Training of Healthcare Workers in the Care of Non-communicable Diseases: a Systematic Review on Quality and Clinical Practice Impacts

Formação de Trabalhadores da Saúde no Cuidado Às Doenças Não Transmissíveis: Uma Revisão Sistemática Sobre Qualidade e Impactos na Prática Clínica

Formación de Trabajadores de la Salud en el Cuidado de Enfermedades no Transmisibles: Una Revisión Sistemática Sobre Calidad y Impactos en la Práctica Clínica

RESUMO

Objetivo: Desenvolver uma revisão sistemática sobre a característica da força de trabalho no sistema de saúde nacional, focada no treinamento sobre doenças não transmissíveis e na qualidade do cuidado às pessoas com essas condições. **Método:** Utilizou-se a sigla PEO: P para População (trabalhadores da saúde que atendem pessoas com doenças não transmissíveis), E para Exposição (treinamento dos trabalhadores) e O para Resultado (qualidade do cuidado). A pesquisa foi realizada em cinco bases de dados: Embase, PubMed/Medline, LILACS, Scopus e Web of Science. Estudos descritivos que relataram treinamento e resultados obtidos foram incluídos. **Resultados:** Os estudos foram avaliados pela diferença média com desvio padrão, diferença média e frequências absolutas e relativas em escalas Likert ou questionários. **Conclusão:** Métodos de treinamento, cuidados com doenças não transmissíveis e escalas de medição apresentaram ampla variação. Todos os estudos indicaram melhorias nas habilidades de saúde no cuidado com doenças não transmissíveis**.**

DESCRITORES: Doenças não transmissíveis; Saúde pública; Revisão; Recursos humanos; Revisão sistemática; Prática clínica baseada em evidências.

ABSTRACT

Objective: To develop a systematic review of the characteristics of the workforce in the national health system, focusing on training on non-communicable diseases and the quality of care for people with these conditions. **Method:** The acronym PEO was used: P for Population (health workers who care for people with non-communicable diseases), E for Exposure (worker training) and O for Outcome (quality of care). The search was conducted in five databases: Embase, PubMed/Medline, LILACS, Scopus and Web of Science. Descriptive studies that reported training and results obtained were included. **Results:** The studies were evaluated by mean difference with standard deviation, mean difference and absolute and relative frequencies on Likert scales or questionnaires. **Conclusion:** Training methods, care for non-communicable diseases and measurement scales showed wide variation. All studies indicated improvements in health skills in the care of non-communicable diseases.

DESCRIPTORS: Non-communicable diseases; Public health; Review; Human resources; Systematic review; Evidence-based clinical practice.

RESUMEN

Objetivo: Desarrollar una revisión sistemática sobre las características de la fuerza laboral en el sistema de salud nacional, centrada en la formación sobre enfermedades no transmisibles y en la calidad de la atención a las personas con estas condiciones. **Método:** Se utilizó el acrónimo PEO: P para Población (trabajadores de la salud que atienden a personas con enfermedades no transmisibles), E para Exposición (entrenamiento de los trabajadores) y O para Resultado (calidad de la atención). La investigación se realizó en cinco bases de datos: Embase, PubMed/Medline, LILACS, Scopus y Web of Science. Se incluyeron estudios descriptivos que informaron sobre el entrenamiento y los resultados obtenidos. **Resultados:** Los estudios fueron evaluados mediante la diferencia media con desviación estándar, la diferencia media y las frecuencias absolutas y relativas en escalas Likert o cuestionarios. **Conclusión:** Los métodos de formación, el cuidado de las enfermedades no transmisibles y las escalas de medición mostraron una amplia variación. Todos los estudios indicaron mejoras en las habilidades de salud en el cuidado de las enfermedades no transmisibles.

DESCRIPTORES: Enfermedades no transmisibles; Salud pública; Revisión; Recursos humanos; Revisión sistemática; Práctica clí-

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INTRODUCTION

Chronic non-communicable diseases (NCDs) include cardiovascular disease (CVD), diabetes, cancer, mental illness and chronic respiratory diseases. Risk factors for these health problems include tobacco use, unhealthy diets, sedentary lifestyle and alcoholism. The social and economic consequences of NCDs are felt in all countries, especially in the most vulnerable populations.

According to the World Health Organization (WHO), NCDs account for 74% of all deaths globally. [1] Of all NCD deaths, 77% occur in low- and middle-income countries [1], representing a high socioeconomic cost, and causing disabilities and premature deaths. [2]

Primary health care providers can contribute to the prevention and management of NCDs in communities by improving medication adherence and identifying related risk factors through health services. [2] Identification, screening and treatment of NCDs, as well as palliative care, are key components of the NCD response. [1]

However, the management of NCDs faces major challenges, such as limited health funding, scarcity of local data/evidence, and heterogeneity in access to services and delivery of care. These challenges are compounded by two significant and often underestimated obstacles: limited human capacity and lack of leadership. [3]

> “Employee training can improve implementation research capacity and leadership skills in the public health workforce. [3]”

Programs focused on the prevention, screening, diagnosis and management of hypertension, diabetes, cardiovascular diseases and cancer are necessary for countries to provide

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health services with adequate quantity and quality to the population, especially the most vulnerable populations. Therefore, this study aimed to develop a systematic review to size the health system workforce at the national level, focusing on training on NCDs and the quality of care for people with these conditions.

METHOD

This is a qualitative study. This study adhered to the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) and its protocol was registered with the International Prospective Register of Systematic Reviews (PROSPERO) under number CRD408154.

