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Vitória Karoline Rodrigues Molica
vitoria.molica@ufv.br
Universidade Federal de Viçosa
Mayra Marcela Ribeiro Simião Jacinto
Universidade Federal de Viçosa
Ana Luiza Paes Mingote
Universidade Federal de Viçosa
Emanuele Louise Gomes de Magalhães Jorge
Universidade Federal de Viçosa
Emily de Souza Ferreira
Universidade Federal de Viçosa
Glauce Dias da Costa
Universidade Federal de Viçosa
Fernanda Maria de Almeida
Universidade Federal de Viçosa
Rosângela Minardi Mitre Cotta
Universidade Federal de Viçosa

Systematic Review

Keywords: Chronic Disease, Patient Care Team, Evaluation Studies as Topic, Public Health Practice, Treatment Outcome

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Vitória Karoline Rodrigues Molica[1]*, Mayra Marcela Ribeiro Simião Jacinto[1], Ana Luiza Paes Mingote[1], Emanuele Louise Gomes de Magalhães Jorge[1], Emily de Souza Ferreira[1], Glauce Dias da Costa[1], Fernanda Maria de Almeida[2] and Rosângela Minardi Mitre Cotta[1].

[1] Department of Nutrition and Health, Universidade Federal de Viçosa (UFV), Viçosa, Minas Gerais, Brazil.

[2] Department of Administration and Accounting, Universidade Federal de Viçosa (UFV), Viçosa, Minas Gerais, Brazil.

*Correspondence: Vitória Karoline Rodrigues Molica, e-mail: vitoria.molica@ufv.br.

ABSTRACT

Background: Interprofessional collaborative practice (ICP), including dietitians, is important for the care of obesity, diabetes and hypertension. However, evidence on the effectiveness of these practices for managing these conditions in adults and older adults is scarce. This study aimed to analyze the effectiveness of ICP involving dietitians in the management of hypertension, diabetes and/or obesity in adults and older adults through a systematic review and meta-analysis.

Methods: A search was conducted in the PubMed/MEDLINE, Embase, LILACS, Scopus, Web of Science and Cochrane Library databases on 28 April 2026, following the PRISMA guidelines. Studies that focused on ICP with dietitian involvement and that assessed glycated hemoglobin (HbA1c), systolic (SBP) and diastolic blood pressure (DBP) and body mass index

(BMI) were included. The meta-analysis was conducted with the randomized controlled trials using Jamovi software. A random-effects model was adopted, and the effect size was expressed as the mean difference with 95% confidence intervals (95% CI). Heterogeneity was assessed using the I^2 statistic. Methodological quality was assessed with the Joanna Briggs Institute critical appraisal tools, and publication bias with funnel plots and Egger's regression test, at a 5% significance level. Risk of bias was assessed with the Cochrane Risk of Bias 2 tool.

Results: Thirty articles were included in the systematic review, of which 10 (1,782 participants) were included in the meta-analysis. Several studies showed positive effects of ICP on the clinical and biochemical outcomes assessed. The meta-analysis showed that ICP reduced HbA1c (−0.58; 95% CI −1.00 to −0.15; p = 0.008) and SBP (−4.99; 95% CI −9.89 to −0.09; p = 0.046), but not BMI (−1.22; 95% CI −2.93 to 0.50; p = 0.164) or DBP (−1.44; 95% CI −4.18 to 1.30; p = 0.303). All outcomes showed high heterogeneity ($I^2 > 75\%$).

Conclusions: ICP showed favorable results in the management of diabetes, hypertension and obesity. The meta-analysis indicated the effectiveness of these interventions in reducing HbA1c and SBP. These findings highlight the relevance of interprofessional work, including dietitians, in the care of chronic diseases.

Systematic review registration: PROSPERO CRD420261369569.

Keywords: Chronic Disease, Patient Care Team, Evaluation Studies as Topic, Public Health Practice, Treatment Outcome.

BACKGROUND

Noncommunicable diseases (NCDs) account for a large share of the global burden of disease (GBD), especially in developing countries [1, 2]. In 2021, an estimated 12.4 billion new cases and 43.8 million deaths were attributed to NCDs, with increasing projections up to 2050

[3]. Raised blood pressure, raised blood glucose, overweight and obesity are the main metabolic risk factors for NCD-related mortality [4].

The American Diabetes Association (ADA) defines diabetes mellitus (DM) as a condition of chronic hyperglycemia, and the diagnostic criteria may be: fasting plasma glucose (8 h) ≥ 126 mg/dL, plasma glucose ≥ 200 mg/dL two hours after an oral glucose tolerance test (75 g), glycated hemoglobin (HbA1c) ≥ 6.5%, or random plasma glucose ≥ 200 mg/dL in patients with classic symptoms of hyperglycemia [5].

Systemic arterial hypertension, in turn, is the main contributor to the GBD, since control rates are low and guidelines adopt different cut-off points for diagnosis [6]. According to the International Society of Hypertension (ISH), hypertension is defined as systolic blood pressure (SBP) ≥ 140 mmHg and/or diastolic blood pressure (DBP) ≥ 90 mmHg on repeated office measurements [7].

According to the World Health Organization (WHO), obesity is diagnosed by a body mass index (BMI) ≥ 30 kg/m². Regarding the epidemiology of the disease, 506 million women and 374 million men were living with obesity in 2022 [8].

People with NCDs require continuous professional follow-up, which allows early detection of complications, adjustment of treatment and support for clinical and managerial decision-making [9, 10]. However, usual care tends to be professional-centered, with different professions working in parallel, little interaction and decisions made in isolation [11]. In this scenario, the management of NCDs requires coordinated, continuous and multiprofessional care, and interprofessional collaborative practice (ICP), understood as the work of multiple health professionals guided by comprehensive care and involving patients, caregivers, families and communities, becomes essential at all levels of care [12].

In addition, diet is one of the main modifiable risk factors in the treatment of hypertension, DM and obesity. In this context, the dietitian is an indispensable member of

multidisciplinary teams, providing nutritional counseling that contributes significantly to the treatment of chronic diseases [4, 13].

Studies that assessed the impact of ICP in the context of chronic diseases, mainly hypertension and DM, have shown positive results; however, the participation of dietitians in these teams has been limited [14–18].

Systematic reviews and meta-analyses on the topic reflect this scenario: they prioritize hypertension and DM and rarely include dietitians. Moreover, in the context of obesity, the literature highlights the role of dietitians in multiprofessional teams but seldom explores the role of ICP itself. These findings underscore the relevance of collaborative care with dietitian participation; however, the evidence remains scattered, as existing reviews address these conditions separately [14, 19–22].

Therefore, this study aimed to analyze, through a systematic review with meta-analysis, the effectiveness of ICP involving dietitians in the management of hypertension, DM and/or obesity in adults and older adults.

