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ORIGINAL RESEARCH

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Systematic review and meta-analysis of knowledge, attitudes, and practices regarding COVID-19 among chronic disease patients: A global perspective

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Abstract

Background: Chronic health conditions were significantly correlated with an increased clinical severity of coronavirus 2019 (COVID-19) and a heightened risk of COVID-19 mortality. This study aims to determine global knowledge, attitudes, and practices (Knowledge Abuse Profile) of the patients with chronic diseases toward COVID-19.

Methods: The study was initiated in December 2019 and extended until April 2023, during which an extensive search for relevant English-language literature was conducted as part of this systematic review and meta-analysis. Google Scholar, Scopus, PubMed/MEDLINE, Science Direct, Web of Science, EMBASE, Springer, and ProQuest were utilized for the search. The quality of included studies was assessed using a quality rating checklist created by Joanna Briggs Institute for cross-sectional research. In the STATA software version 14, inverse variance and Cochran Q statistics were used for statistical analysis to assess heterogeneity among the studies. The Dersimonian and Liard random-effects models were applied in cases where heterogeneity existed.

Results: A total of 23 studies involving 14,587 patients contributed to this meta-analysis. These studies comprised 21 studies focused on knowledge, with 6864 participants, 12 studies on attitudes involving 3597 patients, and 12 on practices, encompassing 4126 patients. The pooled estimates for sufficient knowledge, positive attitudes, and COVID-19 preventive behaviors among chronic disease patients were determined as 48.2% (95% confidence interval [95% CI]: 33.9%–62.5%), 60.8% (95% CI: 46.8%–74.8%), and 58.3% (95% CI: 39.5%–77.0%), respectively. Over the years, there was a consistent decrease in adequate knowledge, positive attitudes, and COVID-19 preventive behaviors among the population. Specifically, regarding knowledge, the rates declined from 50.2% in 2020 to 49.7% in 2021 and dropped to 45.1%. Similarly, the percentage of individuals with a positive attitude fell, decreasing from 64.1% in 2020 to 60.3% in 2021 and

dropping to 57.9% in 2022. Furthermore, COVID-19 preventive behaviors showed fluctuations, with the rates recorded at 63.7% in 2020, increasing to 75.4% in 2021, and then decreasing to 47% in 2022, in line with the publication dates of included studies.

Conclusion: The findings of meta-analysis show a significant decrease in the levels of knowledge, attitudes, and adherence to preventative interventions for COVID-19 among individuals with chronic diseases. The findings emphasize the need for targeted interventions, and ongoing education to address this trend.

KEYWORDS

attitudes, chronic disease, COVID-19, knowledge, practices

1 | INTRODUCTION

World Health Organization declared coronavirus disease 2019 (COVID-19) a global health emergency in January 2020.[1] As of September 25, 2023, there were 6,919,341 deaths and 695,729,158 confirmed COVID-19 cases worldwide.[2] The pandemic has created enormous challenges for healthcare systems worldwide, affecting both the general population and those with chronic diseases.[3]

Chronic diseases, such as diabetes, hypertension, heart disease, chronic respiratory ailments, and cancer, are persistent health issues that have a significant impact on an individual's overall well-being. Diabetes is a prevalent health condition that impacts individuals worldwide, irrespective of their age or where they live. Based on 2019 Global Burden of Disease Study, diabetes is presently ranked as the eighth most significant cause of mortality, and disability on a global scale.[4]

Research found that being older, male, obesity, high blood pressure, diabetes, heart problems, chronic breathing issues, and cancer can make COVID-19 more severe, and increase the chances of death.[5–7] Therefore, understanding their Knowledge Abuse Profile (KAP) towards COVID-19 is essential to implement targeted measures to protect this vulnerable population.

The people with weakened immune systems, including those with rheumatic diseases and those taking immunosuppressive drugs, are more likely to experience severe disease symptoms and respiratory issues when they get any viral infection, including COVID-19.[8] These present medical conditions will likely increase the number of specific cell receptors (such as angiotensin-converting enzyme-2 and transmembrane protease, serine 2). These receptors help severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) virus enter the human body more easily.[9]

A study among chronic patients in Nepal showed that 55.5% of the participants had good knowledge, 56.2% had good practice, and 30.7% had a positive attitude towards COVID-19. Young patients with the families with less than average income and those unable to read and write were less likely to have a positive attitude toward COVID-19. Furthermore, a significant association was observed among patients' knowledge, attitude, and practice regarding COVID-19 ($p < 0.001$).[10]

