, as evidenced by high Cronbach's alpha values ranging from 0.75 to 0.96. The test-retest procedure indicated good stability of the instrument.

The performance of Bangladeshi nursing and medical students was found to be higher than their self-efficacy scores across all subscales and in total. Since self-efficacy is a critical precursor to behavior, it is recommended that performance and self-efficacy items be assessed in an integrated manner. These preliminary findings suggest that Bangladeshi nursing and medical students are actively engaged in supporting patients' self-management of NCDs in different stages but may lack confidence in their level of proficiency and competency to provide efficient, safe, and timely care. These initial findings can provide insight to nursing and medical educators in the selected higher education institutes on the significance of designing and implementing specific educational interventions that concentrate on enhancing students' competencies in crucial aspects of self-management support, including patient-centered communication and counseling, shared decision-making, information provision, innovative thinking, and cultural, religious, and spiritual awareness [25–27].

However, it is important to consider the limitations of our study. Firstly, we recruited participants from only three non-randomized universities, which may limit the generalizability of our findings. Additionally, our model analysis did not account for the potential differences in undergraduate students' scoring of the SEPSS instrument based on their scientific background and year of study. Therefore, further validation studies are required to ensure the instrument's reliability and construct validity for specific undergraduate healthcare courses and to assess whether students' progression through the course affects their perception and scoring of the instrument. Furthermore, given the interdisciplinary nature of self-management support, it is recommended that the translated and culturally adapted version of the SEPSS instrument be validated with other key stakeholders, such as physiotherapy, pharmacy, and nutrition students.

Secondly, although our selection of undergraduate students was intentional, we believe that the Bangla version of the SEPSS instrument could also be a reliable tool to assess self-management support competencies among post-graduate students and licensed healthcare professionals. In Bangladesh, these groups face increasing pressure to plan and deliver care in increasingly demanding scenarios due to the exponential growth in citizens requiring care and the increasing complexity of their health conditions and needs.

## 5. CONCLUSIONS

The Bangla version of the SEPSS instrument demonstrated both semantic and linguistic equivalence to the original version and was positively received by academic experts and undergraduate nursing and medical students in Bangladesh. The instrument also displayed favorable psychometric properties, suggesting its potential for evaluating the self-efficacy and performance of undergraduate healthcare students in supporting patients' self-management of NCDs. Future studies with a more diverse and inclusive sample, including students with varying scientific backgrounds, post-graduate students, and healthcare professionals, are necessary to further refine the instrument.

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# COVID-19 PANDEMIC'S INFLUENCE ON THE STUDY OF BURNOUT: A BIBLIOMETRIC ANALYSIS

## *A INFLUÊNCIA DA PANDEMIA DE COVID-19 NO ESTUDO DE BURNOUT: UMA ANÁLISE BIBLIOMÉTRICA*

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## ABSTRACT

Burnout affects physical and psychological health and is considered a major public health threat. The COVID-19 pandemic brought numerous social and economic challenges to organizations across the different work sectors, enhancing the risk of workers experiencing Burnout. However, the influence of the COVID-19 pandemic on the study of Burnout Syndrome remains unclear. To address this challenge, we analyzed pre-pandemic and post-COVID-19 outbreak research trends in this field. A comparative bibliometric analysis was conducted for the pre-pandemic period (01/2015 to 12/2019) and after the COVID-19 outbreak (01/2020 to 06/2021). Twelve thousand eighty-one publications were analyzed. Exponential growth in annual research activity on this subject was found since the COVID-19 outbreak. After 2020, the keyword "COVID-19" is often associated with "Burnout", showing a clear international focus on this field. Research output disparities among the most affected countries have been found, with increased publications in countries such as the United States of America, China, Spain and Italy, while others have understudied this subject (e.g., India, Brazil, France). Further bibliometric analyses in this scope are recommended.

**Keywords:** Bibliometric; Bibliometrix; Burnout; COVID-19; Pandemic.

## RESUMO

O Burnout afeta a saúde física e psicológica e é considerado como uma grande ameaça para a saúde pública. A pandemia de COVID-19 trouxe inúmeros desafios sociais e económicos às organizações dos diferentes setores de trabalho, aumentando o risco de os trabalhadores sofrerem de Burnout. Contudo, a influência da pandemia de COVID-19 no estudo da Síndrome de Burnout permanece pouco clara. Para enfrentar este desafio, analisámos as tendências de investigação pré e pós-pandemia de COVID-19. Foi realizada uma análise bibliométrica comparativa para o período pré (01/2015 a 12/2019) e pós-pandémico (01/2020 a 06/2021). Foram analisadas doze mil e oitenta e uma publicações. Foi encontrado um crescimento exponencial na atividade anual de investigação sobre este assunto desde o surto da COVID-19. Após 2020, a palavra-chave "COVID-19" está frequentemente associada a "Burnout", mostrando um claro enfoque internacional neste campo. Foram encontradas disparidades na produção de investigação entre os países mais afetados, com o aumento de publicações em países como os Estados Unidos da América, China, Espanha e Itália, enquanto outros estudaram pouco este assunto (por exemplo, Índia, Brasil, França). Recomenda-se a realização de mais análises bibliométricas neste âmbito.

**Palavras-Chave:** Bibliometria; Bibliometrix; Burnout; COVID-19; Pandemia.

## 1. INTRODUCTION

Coronavirus Disease-2019 (COVID-19) refers to a life-threatening pandemic that challenged the world since January 2020, with unprecedented and long-lasting disruptive effects on a human, social and financial level (Chen et al., 2021; Kamps & Hoffman, 2020a, 2020b; Kloutsiniotis et al., 2022; World Health Organization [WHO], 2020). Since January 2020, several worldwide efforts were concentrated to manage the spread of the virus (e.g., restrictive social isolation, mandatory mask use), transforming work environments and exposing workers to previously unheard-of working conditions and scenarios (Chahrour et al., 2020; Fan et al., 2020; Ramaci et al., 2020; Sullivan et al., 2022). Most organizations felt pressured to restructure their activities (e.g., remote work, halt areas/departments) to cope with the global public health crisis and ensure workers' health and well-being (Ramaci et al., 2020).

Despite such efforts, current reports suggest that workers experience psychological problems (e.g., stress, depression, fear, anxiety) (Kloutsiniotis et al., 2022). COVID-19 has disrupted workers' daily lives, increasing their workload while undermining their sense of control and organizational reward/recognition. This can likely lead work personnel to experience Burnout Syndrome (Leiter, 2020; Maslach, 2020).

Burnout, discovered by Freudenberger (1974) and Maslach (1976), refers to a physical, emotional, and mental exhaustion state that can be a potential consequence of prolonged exposure to highly emotionally demanding situations in the workplace, typically caused by combining very high expectations and chronic situational stress levels (Maslach, 2020; Maslach et al., 2001; Maslach & Jackson, 1981; Queen & Harding, 2020). According to Maslach and Jackson (1981), Burnout Syndrome is composed of emotional exhaustion, depersonalization, and reduced personal accomplishment. Emotional exhaustion refers to the stress dimension, where the individual feels emotionally drained, fatigued, and with low energy and resilience levels to perform normal daily tasks or address changes (Maslach, 2006; Maslach & Leiter, 1997). Depersonalization represents Burnout's interpersonal dimension, where the individual's frustration is externalized as cynicism, coldness, and social/emotional detachment, mainly towards work settings and coworkers (Maslach, 2006; Maslach & Leiter, 1997, 2017). Reduced personal accomplishment represents Burnout's self-assessment indicator, where individuals experience feelings of incompetence and lower work achievement and productiveness (Maslach, 2006). Although this is mainly experienced for work-related tasks, individuals can also experience reduced personal accomplishments in their personal and private spheres. Each new task is felt too demanding, accompanied by apathy, low levels of creativity, concentration difficulties and negative self-image (Maslach & Leiter, 1997).

Burnout can pose significant threats to individuals' physical and psychological health, influencing their work performance (Maslach & Leiter, 2017). Over the years, studies have reported a link between Burnout and several diseases such as cardiovascular problems, type 2 diabetes, depression, anxiety and irritability, and recurrence to unhealthy behaviours (e.g., tobacco, alcohol, and drug use) (Ahola, 2007; Greenglass & Burke, 1990; M. P. Leiter et al., 2013; Melamed et al., 2006; Toker et al., 2005, 2012). In parallel, Burnout can cause people to have more negative reactions to work (e.g., job dissatisfaction, poor performance, absenteeism, turnover), impacting their personal and family lives (Maslach & Leiter, 2017).

Over time, the scientific community has shown an interest in defining the Burnout construct and studying its prevention, diagnosis, and treatment (Maslach & Leiter, 2017; Schaufeli et al., 2009). Since the initial COVID-19 reports worldwide, research activity on Burnout Syndrome has grown exponentially (Mohadab et al., 2020).

However, no prior study sought to comprehend the influence of the COVID-19 pandemic on the study of Burnout Syndrome, addressing possible theoretical and practical limitations. To address this challenge, we analyzed pre-

pandemic and post-COVID-19 outbreak research trends in this field.

## 2. METHODS

A bibliometric literature analysis was conducted, aiming to quantitatively analyze published data and to build bibliometric maps that describe how specific research disciplines, scientific domains, or fields are conceptually, intellectually, and socially structured (Araújo, 2018; Bakker et al., 2005; Chen et al., 2019). Morevover, we aimed to provide an overview of Burnout and discuss potential areas for further research (Bakker et al., 2005). This bibliometric review focused on five main areas: study design, data collection, data analysis, data visualization and interpretation (Aria & Cuccurullo, 2017; Zupic & Čater, 2015).

### 2.1. STUDY DESIGN

We analyzed the research activity on Burnout before and after the COVID-19 outbreak. Articles on this subject were categorized as pre-pandemic (between January 1, 2015, to December 31, 2019) and after the outbreak (January 1, 2020, to June 25, 2021). The pre-pandemic period was confined to five years, reporting the most recent publications on Burnout Syndrome.

### 2.2. DATA COLLECTION

Data collection was performed in three steps: data retrieval, data loading and converting, and data cleaning (Aria & Cuccurullo, 2017). Data retrieval selects datasets, filtering and targeting documents for a constantly evolving search (Aria & Cuccurullo, 2017). Only English-language articles indexed in the Scopus database and containing the word “Burnout” in the title, abstract, or keywords were considered.