METHODS

Study design

This is a systematic review and meta-analysis conducted in accordance with the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) recommendations [23] (Additional file 1) and registered in the International Prospective Register of Systematic Reviews (PROSPERO) under protocol number CRD420261369569. Deviations from the registered protocol were as follows: lipid profile and weight change, initially planned as outcomes, were not analyzed because the review focused on the clinical markers used for the diagnosis of each condition (HbA1c, blood pressure and BMI) and few trials reported lipid outcomes in a comparable way; the JBI critical appraisal tools were added

because the RoB 2 tool applies only to randomized trials and non-randomized studies were also included; and meta-regression was not performed because fewer than ten studies were available per outcome, so heterogeneity was explored through leave-one-out sensitivity analysis and Baujat plots.

The research question was structured using the PICOS strategy (Population, Intervention, Comparator, Outcomes and Study design), as follows: P, adults and older adults diagnosed with hypertension, DM and/or obesity; I, ICP involving dietitians; C, usual care delivered by a single professional, or multiprofessional care without clear evidence of collaboration between professions; O, effectiveness of ICP; and S, randomized controlled trials, cohort studies, case-control studies and quasi-experimental studies.

The guiding question was: *What is the effectiveness of interprofessional collaborative practices involving dietitians in the management of hypertension, diabetes and/or obesity in adults and older adults?*

Search strategy

Controlled terms from the Health Sciences Descriptors (DeCS) and Medical Subject Headings (MeSH) were used in the search strategy, including: Health Personnel, Patient Care Team, Interprofessional Relations, Nutritionists, Hypertension, Diabetes Mellitus, Obesity, Aged, Adult and Aged, 80 and over. To increase the sensitivity of the search, free-text terms frequently used in the literature were also included, such as: health care personnel, Interprofessional Practice, Collaborative Practice, Dietitian and Very Elderly.

After the descriptors were defined, the search was performed by combining the selected terms with the Boolean operators AND and OR to broaden and target the retrieval of relevant studies. The search strategy used was: (("Health Personnel" OR "health care personnel" OR "Interprofessional Practice" OR "Collaborative Practice" OR "Patient Care Team" OR

"Interprofessional Relations") AND (Nutritionists OR dietitian) AND (Hypertension OR "Diabetes Mellitus" OR Obesity) AND (Aged OR Adult OR "Aged, 80 and over" OR "very elderly")) (Additional file 2).

Data sources

The search was conducted on 28 April 2026 in the following electronic databases: Medical Literature Analysis and Retrieval System Online (PubMed/MEDLINE); Excerpta Medica dataBASE (Embase); Latin American and Caribbean Health Sciences Literature (LILACS); Scopus; Web of Science; and Cochrane Library. The same search strategy was applied to all six databases, in all fields, without adaptation to the specific syntax of each database (Additional file 2).

The Rayyan software (Qatar Computing Research Institute, Qatar) was used for study selection. No language or publication date filters were applied at the search stage.

Eligibility criteria

Studies were included if they were conducted with individuals aged 18 years or older diagnosed with hypertension, DM and/or obesity and used ICP with a team composed of at least two different professions, necessarily including a dietitian. Studies that assessed the following clinical and biochemical outcomes of interest were eligible: HbA1c, SBP, DBP and BMI.

Articles were excluded if they assessed individuals with prediabetes or gestational DM; did not involve an interprofessional team; involved an interprofessional team that did not include a dietitian; or used exclusively pharmacological or supplementation protocols. Review articles, conference proceedings, editorials, letters to the editor, case reports and grey literature, including dissertations, theses and unpublished reports, were also excluded.

Study selection

Study selection was performed independently by two reviewers (VKRM and MMRSJ) using the Rayyan software. Titles and abstracts were screened first, followed by the full texts of the studies identified. Disagreements between reviewers were discussed and, when necessary, referred to a third reviewer (ELGMJ) for resolution.

Data extraction

A Microsoft Excel spreadsheet (Microsoft Corp., Redmond, WA, USA) was used to organize the data extracted from the articles included in the systematic review. The following information was collected: title, year of publication, authors, country, year of the study, design, sample size, study duration, sample characteristics, health condition assessed, outcomes assessed, main intervention, results and main conclusions.

To characterize the ICP, information was extracted on the professionals involved, the form of collaboration, the mode of delivery and the setting in which the practice was implemented.

Meta-analysis

The meta-analysis was performed with data from randomized controlled trials that provided sufficient information to calculate the effect size, including means and standard deviations. Studies with a control group but without randomization and single-arm studies were synthesized separately, narratively, considering the differences in risk of bias and the potential for confounding between designs.

The outcomes of interest were the following clinical and biochemical parameters: HbA1c (%), BMI (kg/m²), DBP (mmHg) and SBP (mmHg). The meta-analysis was conducted in Jamovi software (version 2.7.31) using the MAJOR module (Meta-Analysis for Jamovi), which uses the *metafor* package for estimation.

Given the expected heterogeneity across settings, populations and types of intervention, the meta-analysis was conducted using a random-effects model with the restricted maximum likelihood (REML) estimator. The effect size was expressed as the mean difference (intervention − control) with 95% confidence intervals (95% CI). Heterogeneity between studies was assessed using the I^2 statistic, with values of 25%, 50% and 75% considered indicative of low, moderate and high heterogeneity, respectively.

Small-study effects were explored using funnel plots and Egger's regression test, at a 5% significance level. To investigate the influence of individual studies on the results and on heterogeneity, a sensitivity analysis was performed using the sequential leave-one-out method, complemented by the Baujat plot. These analyses were conducted in R software (version 4.6.1) using the *meta* and *metafor* packages.

Quality and risk of bias assessment

The methodological quality of the studies was assessed independently by three reviewers using the Joanna Briggs Institute (JBI) critical appraisal tools, selected according to the design of each study [24]. Items were rated as "yes", "no", "unclear" or "not applicable", and studies scoring ≥ 70% were considered of good methodological quality [25].

The risk of bias of the randomized controlled trials was assessed independently by three reviewers using the Cochrane Risk of Bias 2 (RoB 2) tool, available on the Review Manager (RevMan) Web platform. The assessment considered the five domains of the tool, with ratings of "low risk", "some concerns" or "high risk".

The authors used Claude (Anthropic) to translate the manuscript from Portuguese into English. The authors reviewed and edited the translated text and take full responsibility for the content of the manuscript.

RESULTS

Study identification

As shown in Fig. 1, 5,677 records were identified in the searches of the six databases. After removing 947 duplicates, 4,730 articles were screened by title, of which 4,553 were excluded. The abstracts of the remaining 177 records were then screened, and 113 were excluded. Of the 64 reports sought for retrieval, two could not be retrieved, and 62 were assessed in full text. After applying the eligibility criteria, 30 studies were selected, of which 20 were included in the systematic review only and 10 in both the systematic review and the meta-analysis.