Understanding the role of knowledge in shaping people's attitudes, and the actions is crucial to create effective ways to encourage the public to follow COVID-19 prevention measures. As knowledge is linked to attitudes and preventive actions, it may be very helpful in improving the practice of public preventive behavior. During health crises and emergencies, the public should always practice precautionary behaviors, as the novelty and unpredictability of epidemics may exceed a health system's capability to respond.[11] Understanding KAP in high-risk populations, particularly in the patients with chronic diseases, can help produce favorable outcomes in planned behavior concerning COVID-19 prevention.[10,12]

Although numerous studies have explored chronic disease patients' knowledge, and attitudes toward COVID-19,[10,13–23] their findings are inconsistent in some cases, such as the level of knowledge, attitude, and practice. To safeguard this high-risk population, improve disease treatment, and put into place efficient public health measures to stop the virus's transmission and lessen its effects on vulnerable groups, it is essential to comprehend the KAP of people with chronic illnesses with regard to COVID-19. Therefore, an overall understanding of chronic disease patients' knowledge, attitudes, and practice related to COVID-19 is essential for the health system policymakers, and stakeholders to design prevention programs. This study aimed to determine the global knowledge, attitudes, and practices (KAP) of patients with chronic diseases towards COVID-19.

2 | MATERIALS AND METHODS

2.1 | Study design and setting

This systematic review, and meta-analysis was conducted to determine pooled knowledge, attitude, and practice of COVID-19 among chronic disease patients globally. Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) standards, which include 27 items for precise and transparent reporting of systematic reviews, and meta-analyses, were followed.[24] Our search strategy encompasses English-language articles published between

December 2019 until April 2023, sourced from various databases. Eligibility criteria were applied rigorously, focusing on cross-sectional studies that shed light on COVID-19 knowledge, attitudes, and practices within chronic illness.

2.2 | Search strategy

We conducted a comprehensive search for the research articles as part of our systematic review, and meta-analysis. Our search covered various databases, including Google Scholar, Scopus, PubMed/MEDLINE, Science Direct, Web of Science, EMBASE, Springer, and ProQuest. Articles were retrieved using medical subject headings (MeSH), and keywords on online databases. To connect MeSH terms and keywords during our search, we used Boolean operators, such as "AND" and "OR" ((("Knowledge"[Mesh]) OR ("Awareness"[Mesh]) OR ("Attitude"[Mesh]) OR ("Perception"[Mesh]) OR ("Practice"[Mesh]) OR ("Compliance"[Mesh])) AND (("COVID-19"[Mesh]) OR ("Coronavirus"[Mesh]) OR ("Corona Virus"[Mesh]) OR ("Pandemic"[Mesh]) OR ("SARS-CoV-2"[Mesh])) AND (("Chronic disease patients"[Mesh]) OR ("Chronic illness patients"[Mesh]) OR ("Diabetes patients"[Mesh]) OR ("Hypertension patients"[Mesh]) OR ("High Blood Pressure patients"[Mesh]) OR ("Heart disease patients"[Mesh]) OR ("Cardiac Diseases"[Mesh]) OR ("Heart Disorders"[Mesh]) OR ("Diabetes Mellitus patients"[Mesh]) OR ("Rheumatoid disease patients"[Mesh]) OR ("Arthritis Rheumatoid rheumatic patients"[Mesh]) OR ("Chronic kidney disease patients"[Mesh]) OR ("Renal Osteodystrophy patients"[Mesh]) OR ("Pulmonary disease patients"[Mesh]) OR ("COPD patients"[Mesh]) OR ("Chronic Obstructive Airway Disease"[Mesh]) OR ("Airflow Obstructions"[Mesh]) OR ("Chronic"[Mesh]) OR ("Autoimmune disease patients"[Mesh]) OR ("Disease"[Mesh]) OR ("Autoimmune patients"[Mesh]) OR ("Cancer"[Mesh])) (Supporting Information S1: Table 1).

Furthermore, a hand search was made on references of retrieved articles to find all eligible articles for this review. The processes of searching, and selecting related articles are shown in the PRISMA flowchart (Figure 1).

2.3 | Inclusion and exclusion criteria

Inclusion criteria comprised all cross-sectional studies that provided data on knowledge, attitudes, and practices of chronic disease patients regarding COVID-19. Studies concentrating on COVID-19 knowledge, attitudes, and practices (KAP) among patients with chronic illnesses were also included. The research also included studies where participants were chosen at random or via a census. Exclusion criteria were applied to articles that did not meet specific requirements. This notably excluded non-observational studies, such as short communications, and studies targeting populations other than the chronic disease patients, including the general population, pregnant women, healthcare workers, and students.