The acronym PEO, from the English Population, Exposure and Outcomes, can be translated respectively as Population, Exposure and Results [4] was used to formulate the main question and to define the eligibility criteria for this systematic review, where: (P) corresponds to Health workers who care for people with chronic non-communicable diseases (NCDs); (E) corresponds to Worker training; and (O) corresponds to Quality of care for people with NCDs.

Descriptive studies that reported the training of health workers for NCDs and the results obtained were included. No restriction criteria were applied regarding language or publication time. The exclusion criteria were studies with people with NCDs, studies with animals, or in vitro, evaluation of different outcomes, unavailable full texts (even after contacting the author or the journal), as well as reviews, conference abstracts, case series, in vitro studies and books.

The Information Sources and Search Strategy were conducted through an online search conducted on March 9, 2023, in five databases: Embase, PubMed/Medline, LILACS, Scopus, and Web of Science. Gray literature was also searched in Google Scholar, ProQuest Dissertation and Theses, and OpenGrey.

The EndNote X9 reference management software (Thomson Reuters) was used to collect references and exclude duplicates. Rayyan software (Qatar Computing Research Institute) was used to assess the titles and abstracts according to the eligibility criteria. All search strategies used are presented (see Appendix A1).

In the selection process, two independent reviewers (K.D. and L.R.H.) conducted a two-phase selection process. In phase 1, the titles and abstracts were assessed according to the eligibility criteria. In phase 2, the same reviewers applied the eligibility criteria after reading the remaining studies in full.

In the data collection process, pertinent data from the included studies were extracted by two independent reviewers (K.D. and L.R.H.) using a pre-tested form and subsequently reviewed by consensus to ensure the integrity of the collected information. The following information was extracted from the included studies: authors, country and year of publication, study location, sample size, specialty of health workers, gender, age range, mean age, training method, NCD care, follow-up period, parameters used to measure training outcomes, improvements, statistical analysis, and conclusions.

The methodological quality of individual studies was assessed using the Joanna Briggs Institute checklist for critical appraisal of qualitative studies. [5] Studies with "yes" answers to all items on the list were classified as having good methodological quality; those with at least one "uncertain" answer were classified as having moderate methodological quality; and those with at least one "no" answer were classified as having low methodological quality. Figure 4 was generated using the robvis software, Risk-of-bias VISualization. [6]

There was also an assessment of effect measures and synthesis methods, in which the results of health worker training on the quality of care for people with NCDs were described based on the parameters of the studies. Mean differences with standard deviations were used for continuous variables to assess the synthesis measures. For descriptive data, service goals (objectives defined by public health policies or by the training institution) were analyzed. A quantitative analysis of the impact of training for health workers on the care of patients with NCDs was planned; however, it was not possible due to high heterogeneity. A qualitative analysis of the studies that measured the quality of care after training was performed and, as a secondary outcome, a descriptive synthesis of the types of training found in the included studies was made.

RESULT

Study selection

Of a total of 174 studies identified in the database searches, 109 remained after duplicates were removed. After the first selection phase in which titles and abstracts were read, 24 studies were read in full in the second phase. Subsequently, 19 studies were excluded (see justifications in Appendix A2). Two studies [7,8] were included from the gray literature, totaling seven studies [2,3,7-11] included for narrative synthesis. No studies were included through manual search or expert recommendations, since all had already been selected in the second phase list. All stages of study selection are described in Figure 1.

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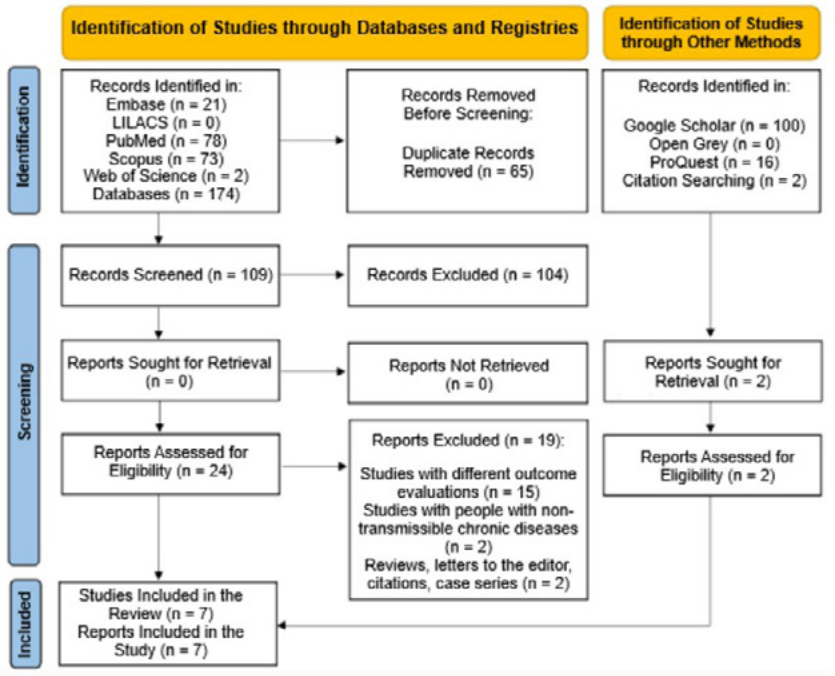
Figure 1. Flowchart of literature searches and selection criteria (adapted from preferred reporting items for systematic reviews and meta-analyses).