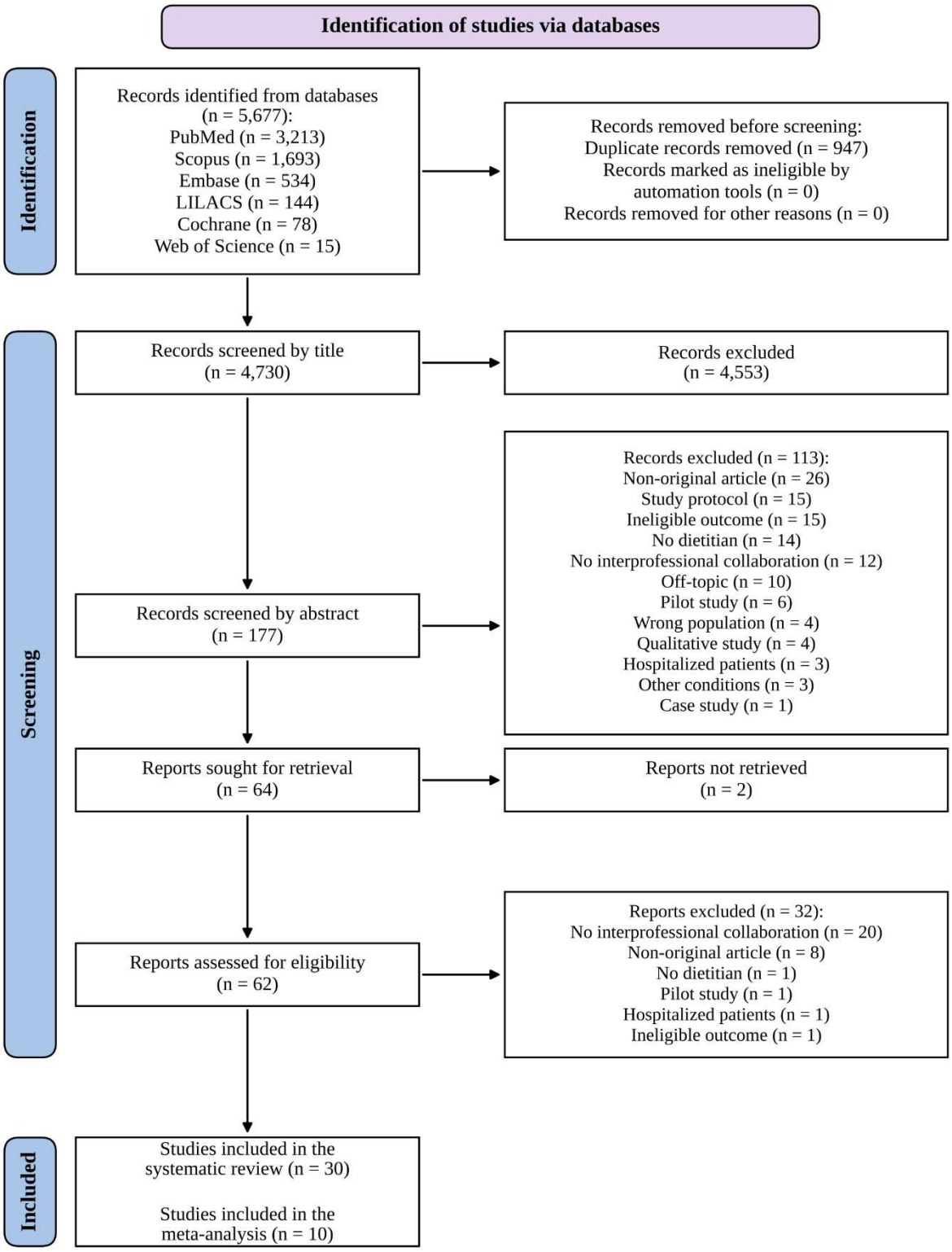


Fig. 1 PRISMA 2020 flow diagram of study identification, screening and inclusion

Characteristics of included studies

The studies were conducted between 1998 and 2024 in several countries, mostly in the United States (n = 9), followed by Canada (n = 4), Brazil (n = 3), Italy (n = 2), Australia (n = 2), China (n = 2) and the United Kingdom (n = 2). The remaining studies were conducted in Spain, Saudi Arabia, Singapore, Poland, Taiwan and Israel. In total, 30,041 individuals were assessed, with sample sizes ranging from 36 to 18,188 participants. Only one study included exclusively women [26], while the others assessed participants of both sexes. Regarding age, most studies included adults and older adults; three assessed adults exclusively [26–28].

Regarding the NCDs assessed, most studies included individuals with type 2 DM (n = 12), followed by studies of individuals with obesity (n = 5), type 1 and type 2 DM (n = 4) and hypertension (n = 3). The remaining studies (n = 6) assessed individuals with metabolic syndrome, overweight and obesity associated with complications such as type 2 DM and hypertension, as well as individuals with concomitant diagnoses of type 2 DM and obesity, type 2 DM and hypertension, and/or chronic kidney disease and type 2 DM (Additional file 3).

Regarding ICP, information sharing predominated, including clinical monitoring and the recording of care plans, mediated by information technologies such as shared electronic health records (n = 10). Team meetings were also frequently reported (n = 9) and were used for case discussions, the development of individualized care plans, the periodic review of these plans and the monitoring of interventions. In addition, in some studies, these meetings were used to establish consensus diagnoses among physicians (Additional file 3).

The integration of appointments also stood out, characterized by consultations with different team professionals on the same day, as well as joint appointments, in which two or more professionals simultaneously took part in an individual consultation or visit or conducted group health education sessions. Among the strategies used to integrate appointments into a

single day, paired consultations [29, 30] and "speed dating", characterized by a rotation of 15- to 30-minute meetings with each team professional [31], stood out (Additional file 3).

Many studies had a health professional responsible for coordinating the intervention, a role frequently performed by nurses or case managers. These professionals played a central role in integrating information, identifying barriers to treatment and liaising between the different team professionals and the individuals receiving care [29, 32–35].

Regarding the composition of the interprofessional teams, all studies included a dietitian, since the participation of this professional was one of the inclusion criteria of the review. The roles of dietitians ranged from dietary prescription to acting as DM educators and in interventions targeting behavioral factors. Besides dietitians, the professionals most frequently included in the teams were physicians (n = 27) and nurses (n = 23). In the study by Moffat et al. [36], the team showed the least professional diversity, consisting only of dietitians and psychologists. In contrast, Ni et al. [35] showed the greatest diversity, with eight professions, including endocrinologists, dietitians, psychologists, cardiologists, nephrologists, specialist nurses, general practitioners and community nurses.