2.4 | Quality assessment

This study used Joanna Briggs Institute (JBI) quality checklist designed for cross-sectional studies to assess the risk of bias in the included studies. The nine items on JBI checklist evaluate the possibility of bias in the cross-sectional study. These questions are divided into three main categories: study design, sampling method, and measurement tools. A thorough quality evaluation of the studies was carried out by two independent reviewers using the JBI quality rating checklist. The identities of the authors and the titles of the journals were not withheld throughout this evaluation to maintain transparency. Any discrepancies or disagreements among the reviewers were actively resolved through discussion in a group meeting. To measure the quality of each study, we assigned an overall score based on the JBI checklist. This score classified studies into three categories: low risk of bias (8–9), moderate risk of bias (4–7), and high risk of bias (0–3).[25]

2.5 | Data extraction

First, duplicate entries were deleted from EndNote X8 after importing all chosen articles. The remaining publications were then individually assessed by two team members, who looked at the titles and abstracts to weed out research that wasn't relevant. The selection criteria were in line with descriptive and cross-sectional study techniques which were based on reports related to the research issue. Following the identification of relevant articles, a group debate led to the ultimate choice, which was then put into report for qualitative analysis and information extraction in later stages of the study. Numerous factors were included in the data taken out for analysis, including authors' names, study's year, kind, sample size, geographic location, and the participant's knowledge, attitudes, and practice on COVID-19. The evaluation of knowledge focused on some topics, including COVID-19 prevention strategies, illness symptoms, and modes of transmission. A high level of skill was indicated by a score above the mean. People's abilities to battle COVID-19 and their trust in their government and fellow citizens to effectively contain the pandemic were utilized as indicators of their attitudes. An above-mean value suggested a favorable attitude toward managing, and regulating COVID-19. Finally, the precautions were evaluated, including keeping a physical distance, washing your hands often, using a mask, avoiding crowded areas or social gatherings, and following isolation or quarantine rules. A practice was deemed suitable if it received a mean value or better score.

2.6 | Data analysis

STATA version 14 was used for the statistical analysis in this meta-analysis. Inverse variance and Cochran Q statistics were used to evaluate the studies' heterogeneity, with the levels of heterogeneity classified as low, moderate, or high based on I^2 test statistics.