Data loading and converting were conducted through Bibliometrix, where essential data was retrieved (e.g., authors, citations, production country or keywords) (Zupic & Čater, 2015) and converted into a suitable format for posterior analysis (Aria & Cuccurullo, 2017). Data cleaning was performed to remove duplicates and misleading elements (e.g., overlapping authors’ names, journals) (Aria & Cuccurullo, 2017).

### 2.3. DATA ANALYSIS

Data analysis was performed using R software, specifically Bibliometrix codes and Biblioshiny. R Software is a highly capable statistical programming language that provides a free, flexible and extensible environment for research and analysis (Aria & Cuccurullo, 2017). Bibliometrix is the most popular R package tool, allowing descriptive and interactive analyses (Aria & Cuccurullo, 2017). It has simple functions enabling descriptive analyses (e.g., the most relevant authors by publication number or creating a co-citation network) (Aria & Cuccurullo, 2017; Campra et al., 2021; Linnenluecke et al., 2020). Biblioshiny is a web interface for bibliometrix that creates conceptual maps, subject dendrograms and thematic trend figures, and analyses the most active geographic areas (Campra et al., 2021).

### 2.4. DATA VISUALIZATION AND INTERPRETATION

During this step, we extracted relevant information through analytical methods (Aria & Cuccurullo, 2017). Result analysis was conducted through visual data reporting (e.g., proximity maps, temporal analysis maps, or thematic networks), as well as analyzing a subject’s conceptual, intellectual, or social evolution and determining patterns, trends, or outliers (Aria & Cuccurullo, 2017; Campra et al., 2021).

## 3. RESULTS

Twelve thousand and eighty-one records were retrieved from Scopus during data collection, of which 7373 (61%) were published during the pre-pandemic period. We identified 3343 publishing sources, with 17220 keywords used to describe the published records, where the keywords plus are higher than articles found (Table 1).

**Table 1 –** Key information from the total sample of publications (*n* = 12081)

| Description | Results |
|---|---|
| Documents | 12,081 |
| Time period | 2015–2021 |
| Sources (journals, books, etc.) | 3,343 |
| Keywords plus (ID) | 16,875 |
| Authors keywords (DE) | 17,220 |
| Average citations per document | 8,475 |
| Authors | 37,321 |
| Authors' manifestations | 52,879 |
| Authors of single-authored documents | 1,078 |
| Authors of co-authored documents | 36,243 |
| Individual authorship documents | 1,218 |
| Documents per author | 0.324 |
| Authors per document | 3.09 |
| Co-authors per document | 4.38 |
| Collaboration index | 3.34 |

In total, 37321 authors were involved in the global research output found, with each article averaging four authors (4.38), with a collaboration index of 3.34 (Köseoglu et al., 2018).

The analysis period covers almost seven years of research activity, with the last three years coinciding with the most substantial growth in subject-related publications (Table 2). The number of publications on Burnout Syndrome was constant during the pre-pandemic period, with a yearly increase in studies ranging from 17.5% (2015 to 2016) to 26.5% (2018–2019). However, after the COVID-19 outbreak, a 36.2% increase in publications on Burnout Syndrome was identified from 2019 to 2020. More impressively, the number of publications that focus on Burnout Syndrome was bigger in the first semester of 2021 than in 2018.

**Table 2 –** Annual research activity on Burnout between January 2015 and June 2021

| | Year | Papers |
|---|---|---|
| **Pre-pandemic** | 2015 | 1,009 |
| | 2016 | 1,186 |
| | 2017 | 1,371 |
| | 2018 | 1,681 |

| | | |
|---|---|---|
| | 2019 | 2,126 |
| **After the COVID-19 outbreak** | 2020 | 2,895 |
| | 2021 | 1,813 |

Before COVID-19, Zhang Y was the leading author on Burnout (*n* = 49), followed by Wang Y (*n* = 45), while after COVID-19, Wang Y became the most-published author on the topic (*n* = 28), followed by Li X (*n* = 25) (Table 3).

**Table 3 –** The number of papers per author before and after the COVID-19 outbreak

| **Pre-pandemic** | | | **After the COVID-19 outbreak** | | |
|---|---|---|---|---|---|
| **Ranking** | **Authors** | **Papers** | **Ranking** | **Authors** | **Papers** |
| **1** | Zhang Y | 49 | **1** | Wang Y | 28 |
| **2** | Wang Y | 45 | **2** | Li X | 25 |
| **3** | Liu J | 35 | **3** | Wang J | 24 |
| | Liu Y | 35 | | | |
| **4** | Li Y | 34 | **4** | Wang X | 23 |
| | | | | Zhang L | 23 |
| **5** | Wang Z | 33 | **5** | Liu J | 22 |
| | | | | Liu Y | 22 |
| **6** | Li X | 29 | **6** | Li J | 21 |
| | | | | Zhang X | 21 |
| **7** | Shanafelt Td | 28 | **7** | Li Y | 20 |
| | | | | Liu X | 20 |
| | Zhang J | 28 | | Wang C | 20 |
| | | | | Wang H | 20 |
| **8** | Li J | 26 | **8** | Shanafelt Td | 18 |
| | Li Z | 26 | | West Cp | 18 |
| **9** | Bianchi R | 25 | **9** | Liu H | 17 |
| | Wang L | 25 | | | |
| **10** | Wang X | 23 | **10** | Dyrbye Ln | 16 |
| | | | | Roskam I | 16 |
| | | | | Wang L | 16 |
| | | | | Zhang Y | 16 |

Authors' keywords are essential to determine research trends, identify possible gaps in the subject study, and identify fields that may require further investment (Campra et al., 2021). In the pre-pandemic period (Table 4), "Burnout" appears to be the most used keyword in published articles (*n* = 2538), followed by "stress" (*n* = 477). After the pandemic outbreak, the keyword "COVID-19" (*n* = 301) immediately follows "Burnout" (*n* =

1755) in published articles. From 2015 to date, “stress” (*n* = 765), “job satisfaction” (*n* = 445), and “mental health” (*n* = 394) are the three terms that most closely follow “Burnout” (*n* = 4293), placing “COVID-19” (*n* = 301) in a less prominent, though significant and influential position since the initial outbreak reports.

**Table 4 –** Keywords most used by the authors between January 2015 and June 2021: a) In total; b) Comparative analysis for both periods

| a) In total | |
|---|---|
| **Keyword** | **Frequency** |
| Burnout | 4,293 |
| Stress | 765 |
| Job Satisfaction | 445 |
| Mental Health | 394 |
| Resilience | 378 |
| Depression | 353 |
| Nurses | 343 |
| Compassion Fatigue | 303 |
| COVID-19 | 301 |
| Well-being | 282 |

| b) Comparative analysis in both periods | | | |
|---|---|---|---|
| **Pre-pandemic** | | **After the COVID-19 outbreak** | |
| **Keyword** | **Frequency** | **Keyword** | **Frequency** |
| Burnout | 2,538 | Burnout | 1,755 |
| Stress | 477 | COVID-19 | 301 |
| Job satisfaction | 295 | Stress | 288 |
| Depression | 213 | Mental health | 213 |
| Nurses | 211 | Resilience | 178 |
| Resilience | 200 | Job satisfaction | 150 |
| Compassion fatigue | 187 | Well-being | 146 |
| Mental health | 181 | Depression | 140 |
| Emotional exhaustion | 167 | Nurses | 132 |
| Job burnout | 163 | Compassion fatigue | 116 |

Analyzing the study of Burnout by geographic area requires the understanding of essential variables such as the number of publications, citation rates, and networking. As Table 5 shows, Burnout Syndrome was most studied in the United States of America (USA) (*n* = 6292 publications in the pre-pandemic period; *n* = 4670 after the COVID-19 outbreak), followed by China (*n* = 1640 publications in the pre pandemic period; *n* = 1228 after the COVID-19 outbreak).

**Table 5 –** Countries with the highest research activity compared the ten countries with the most confirmed COVID-19 cases on June 25, 2021 (WHO, 2022)

a) Before COVID-19

| Ranking | Country | Publications |
|---|---|---|
| **1** | USA | 6292 |
| **2** | China | 1640 |
| **3** | UK | 1027 |
| **4** | Canada | 904 |
| **5** | Australia | 835 |
| **6** | Spain | 708 |
| **7** | Germany | 526 |
| **8** | France | 495 |
| **9** | Netherlands | 477 |
| **10** | Brazil | 462 |

b) After the COVID-19 outbreak, compared to the ten countries with the most confirmed cases on June 25, 2021 (WHO, 2022)

| Ranking | Country | Publications | Ranking | Country | Confirmed cases |
|---|---|---|---|---|---|
| **1** | USA | 4670 | **1** | USA | 33,245,165 |
| **2** | China | 1228 | **2** | India | 30,134,445 |
| **3** | Spain | 647 | **3** | Brazil | 18,169,881 |
| **4** | UK | 637 | **4** | France | 5,656,376 |
| **5** | Canada | 534 | **5** | Russia | 5,409,088 |
| **6** | Australia | 467 | **6** | Turkey | 5,393,248 |
| **7** | Italy | 450 | **7** | UK | 4,794,629 |
| **8** | France | 380 | **8** | Argentina | 4,492,092 |
| **9** | Turkey | 282 | **9** | Italy | 4,255,700 |
| **10** | Iran | 276 | **10** | Colombia | 4,027,016 |

Several of the countries deeply affected during the first wave of COVID-19 also showed a greater volume of scientific production. Spain moved from sixth place before the pandemic (*n* = 708 publications) to third place after the COVID-19 outbreak (*n* = 647). Other countries such as Italy (*n* = 450 publications), Turkey (*n* = 282) and Iran (*n* = 275) only emerged in the ranking of countries with the highest scientific production on this topic after the COVID-19 outbreak. Conversely, countries such as India and Brazil [second and third countries with the highest rate of confirmed COVID-19 cases until June 25, 2021 (WHO, 2022) did not appear in this ranking.

Concerning the number of citations per country (Table 6), during the pre-pandemic period, studies conducted in the USA (*n* = 25774), China (*n* = 8359), and the United Kingdom (UK; *n* = 3940) received the highest number of

citations (Table 6). Despite their population number, studies conducted in countries such as Belgium (27.98), the Netherlands (21.59), and Finland (17.62) showed a significant citation average. After the COVID-19 outbreak, China became the country with the highest citation number (*n* = 2570), followed by the USA (*n* = 2256) and Italy (*n* = 610). Additionally, countries such as China (6.47), Singapore (5.87), and India (5.65) displayed the highest citation averages.