Regarding outcomes, the studies showed positive effects of ICP on clinical and biochemical outcomes related to hypertension, DM and obesity. Glycemic control, assessed by HbA1c levels, was analyzed in 22 studies. Significant reductions after the intervention were observed in several studies [29, 37–41]. In addition, several studies showed better glycemic outcomes among individuals who received the interprofessional intervention compared with the control group [27, 30–32, 35, 42–49]. An increase in the proportion of individuals who achieved the HbA1c target, or a higher likelihood of reaching this target compared with the control group, was also observed [31, 39, 45, 46, 49]. Only two studies found no reductions in HbA1c levels [50, 51].

Regarding blood pressure control, ICP also showed favorable results. Ten studies showed reductions in both SBP and DBP [34, 37–41, 44, 48, 52, 53]. In addition, one study found a reduction in SBP only [30], while another found a reduction in DBP only [43]. On the other hand, 12 studies found no significant differences in blood pressure levels after the intervention or compared with the control group [27, 29, 31, 32, 42, 45–47, 49–51, 54].

Regarding BMI, assessed in 17 studies, the interprofessional collaborative interventions resulted in significant reductions in seven [27, 28, 30, 34, 37, 40, 43], while nine found no statistically significant results [31, 32, 41, 42, 44, 45, 47, 51, 54]. Only one study reported a significant increase in BMI despite ICP [46].

Although some studies found no significant changes in some or all of the outcomes assessed [55], overall, the findings suggest favorable effects of ICP on different clinical and biochemical outcomes. Beyond these outcomes, some articles reported reductions in hospitalizations and improvements in quality of life and self-care [35, 36, 40, 42].

Meta-analysis

Ten articles were included in the meta-analysis, all of them randomized controlled trials that reported means, standard deviations and sample sizes per group, as required for the quantitative synthesis. The remaining studies did not have a randomized controlled trial design or a control group and were therefore not included in the meta-analysis; their results were presented only in the narrative synthesis. Table 1 presents the effect estimates of the included studies for each of the four outcomes analyzed.

Table 1. Effects of the interventions by outcome in the randomized controlled trials included in the meta-analysis

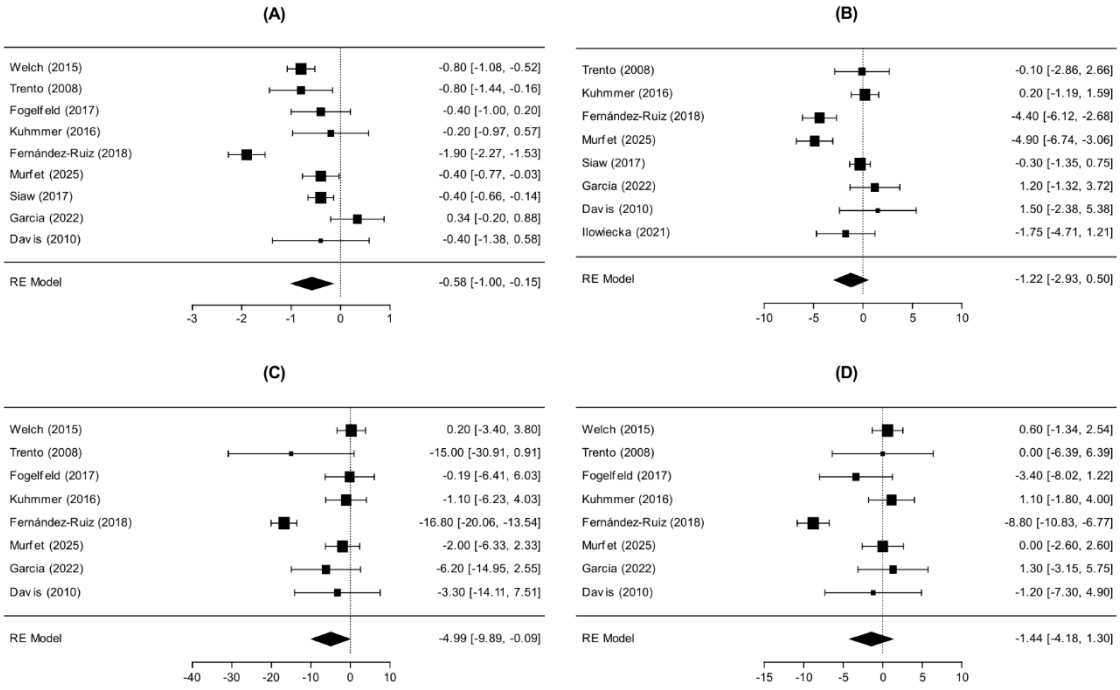
Author (year)	Country	N (I/C)	FU (mo)	Glycemic control HbA1c (%)	Blood pressure (mmHg)	Anthropometry BMI (kg/m²)
Trento (2008)	Italy	24/21	24	-0.80 [-1.44; -0.16]	SBP -15.00 [-30.91; 0.91] DBP +0.00 [-6.39; 6.39]	-0.10 [-2.86; 2.66]

Author (year)	Country	N (I/C)	FU (mo)	Glycemic control HbA1c (%)	Blood pressure (mmHg)	Anthropometry BMI (kg/m²)
Davis (2010)	USA	85/80	12	-0.40 [-1.38; 0.58]	SBP -3.30 [-14.11; 7.51] DBP -1.20 [-7.30; 4.90]	+1.50 [-2.38; 5.38]
Welch (2015)	USA	199/200	6	-0.80 [-1.08; -0.52]	SBP +0.20 [-3.40; 3.80] DBP +0.60 [-1.34; 2.54]	-
Kuhmmer (2016)	Brazil	113/114	6	-0.20 [-0.97; 0.57]	SBP -1.10 [-6.23; 4.03] DBP +1.10 [-1.80; 4.00]	+0.20 [-1.19; 1.59]
Fogelfeld (2017)	USA	60/60	24	-0.40 [-1.00; 0.20]	SBP -0.19 [-6.41; 6.03] DBP -3.40 [-8.02; 1.22]	-
Siaw (2017)	Singapore	214/197	6	-0.40 [-0.66; -0.14]	-	-0.30 [-1.35; 0.75]
Fernández-Ruiz (2018)	Spain	37/37	12	-1.90 [-2.27; -1.53]	SBP -16.80 [-20.06; -13.54] DBP -8.80 [-10.83; -6.77]	-4.40 [-6.12; -2.68]
Iłowiecka (2021)	Poland	18/18	30	-	-	-1.75 [-4.71; 1.21]
Garcia (2022)	Brazil	47/42	12	+0.34 [-0.20; 0.88]	SBP -6.20 [-14.95; 2.55] DBP +1.30 [-3.15; 5.75]	+1.20 [-1.32; 3.72]
Murfet (2025)	Australia	109/107	24	-0.40 [-0.77; -0.03]	SBP -2.00 [-6.33; 2.33] DBP +0.00 [-2.60; 2.60]	-4.90 [-6.74; -3.06]

Legend: Values are expressed as mean differences (intervention − control) and 95% confidence intervals. N (I/C), number of participants randomized to the intervention and control groups; FU (mo), follow-up in months; –, outcome not reported. Kuhmmer (2016): N varied by outcome (HbA1c, n = 65) owing to subgroup/missing data. BMI, body mass index; DBP, diastolic blood pressure; HbA1c, glycated hemoglobin; SBP, systolic blood pressure.