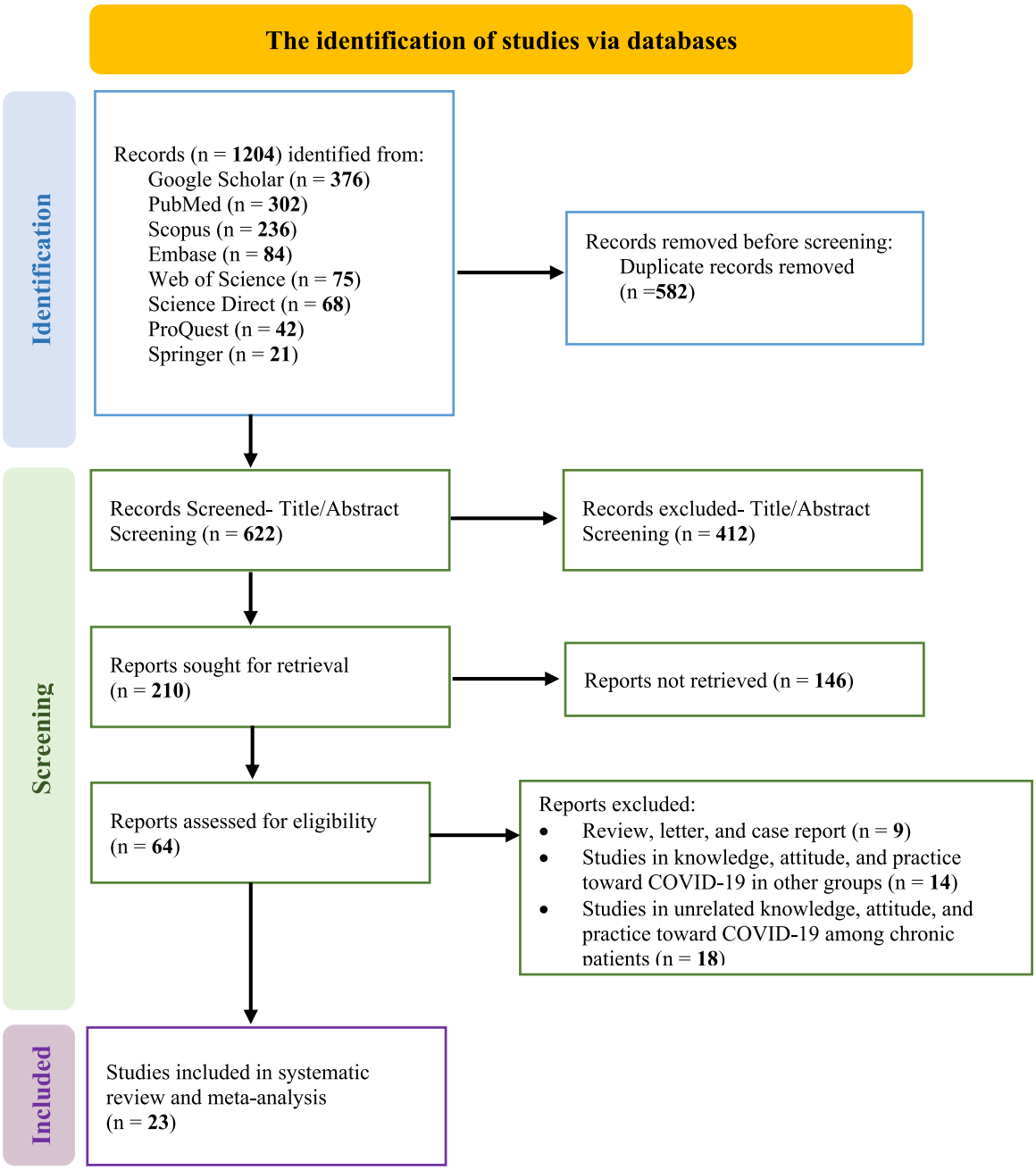

FIGURE 1 Preferred Reporting Items for Systematic Reviews and Meta-Analyses flowchart of studies included in this systematic review and meta-analysis. COVID-19, coronavirus disease 2019.

Low, moderate, and high heterogeneity were defined as values <50%, 50%–80%, and >80%, respectively. The presence of heterogeneity led to the use of Dersimonian and Liard random-effects models.

The heterogeneity in included studies was evaluated using subgroup analysis, univariate meta-regression, and multivariable meta-regression techniques. Geographical considerations were considered while estimating the requisite knowledge, positive attitude, and adequate implementation of COVID-19 preventative behaviors. The funnel plot and Egger's regression test were used to identify potential publication bias. We used ArcGIS 10.3 software to conduct a geographic analysis of the distribution of good knowledge, positive attitudes, and COVID-19 preventive behaviors. This analysis allowed us to gain valuable insights into how these factors varied across continents.

3 | RESULTS

3.1 | Eligibility studies and search results

Based on predefined inclusion criteria, 1204 articles were initially selected from the current databases. Subsequently, during the initial

screening phase, 582 publications were excluded in terms of repetitive or redundant titles and abstracts. Following this phase, a comprehensive review of the full-text articles was conducted, excluding 186 studies from further consideration. A total of 23 studies, including 21 studies for knowledge,[10,12,13,15,17–23,26–35] 12 studies for attitudes,[10,12,14,15,19–21,23,29,30,34,35] and 12 studies for practice[10,12,18–21,23,29–31,35] were included in the meta-analysis (Figure 1).

3.2 | Features of the eligible studies

A total of 23 journal papers that were selected from the original pool of publications, and satisfied the eligibility requirements were used in the research. Twenty-three studies were all deemed to have a low risk of bias, demonstrating their methodological robustness when the quality of these publications was evaluated using the JBI quality evaluation checklist (Table 1). There was no indication that any of the studies had a significant risk of bias. Based on research location, 12 studies were done in Asia, 10 in Africa, and one in Europe (Table 1).

3.3 | Pooled good knowledge about COVID-19

The pooled knowledge was calculated using a random-effects model, considering the presence of heterogeneity (*I–V* heterogeneity). A comprehensive analysis of 22 studies, which collectively involved 6864 patients with chronic diseases, was conducted to assess their knowledge regarding COVID-19. In general, 48.2% (95% confidence interval [95% CI]: 33.9%–62.5%) of patients demonstrated good knowledge (Figure 2). However, there was a significant level of heterogeneity ($I^2 = 99.0\%$, Q statistic = 5017.38, df = 21, $p < 0.0001$) among the studies.

TABLE 1 The included studies in this systematic review and meta-analysis.