**Table 6 –** Most frequently cited countries in the Burnout study before and after the COVID-19 outbreak

a) Pre-pandemic

| **Ranking** | **Country** | **Total citations** | **Average citations per article** |
|---|---|---|---|
| **1** | USA | 25744 | 15.85 |
| **2** | China | 8359 | 13.66 |
| **3** | UK | 3940 | 13.87 |
| **4** | Australia | 3508 | 13.70 |
| **5** | Canada | 2810 | 12.60 |
| **6** | Spain | 2705 | 13.66 |
| **7** | Netherlands | 2569 | 21.59 |
| **8** | Germany | 2420 | 13.52 |
| **9** | Korea | 1692 | 9.51 |
| **10** | Sweden | 1605 | 15.58 |
| **11** | Italy | 1581 | 11.80 |
| **12** | Belgium | 1287 | 27.98 |
| **13** | France | 1262 | 9.63 |
| **14** | Finland | 1110 | 17.62 |
| **15** | Brazil | 1025 | 8.99 |
| **16** | South Africa | 926 | 13.23 |
| **17** | Turkey | 901 | 7.90 |
| **18** | Switzerland | 867 | 12.39 |
| **19** | Israel | 816 | 9.71 |
| **20** | Portugal | 793 | 14.16 |

b) After the COVID-19 outbreak, compared to the ten countries with the most confirmed cases on June 25, 2021 (WHO, 2022)

| Ranking | Country | Total citations | Average citations per article |
|---|---|---|---|
| **1** | China | 2570 | 6.47 |
| **2** | USA | 2256 | 2.08 |
| **3** | Italy | 610 | 5.00 |

| | | | |
|---|---|---|---|
| **4** | Spain | 411 | 2.32 |
| **5** | UK | 358 | 2.14 |
| **6** | India | 339 | 5.65 |
| **7** | France | 246 | 3.24 |
| **8** | Korea | 231 | 2.27 |
| **9** | Iran | 217 | 2.71 |
| **10** | Australia | 196 | 1.59 |
| **11** | Singapore | 182 | 5.87 |
| **12** | Germany | 157 | 1.94 |
| **13** | Canada | 154 | 1.18 |
| **14** | Finland | 117 | 3.00 |
| **15** | Turkey | 115 | 1.25 |
| **16** | Belgium | 113 | 2.90 |
| **17** | Switzerland | 97 | 2.62 |
| **18** | Netherlands | 91 | 1.94 |
| **19** | Poland | 73 | 1.28 |
| **20** | Portugal | 70 | 1.67 |

It is worth noting that there were countries that published considerably on this subject in the pre-pandemic period but developed their studies at a slower pace in the following period, namely Sweden (*n* = 1605 publications), Brazil (*n* = 1025), South Africa (*n* = 926), and Israel (*n* = 816). Contrasting, countries such as India (*n* = 339), Iran (*n* = 217), Singapore (*n* = 182), and Poland (*n* = 73) emerged in this thematic study.

**Table 7 –** Major affiliations related to the burnout study before and after the COVID-19 outbreak

a) Pre-pandemic

| **Ranking** | **Affiliations** | **Papers** |
|---|---|---|
| **1** | University of California | 123 |
| **2** | Mayo Clinic | 116 |
| **3** | Harvard Medical School | 99 |
| **4** | University of Toronto | 94 |
| **5** | Stanford University School of Medicine | 60 |
| **6** | University of Pennsylvania | 57 |
| **7** | University of Alberta | 55 |
| **8** | University of Helsinki | 55 |
| **9** | University of Michigan | 52 |

| | | |
|---|---|---|
| **10** | University of Minnesota | 50 |

b) After the COVID-19 outbreak

| **Ranking** | **Affiliations** | **Papers** |
|---|---|---|
| **1** | University of California | 94 |
| **2** | Harvard Medical School | 91 |
| **3** | Mayo Clinic | 62 |
| **4** | Stanford University | 57 |
| **5** | Stanford University School of Medicine | 53 |
| **6** | University of Toronto | 51 |
| **7** | University of Pennsylvania | 44 |
| **8** | University of Calgary | 41 |
| **9** | Vanderbilt University Medical Center | 40 |
| **10** | University of Washington | 39 |

**Table 7** presents the authors' institutional affiliations for publications considered in both analysis periods. During the pre-pandemic period, authors from the University of California (*n* = 123) and the Mayo Clinic (*n* = 116) published the most on Burnout Syndrome. After the COVID-19 outbreak, this was accomplished by authors from the University of California (*n* = 94) and Harvard Medical School (*n* = 91). Regarding the journals in which these articles were published (**Table 8**), the International Journal of Environmental Research and Public Health was one of the lead publications in both periods, being the second journal that published the most on Burnout during the pre-pandemic period (*n* = 86 articles), assuming the leading position after the COVID-19 outbreak (*n* = 220).

**Table 8 –** Top journals published before and after the COVID-19 outbreak

a) Pre-pandemic

| **Ranking** | **Sources** | **Papers** |
|---|---|---|
| **1** | Frontiers in Psychology | 87 |
| **2** | International Journal of Environmental Research and Public Health | 86 |
| **3** | Plos One | 85 |
| **4** | Bmj Open | 64 |
| **5** | Journal of Nursing Management | 61 |
| **6** | Energy and Fuels | 56 |
| **7** | Fuel | 56 |
| **8** | Journal of General Internal Medicine | 56 |
| **9** | Bmc Medical Education | 42 |
| **10** | Academic Psychiatry | 37 |

| b) After the COVID-19 outbreak | | |
|---|---|---|
| **Ranking** | **Affiliations** | **Papers** |
| **1** | International Journal of Environmental Research and Public Health | 220 |
| **2** | Frontiers in Psychology | 90 |
| **3** | Fuel | 49 |
| **4** | Plos One | 46 |
| **5** | Current Psychology | 36 |
| **6** | Bmc Medical Education | 34 |
| **7** | Journal of Surgical Education | 34 |
| **8** | Journal of Nursing Management | 30 |
| **9** | Bmj Open | 29 |
| **10** | Journal of General Internal Medicine | 29 |

## 4. DISCUSSION

The COVID-19 outbreak is considered a major public health threat worldwide, with a tremendous impact on every form of social order (Sohrabi et al., 2020). After the COVID-19 global outbreak, every sector of the economy has been hit by a severe economic slump, causing widespread internal and external organizational pressure, which can lead to the experience of Burnout Syndrome across the workforce (Maslach, 2020; López-López et al., 2020). Given the large increase in research activity following the COVID-19 pandemic, our data confirm this notion.

The COVID-19 pandemic has created unique challenges for organizations worldwide, contributing to workforce attrition while caring for employees' health and well-being (ElHawary et al., 2020; Quintero & Gutiérrez-Carvajal, 2021). Other challenges were larger than the organizations, prompting debates about social equality between workers from different sectors. For example, while many employees were mandated to work remotely, others were forced to remain on the front line, with increasing reports of insufficient personal protective equipment or adequate training. Moreover, financial anxiety was also high due to mass layoffs across different sectors (ElHawary et al., 2020; Iorio et al., 2020; Seleiman et al., 2020).

When work demands increase, and in certain circumstances, there can be an imbalance, whether caused by excessive workload, low hierarchical support, job instability, or even future uncertainty (Schaufeli et al., 2009). Excessive work demands, work-related ambiguities and conflicts, and insufficient family and social support can result in Burnout Syndrome (Maslach, 2020; Maslach et al., 2001).

Despite being a worldwide public health issue, the USA and China emerged as the top two contributors to the study of Burnout Syndrome in both periods. Only one of the ten most prolific institutes in the study of Burnout Syndrome during the pre-pandemic period was not headquartered in the United States. The University of California, Harvard Medical School, and the Mayo Clinic are the three institutions that dominate this analysis, and their research activity has not reduced with COVID-19, on the contrary.

Other countries with a high number of confirmed cases of COVID-19 (e.g., India and Brazil) (WHO, 2022) did not contribute as vastly to the study of their communities' physical and emotional exhaustion during the pandemic. Conversely, researchers from countries like Italy and Turkey focused their attention and resources on studying Burnout Syndrome after the COVID-19 outbreak.

Interestingly, countries with high research activity on Burnout Syndrome have strong scientific partnership agreements (Eurofound, 2018), indicating a desire to collaborate and share data to establish the scientific significance of their study findings on a macro level.

Some international scientific publication groups and journals immediately embraced the need for open-source, fast-track dissemination of research activity related to the COVID-19 pandemic. This may explain why after the COVID-19 outbreak, new publication sources rose to the top ten, focusing on several health-related disciplines such as public health, psychology, medicine and nursing.

Our findings must be analyzed with some limitations. First, most research on Burnout Syndrome was focused on the healthcare sector (e.g., physicians, nurses, psychologists). Although healthcare professionals were at risk of experiencing Burnout Syndrome even before the COVID-19 outbreak, other work sectors require the same amount of attention internationally. Comprehensive and reliable data on the effect of the COVID-19 pandemic on other workforces' experience of Burnout Syndrome (e.g., first responders, retail, tourism and hospitality) is urgently needed to increase organizational awareness and implement preventive strategies. Second, our results mirror the research activity indexed in the Scopus database. Although Scopus is a well-renowned and comprehensive scientific database, including records from other international databases would further refine our analysis.

Research constraints (e.g., time, resources, access to study population) on studying COVID-19 effects are increasingly less significant, and international collaborative efforts are emerging. Similar to social withdrawal effects on the individuals' emotional exhaustion (Fontanari, 2021; Mosolova et al., 2021), models must be developed to investigate, analyze, and combat Burnout Syndrome in a variety of work sectors, tailoring them to specific job demands, situations, and patterns.

## 5. CONCLUSIONS

Understanding the psychosocial impact that COVID-19 seems to have on workers' lives is essential, given that it can cause anxiety, depression, distress and insomnia, as well as Burnout symptoms (Duarte et al., 2020; Lai et al., 2020; Magnavita et al., 2020). In light of the continued economic and social challenges of the COVID-19 pandemic, future research should focus on the long-term effects of Burnout Syndrome on workers' quality of life and well-being.

## DECLARATION OF INTEREST STATEMENT

The authors reported no potential conflict of interest.