Overall, 1,782 participants were randomized across the included trials, 906 in the intervention group and 876 in the control group. For HbA1c, the analysis of nine studies showed that ICP significantly reduced HbA1c (−0.58; 95% CI −1.00 to −0.15; p = 0.008; Fig. 2A), with high heterogeneity between studies (I^2 = 87.81%). For BMI, eight studies were analyzed and showed no statistically significant difference (−1.22; 95% CI −2.93 to 0.50; p = 0.164; Fig. 2B), with high heterogeneity (I^2 = 83.87%). Blood pressure was reported in eight of the included randomized controlled trials (RCTs). For SBP, the meta-analysis showed a significant difference between groups (−4.99; 95% CI −9.89 to −0.09; p = 0.046; Fig. 2C), with a heterogeneity of I^2 = 83.55%. However, no statistically significant difference was observed for DBP (−1.44; 95% CI −4.18 to 1.30; p = 0.303; Fig. 2D), with high heterogeneity (I^2 = 82.59%). Notably, high heterogeneity (I^2 > 75%) was observed for all outcomes, attributable to

304 differences between populations, variation in follow-up duration, type of intervention and
305 methodological differences.



306

307 **Fig. 2** Forest plots of the effect of interprofessional collaborative practice on clinical outcomes.
308 (A) HbA1c (%); (B) BMI (kg/m²); (C) systolic blood pressure (mmHg); (D) diastolic blood
309 pressure (mmHg). Squares represent the mean difference between intervention and control
310 groups in each study, with size proportional to study weight; horizontal lines indicate 95%
311 confidence intervals. Diamonds represent pooled estimates from random-effects models.
312 Negative values favour the intervention. Heterogeneity: (A) $I^2 = 87.81\%$; (B) $I^2 = 83.87\%$; (C)
313 $I^2 = 83.55\%$; (D) $I^2 = 82.59\%$. BMI, body mass index; HbA1c, glycated hemoglobin; RE,
314 random effects.

315

316 **Study quality**

317 Of the 30 studies included in the systematic review, 20 met between 50% and 69% of
318 the JBI critical appraisal criteria [24] and were rated as moderate quality. Nine studies met 70%

or more of the criteria and were rated as high quality, while only one met less than 50% of the criteria and was rated as low quality (Additional file 3).

Risk of publication bias

Publication bias was assessed using funnel plots and Egger's regression test. No evidence of statistically significant asymmetry was observed for any of the outcomes analyzed: HbA1c ($p = 0.407$), BMI ($p = 0.435$), SBP ($p = 0.664$) and DBP ($p = 0.589$). Consistently, the distribution of studies in the funnel plots was predominantly symmetrical, showing no evidence of publication bias.

Fig. 3 presents the risk of bias assessment of the studies included in the meta-analysis, performed with the RoB 2 tool. In the overall assessment, "some concerns" predominated, followed by similar proportions of studies rated as low and high risk of bias. Among the domains assessed, the randomization process accounted for the largest number of studies with "some concerns" [32, 34, 42, 45, 46], followed by the domains related to deviations from intended interventions and missing outcome data. In the individual assessment, only one study showed a high overall risk of bias [30], attributed to problems related to the randomization process. In contrast, the study by Kuhmmer et al. [54] was the only one rated as low risk of bias in all domains assessed.