N	Authors name	Year	Study region	Type of disease	Sample size	Good level of knowledge %	Good practice%	Positive attitude %
1	Gheorghe et al.[26]	2021	Romania	Cancer	172	10.8	NR	NR
2	Ranabhat et al.[10]	2022	Nepal	Chronic diseases	400	55.5	56.2	30.7
3	Addis et al.[12]	2021	Ethiopia	Chronic diseases	413	34.6	40.7	81.4
4	Khaliq et al.[20]	2021	Pakistan	Rheumatic disease	110	24.5	70.9	65.5
5	Gautam et al.[27]	2021	Nepal	Cancer	83	75.9	NR	NR
6	Rijal et al.[21]	2022	Nepal	Ear, nose, and throat	906	52.1	98.6	55.5
7	Nshimyiryo et al.[22]	2022	Rwanda	Chronic diseases	150	31.3	NR	NR
8	Subyani et al.[13]	2022	Saudi Arabia	Diabetes	267	6.25	NR	NR
9	Yasin et al.[28]	2022	Ethiopia	Chronic diseases	633	66.35	NR	NR
10	Jadon et al.[29]	2022	India	Obesity	260	13	92	23.5
11	Geleta et al.[19]	2022	Ethiopia	Hypertension	360	58.3	58.3	55.3
12	Vaidya et al.[14]	2020	Nepal	Musculoskeletal and rheumatic	380	NR	NR	71.5
13	Taye et al.[30]	2020	Ethiopia	Hypertension	423	37.5	10.4	49.8
14	Akalu et al.[31]	2020	Ethiopia	Chronic diseases	404	37.4	25.9	NR
15	Geleta et al.[19]	2020	Ethiopia	Chronic diseases	410	66.7	62	NR
16	Iradukunda et al.[15]	2021	Rwanda	HIV/AIDS	376	97	N.R.	73
17	Swain et al.[32]	2022	India	Diabetes	150	78	NR	NR
18	Pal et al.[17]	2020	India	Diabetes	212	12	NR	NR
19	Huynh et al.[23]	2020	Vietnam	Chronic diseases	522	68.4	77.2	90.8
20	Twinamasiko et al.[18]	2021	Uganda	Chronic diseases	102	55.9	52	NR
21	Kamel et al.[33]	2021	Egypt	Cancer	50	46	NR	NR
22	Sah et al.[34]	2020	Nepal	Cancer	224	79.4	NR	89.7
23	Mohta et al.[35]	2021	India	Dermatology	237	53.1	54.8	42.6

Abbreviations: HIV, human immunodeficiency virus; *N*, number; NR, no report.