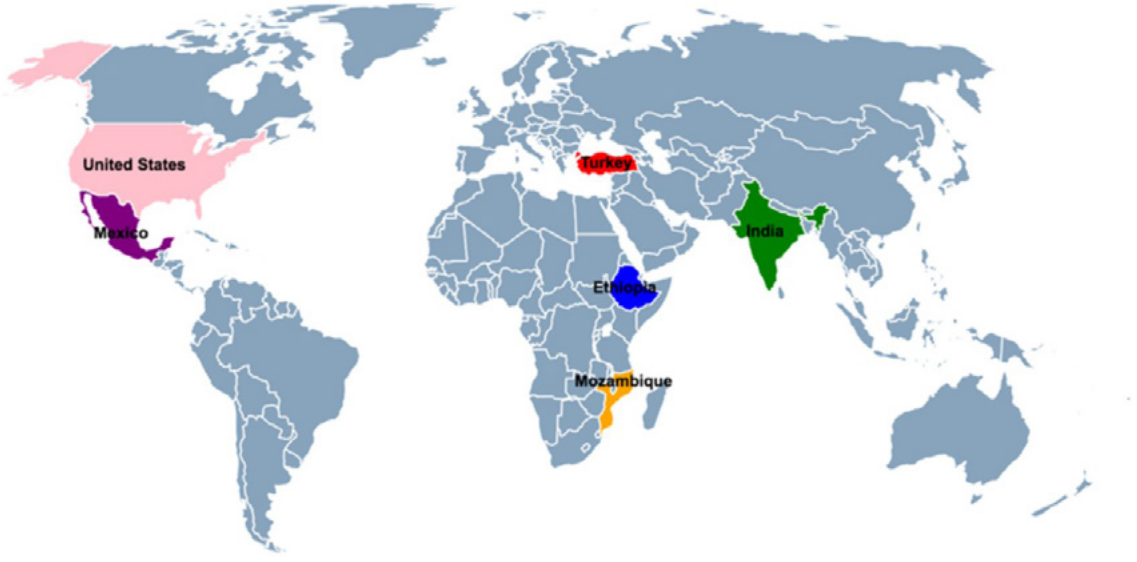


Study Characteristics

Among the 7 studies included, the sample ranged from 4 [9] to 6161[2], and only three studies [2,3,11] reported the age of the participants, which ranged from 16 to 76 years. [11] The area of training of the health professionals varied between the studies; they were pharmacists [2,7], pediatric hematologists or/and medical oncologists [9], ophthalmic assistants, paramedics, ophthalmologists, residents, nurses, indigenous health nurses or diabetes specialists [7], Other studies have reported how medical professionals or managers who worked with the NCD program [8], or just as health professionals [10], NCD professionals [3], nursing health professionals [11] or community health with an emphasis on health promotion. [11]

In total, the studies included 9,357 individuals. They were published between 2014 [11] and 2022[2,8,10], and were conducted in Ethiopia [9], India [3,7,8], Mexico[3], Mozambique[10], Turkey [2] and United States. [3]

Figure 2. Representative model of geographic location of included studies.



Participants received training in different types of NCDs, including asthma [2], COPD (Chronic Obstructive Pulmonary Disease) [2], hypertension [2,8,10], diabetes [2,7,8,10], cardiovascular diseases [8], cancer [8,9,11] and pediatric blood disorders [9], in addition, one study did not specify the type of NCD addressed. Detailed information about each included study is presented in Table 1.

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Tabela 1. Características descritivas dos estudos incluídos (n = 7)

Author(s), year, country	Configuration Healthcare workers N (m/f) Mean age (SD or range)	Training	NCD care (n) Follow-up	Tools / Parameters / Scale	Improvements	Statistical analysis	Conclusions
Apikoglu, S. et al (2022), Turkey	Community pharmacies Pharmaceutical care 6161 (1848/4313) 42.9 (11.35)	Phase 1 – training Continuing professional development approach. (1) core practitioner teams; (2) online accessible portal; (3) peer training process. Phase 2 – implementation of learning.	Asthma (313) COPD (147) Diabetes (277) Hypertension (254) Two visits - mean (SD) number of days between visits Asthma care 70.5 (74.35) COPD 57.6 (52.90) Diabetes 81.2 (94.22) Hypertension 65.2 (62.09)	The evaluation of the program was based on the assessment of patient clinical outcomes. The impact of the pharmacist's contribution was assessed by testing the significance of the improvement in clinical and allied parameters. Peak flow rate (L/min) Asthma control test COPD assessment test Inhaler technique Weekly rescue medication requirement Pharmacy blood glucose (mg/dL) Fasting blood glucose (mg/dL) HbA1c (%) LDL cholesterol (mg/dL) Systolic BP (mmHg) Diastolic BP (mmHg) Medication adherence score Insulin injection or BP measurement technique Medication knowledge score	Asthma care All investigated parameters improved after pharmacist intervention. COPD care All investigated parameters improved after pharmacist intervention. Diabetes care The following parameters improved after pharmacist intervention: pharmacy-measured blood glucose (mg/dL), fasting blood glucose (mg/dL), HbA1c (%), LDL (mg/dL), insulin injection technique and patient medication knowledge scores. The rate of patients achieving the glycemic target increased from 19 to 44% after pharmacist intervention. However, systolic and diastolic BP and medication adherence were not affected by pharmacist input. Hypertension care Systolic BP (mmHg), medication adherence, medication knowledge and BP measurement technique scores improved significantly after pharmacist intervention. The rate of patients achieving BP goal increased (33%/51%–40%/75%, respectively) after pharmacist intervention. Blood glucose (mg/dL), diastolic BP (mmHg), and LDL levels were unaffected by pharmacist input.	Asthma care Asthma treatment peak flow rates 286.1±122.57 vs. 310.8±127.44 (p<0.001). Inhaler technique scores 3.7±1.66 vs. 4.7±1.46 (p=0.025). Weekly reliever medication requirement 6.69±16.9 vs. 4.85±15.09 (p<0.001). Asthma control test score 19.58±5.68 vs. 20.89±5.82 (p<0.001). COPD Care COPD Treatment Inhaler Technique Scores 3.9 ± 1.68 vs. 5.3±1.07 (p=0.001). Weekly Reliever Medication Requirement 8.15 ± 18.79 vs. 5.17 ± 10.39 (p<0.001). COPD Assessment Test Score 19.50 ± 8.14 vs. 17.87 ± 7.63 (p<0.001). Diabetes Care Blood Glucose (mg/dL) 208.6 ± 90.16 vs. 185.2 ± 80.60 (p=0.008). Fasting blood glucose (mg/dL) 173.2 ± 63.70 vs. 140.3 ± 44.10 (p<0.001). HbA1c (%) 8.8 ± 2.12 vs. 7.5 ± 1.82 (p=0.001). LDL (mg/dL) 131.1 ± 46.13 vs. 122.5 ± 43.70 (p=0.039). Insulin injection technique 7.4 ± 2.43 vs. 8.7 ± 2.38 (p<0.001). Medication knowledge scores 4.8 ± 1.27 vs. 5.2±1.38 (p=0.021). Systolic BP levels 135.0 ± 19.12 vs. 133.5 ± 17.92 (p=0.241). Diastolic BP 79.6 ± 10.73 vs. 79.3 ± 11.04 (p=0.739). Medication adherence scores 2.1 ± 1.39 vs. 2.1 ± 1.12 (p=0.925). Hypertension care Systolic BP levels (mmHg) 139.7 ± 24.14 vs. 136.3 ± 21.42 (p=0.008).	Community pharmacists can help improve health outcomes for patients with asthma, COPD, diabetes, and hypertension by combining a continuous professional development approach to learning and delivering pharmaceutical care services.