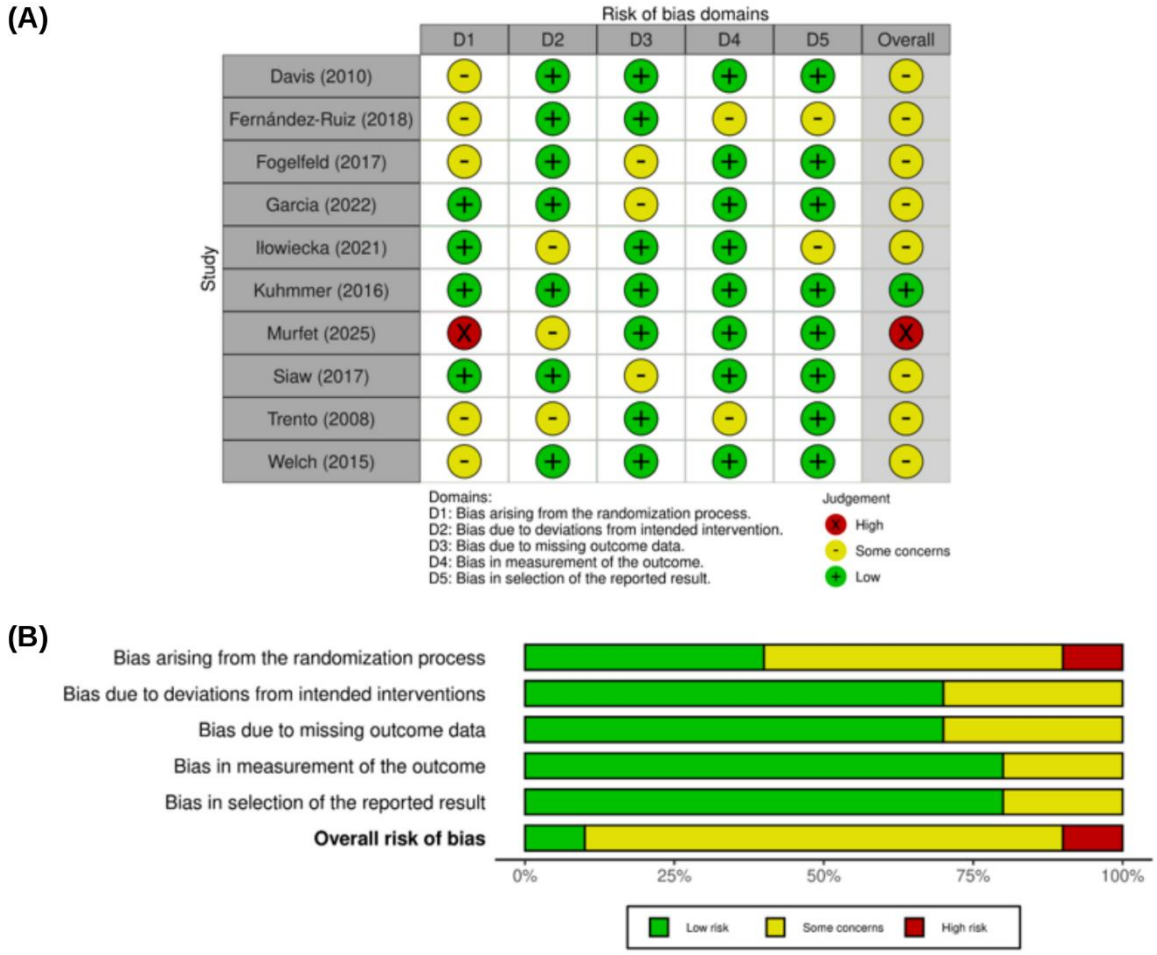


Fig. 3 Risk of bias of the randomized controlled trials included in the meta-analysis, assessed with the RoB 2 tool. (A) Traffic-light plot of judgements for each study and domain; (B) summary plot showing the proportion of studies in each risk-of-bias category per domain.

Sensitivity analysis

To explore possible sources of the high heterogeneity, a sensitivity analysis was performed by sequentially excluding each study (leave-one-out). Overall, the individual exclusion of most studies did not result in substantial changes in the heterogeneity of the outcomes analyzed (Table 2). However, excluding the study by Fernández-Ruiz et al. [34] reduced heterogeneity for all outcomes. For HbA1c, I^2 decreased from 87.81% to 58.98%, while for BMI it decreased from 83.87% to 79.09%. The reduction was more pronounced for the

blood pressure outcomes, with I^2 reaching 0% for both SBP and DBP. These findings were corroborated by the Baujat plot (Fig. 4), in which the study by Fernández-Ruiz et al. [34] stood out for its contribution to the overall heterogeneity for HbA1c, SBP and DBP. For BMI, the largest contribution came from the study by Murfet et al. [30], followed by Fernández-Ruiz et al. [34] (Fig. 4B).

Table 2. Sensitivity analysis (leave-one-out): heterogeneity (I^2) after excluding each study, by outcome

Excluded study (leave-one-out)	HbA1c		BMI		SBP		DBP	
	I^2 (%)	Overall I^2 (%)	I^2 (%)	Overall I^2 (%)	I^2 (%)	Overall I^2 (%)	I^2 (%)	Overall I^2 (%)
Kuhmmer (2016)	89.53	87.81	83.27	83.87	84.76	83.55	83.07	82.59
Fernández-Ruiz (2018)	58.98	87.81	79.09	83.87	0	83.55	0	82.59
Welch (2015)	87.36	87.81	83.87	83.87	81.51	83.55	80.81	82.59
Trento (2008)	89.73	87.81	86.46	83.87	85.36	83.55	85.46	82.59
Fogelfeld (2017)	89.68	87.81	83.87	83.87	85.08	83.55	85.18	82.59
Murfet (2025)	88.7	87.81	76.32	83.87	84.27	83.55	83.43	82.59
Siaw (2017)	87.11	87.81	82.31	83.87	83.55	83.55	82.59	82.59
Garcia (2022)	85.53	87.81	84.35	83.87	86.51	83.55	84.51	82.59
Davis (2010)	89.84	87.81	85.41	83.87	86.55	83.55	85.63	82.59
Iłowiecka (2021)	87.81	87.81	86.92	83.87	83.55	83.55	82.59	82.59