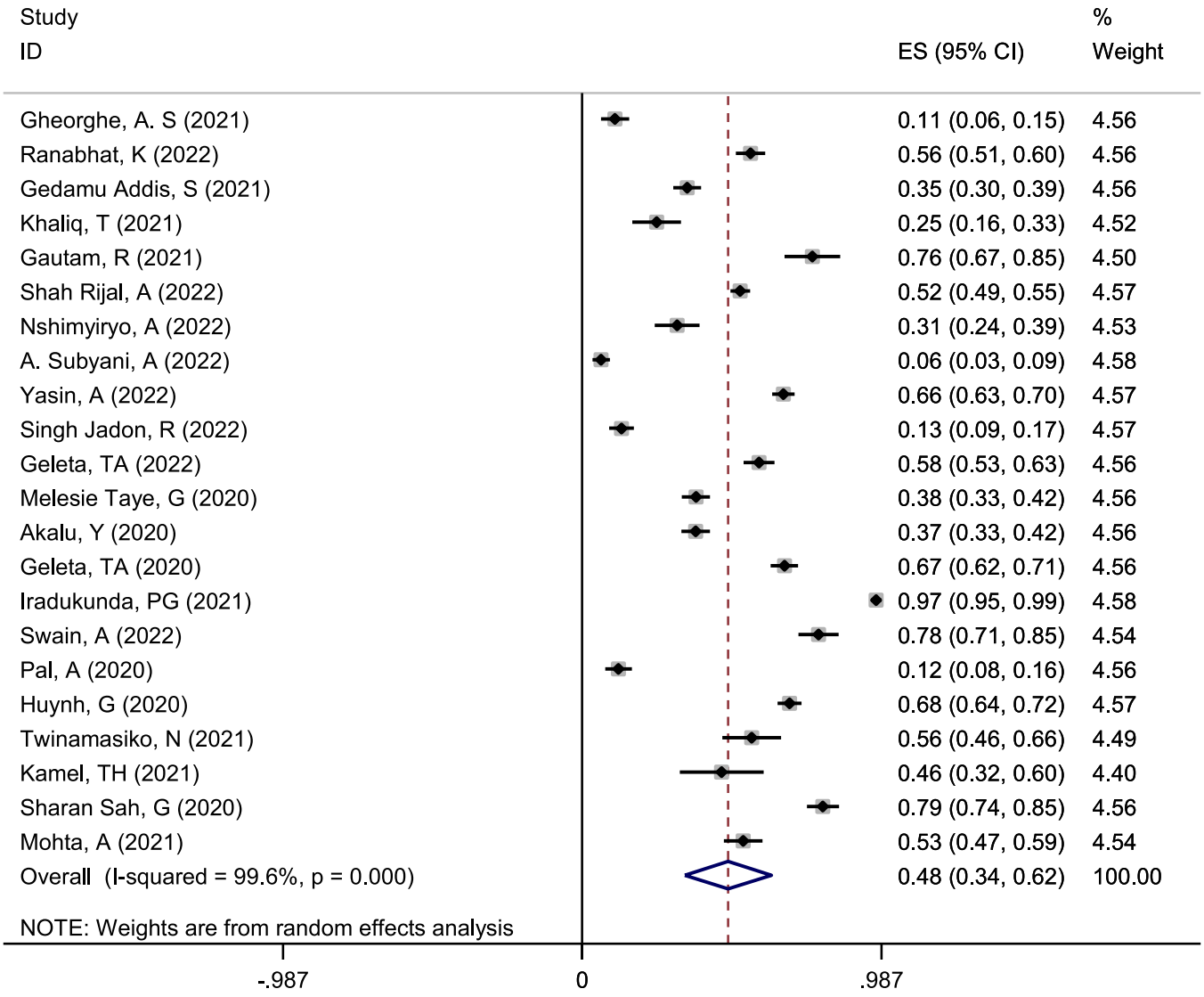

FIGURE 2 Forest plot of *I–V* heterogeneity random-effect meta-analysis for good knowledge of coronavirus 2019 (COVID-19) among chronic disease patients. 95% CI, 95% confidence interval.

Univariable and multivariable meta-regression was used to identify the heterogeneous cause of heterogeneity. The findings of univariable test suggested that the continent ($B = 0.118$, $p = 0.0177$) and type of chronic illnesses ($B = 0.014$, $p = 0.037$) could have a heterogenic origin. In contrast, the application of multivariable meta-regression analysis unveiled that the continent associated with a coefficient of 0.108 could potentially contribute to heterogeneity. This suggests that altering the continent alters the precise understanding of the value of 0.108 ($p = 0.024$) (Table 2). Based on subgroup analysis, the knowledge in Africa was 53.2%, Asia was 47%, and Europe was 10.8% (Figure 3). This proportion in cancer patients was the highest (53%) and the lowest (13%) in obese. The knowledge showed a decreasing trend over time, with rates of 50.2% (95% CI: 29.9%–70.5%), 49.7% (95% CI: 19.6%–79.9%), and 45.1% (95% CI: 25.8%–64.3%) in 2020, 2021, and 2022, respectively (Table 3).

3.4 | Pooled good attitudes toward COVID-19

A total of 12 studies with 3597 participants from Asia (1559 participants in seven studies), Africa (2395 participants in seven studies), and Europe (172 participants in one research) were looked at for the attitude analysis. Based on random-effect model with *I–V* heterogeneity, the percentage of chronic illness patients with positive attitudes was 60.8% (95% CI: 46.8%–74.8%) (Figure 4). However, there was a significant level of heterogeneity ($I^2 = 99.0\%$, Q statistic = 1056.90, df = 11, $p < 0.0001$) among the studies.

The results of univariable meta-regression showed that the country ($B = 0.045$, $p = 0.019$) might be the source of heterogeneity. On the other hand, multivariable meta-regression showed that the type of disease ($B = 0.072$, $p = 0.001$), country ($B = 0.046$, $p = 0.018$), and sample size ($B = -0.001$, $p = 0.010$) could be one of the possible causes of heterogeneity (Table 2).

TABLE 2 Univariate and multivariable meta-regression to find possible causes of heterogeneity among studies included in the meta-analysis.

Type	Possible cause of heterogeneity	Univariate		Multivariable	
		Coefficient (95% CI)	*p*	Coefficient (95% CI)	*p*
Knowledge	Type of disease	0.014 (0.017, 0.046)	0.037	−0.003 (−0.048, 0.041)	0.885
	Continent	0.118 (0.052, 0.289)	0.017	0.108 (0.082, 0.319)	0.024
	Country	−0.006 (−0.047, 0.033)	0.744	−0.004 (−0.047, 0.038)	0.835
	Year	−0.026 (−0.156, 0.102)	0.685	−0.023 (−0.147, 0.100)	0.707
	Sample size	0.0002 (−0.0002, 0.0007)	0.381	0.0001 (−0.0004, 0.0008)	0.569
Attitude	Type of disease	0.005 (−0.029, 0.040)	0.754	0.072 (0.029, 0.115)	0.001
	Continent	0.088 (−0.105, 0.281)	0.373	−0.101 (−0.291, 0.088)	0.296
	Country	0.045 (0.007, 0.083)	0.019	0.046 (0.008, 0.085)	0.018
	Year	−0.031 (−0.174, 0.112)	0.670	−0.084 (−0.184, 0.015)	0.098
	Sample size	−0.0004 (−0.001, 0.0003)	0.264	−0.001 (−0.001, −0.0002)	0.010
Practice	Type of disease	0.005 (−0.034, 0.044)	0.802	0.003 (−0.061, 0.068)	0.10
	Continent	0.029 (−0.190, 0.249)	0.793	0.293 (−0.030, 0.617)	0.076
	Country	0.012 (−0.048, 0.073)	0.683	0.0103 (−0.038, 0.059)	0.679
	Year	0.102 (−0.053, 0.257)	0.197	0.164 (0.008, 0.320)	0.039
	Sample size	−0.0002 (−0.001, 0.0006)	0.531	−0.001 (−0.002, −0.00007)	0.037

Abbreviation: 95% CI, 95% confidence interval.