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## PROCEDIMENTOS ÉTICOS

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# HOW DO NURSING STUDENTS PERCEIVE HEALTHCARE TECHNOLOGY? A PSYCHOMETRIC VALIDATION STUDY OF THE USABILITY EVALUATION QUESTIONNAIRE IN VIETNAM

## *COMO É QUE OS ESTUDANTES DE ENFERMAGEM PERCEBEM A TECNOLOGIA EM SAÚDE? UM ESTUDO DE VALIDAÇÃO PSICOMÉTRICA DO USABILITY EVALUATION QUESTIONNAIRE NO VIETNAME*

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## ABSTRACT

The rapid advancement of technology has transformed the role of nurses and nursing students in patient care, making it an integral component of healthcare delivery. The use of innovative technologies has become commonplace in healthcare settings, creating a high-tech environment that can enhance nursing care quality and patient experience. It is essential for nursing staff and students to be receptive to incorporating such tools into their practice to ensure safe and efficient use of various forms of healthcare technology.

**Objective:** Given the absence of an existing tool in Vietnam to evaluate healthcare students' technology acceptance, the aim of our research was to culturally adapt, translate, and validate the Usability Evaluation Questionnaire (UtEQ) among nursing students in Vietnam.

**Method:** We conducted a methodological and cross-sectional study in two phases: translation of the UtEQ to Vietnamese (UtEQ-V) following six stages proposed by Beaton and collaborators, and assessment of its psychometric properties in a non-probability sample of 295 Vietnamese nursing students.

**Results:** The UtEQ-V's reliability was found to be above 0.8 for all factors (.88–.95), while confirmatory factor analysis showed adequate goodness-of-fit indicators.
**Conclusion**: The UtEQ-V is a reliable and valid instrument that can support nursing educators and researchers to assess students' technology acceptance during their clinical training.
**Keywords:** Technology Acceptance, Nursing Students, Vietnam.

**RESUMO**

O rápido avanço da tecnologia transformou o papel das enfermeiras e dos estudantes de enfermagem nos cuidados aos pacientes, tornando-o um componente integral da prestação de cuidados de saúde. O uso de tecnologias inovadoras tornou-se comum nos contextos de saúde, criando um ambiente de alta tecnologia que pode melhorar a qualidade dos cuidados de enfermagem e a experiência do paciente. É essencial que a equipa de enfermagem e os estudantes estejam recetivos à incorporação de tais ferramentas na sua prática, a fim de garantir o uso seguro e eficiente de várias formas de tecnologia de saúde.
**Objetivo:** Dada a inexistência de uma ferramenta existente no Vietname para avaliar a aceitação da tecnologia por parte dos estudantes de saúde, o objetivo da nossa investigação foi adaptar culturalmente, traduzir e validar o Questionário de Avaliação da Usabilidade (UtEQ) entre estudantes de enfermagem no Vietname.
**Método:** Realizámos um estudo metodológico e transversal em duas fases: tradução do UtEQ para vietnamita (UtEQ-V) seguindo as seis etapas propostas por Beaton e colaboradores e avaliação das suas propriedades psicométricas numa amostra não probabilística de 295 estudantes de enfermagem vietnamitas.
**Resultados:** A fiabilidade do UtEQ-V revelou-se superior a 0,8 para todos os fatores (.88–.95), enquanto a análise fatorial confirmatória apresentou indicadores adequados de ajustamento.
**Conclusão:** O UtEQ-V é um instrumento fiável e válido que pode apoiar os educadores e os investigadores de enfermagem na avaliação da aceitação da tecnologia pelos estudantes durante o seu treino clínico.
**Palavras-Chave:** Aceitação de Tecnologia, Estudantes de Enfermagem, Vietname.

## 1. INTRODUCTION

In Vietnam, nursing staff and students commonly use information and communication technologies such as electronic patient health records, internet-based health websites, digital applications, and telemedicine software in their daily clinical performance [1–3]. According to Barchielli et al. [4], there is a harmonious coexistence between technological competence and nursing care for nurses. Technological innovations enable nurses to establish closer connections with individuals by facilitating a more profound understanding of their patients. When nurses proactively embrace and purposefully adopt technological innovations, they can be viewed as successful innovators [4]. Nurses must recognize the potential opportunities presented by these innovations and strive to minimize direct risks for both themselves and the patients under their care.

However, before implementing a new technology, it is crucial to evaluate its advantages and limitations. Low levels of technology acceptance can negatively impact the adoption and implementation of new technologies in daily clinical practice, leading to delayed or failed attempts at integrating these technologies into healthcare delivery [5,6]. This can hinder the quality and safety of nursing care delivery and negatively impact healthcare objectives [2].

Technology acceptance refers to users' willingness to use technology for the tasks it is designed to support [3]. Understanding how nursing professionals and students react to new technologies is therefore crucial in ensuring their successful implementation and adoption in daily clinical practice [2]. Nursing professionals and students' knowledge and beliefs influence the evaluation process and contribute to their adoption of technology [3]. Social and cultural factors, as well as changes in information systems, designs, working environments, and potential users, can affect

nursing professionals and students' needs and acceptance of technology [3].

In their scoping review on technology literacy in nursing education, Nes et al. [7] identified a significant gap in pedagogical models that comprehensively address the acquisition, measurement, and maintenance of technological literacy among nursing students. According to the authors, nursing universities and colleges bear the responsibility of equipping future nurses with the necessary technological literacy knowledge to thrive in an increasingly technology-driven healthcare environment [7].

To achieve this, nursing educators and researchers can use several technology acceptance models and theories to identify underlying factors that affect users' behaviors towards technology. The Technology Acceptance Model (TAM) is widely accepted in existing literature for understanding predictors of user intention towards technology usage [5,8,9]. According to TAM, perceived ease of use and perceived usefulness are two primary factors that influence an individual's intention to use new technology. The Usability Evaluation Questionnaire (UtEQ) has been developed based on TAM to measure end-users' assessment of medical devices' efficacy, performance, and safety [10]. Healthcare educators and researchers in several countries, including Portugal, Belgium, Finland, Slovenia, and Vietnam, have used the UtEQ to assess healthcare students' acceptance of different technologies during their clinical training, with positive results [11,12].

As no instrument is available to assess nursing students' technology acceptance in Vietnam, we aim to culturally adapt and validate the psychometric properties of the UtEQ among undergraduate medical and nursing students.

## 2. MATERIALS AND METHODS

### 2.1. STUDY DESIGN

*Phase 1*: *Translation and Adaptation/Cross-Cultural Adaptation*

The UtEQ was translated into Vietnamese following the guidelines for the process of cross-cultural adaptation of self-report measures of Beaton and collaborators [13], in six stages. In stage I (Translation), two reviewers with a background in nursing were invited to independently assess and translate the UtEQ into Vietnamese. All the invited reviewers were fluent in written and spoken English and had integrated the language into their professional activities, with high knowledge of scientific and technical terms.

In stage II, the research team and the reviewers analyzed and discussed the two resulting translations, which were synthesized, and resulted in the development of a new version in Vietnamese (UtEQ-V). In stage III, two official translators whose native language was English back-translated the new version from Vietnamese to English. Both back-translations were reviewed by the research team in collaboration with the translators. To proceed with the translation process, an Expert Committee was formed (stage IV). Each expert from each University was invited to assess the UtEQ-V. After reviewing all feedback provided by the experts, the research team deemed that the original UtEQ and the developed new version of the instrument in Vietnamese (UtEQ-V) had linguistic equivalence.

In stage V (Pretest), 68 students from three Vietnamese Higher Education Institutions (Hanoi Medical College, Hanoi Medical University, and Namdinh University of Nursing) were requested to score the UtEQ-V. In general, the students considered that the items on the UtEQ-V were clear and easily scored, alluding to the fact that no deviations were needed to answer the scale. In terms of questionnaire completion, the mean time required by the student participants was 15 minutes. With regard to the questionnaire's content, no issues were reported by the students concerning the comprehension of the questions.

*Phase 2: Psychometric Validation of the UtEQ-V instrument*

The psychometric validation of the UtEQ-V was conducted between Hanoi Medical University and Nam Dinh University of Nursing in Vietnam. The selected HEIs are members of a consortium financed by the European Union Erasmus+ Capacity Building initiative.

### 2.2. INSTRUMENTS

The UtEQ was developed by Parreira and collaborators [10] based on the TAM model, and includes 45 items divided into four factors: Utility Performance (UP), Utility Empowerment (UE), Utility Relationship (UR), Easy of Use (EU). The UtEQ items can be scored between 1 (Strongly disagree) and 7 (Strongly agree) points. As the respondent's score increases, their inclination towards incorporating technology in their daily clinical practice becomes more apparent, as they perceive it as a beneficial tool for delivering care [9]. A succinct segment containing inquiries regarding the sociodemographic characteristics of participants (e.g., age, sex) and their academic information (e.g., course year, enrollment status) was also included at the end of the data collection instrument.

### 2.3. SAMPLE SIZE, STUDY RECRUITMENT AND DATA COLLECTION

Hair and colleagues [14] recommend using confirmatory factor analysis if the scale has already undergone exploratory factor analysis, and they suggest having at least five respondents per item. Kline [15], on the other hand, proposes a sample size of at least 200 participants for such assessments. Based on these assumptions, recruitment and data collection for this study were conducted at Hanoi Medical University and Nam Dinh University of Nursing from May to August 2021, using a non-probability convenience sampling method. A senior research team member approached students between classes, explained the study's objectives, and asked if they would like to participate in completing the UtEQ-V. Once completed, the students were instructed to place the scale form in a sealed box.

Inclusion criteria for the study required that students be at least 18 years old, enrolled in a bachelor's degree program in nursing science, and proficient in written Vietnamese. Exclusion criteria included students who did not want to participate in the study and international students who were enrolled in the selected Higher Education Institutions for a brief mobility period.

### 2.4. DATA ANALYSIS

The data were synthesized by using SPSS 20.0 and AMOS 20.0 software. Descriptive statistics including mean, percentage, and the standard deviation were used to describe the variables of the study. We conducted a confirmatory factor analysis (CFA) using AMOS (SPSS Inc., Chicago IL) to estimate the structural model. Cronbach's alpha was used to estimate the reliability of the factors. A variety of goodness-of-fit indexes was used to assess the data's fit of the model. There were specific measures that can be calculated to determine goodness of fit along with their acceptable fit. Hu and Bentler [16] suggested that the goodness of fit of the proposed structures to the correlational structure of the data was evaluated with $\chi 2/df$, CFI, GFI, TLI, SRMR, RMSEA, and the 90% confidence interval for RMSEA. It is assumed that a good fit occurred when the chi-square/degrees of freedom should be less than 5.0. When CFI is greater than .97, we considered good adjustment, when between $.95 \leq CFI < .97$, we considered acceptable fit. About GFI, we considered a good fit when it is greater than .95 and an acceptable fit when $.90 \leq GFI < .95$. A Root Mean Square Error of Approximation (RMSEA) value of less than .05 was considered to indicate a good fit, while values between .05 and .08 were considered acceptable. The statistical significance was assumed at a .05 level [17].