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						Medication adherence 0.5 ± 0.97 vs. 0.3 ± 0.72 (p<0.001). Knowledge about medication 4.8 ± 1.41 vs. 5.0 ± 1.29 (p=0.030). BP measurement technique scores 3.3 ± 2.16 vs. 4.4 ± 1.53 (p<0.001). Glycemia (mg/dL) 167.4±76.88 vs. 189.1±77.73 (p=0.064). Diastolic BP (mmHg) 81.5 ± 13.12 vs. 80.5±12.43 (p=0.273). LDL (mg/dL) 146.2±49.37 vs. 121.1±29.63 (p=0.061).	
Galaviz, KI et al (2016), USA, Mexico and India	Emory University, National Institute of Public Health, and Public Health Foundation of India NCD Professionals 67 (36/31) 38.7 (NR)	The NCD Public Health Leadership and Implementation Academy is based on a two-month preparatory course period, a three-week summer course at Emory University (the academy with module 1 – public health methods and analytical skills; module 2 – implementation research and evidence-based public health skills; module 3 – public health leadership and leadership competencies), and a nine-month project phase with in-country mentoring	NR 5 years	Annual self-reported information on accomplishments (e.g., job promotion and career advancement); Outputs (e.g., publications, project scaling up or expansion, additional funding obtained) associated with program participation	49 projects focused on implementing programs and policies that address NCDs have been completed or are ongoing; 20 manuscripts for publication (13 India/7 Mexico); 4 abstracts for conference presentations (1 India/3 Mexico); New research proposals based on existing projects (3 India/3 Mexico)..	NA	The NCD Public Health Leadership and Implementation Academy has an impact in low- and middle-income countries in terms of the ability of trainees to successfully manage and mentor their teams and projects and the quality of the research projects they undertake to address NCDs.

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Hailu, D. et al (2020), Ethiopia	Tikur Anbessa Specialist Hospital in Ethiopia; Jimma University Medical Center in Ethiopia; and Tata Memorial Hospital in India. Pediatric Hematologist/ Oncologists 4 (NR) NR	Pediatric hematology-oncology fellowship program led by the Asian Project. Consistent teaching and clinical training from external Pediatric Hematologist/ Oncologist specialists through on-site faculty visits. Experiential training blocks included 18 months of Pediatric Hematologist/ Oncologist service in Ethiopia with inpatient, outpatient, and consultancy responsibilities. Fellows sponsored for a 6-month internship at a high-performing cancer institution in a middle-income country.	Pediatric Blood Disease and Cancer (NR) 2 years	Written evaluation evaluating fellow(s) based on performance, skill level, attendance, and other measures. Fellow's personal portfolios, case logs, or mini-clinical encounters. A multiple-choice midterm exam was administered in the first year of training. At the end of the 2-year program, a final qualifying exam was held, with practical, written, hematopathological, and clinical skills components.	Four physicians completed pediatric hematology/oncology fellowship training in Ethiopia.	NR	With a focus on physician training for pediatric hematologists/ oncologists in Ethiopia, a training framework and curriculum was developed to: (a) teach resource-appropriate medical care, (b) provide sustained clinical mentorship, (c) develop leadership skills in the health system, and (d) retain physicians to work in local pediatric oncology units.
Harris, P. et al (2022), Mozambique.	National Institute of Health of Mozambique and Primary Care International in the United Kingdom. Mavalane General Hospital. Health professionals 60 (9/51) NR	Hypertension and Associated Risk Factors Management Program. Phase 1 – Multidisciplinary stakeholder team. Establishment and assessment of facility needs. Phase 2 – Adaptation of international primary care evidence-based guidelines and training materials. Phase 3 – Training of local trainer team and cascade training of trainers. Trainee Cohort 1: International primary care trainers (5 days). Trainee Cohort 2: Local trainers (3 days). Trainee Cohort 3: Local trainers (3 days).	Hypertension and Diabetes Mellitus (NR) 18 months	The questionnaire included 10 multiple-choice questions related to clinical knowledge of hypertension, diabetes mellitus and their cardiovascular complications. Pre- and post-course clinical skill confidence in diabetic foot examination and smoking cessation counseling was measured using a 5-point Likert scale (1 – not confident, 5 – very confident). A detailed end-of-course evaluation questionnaire was completed confidentially by participants in training workshops. An anonymous feedback survey was obtained from new local trainers using written questionnaires, using a 5-point Likert scale.	Trainee cohort 1: n=23 (11 passed). Pre- and post-test scores: 53% to 90%. Diabetic foot examination: 3.4 to 4.4. Smoking cessation counseling: 3.3 to 4.0. Trainee cohort 2: n=18 (7 passed). Pre- and post-test scores: 59% to 78%. Diabetic Foot Exam: 3.1 to 4.3. Smoking Cessation Counseling: 3.1 to 4.3. On average, participants rated the course 9.7 out of 10. Trainee Cohort 3: n=19 (7 passed). Pre- and post-test scores: 58% to 74%. Diabetic Foot Exam: 2.6 to 4.6. Smoking Cessation Counseling: 3.1 to 4.4. On average, participants rated the course 9.6 out of 10. Ten local instructors confidentially reported that they enjoyed the training program very much (mean Likert scale 4.9/5) and felt that they met their learning objectives (mean Likert scale 4.6/5). All respondents felt they were more confident as trainers, with confidence levels in training improving from a mean Likert scale of 3/5 pre-training to 4.8/5 post-training.	NA	This specific interprofessional training model was successful in cascading knowledge and skills acquisition, and in establishing the initial cohort of trainers of trainers to scale up hypertension, diabetes mellitus, and cardiovascular disease risk management to frontline non-physician healthcare professionals across the country. Intensive on-site supervision and hands-on training empowered a new cohort of trainers to strengthen cardiovascular disease prevention and control..