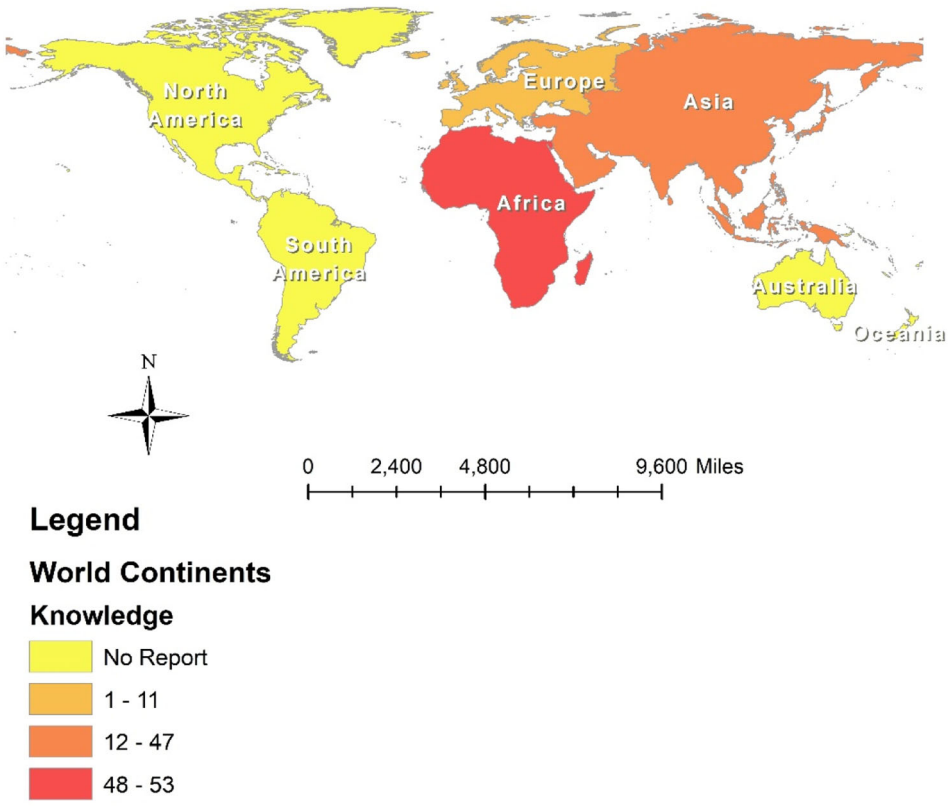

FIGURE 3 The percentage of coronavirus disease 2019 knowledge among chronic disease patients across continents.

TABLE 3 The results of subgroup analysis based on country and continent for knowledge, attitude, and practice for COVID-19 in chronic disease patients.