### 2.5. ETHICAL CONSIDERATIONS

The research proposal was approved by the Ethics Committee of the Health Sciences Research Unit: Nursing of the Nursing School of Coimbra with number P781-5/2021. Informed consent was obtained to ensure that the subjects voluntarily participated in this study. The students participating in the study were provided with full information about the study, including the purpose, data collection and treatment procedures, and rights when participating in the study. Students were informed of their right to withdraw from the study at any time without consequences.

## 3. RESULTS

A total of 295 nursing students participated voluntarily in the study. Most of the participants were female students ($n$ = 267, 90.5%), which

is representative of the gender distribution in the nursing workforce in Vietnam. Most of the participants (*n* = 239, 81%) were full-time students, with only a small proportion being part-time students (*n* = 56, 19%). The average age of the respondents was 22.7 years (± 5.69). The descriptive statistics of the UtEQ-V for phase two can be found in Table 1.

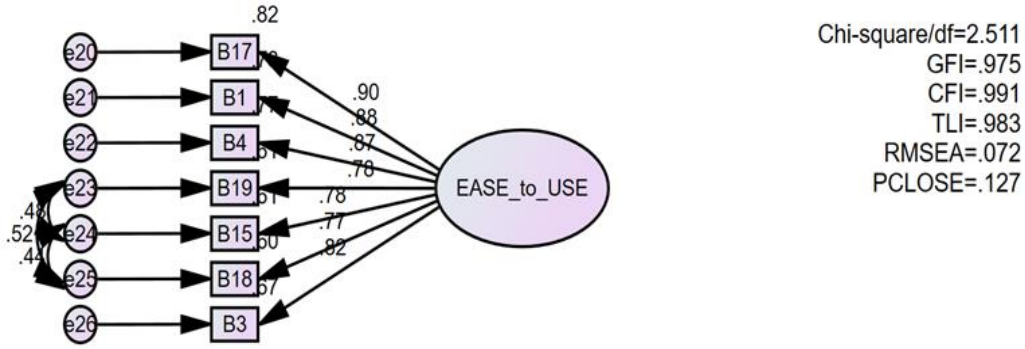
**Table 1 –** Descriptive statistic of the UtEQ-V (*n* = 295)

| ***Subscales*** | ***Min. value*** | ***Max. value*** | ***Mean ± SD*** |
|---|---|---|---|
| *Utility-Performance (UP)* | *2.67* | *7.00* | *5.51 ± .81* |
| *Utility-Empowerment (UE)* | *2.00* | *7.00* | *5.38 ± .96* |
| *Utility-Relationship (UR)* | *2.80* | *7.00* | *5.29 ± .95* |
| *Ease of Use (EU)* | *1.86* | *7.00* | *5.08 ± .87* |

The Cronbach's Alpha values for the factors were respectively adequate: Utility-Performance (UP) with α = .95, Utility-Empowerment (UE) with α = .88, Utility-Relationship (UR) with α = .94, and Ease of Use (EU) with α = .94.

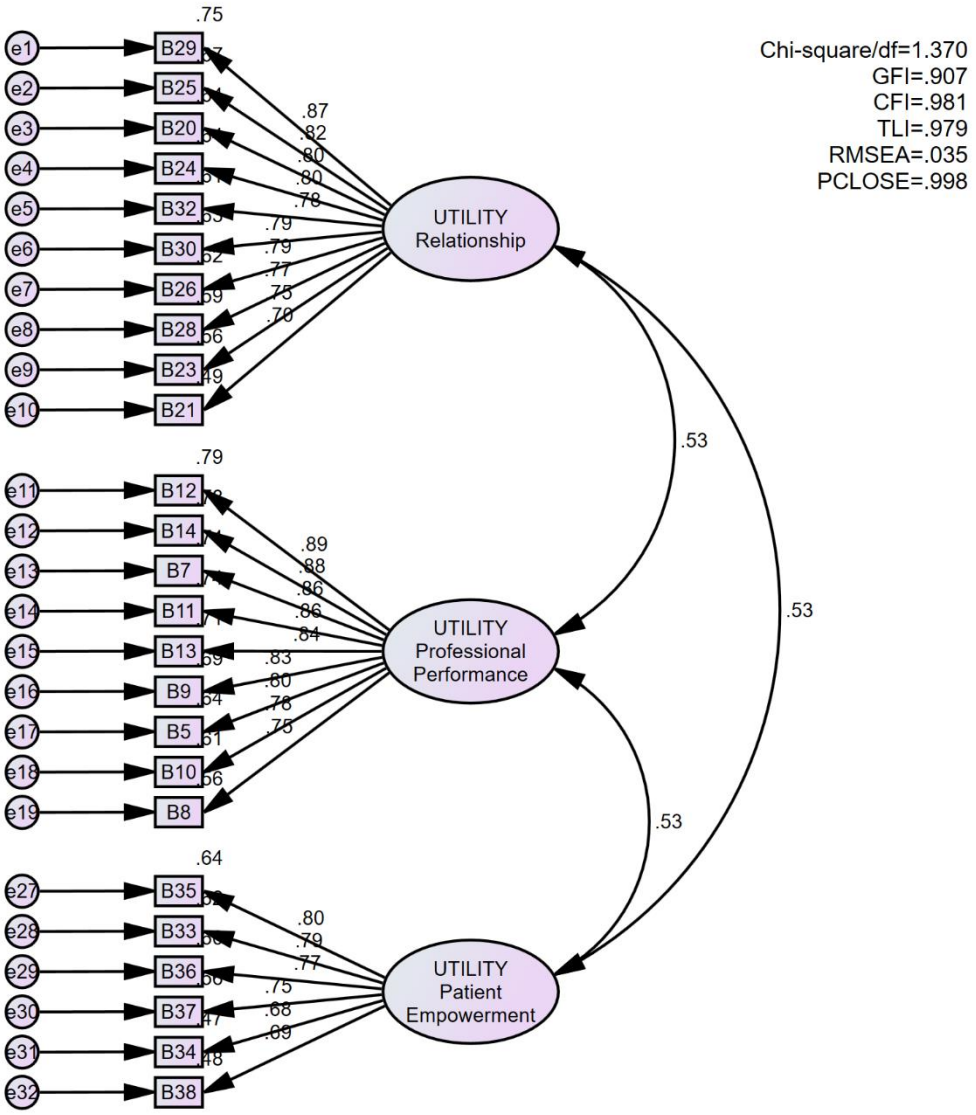
Confirmatory factor analysis was performed (Figure 1). The results showed that the goodness-of-fit indexes (CMIN/DF = 2.511, which is less than 3; GFI = 0.975, which is greater than .9; CFI = .991, which is greater than .9; TLI = .983, which is greater than .9; RMSEA = .072, which is less than 0.08; and PCLOSE = .127, which is greater than .05) are adequate, supporting the factor of Ease of Use (α = .94), as depicted in Figure 1. Additionally, all observed variables in the model are significant (p-values < .05), and all normalized weights are greater than .5, indicating a high degree of agreement among the observed variables. Moreover, the CR values are greater than .7, and AVE is greater than .5, demonstrating convergence.

**Figure 1 –** Confirmatory Factor Analysis of the UtEQ-V's EU factor



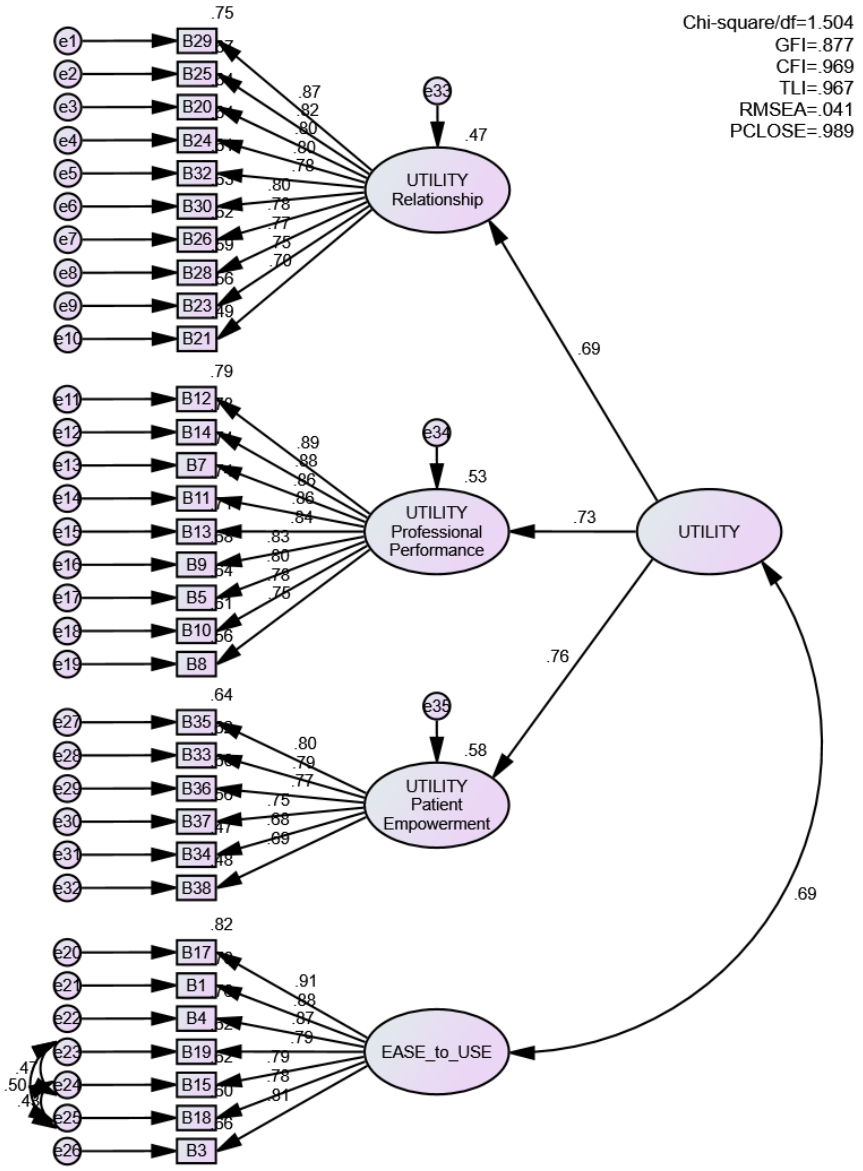

Confirmatory factor analysis was conducted based on the proposed model shown in Figure 2. The results indicated good model fit with the following goodness-of-fit indexes: CMIN/DF = 1.370 (less than 3), GFI = .907 (greater than .9), CFI = .981 (greater than .9), TLI = .979 (greater than .9), RMSEA = .035 (less than .08), and PCLOSE = .998 (greater than .05). All observed variables in the model were found to be significant, with *p*-values less than .05. Additionally, all normalized weights were greater than 0.5, indicating a high degree of agreement among the observed variables. The CR values were greater than .7, and AVE was greater than .5, confirming the UtEQ-V's convergence.