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Keating, LN et al (2014), Mexico	Civil society organization Tómatelo a Pecho AC; Mexican Health Foundation; National Institute of Public Health of Mexico; Seguro Popular and State Ministries of Health of Jalisco and Nuevo León. Group 1: Professional health promoters (with nursing training) 195 (169 completed) 36 (20-61) NR Group 2: Community health promoters with basic training in health promotion 3170 (2651 completed) 38 (16-76)	Training-of-trainers program Professional health promoters participated in a 40-hour competency-based training program that combined an 8-hour, 1-day in-person training session (phase I) with an additional 32 hours of online training (phase II). Professional health promoters were required to lead a 10-hour course or internship for at least two groups of community health promoters, training 10 to 25 community health promoters in total (phase III).	Breast cancer risk factors. 3m, 6m	43-item survey. Round 1: Written survey for all professional health promoters prior to phase I training. Round 2: Written survey administered in person during professional health promoter diploma conferral ceremonies. Round 3: 3 to 6 months after round 2 to assess knowledge retention (administered online); Community health promoters were surveyed in person, before (round 1) and immediately after (round 2). A random sample of approximately 15% of community health promoters was surveyed again (round 3) in person 3 to 6 months after round 2. For groups of items assessing breast cancer risk factors (10 items), breast cancer signs/ symptoms (12 items), and individuals with a positive family history (9 items), the number of correct responses was summed to create a risk factor score (range, 0–10), symptom score (range, 0–12), and family history score (range, 0–9). Pre- and post-training survey responses were compared using paired t-tests for scales and chi-square tests for individual items to determine whether the training increased breast cancer knowledge (comparing post-training with pre-training) and whether knowledge was maintained after 3 to 6 months (comparing 3- to 6-month survey with pre- and post-training).	Group 1: Training was associated with a significant increase in the proportion who identified breast cancer as a leading cause of death for women aged 30–54 in Mexico (86% vs. 99%, p < 0.001), indicated that routine mammograms should begin at age 40 or 50 for women with no family history (83% vs. 99%, p < 0.001), reported that clinical breast examinations should be performed annually (76% vs. 93%, p < 0.001), and understood that Seguro Popular covers breast cancer treatment (85% vs. 100%, p < 0.001). Training was associated with significant increases in risk factor, symptom, and family history scores. Values for the three composite scores after training and at 3- to 6-month follow-up were significantly higher than at baseline, and scores at the 3- to 6-month assessment did not differ from scores at the post-training assessment. Group 2: Training was associated with a significant increase in the number of individuals who identified breast cancer as a leading cause of death for women aged 30 to 54 in Mexico (88% vs. 95%, p < 0.001), indicated that routine mammograms should be initiated at age 40 or 50 (51% vs. 82%, p < 0.001), and were aware that Seguro Popular covers breast cancer treatment (61% vs. 92%, p < 0.001). Post-training scores were significantly higher than baseline for the risk factor score, symptom score, and family history score. Values for the three composite scores at the 3- to 6-month follow-up were significantly higher than at baseline and did not differ from the post-training assessment.	Group 1 Baseline – post-training (n=164) Risk factor Mean (7.0–8.2 of 10), p<0.001 Symptom score Mean (10.2–11.6 of 12), p<0.001 Family history scores Mean (7.7–8.1 of 9), p=0.04 Baseline/Post-training - 3m and 6m follow-up (n=104): Risk factor p<0.05/ p>0.48 Symptom score p<0.05/ p>0.48 Family history scores p<0.05/ p>0.48 Group 2 Baseline – post-training (n=2651) Risk Factor p<0.001 Symptom Score p<0.001 Family History Scores p<0.04 Baseline/Post-Training - 3m and 6m Follow-up (n=364): Risk Factor p<0.001/ p>0.12 Symptom Score p<0.001/ p>0.12 Family History Scores p<0.001/ p>0.12	Our findings demonstrate that even with relatively low levels of formal education, health promoters can be trained to understand the complexities of breast cancer, which are essential for early detection and encouraging women to seek timely treatment.