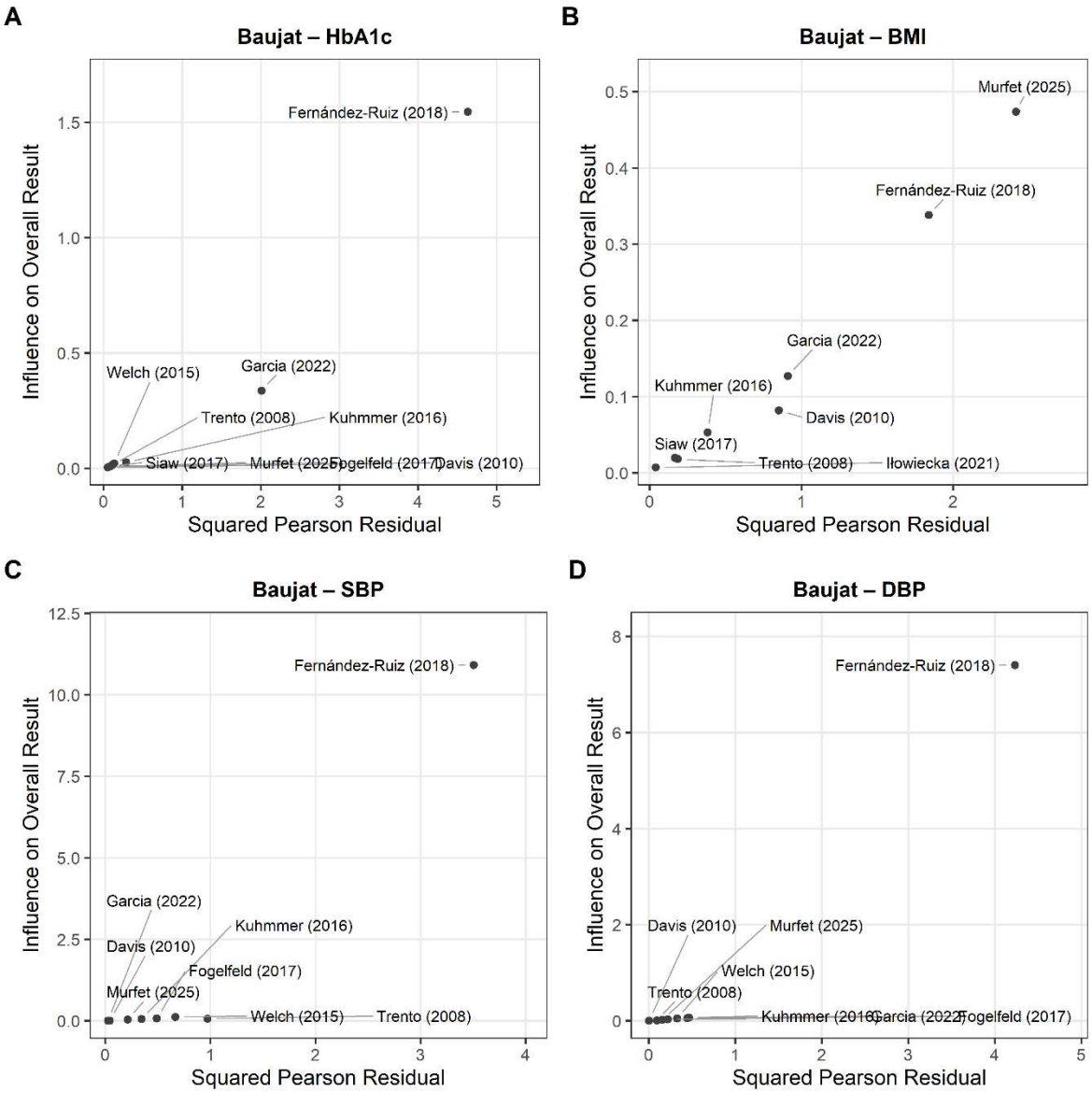


Fig. 4 Baujat plots of study contribution to heterogeneity and influence on pooled results. (A) HbA1c; (B) BMI; (C) systolic blood pressure (SBP); (D) diastolic blood pressure (DBP). The x-axis shows each study's contribution to overall heterogeneity (squared Pearson residual); the y-axis shows its influence on the pooled effect estimate. Studies in the upper-right area contribute most to both.

DISCUSSION

This systematic review with meta-analysis synthesized the evidence on the effectiveness of ICP in the management of individuals with hypertension, DM and/or obesity. Overall, the narrative synthesis indicated favorable results of the interventions on different clinical and biochemical outcomes, with particularly consistent findings for glycemic control. In the quantitative synthesis, ICP was associated with significant reductions in HbA1c and SBP, whereas no statistically significant differences were observed for DBP and BMI. However, the statistical heterogeneity observed was high for all outcomes assessed, indicating important variability between studies and calling for caution in the interpretation of the pooled estimates. Nevertheless, the importance of the findings of this study on the effectiveness of ICP involving dietitians in the management of hypertension, DM and/or obesity in adults and older adults should be highlighted.

This variability may result from population diversity, such as age, baseline biochemical parameters and time since diagnosis, or from methodological characteristics of the included studies, which differ in measurement methods, duration and type of intervention.

For SBP and DBP, heterogeneity became null (0%) in the sensitivity analysis after excluding the study by Fernández-Ruiz et al. [34]. This finding reinforces that the results across studies were homogeneous and therefore indicates that ICP was effective in reducing SBP but not DBP.

HbA1c showed a significant effect in the meta-analysis, albeit with high heterogeneity, which decreased slightly after the sensitivity analysis, becoming moderate. This may be explained by the different baseline values found in the studies, which ranged from 6.7% in the study by Fernández-Ruiz et al. [34] to 9.9% in the study by Garcia et al. [51]. In addition, higher HbA1c values leave greater room for significant reductions than values close to the therapeutic target (< 7%), which may have contributed to the heterogeneity found. Optimization and

389 intensification of drug therapy were strategies present in some interventions but not in others,
390 which may also have contributed to improving glycemic control and to the heterogeneity.

391 The absence of a significant effect on BMI should be interpreted in light of the
392 considerable heterogeneity between interventions, particularly regarding intensity, duration and
393 weight management components. In addition, differences in pharmacological treatment may
394 have influenced this outcome, since some studies included strategies potentially favorable to
395 weight loss, whereas others prioritized glycemic control with therapeutic regimens that may
396 favor weight gain. The study by Murfet et al. [30], for example, applied a higher-intensity
397 intervention in which weight-promoting medications, such as insulins, were replaced by
398 glucagon-like peptide-1 (GLP-1) analogues and orlistat, which may have favored the 3.51
399 kg/m^2 reduction in BMI.

400 Although 20 studies were not included in the meta-analysis because of their different
401 designs, their results reinforce the quantitative findings regarding the reduction in HbA1c,
402 which was the most consistent outcome among the included studies. The focus on behavioral
403 change, DM education activities and self-management support, fostering patient empowerment,
404 in addition to the optimization of drug therapy, frequently carried out by physicians,
405 pharmacists and/or nurses [31, 39, 47, 48, 53], were components of the interventions that may
406 have contributed to the results observed.

407 Regarding blood pressure, most of the studies not included in the meta-analysis that
408 reported this outcome found significant reductions in SBP and DBP, which differs from the
409 meta-analysis, in which only SBP showed a significant difference. This apparent divergence
410 between the narrative synthesis and the quantitative analysis may be related to differences in
411 design, sample size, follow-up duration and intervention characteristics, as well as to the greater
412 rigor of the controlled comparison provided by the RCTs included in the meta-analysis.

The results of this meta-analysis showed a reduction of 0.58% in HbA1c ($p = 0.008$) and of 4.99 mmHg in SBP ($p = 0.046$). A systematic review and meta-analysis that evaluated the effect of ICP on chronic disease management found a mean difference of −0.20 (95% CI −0.47 to −0.07) for HbA1c and −3.70 (95% CI −7.39 to −0.01) for SBP and, unlike the present study, also found a significant result for DBP (−1.95; 95% CI −3.18 to −0.72) [56].

Furthermore, a systematic review and meta-analysis conducted in primary care to examine the effect of ICP involving three or more professions in individuals with hypertension and DM found a significant reduction in HbA1c regardless of baseline value, although this reduction was greater in individuals with baseline levels above 9% (HbA1c < 8%, standardized mean difference (SMD) = −0.13; $p < 0.001$; HbA1c ≥ 8% to < 9%, SMD = −0.24; $p = 0.007$; and HbA1c ≥ 9%, SMD = −0.60; $p < 0.001$). In addition, significant reductions in SBP (−0.31; 95% CI −0.46 to −0.17; $p < 0.001$) and DBP (−0.28; 95% CI −0.42 to −0.14; $p < 0.001$) were reported [14].

Recent evidence shows that the effects of ICP on blood pressure are more evident and of greater magnitude for SBP than for DBP; moreover, factors such as short follow-up periods, heterogeneous studies and small samples may underlie the smaller magnitude, or even the lack of significance, of the effect on DBP. The literature also suggests the need for further studies to clarify the efficacy of team-based interventions in reducing DBP [14, 57–59].

Moreover, the presence of dietitians in interprofessional teams may favor the integrated management of the dietary, metabolic and behavioral components of NCDs, optimizing health outcomes [15, 60, 61]; however, the mere presence of this professional does not allow the observed effects to be attributed to them alone.

Strengths and limitations

Among the strengths of this systematic review with meta-analysis is the comprehensiveness of the search strategy, carried out in six databases, which enabled the identification of studies involving different populations, care settings and ICP configurations. Furthermore, the review was conducted rigorously, in accordance with the PRISMA recommendations, and integrated narrative synthesis and meta-analysis, allowing a comprehensive assessment of the available evidence and the quantitative estimation of effects on relevant clinical and biochemical outcomes.