**Figure 2 –** Confirmatory factor analysis for the factors UP, UE, and UR




We attempted a third model proposal that integrated all the factors of the original UtEQ (Figure 3). The model fit showed an improvement in RMSEA, with the following goodness-of-fit indexes: CMIN/DF = 1.504 (less than 3), GFI = .877 (greater than .8), CFI = .969 (greater than .9), TLI = .967 (greater than .9), RMSEA = .041 (less than .08), and PCLOSE = .989 (greater than .05), indicating a good model fit (Figure 3). All subscales of UTILITY were found to be significant, with p-values less than .05. The results showed that the order of explanation for the UTILITY variable, from strong to weak, is UTILITY_Patient_Empowerment > UTILITY_Professional_Performance > UTILITY_Relationship. The CR values were greater than .7, and AVE was greater than .5, indicating that the scales were convergent. Additionally, the square root of AVE was larger than the correlations between latent variables, and MSV was less than AVE, indicating that the discriminant was guaranteed. The correlation analysis indicated a significant positive correlation between EASE_to_USE and UTILITY, with a p-value of .000 (less than .05) and a high correlation coefficient of .692, suggesting a strong correlation between these two factors.

**Figure 3 –** Goodness-of-fit indexes obtained in Confirmatory Factor Analysis of all the factors of the UtEQ-V




## 4. DISCUSSION

This study aimed to translate the UtEQ from English to Vietnamese and evaluate its psychometric properties among nursing students in Vietnam. The Vietnamese version of the UtEQ was assessed for internal consistency, construct validity, and external validity. The Cronbach's alpha coefficients for all items were above .80 for the four factors measured (Utility Performance, Utility Empowerment, Utility Relationship, and Ease of Use), indicating high internal consistency.

The final model proposal showed adequate goodness of fit, suggesting that the original model proposed by Parreira et al. [10] could be used in Vietnamese nursing student population. However, correlating the error of items 23, 24, and 25 was necessary to improve the goodness of fit, indicating the need for further research to explain the unexplained variability in the sample. The results also revealed a high positive correlation between Ease of Use and Utility, consistent with previous studies [4,18–20].

Regarding construct validity, the factor of Utility Relationship in the Vietnamese version was interpreted by items B20, B21, B23-B26, B28-B30, and B32 (factor loadings .75–.88); Utility Performance by items B5 and B7-B14 (factor loadings .72–.91); Utility Empowerment by items B33-B38 (factor loadings .82–.89), and Ease of Use by items B1, B3, B4, B15, and B17-B19 (factor loadings .69–.83). It is important to note that the factor loadings and factors themselves vary depending on the national culture of each study population [19,20].

This study has several limitations that need to be addressed. Firstly, the participants were recruited from only two universities in a non-randomized manner, which could limit the generalizability of the findings. Likewise, our model analysis did not consider the potential differences in undergraduate students' perceptions of healthcare technology during the advancement of their studies. As an example, first-year students may have more reservations with some forms of healthcare technology than last-year students, who have more experience in a real-life clinical setting. Therefore, further testing of the instrument is necessary to ensure its reliability and construct validity. Secondly, although the selection of undergraduate nursing students was intentional, we believe that the UtEQ-V may also be a reliable instrument to assess technology acceptance among post-graduate nursing students and nursing staff. These groups are constantly under pressure to plan and deliver care in increasingly technological clinical environments. Moreover, given its structure, content, and nature, future researchers may want to explore the UtEQ-V's applicability and reliability in assessing technology acceptance among other healthcare professionals and students from different backgrounds, such as medicine, physiotherapy, and pharmacy.

## 5. CONCLUSIONS

The UtEQ-V was found to have semantic equivalence to the original version and was positively received by academic experts and undergraduate nursing students. The UtEQ-V demonstrated satisfactory reliability properties, rendering it a useful tool for evaluating nursing students' technology acceptance during their formal education. Structured evaluation of this domain could be advantageous for nursing educators and researchers, enabling targeted interventions to enhance students' perceptions of the role of technology in care delivery, as well as its ease of use and utility.

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## PROCEDIMENTOS ÉTICOS

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# EFFECTIVENESS OF THE DIGICARE EDUCATIONAL INTERVENTION IN IMPROVING NURSING AND MEDICAL STUDENTS' CLINICAL COACHING SKILLS IN VIETNAM AND BANGLADESH: AN EXPLORATORY PRE-POST STUDY

## *EFETIVIDADE DA INTERVENÇÃO EDUCACIONAL DIGICARE NA MELHORIA DAS HABILIDADES DE COACHING CLÍNICO DE ESTUDANTES DE ENFERMAGEM E MEDICINA NO VIETNAME E BANGLADESH: UM PRÉ- E PÓS-ESTUDO EXPLORATÓRIO*

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## ABSTRACT

Coaching has become an important approach to support self-management of patients with non-communicable diseases (NCDs) in healthcare education. Studies conducted in European countries have emphasized the significance of formal coaching training in enhancing the competencies of healthcare students. However, in Southeast Asia, where NCDs pose a serious public health concern, there is a lack of such training opportunities. To address this issue, an exploratory pre and post study was conducted to evaluate the effectiveness of the DigiCare educational intervention in improving clinical coaching skills. Nursing and medical students from six universities in Vietnam and Bangladesh were invited to participate. The intervention included both theoretical and practical classes with interactive methods and home assignments, with a total duration of over 10 contact hours. Pre- and post-intervention assessments were conducted using the Self-Efficacy and Performance in Self-management Support instrument, which was translated and culturally adapted to both countries. Statistical analysis showed a significant improvement in students' overall competence scores from before

(M = 2.6, SD = .67) to after the intervention (M = 3.05, SD = .55), with a medium effect size ($p$ < .001; $d$ = .73). The DigiCare educational intervention appears to be a low-cost and meaningful addition to the curriculum of both nursing and medical universities across countries, with potential benefits in the development of students' clinical coaching competencies.
**Keywords:** Clinical Coaching; Self-Management Support; Nursing Students; Medical Students.

**RESUMO**

O coaching tornou-se uma abordagem importante para apoiar a autogestão de pacientes com doenças não transmissíveis (DNTs) na educação em saúde. Estudos realizados em países europeus têm enfatizado a importância do treinamento formal em coaching para aprimorar as competências dos estudantes de saúde. No entanto, no Sudeste Asiático, onde as DNTs representam uma séria preocupação de saúde pública, há uma falta de oportunidades de treinamento nesse sentido. Para abordar essa questão, foi conduzido um pré- e pós-estudo exploratório para avaliar a eficácia da intervenção educacional DigiCare na melhoria das habilidades de coaching clínico. Estudantes de enfermagem e medicina de seis universidades no Vietname e em Bangladesh foram convidados a participar. A intervenção incluiu aulas teóricas e práticas com métodos interativos e tarefas domiciliares, totalizando mais de 10 horas de contato. Avaliações pré e pós-intervenção foram conduzidas utilizando o instrumento de Autoeficácia e Desempenho no Suporte à Autogestão, que foi traduzido e adaptado culturalmente para ambos os países. Análises estatísticas mostraram uma melhoria significativa nas pontuações gerais de competência dos estudantes, de antes (M = 2,6, DP = 0,67) para depois da intervenção (M = 3,05, DP = 0,55), com um efeito médio ($p$ < 0,001; $d$ = 0,73). A intervenção educacional DigiCare parece ser uma adição de baixo custo e significativa para o currículo de universidades de enfermagem e medicina em diferentes países, com benefícios potenciais no desenvolvimento das competências clínicas de coaching dos estudantes.
**Palavras-Chave:** Coaching Clínico; Suporte à Autogestão; Estudantes de Enfermagem; Estudantes de Medicina.

## 1. INTRODUCTION

The prevalence of NCDs has been steadily increasing in Asian countries due to various factors, such as aging populations, unhealthy lifestyles, and urbanization. According to the World Health Organization, NCDs account for 9 million deaths in the Southeast Asia region alone, almost half of them premature, in people's prime productive years [1,2]. In addition to the health consequences, NCDs also impose a significant economic burden on Asian countries. The cost of healthcare, lost productivity, and premature deaths due to NCDs is estimated to reach trillions of dollars in the coming decades [2,3].

To address the growing burden of NCDs in Southeast Asian countries, various initiatives have been implemented, including policies to promote healthy lifestyles, public health campaigns, and restructuring of existing healthcare systems to prioritize early detection and management of NCDs [2].

Despite these efforts, there are still challenges to addressing NCDs in Southeast Asian countries, including limited resources and inadequate healthcare infrastructure. However, one of the most referenced challenges concerns cultural attitudes towards health and the self-management of existing conditions. Self-management involves taking responsibility for one's health and wellbeing, including making lifestyle changes, adhering to treatment plans, and making informed decisions about one's health [4,5]. While self-management is critical for improving health outcomes and reducing healthcare costs, many patients struggle to manage their health effectively.

Coaching is a relatively new concept that has its roots in sports, psychology, and business [6,7]. The role of a coach is to assist clients in leveraging their own resources and overcoming obstacles to achieve mutually agreed-upon goals. Recently, coaching has gained popularity in the healthcare sector in the

form of clinical coaching. Numerous studies have shown that clinical coaching can be effective in helping patients adopt healthy behaviors that can prevent and manage lifelong NCDs, such as arterial hypertension, diabetes, hyperlipidemia, or asthma [8,9].