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Ramakrishman, R. et al (2020), India.	Tirunelveli Medical College and Hospital, Aravind Eye Hospital - Tirunelveli (mentor institution), government primary health centres and community health centres. Paramedical eye assistant 8 NR Ophthalmologists 41 NR Residents 16 NR Nurses 16 NR Sector health nurse, village health nurse or pharmacist 101 NR Doctor/ diabetologist 16 NR	training days for NCD staff at Aravind Eye Hospital, Tirunelveli, diabetic retinopathy screening, counselling, referral and follow-up duties were included in the scope of NCD nurses in primary health centres and community health centres. A 2-month structured training was provided to government ophthalmologists on laser treatment of diabetic retinopathy. The Public Health Foundation of India's "Certificate Course in Evidence-Based Management of Diabetic Retinopathy" programme was conducted for general practitioners of community health centres in the mentor institution to understand, identify and refer patients with diabetic retinopathy.	Diabetes (8574) Diabetic retinopathy (581) 3 years	NR	NR	NR	This method of screening, diagnosing and treating diabetic retinopathy is a new development that uses the telemedicine platform.
Ramalingam, A. et al (2022), India.	National Institute of Epidemiology, Indian Council of Medical Research, Chennai and National Centres for Disease Control, India Advanced group: Medical professionals 5 in 2018 (2 completed) NR 8 in 2019 NR 15 in 2021 (ongoing) NR Intermediate group: Program managers who have worked with the NCD program 22 NR	Field Epidemiology Training Programs There were 2 levels: Advanced (2 years) started in 2018 and Intermediate (1 year) started in 2021. The 2 levels were started keeping in mind the different training needs of public health professionals working in leadership positions and those working as mid-level managers. Advanced admits a maximum of 15 candidates each year and Intermediate admits 25 candidates. Advanced (2 years): Classroom training (12–14 weeks) and field posting (72–74 weeks). Intermediate (1 year): Classroom training (8–10 weeks) and field posting (38–40 weeks) The mode of training was face-to-face workshop sessions, webinars and small group training at field posting locations	Hypertension (NR) Diabetes (NR) Cardiovascular disease (NR) Cancer (NR) 3 years	Advanced 1) secondary data analysis of the NCD programme to assess treatment outcomes (BP control status) of patients with hypertension, 2) field investigation to assess reasons for missed visits by patients with hypertension, 3) evaluation of the diabetes programme in Kerala to understand the gaps in programme implementation and 4) an advanced epidemiological study to assess compliance with the hypertension treatment protocol by treating physicians. Intermediate Interns conducted data analysis of the NCD (screening, diagnosis and treatment) programme at the district and state levels, providing critical information on hypertension or diabetes control rates.	Advanced One of the small grant projects focused on assessing physicians' compliance with hypertension treatment protocols in primary and secondary health centers. The study found that nearly three-fifths of physicians' prescriptions adhered to the treatment protocol. The second small grant project focused on the forecasting, procurement process, and availability of protocol-based antihypertensive drugs in public health facilities across 4 states in India between June 2019 and May 2020. The study found that the drug forecasting tool (provided as part of the India Hypertension Control Initiative) helped improve drug availability over time. It also identified a gap in the knowledge of district-level NCD nodal officers on the drug forecasting process, which was subsequently addressed through refresher trainings. The bridge program is ongoing.	NR	The Advanced Program is required to develop qualified public health leaders at the national, regional, and state levels. The Intermediate program is scalable, can be incorporated into state health systems, and is best suited to the competency needs of the public health workforce at the state and district levels.

Abreviações: a, ano; DCNTs, Doenças Crônicas Não Transmissíveis; DPOC, Doença Pulmonar Obstrutiva Crônica; NA, Não Aplicável; NR, Não Relatado; PA, pressão arterial.

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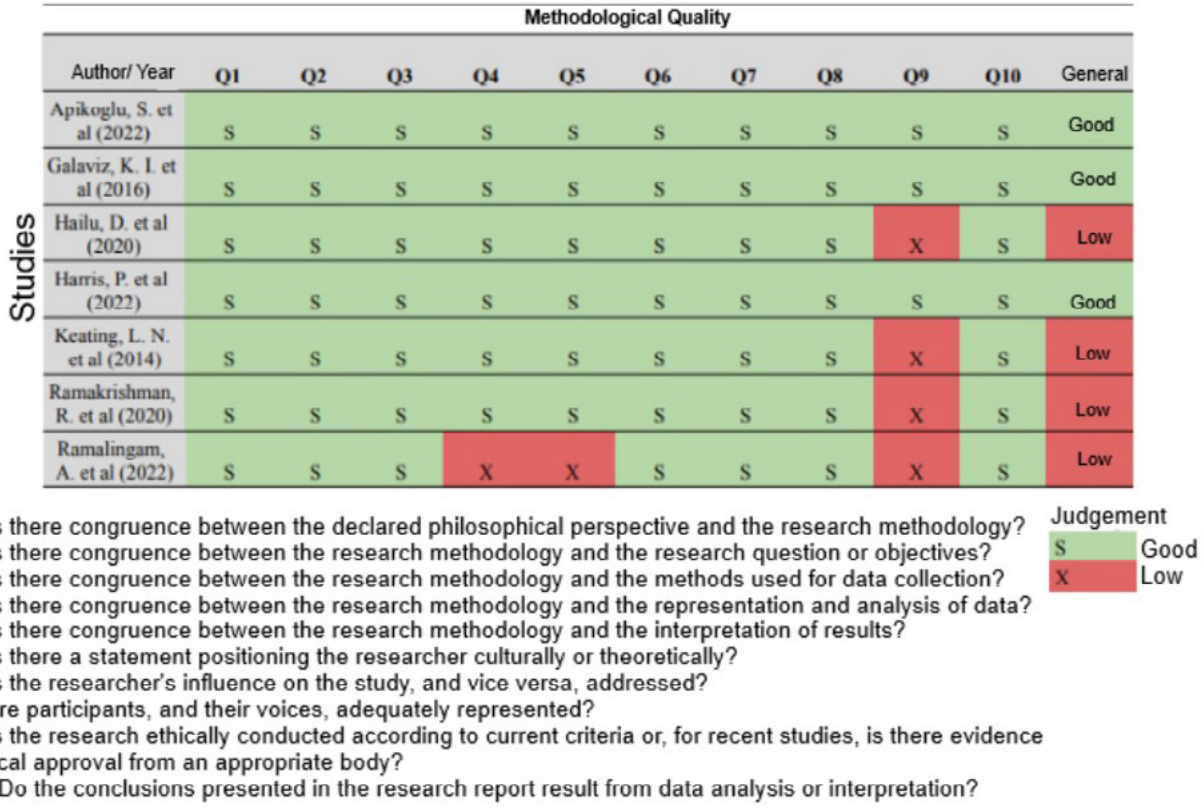
Assessment of the methodological quality of the studies