The findings of this review also point to important perspectives for future research. Studies with longer follow-up are needed to assess whether the effects of ICP are sustained, especially on glycemic and blood pressure control. Furthermore, given the diversity of the interventions identified, future investigations should characterize their composition, intensity, frequency and duration in more detail, as well as the roles of the different professionals and the mechanisms of collaboration between them. Identifying the components and team configurations associated with better outcomes may contribute to the development of more consistent and reproducible interventions applicable to different care settings.

Some methodological considerations should be taken into account when interpreting the results. The number of studies available for the quantitative synthesis varied across outcomes, which calls for caution in interpreting the heterogeneity estimates and the analyses of possible publication bias, especially given the lower power of Egger's test when applied to a small number of studies. In addition, using the same search string in all databases without adaptation may have reduced the sensitivity of the search; however, this risk may have been mitigated by searching all fields in six databases. Among the primary studies, variations in methodological quality and risk of bias were identified, although most showed moderate to high quality. Moreover, clinical and methodological heterogeneity was observed regarding population

characteristics, diagnostic criteria, follow-up periods and the composition, intensity and duration of the interventions. This diversity partly reflects the complexity of ICP itself and of the different settings in which it is implemented, and should be considered when interpreting and generalizing the pooled estimates.

CONCLUSIONS

The findings of this systematic review with meta-analysis point to the importance of ICP in the management of individuals with DM, hypertension and obesity, fostering integrated and coordinated care with the joint work of different professionals. The quantitative synthesis showed favorable effects on glycemic control and systolic blood pressure, whereas no significant effects were observed on diastolic blood pressure and body mass index. These results, together with the findings of the narrative synthesis, reinforce the potential of ICP in NCD care.

The participation of dietitians in interprofessional teams may contribute to the management of dietary, metabolic and behavioral factors related to these conditions, especially when integrated with the actions of other professionals and with education, self-management and longitudinal follow-up strategies. However, the high heterogeneity between studies calls for caution in generalizing the pooled estimates and highlights the need for a better understanding of the components and configurations of ICP associated with their effects. In this regard, the findings of this study reinforce the relevance of integrated, person-centered care models grounded in interprofessional collaboration for the management of NCDs.

ABBREVIATIONS

ADA: American Diabetes Association

BMI: Body mass index

CAPES: Coordenação de Aperfeiçoamento de Pessoal de Nível Superior (Coordination for the Improvement of Higher Education Personnel)

CI: Confidence interval

DBP: Diastolic blood pressure

DeCS: Health Sciences Descriptors

DM: Diabetes mellitus

Embase: Excerpta Medica dataBASE

GBD: Global burden of disease

GLP-1: Glucagon-like peptide-1

HbA1c: Glycated hemoglobin

ICP: Interprofessional collaborative practice

ISH: International Society of Hypertension

JBI: Joanna Briggs Institute

LILACS: Latin American and Caribbean Health Sciences Literature

MAJOR: Meta-Analysis for Jamovi

MEDLINE: Medical Literature Analysis and Retrieval System Online

MeSH: Medical Subject Headings

NCDs: Noncommunicable diseases

PICOS: Population, Intervention, Comparator, Outcomes and Study design

PRISMA: Preferred Reporting Items for Systematic Reviews and Meta-Analyses

PROSPERO: International Prospective Register of Systematic Reviews

RCT: Randomized controlled trial

REML: Restricted maximum likelihood

RevMan: Review Manager

RoB 2: Cochrane Risk of Bias tool, version 2

SBP: Systolic blood pressure

SMD: Standardized mean difference

WHO: World Health Organization

DECLARATIONS

Ethics approval and consent to participate

Not applicable. This study is a systematic review and meta-analysis of previously published data and therefore did not directly involve human participants.

Consent for publication

Not applicable, as the manuscript does not contain any individual person's data or images of an identifiable person (photograph, case report).

Availability of data and materials

All data generated or analyzed during this study are included in this published article and its supplementary information files.

Competing interests

The authors declare that they have no competing interests.

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538 **Authors' contributions**

539 VKRM and MMRSJ performed the database searches, study selection, data extraction and
540 methodological quality assessment and drafted the manuscript. ELGMJ acted as the third
541 reviewer in study selection. VKRM prepared the PRISMA flow diagram and conducted the
542 statistical analyses, including the meta-analysis, with methodological support from FMA.
543 ELGMJ and ESF reviewed the early versions of the manuscript. ALPM reviewed the
544 manuscript, checked the consistency of the reported data, adapted the manuscript to the journal's
545 guidelines, reviewed the English version and prepared the additional files. RMMC coordinated
546 and supervised the study and performed the final review, with support from GDC. All authors
547 critically reviewed the manuscript and read and approved the final version.

548

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556

557 **Authors' information**

558 The authors are Brazilian researchers affiliated with UFV. VKRM and ALPM are
559 dietitians and master's students in the PPGCN. MMRSJ is a dietitian with a master's degree in
560 Nutrition and Longevity and a specialization in Family Health from the Universidade Federal
561 de Alfenas (UNIFAL) and is a doctoral student in the PPGCN. ELGMJ and ESF are dietitians
562 with master's and doctoral degrees from the same program, where they are postdoctoral

563 researchers. FMA is an economist with master's and doctoral degrees in Applied Economics
564 from UFV, has completed postdoctoral training and is an associate professor in the Department
565 of Administration and Accounting (DAD). GDC is a dietitian with master's and doctoral degrees
566 from the PPGCN, has completed postdoctoral training and is an adjunct professor in the
567 Department of Nutrition and Health (DNS). RMMC is an occupational therapist (Faculdade de
568 Ciências Médicas de Minas Gerais – FCMMG), holds a master's degree in Rural Extension
569 from UFV and a doctoral degree in Public Health from the Universidad de Valencia (Spain),
570 has completed postdoctoral training and is a professor in the DNS.
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ADDITIONAL FILES

Additional file 1 (.pdf). PRISMA 2020 checklist. Completed PRISMA 2020 checklist indicating where each item is reported in the manuscript.

Additional file 2 (.pdf). Search strategies. Search string, databases, platforms, date of search, fields searched and number of records retrieved from each database.

802 **Additional file 3 (.pdf).** Characteristics of included studies. Design, setting, form of
803 collaborative practice, professionals involved, intervention, sample, main results and JBI
804 methodological quality score of the 30 studies included in the systematic review.

Supplementary Files

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

- Additionalfile1PRISMA2020checklist.pdf
- Additionalfile2Searchstrategies.pdf
- Additionalfile3Characteristicsofincludedstudies.pdf