However, managing NCDs can be challenging for most individuals, as they often lack an understanding of disease progression and self-management techniques. Clinical coaching is distinct from other forms of lifestyle improvement services. Counselling provided by healthcare professionals is often fast-paced and focuses on providing clinical advice and guidance [5]. This approach can be rigid and may not consider the patient's personal goals, available resources, and capacity for change [10]. While these professionals are skilled in discussing complex treatment and care issues with patients, time constraints often limit the counseling that can be provided. Thus, clinical coaching provided by trained healthcare professionals is a collaborative approach to enhance patients' self-management of their NCDs [11,12]. The health coach acts as a partner in the change process, actively listening and empowering the patient in a non-judgmental manner based on their concerns [13]. The health coach's role is to ensure that patients are educated about their health and guided towards setting realistic health goals, improving patient health literacy through patient-centered communication, educational materials, and reinforcement [6,7]. It is essential for healthcare professionals to practice both roles concurrently to ensure optimal outcomes for patients [14].

While clinical coaching has garnered significant attention from educators in nursing and medicine [6,7,9,11,13,15], there is a dearth of evidence on how to effectively introduce clinical coaching skills into their training curricula, particularly in low-resource countries. Therefore, our study aimed to evaluate the efficacy of an educational intervention developed to enhance the clinical coaching skills of nursing and medical students in Vietnam and Bangladesh.

## 2. MATERIALS AND METHODS

### 2.1. DESIGN AND SETTING

An exploratory study with a pre- and post-intervention design was carried out simultaneously in higher education institutions from Vietnam and Bangladesh. From Vietnam, data collection was undertaken at Hanoi Medical University (HMU), Hanoi Medical College (HMC), and Nam Dinh University of Nursing (NDUN). In Bangladesh, the educational intervention was conducted in City Medical College and Hospital (CMCH), Khulna City Medical College (KCMC), and Universal Medical College (UMC). The educational intervention was developed by the DigiCare Project consortium, as part of its activities funded by the Erasmus+ Agency, through its Strategic Partnerships for Higher Education Programme (grant number 598267-EPP-1-2018-1-FI-EPPKA2-CBHE-JP). The study was carried out between July and December 2022, with a baseline (T0) and post-intervention assessment (T1).

### 2.2. SAMPLE AND RECRUITMENT

Recruitment was conducted simultaneously at all sites between June and July 2022. The target population for the study included undergraduate nursing and medical students who voluntarily wanted to participate in the ongoing study and were affiliated with one of the partner universities. The inclusion criteria were an ability to understand Vietnamese or Bangla, age over 18 years, no formal training in clinical coaching, and provision of signed informed consent. Undergraduate students who were affiliated with the participating universities under a short-term mobility action were excluded from this study. First-year students and those who had participated in previous activities conducted under the DigiCare project were excluded from the study. However, they were provided access to all existing guiding materials and exercises after T1 was completed.

### 2.3. INTERVENTION

The educational intervention was simultaneously conducted across all partner universities between July and December 2022. The intervention focused on developing clinical coaching skills among nursing and medical students, using a structured pedagogical

approach developed by the project consortium partners (Table 1).

**Table 1 –** Summary of the DigiCare project's educational intervention

| ***Modality and duration*** | ***Topics*** | ***Objectives*** | ***Method*** | ***Home assignment for students*** |
|---|---|---|---|---|
| *Orientation classes (45 minutes)* | ▪ *NCDs emergence and global impact;*<br>▪ *The DigiCare Model.* | ▪ *Students know the elements of the DigiCare Model.* | ▪ *Interactive lecture.* | ▪ *Complete the DigiCare project reading materials (i.e., guiding articles and video tutorials).* |
| *Theory Classes (240 minutes)* | ▪ *Concepts of Self-management;*<br>▪ *Positive Health;*<br>▪ *Professional Communication;*<br>▪ *Life change motivation;*<br>▪ *Coaching and coaching frameworks (5 A's and GROW models);*<br>▪ *Digital tools in* | ▪ *Know general principles of professional communication;*<br>▪ *Know general principles of how to motivate patients for life change;*<br>▪ *Understand the concepts of Positive Health and Salutogenesis;*<br>▪ *Know general principles of the concept of the self-management;* | ▪ *Interactive lecture;*<br>▪ *World café;*<br>▪ *Flipped learning using online software (e.g., Flinga).* | ▪ *Revise and watch the two educational videos on coaching and models;*<br>▪ *Write a short starting point story acting as a* |

| | | | | |
|---|---|---|---|---|
| | *clinical coaching.* | ▪ *Know general principles of coaching and different coaching models.* | | *coachee.* |
| *Practice classes (360 minutes)* | ▪ *Role-play exercise in groups;*<br>▪ *Reflection and discussion.* | ▪ *Perform professional communication/apply professional communication skills;*<br>▪ *Apply GROW coaching model and 5 A's coaching model in coaching practice.* | ▪ *Low fidelity simulation.* | *n/a* |
| | ▪ *Patient coaching and professional interaction skills in real working life.* | ▪ *Practice coaching in real working life.* | ▪ *Three coaching sessions with relatives on a specific topic;*<br>▪ *Learning diary.*<br>▪ *Feedback form.* | *n/a* |

This approach was built upon existing literature reviewed by the research team and included modules and guiding materials that had been previously piloted for their significance and meaningfulness by both teachers and students. One senior professor from each partner team conducted the educational intervention outside of regular degree modules.

The participating professors had previously taken part in piloting rounds of the educational intervention and guiding materials for an entire year. This experience enabled them to become well-acquainted with the intervention's dynamics and discuss potential methods and strategies to be employed.

## 2.4. STUDY VARIABLES AND INSTRUMENTS

Data were collected at T0 (baseline, pre-educational intervention) and T1 (last class, immediately after completing group discussion). Students completed the encoded instruments on paper and submitted them by placing them in a sealed box upon completion. Data were collected using two questionnaires: i) a demographic questionnaire (e.g., age, sex, country and university, degree background, and satisfaction with the course); and ii) the Self-Efficacy and Performance in Self-management Support (SEPSS) instrument.

Duprez and colleagues [3] developed the SEPSS instrument based on the Five A's framework for professional behavior in self-

management support [4]. The instrument consists of six subscales, namely Assessment, Advise, Agree, Assist, Arrange, and Overall Competency, with six items in each subscale. Students rate their perceptions of self-efficacy and performance in each subscale on a five-point Likert scale, ranging from 0 (lowest) to 4 (highest) score. The six subscales allow for the measurement of outcomes on a subscale level, enabling a focus on specific aspects of the self-management process, while the total score provides an overall view of how support is provided. The scores range from 0 to 4 for the subscales and 0 to 24 at the total scale level, with higher scores indicating higher levels of self-efficacy or performance in self-management support.

The original instrument demonstrated high internal consistency with a Cronbach's alpha of .96 [3]. The SEPSS instrument has been translated and adapted for use with Vietnamese and Bangladeshi nursing and medical students, with validation studies currently under review for publication elsewhere. Table 2 presents the internal consistency of the SEPSS scale in this study.

**Table 2 –** Internal consistency of the SEPSS scale adapted for Vietnam and Bangladesh

| ***SEPSS subscales*** | ***SEPSS—Vietnamese version*** | | | ***SEPSS—Bangla version*** | | |
|---|---|---|---|---|---|---|
| | ***Mean*** | ***SD*** | ***α*** | ***Mean*** | ***SD*** | ***α*** |
| ***Assess*** | *2.50* | *.399* | *.68* | *3.00* | *.68* | *.83* |
| ***Advise*** | *2.66* | *.451* | *.74* | *3.01* | *.65* | *.78* |
| ***Agree*** | *2.57* | *.420* | *.75* | *3.00* | *.69* | *.82* |
| ***Assist*** | *2.59* | *.427* | *.75* | *3.00* | *.64* | *.81* |
| ***Arrange*** | *2.57* | *.424* | *.76* | *2.97* | *.72* | *.85* |
| ***Overall competency*** | *2.59* | *.379* | *.76* | *3.04* | *.67* | *.83* |

* SD = Standard deviation; α = Cronbach's Alpha

### 2.5. ETHICS

The Ethics Committee of the Health Sciences Research Unit: Nursing (UICISA: E) at the Nursing School of Coimbra granted approval for the research proposal under the identification code P781-5/2021. Prior to participation, informed consent was obtained from all students to ensure their voluntary participation in the study. The students received comprehensive information regarding the study's objectives, educational methods, and their rights as participants. They were also informed of their right to withdraw from the study at any point without academic repercussions. To prevent any potential identification of individual students, all data collection instruments were coded.

### 2.6. STATISTICAL ANALYSIS

All statistical analyses were performed using SPSS 26.0 for Windows (SPSS Inc., Chicago, IL, USA). Descriptive statistics including mean, percentage, the standard deviation was used to describe the variables of the study. The Kolmogorov Smirnov test showed that the data followed a normal distribution. To verify the effectiveness of the intervention, we measured students' coaching skills from baseline (T0) to the end of educational intervention (T1) using Student's *t*-test for related samples [16]. Effect sizes were estimated using Cohen's d [17]. The significance level was set at ≤ .05.

## 3. RESULTS

Globally, 424 students enrolled in this study, with the following distribution: 52 from HMU (Vietnam), 35 from HMC (Vietnam), 93 from NDUN (Vietnam), 98 from CMCH

(Bangladesh), 82 from KCMC (Bangladesh), and 64 from UMC (Bangladesh). Overall, 352 students were female (83%), with an average age of 22.4 ± 3.8 years. Most students were enrolled in a nursing course (*n* = 336, 79.2%) and attended their course as full-time students (*n* = 349, 82.3%).

At T1, 336 of the 424 (79.2%) students attended the final class and completed the final assessment. Nonetheless, no statistical difference was found between pre- and post-intervention groups concerning their gender ($X^2_{(1)}$ = 3.676; *p* = 0.16) or their average age (Z = .445; *p* = .505). Concerning their academic characteristics, both groups were similar when focusing on their degree background ($X^2_{(1)}$ = 5.163; *p* = 0.08) and type of enrollment ($X^2_{(1)}$ = 1.748; *p* = 0.114).