Among the studies included, four [7-9,11] were classified as having low methodological quality, while three [2,3,10] were considered to have good methodological quality. Question number nine of the checklist, on ethical approval, was determined to have low methodological quality, as some studies did not make it clear whether the study had been approved by the ethics committee. The questions and answers of the checklist for studies (see Appendix A4 and Figure 3) ensured the summary of the assessment of methodological quality.

Figure 3. Summary of methodological quality, assessed by the Cochrane Collaboration's risk of bias tool with the generic data set: authors' judgments for each included study (generated using robvis, risk of bias visualization).



Results of individual studies

Apikoglu et al. [2] evaluated 6,161 pharmacist assistants from community pharmacies in Turkey who received training in the management of asthma, chronic obstructive pulmonary disease (COPD), diabetes, and hypertension. The evaluation of the program was based on the clinical outcomes of the patients. All parameters related to asthma and COPD care improved. For diabetes and hypertension care, most of the measured parameters showed improvement, with only a few without significant change.

Galaviz et al.[8] reported on the training of 67 health professionals in chronic noncommunicable diseases (NCDs) in India. The program was a partnership with institutions in three different countries (USA, Mexico, and India). The NCDs were not specified by the author, and the evaluation method was based on publications and projects associated with participation in the program. Forty-nine projects were completed or are ongoing, twenty manuscripts were published, and four abstracts were presented at conferences.

Hailu et al.[9] published a study of four pediatric hematologists and/or oncologists who received training in pediatric blood disorders and cancer in Ethiopia. The program included a fellowship at a high-performing cancer institution in a middle-income country. Participants were assessed through exams and personal portfolios. All participants completed the training. The author did not provide further details about the written assessment.

Harris et al.[10] evaluated 60 Mozambican health professionals who had received training in hyperten-

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sion and diabetes. The program was a "train-the-trainer" program, in which international trainers provided training to local professionals, who in turn cascaded the training to other health professionals. Participants were assessed using pre- and post-course clinical confidence in their ability to examine the diabetic foot and counsel on smoking cessation. All successful participants (n=25) improved their skills.

Keating et al.[11] reported on breast cancer risk factor training for 169 professional health promoters and 3,170 community health promoters in Mexico. The program followed the "training of trainers" model, and professional health promoters were required to lead courses or practices for at least two groups of community health promoters, training 10 to 25 community promoters in total. Program evaluation was based on responses to questionnaires before and after training. All measured scores improved after the training program and at 3- and 6-month follow-ups.

Ramakrishman et al.[7] published a study of approximately eight paramedical ophthalmic assistants, 41 ophthalmologists, 16 residents, 16 nurses, 101 community health nurses or pharmacists, and 16 diabetologists in India who received training in diabetic retinopathy (DR). The author did not provide details on the evaluation of participants after completion of the program.

Ramalingam et al.[8] evaluated two different groups that received training in hypertension, diabetes, cardiovascular disease, and cancer in India. The advanced group consisted of 25 medical professionals, and the intermediate group included 22 program managers working on NCDs. The program is still ongoing, with fifteen participants in the advanced group. So far, the program results include two small funded projects.

Synthesis Results

Clinical and methodological heterogeneity between studies was considered significant. The training method, NCD care, and scales used to measure training outcomes varied widely between studies. As meta-analysis (MA) was not considered justifiable, a narrative synthesis considering subgroups based on NCD care was performed.

Quality of care for patients with NCDs after training of health workers

The studies were evaluated using mean difference with standard deviation [2], average difference [11] and absolute and relative frequencies of scores assessed by Likert scales or responses to questionnaires. [10,11] A study [2] showed that clinical parameters of patients with asthma, COPD, diabetes and hypertension improved after training of health workers. Two other studies [10,11] also reported that risk management of hypertension, diabetes, and breast cancer improved after training. The values of clinical outcomes before and after training were presented (Table 1).

Type of Formation

Three studies [2,10,11] reported the cascade training model, in which some primary care professionals trained community/local health promoters on NCD management. A study [3] described leadership preparation in the health area for NCDs. Two studies [7,9] focused on training doctors or health workers for a specific NCD, one of which [9] included an international scholarship. Finally, a study [8] reported incomplete training, still in progress, aimed at health professionals in leadership positions and middle managers. Detailed characteristics of the trainings can be found in Appendix A3.