Between T0 and T1, statistical analysis revealed significant differences across the SEPSS instrument subscale scores in the global study sample (Table 3). The effect size, as measured by Cohen's d, indicated a medium effect for all differences found.

**Table 3 –** Pre- and post-intervention differences found in students' coaching skills (global)

| ***SEPSS subscales*** | ***Assessment*** | ***n*** | ***Mean*** | ***SD*** | ***Sig.*** | ***Cohen's d*** | ***Effect-size r*** |
|---|---|---|---|---|---|---|---|
| ***Assess*** | *After* | *336* | *3.01* | *.57* | ***.000*** | *0.65* | *0.31* |
| | *Before* | *424* | *2.60* | *.69* | | | |
| ***Advise*** | *After* | *336* | *3.04* | *.52* | ***.000*** | *0.62* | *0.30* |
| | *Before* | *424* | *2.67* | *.66* | | | |
| ***Agree*** | *After* | *336* | *3.05* | *.54* | ***.000*** | *0.78* | *0.36* |
| | *Before* | *424* | *2.57* | *.68* | | | |
| ***Assist*** | *After* | *336* | *3.04* | *.53* | ***.000*** | *0.62* | *0.30* |
| | *Before* | *424* | *2.67* | *.66* | | | |
| ***Arrange*** | *After* | *336* | *3.03* | *.55* | ***.000*** | *0.76* | *0.35* |
| | *Before* | *424* | *2.54* | *.73* | | | |
| ***Overall competence*** | *After* | *336* | *3.05* | *.55* | ***.000*** | *0.73* | *0.34* |
| | *Before* | *424* | *2.6* | *0.67* | | | |

* SD = Standard deviation; Sig. = statistical significance (p ≤ .05)

A separate analysis was performed for each country, and for the Bangladeshi partner universities, independent samples t-tests were conducted to examine differences in SEPSS instrument subscale scores (Table 4). The results indicated significant differences, with large effect sizes (Cohen's d > 0.8) found for the Agree and Arrange subscales, as well as for students' Overall Competence.

**Table 4 –** Pre- and post-intervention differences found in Bangladeshi students

| ***SEPSS subscales*** | ***Assessment*** | ***n*** | ***Mean*** | ***SD*** | ***Sig.*** | ***Cohen's d*** | ***Effect-size r*** |
|---|---|---|---|---|---|---|---|
| ***Assess*** | *After* | *242* | *3.17* | *.54* | ***.000*** | *0.73* | *0.34* |
| | *Before* | *244* | *2.66* | *.82* | | | |
| ***Advise*** | *After* | *242* | *3.15* | *.49* | ***.000*** | *0.72* | *0.34* |
| | *Before* | *244* | *2.69* | *.76* | | | |
| ***Agree*** | *After* | *242* | *3.20* | *.49* | ***.000*** | *0.91* | *0.42* |
| | *Before* | *244* | *2.61* | *.77* | | | |
| ***Assist*** | *After* | *242* | *3.16* | *.51* | ***.000*** | *0.68* | *0.32* |
| | *Before* | *244* | *2.73* | *.74* | | | |
| ***Arrange*** | *After* | *242* | *3.17* | *.53* | ***.000*** | *0.90* | *0.41* |
| | *Before* | *244* | *2.53* | *.85* | | | |
| | *After* | *242* | *3.21* | *.53* | ***.000*** | *0.83* | *0.38* |

| | | | | |
|---|---|---|---|---|
| ***Overall competence*** | *Before* | *244* | *2.66* | *.77* |

* SD = Standard deviation; Sig. = statistical significance (p ≤ .05)

In Vietnam's partner universities, statistically significant differences were found between T0 and T1, with an increase in students' average scores for all SEPSS subscales (Table 5). The effect size, as measured by Cohen's d, indicated a small effect for all differences found.

**Table 5 –** Pre- and post-intervention differences found in Vietnamese nursing students

| *SEPSS subscales* | *Assessment* | *n* | *Mean* | *SD* | *Sig.* | *Cohen's d* | *Effect-size r* |
|---|---|---|---|---|---|---|---|
| ***Assess*** | *After* | *94* | *2.61* | *.43* | ***.000*** | *0.20* | *0.10* |
| | *Before* | *180* | *2.52* | *.45* | | | |
| ***Advise*** | *After* | *94* | *2.75* | *.46* | ***.000*** | *0.23* | *0.11* |
| | *Before* | *180* | *2.64* | *.51* | | | |
| ***Agree*** | *After* | *94* | *2.67* | *.44* | ***.000*** | *0.31* | *0.15* |
| | *Before* | *180* | *2.52* | *.53* | | | |
| ***Assist*** | *After* | *94* | *2.72* | *.48* | ***.000*** | *0.24* | *0.12* |
| | *Before* | *180* | *2.60* | *.52* | | | |
| ***Arrange*** | *After* | *94* | *2.65* | *.42* | ***.000*** | *0.22* | *0.11* |
| | *Before* | *180* | *2.54* | *.55* | | | |
| ***Overall competence*** | *After* | *94* | *2.64* | *.37* | ***.000*** | *0.18* | *0.09* |
| | *Before* | *180* | *2.56* | *.52* | | | |

* SD = Standard deviation; Sig. = statistical significance (p ≤ .05)

At T0 and T1, students were requested to indicate their current satisfaction with their nursing or medical course. Following the educational intervention, a significant increase in overall students' satisfaction was observed (Z = 18.47; $p$ = .017). This result was further confirmed when examining data specifically for nursing (Z = 8.015; $p$ < .01) and medical students (Z = .131; $p$ = .001).

## 4. DISCUSSION

To our knowledge, this is the first study conducted in both countries on this topic. Our educational intervention shares some similarities with a study conducted by Maini et al. in England [18] and Wuyts et al. [19] in Belgium. In the study by Maini et al. [18], 48 third-year medical students participated in four half-day campus-based small group sessions on coaching over four consecutive weeks. While some initial teaching and learning methods were similar, such as interactive learning, group discussions, and role-playing between students, the authors encouraged students to use their coaching skills during primary care clinical placements with patients. On the other hand, the INTENSS training intervention proposed by Wuyts et al. [19] consisted of a basic training module and a video-interaction guidance module. The DigiCare project intervention combines two approaches by incorporating group discussions and instructional materials (in both text and video formats). However, unlike in Maini et al. [16], the practical assignments

were conducted by the students with their relatives to create a “safe” training environment for their initial attempts as health coaches. This approach enables students to build confidence and competence in their skills before implementing them in real-world clinical settings.

Statistically significant differences were found at T1, with students evidencing higher average scores across the different subscales of the SEPSS instrument. In both countries, the students’ scores on the different subscales of the SEPSS were above the average score of 2.0, indicating a positive perception of their self-efficacy and performance competences in patient self-management support before the intervention.

Interestingly, despite the differences in scores and effect sizes observed between nursing and medical students in Vietnam and Bangladesh, the SEPSS subscale with the highest development was similar. This subscale pertained to the collaborative goal setting (Agree), where nursing and medical students work with patients to achieve a consensus on the goals to aim for. To do so, students must help the patient identify earlier positive experiences with achieving past health goals and develop a joint plan of action [12,20]. The patient’s priorities must be considered, with support from healthcare professionals in making decisions about treatment options. The established goals and agreements must then be documented in the patient’s record to ensure care continuity [12,20].

Previous studies have suggested that clinical coaching training in nursing and medical education is a disruptive approach to self-management support compared to traditional training [6,8,9]. In the study by Maini et al. [18], medical students perceived clinical coaching training as a positive addition to their traditional training, describing it as a meaningful contribution to patient care. They reported changes in their mindset to a non-judgmental and solution-oriented approach, and the development of skills such as self-reflection, active listening, and person-centered communication [18]. Although these educational approaches are well-perceived by students, there are contextual tension factors that affect their implementation during clinical placements, including lack of time, traditional learning and teaching experiences conducted by tutors [21], and patients’ expectations when they approach healthcare professionals about their NCDs.

Our findings indicate that it is crucial to focus on developing nursing and medical students’ competencies in collaborative goal setting, shared decision making, and organizing follow-up care. We observed that Bangladeshi students had lower self-assessed efficacy and performance in the Assist subscale, whereas Vietnamese students scored lowest in the Assess subscale. The Assess phase requires students to explore patients’ beliefs and motivation about living with chronic conditions and personalize the support provided [20,22]. In the Assist phase, students need competencies to help patients adapt their daily activities, monitor their health and progress, and encourage them to seek professional help when necessary [20,22]. Interestingly, these results differ somewhat from those of previous studies with nursing students and nurses from Europe, which found that the most room for improvement was associated with competencies explored in the Agree and Arrange subscales [23,24].

Nonetheless, the implemented educational intervention has the potential to enhance students’ competencies in clinical coaching and enable them to provide patient-centered self-management support to patients with NCDs. The low-cost approach to both theoretical and practical classes make this intervention a potentially valuable addition to the current nursing and medical curriculum in both Bangladesh and Vietnam.

Nevertheless, our findings must be analyzed considering the study’s limitations. Although the sample size was adequate for an exploratory study, the recruitment did not consider potential variations in students’ perceived competence as they progressed through the course. Therefore, future studies should stratify the sample according to degree background and course year to better explore the intervention’s potential benefits based on

the students' development phase. Such experimental studies must ensure true randomization and the existence of a passive control group. Another potential limitation is the heterogeneity of teaching and learning opportunities and environments across the six partner universities in Vietnam and Bangladesh. Although the medical and nursing curriculum in both countries follows national regulations in terms of structure and content, active learning environments transcend the curriculum, and other non-controlled variables may have influenced students' perceptions of their self-efficacy and performance in this field. Likewise, although the involved teaching staff had the opportunity to immerse themselves in the DigiCare educational intervention during a full year of piloting and iterations, potential variations in teaching style may have influenced study outcomes locally. Finally, although our findings showed positive results in terms of self-management support competence and course satisfaction, future studies should explore how the developed educational intervention can impact students' perceptions of their leadership skills, role independence, and career perspectives [21].

## 5. CONCLUSIONS

The results suggest that a structured educational intervention can enhance the competence of nursing and medical students in clinical coaching. The post-intervention scores showed a significant increase across various domains of self-management support, as perceived by the students in terms of both self-efficacy and performance. However, future studies with control groups and longer follow-up periods are necessary to determine the effectiveness of this low-cost educational intervention.

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## PROCEDIMENTOS ÉTICOS

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