DISCUSSION

Programs targeting the health workforce to improve NCD care and patient outcomes have been implemented in different countries under various names. [12] These programs focused on chronic diseases, mainly hypertension, diabetes, dyslipidemia, asthma and COPD. [12] It is well established that workforce education can have a significant positive impact on clinical, humanistic and economic outcomes. [2,3,7-11] In this study, the workforce for NCD care was dimensioned with a focus on specific NCD training and the quality of care for people with these diseases. This national dimensioning of the health system showed that the training method, NCD care, and the scales used to measure training outcomes were different among the included studies. Furthermore, all studies mentioned improvements in NCD care skills.

However, a significant barrier to global efforts in NCD care has been the shortage and even absence of trained professionals in many low- and middle-income countries, where the majority of patients reside. [9] Thus, most of the training described in the included studies was designed and implemented in these countries.

An interdisciplinary training program on NCDs, developed by Galaviz et al. (2016) [3] and called the Public Health Leadership and Implementation Academy (PH-LEADER), promoted the design and implementation of evidence-based strategies to address NCDs in low- and middle-income countries. The PH-LEADER program lasted one year and had three components: a two-month preparation period; a three-week in-person summer school; and a country-led project phase. The training was targeted at mid-level public health professionals from low- and middle-income countries involved in NCD prevention and control. However, the authors have not yet evaluated the impact of the training on either leadership skills or NCD prevention and control.

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Similarly, in Ethiopia, a training program focused on a curriculum that provided educational and clinical experience within the existing resource-limited pediatric hematology-oncology (PHO) environment was successfully implemented. The training was based on visiting PHO faculty, overseas training attachments, and extraordinary professional initiative. This training in Ethiopia is moving toward sustainability through human resource development and is accelerating the growth of dedicated PHO services where none previously existed. [9]

Harris et al. (2022) [10] also highlighted the urgent need to address this weakness and decentralize NCD care. The lack of preparedness of health workers to manage noncommunicable diseases in peripheral health facilities is a critical challenge for the health system. The authors also described training of the primary care workforce through a global health partnership that provided interprofessional training with good knowledge acquisition and increased self-reported confidence in Mozambique. Intensive local supervision and hands-on training enabled a new group of trainers to strengthen cardiovascular disease prevention and control, which is likely to improve coordination and integration at the primary care level and support national scale-up of NCD care delivery.

Similarly, India has adopted an approach to strengthening the quality of the country's public health systems based on capacity building of the public health workforce through field epidemiology training programs (FETs). The FETPs used the concept of "learning by doing" under mentorship to impart critical epidemiological skills to the frontline public health workforce, equipping them with the skills to conduct field investigations and take appropriate public health actions. As FETP trainees analyze program data, evaluate surveillance systems, and conduct epidemiological investigations, they develop critical thinking and problem-solving skills. Globally, in public health emergencies such as the COVID-19 pandemic and Ebola outbreaks, FETPs have helped build resilient health systems. In 2018, the FETPs had five participants, in 2019, eight, and in 2012, 15 participants. All projects to complete the core learning activities were undertaken in priority areas of the NCD programme in India. [8]

Another author from India developed a project to empower the government health system for effective screening, diagnosis and management of diabetic retinopathy (DR) exclusively. Screening, counseling, referral and follow-up tasks for DR were included in the scope of NCD nurses in Community Health Centers and Primary Health Centers using telemedicine platforms. Through this program, almost 70% of DM patients were screened for DR in rural areas where there are no ophthalmologists or facilities for DR screening. In conclusion, teamwork is necessary for the effective and efficient functioning of this project. [7]

Similarly, in a national practice, community pharmacists could improve health outcomes for patients with asthma, chronic obstructive pulmonary disease, diabetes, and hypertension by providing pharmaceutical care services. [2]

The effectiveness of a train-the-trainer program was evaluated in two Mexican states to improve knowledge among professional and non-professional community health workers. Train-the-trainer programs have great potential to empower community health workers, who outnumber other health professionals in many low- and middle-income countries, to engage in health promotion activities for cancer and other noncommunicable diseases. [11]

Despite rapid expansion, high demand, and initial success, as described in the included studies, all training programs face numerous challenges and there are still many areas for improvement. Lack of support from state health departments due to lack of prioritization of NCDs remains a challenge. The trained workforce is often underutilized (assigned to additional clinical responsibilities rather than public health-related tasks). The lack of defined career paths after program completion discourages candidates from enrolling. Difficulties in balancing work commitments with rigorous training requirements lead to attrition. Identifying, developing, and retaining mentors are major challenges. [2,3,7-11]

Finally, the main limitation of this systematic review was the heterogeneity between the methodology and the results described. The unit of measurement to describe the quality of health care varied widely, as did the scales to measure the training results, making meta-analysis not recommended. Although all programs were focused on low- and middle-income countries, we believe that geographic specificities led each research group to think about their specific territory and design the best program for the reality of the local health system. Therefore, proposing to conduct more homogeneous studies to conduct a meta-analysis does not seem appropriate for this topic.

CONCLUSION

This national health system workforce sizing showed that the training method, care for chronic noncommunicable diseases (NCDs) and the scales used to measure training outcomes were largely different among the included studies. Furthermore, all studies mentioned improving health skills in NCD care.

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DECLARATION OF CONFLICT OF INTEREST

The authors declare that there is no conflict of interest.

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AUTHOR CONTRIBUTIONS

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Writing and/or critical review of the manuscript: FRA, LSEPWC, KLDH, LRH, ACLC, GF, MML.

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