Type	Grouping		No. studies	Sample size	Overall frequency (95% CI)	Heterogeneity χ^2	p	I^2 (%)	τ^2
Knowledge	Continent	Africa	10	3321	53.2 (34.5–71.9)	1657.80	<0.001	99.5%	0.0899
		Asia	11	3371	47.0 (29.7–64.4)	1555.09	<0.001	99.4%	0.0854
		Europe	1	172	10.8 (6.2–15.4)	NA	NA	NA	NA
	Country	Romania	1	172	10.8 (6.2–15.4)	NA	NA	NA	NA
		Nepal	4	1613	65.4 (51.6–79.2)	88.88	<0.001	96.6%	0.0189
		Ethiopia	6	2643	50.2 (37.6–62.7)	233.82	<0.001	97.9%	0.0241
		Pakistan	1	110	24.5 (16.5–32.5)	NA	NA	NA	NA
		Rwanda	2	526	64.2 (21.2–98.9)	285.68	<0.001	99.6%	0.2151
		Saudi Arabia	1	267	6.03 (3.03–9.02)	NA	NA	NA	NA
		India	4	859	38.9 (9.09–68.0)	381.59	<0.001	99.2%	0.0872
		Vietnam	1	522	68.4 (64.4–72.4)	NA	NA	NA	NA
		Uganda	1	102	55.9(46.3–65.5)	NA	NA	NA	NA
		Egypt	1	50	46.0 (32.2–59.0)	NA	NA	NA	NA
	Type of chronic diseases	Cancer	4	529	53.0 (12.3–93.7)	414.23	<0.001	99.3	0.1702
		Other	8	3034	52.1 (41.3–62.9)	273.74	<0.001	97.4%	0.0235
		Rheumatoid arthritis	1	110	24.5 (16.5–32.5)	NA	NA	NA	NA
		Ear, Nose, and Throat	1	906	52.1 (48.8–55.4)	NA	NA	NA	NA
		Diabetes	3	629	32.1 (7.04–56.8)	382.50	<0.001	99.5	0.0951
		Obesity	1	260	13.0 (8.9–17.1)	NA	NA	NA	NA
		Hypertension	2	783	47.9 (27.5–68.3)	35.19	<0.001	97.2%	0.0210
		HIV/AIDS	1	376	97.0 (95.3–98.7)	NA	NA	NA	NA
		Dermatology	1	237	53.1 (46.7–59.5)	NA	NA	NA	NA
	Year	2020	6	2195	50.2 (29.9–70.5)	596.88	<0.001	99.2%	0.0640
		2021	8	1543	49.7 (19.6–79.9)	1883.26	<0.001	99.6%	0.1876
		2022	8	3126	45.1 (25.8–64.3)	1154.87	<0.001	99.4%	0.0764
Attitude	Continent	Africa	7	1506	62.8 (33.4–92.2)	486.27	<0.001	99.0%	0.0892
		Asia	7	1919	64.0 (50.2–77.8)	304.30	<0.001	98.0%	0.0338
		Europe	1	172	30.7 (23.8–37.6)	NA	NA	NA	NA
	Country	Romania	1	172	30.7 (23.8–37.6)	NA	NA	NA	NA
		Nepal	4	1087	57.4 (36.8–78.1)	154.95	<0.001	98.1%	0.0431
		Ethiopia	4	1816	58.3 (32.1–84.6)	478.15	<0.001	99.4%	0.0712
		India	2	472	73.1 (38.3–98.9)	93.71	<0.001	98.9%	0.0623
		Egypt	1	50	89.7 (81.3–98.1)	NA	NA	NA	NA
	Type of chronic diseases	Cancer	4	529	54.5 (29.5–79.5)	121.41	<0.001	97.5%	0.0633
		Other	4	1856	60.8 (32.5–89.2)	618.68	<0.001	99.5%	0.0834
		Rheumatoid arthritis	1	380	49.8 (44.8–54.8)	NA	NA	NA	NA
		Diabetes	1	212	90.8 (86.9–94.7)	NA	NA	NA	NA

TABLE 3 (Continued)

Type	Grouping		No. studies	Sample size	Overall frequency (95% CI)	Heterogeneity χ^2	p	I^2 (%)	τ^2
		Obesity	1	260	55.3 (49.3–61.3)	NA	NA	NA	NA
		Hypertension	1	360	71.5 (66.8–76.2)	NA	NA	NA	NA
	Year	2020	4	1226	64.1 (42.7–85.6)	242.32	<0.001	98.8%	0.0471
		2021	4	718	60.3 (37.4–83.3)	123.33	<0.001	97.6%	0.0532
		2022	4	1653	57.9 (28.3–87.5)	580.09	<0.001	99.5%	0.0908
Practice	Continent	Africa	4	2395	60.6 (35.5–85.6)	912.96	<0.001	99.6%	0.0813
		Asia	6	1559	56.7 (22.5–90.8)	1998.27	<0.001	99.7%	0.1816
		Europe	1	172	56.2 (48.8–63.6)	NA	NA	NA	NA
	Country	Romania	1	172	56.2 (48.8–63.6)	NA	NA	NA	NA
		Nepal	4	1087	51.1 (3.02–99.1)	1962.92	<0.001	99.8%	0.2390
		Ethiopia	4	1873	62.7 (32.6–92.8)	811.87	<0.001	99.6%	0.0939
		India	2	472	67.8 (49.3–86.3)	20.24	<0.001	95.1%	0.0170
		Vietnam	1	522	52.0 (47.7–56.3)	NA	NA	NA	NA
	Type of chronic diseases	Cancer	3	479	70.0 (36.5–99.7)	236.16	<0.001	99.2%	0.0868
		Other	5	2372	63.6 (42.9–84.2)	585.80	<0.001	99.3%	0.0550
		Rheumatoid arthritis	1	380	10.4 (7.03–13.5)	NA	NA	NA	NA
		Diabetes	1	212	77.2 (71.6–82.8)	NA	NA	NA	NA
		Obesity	1	260	58.3 (52.3–64.3)	NA	NA	NA	NA
		Hypertension	1	423	25.9 (21.7–30.1)	NA	NA	NA	NA
	Year	2020	3	2165	63.7 (28.6–98.8)	692.94	<0.001	99.3%	0.0713
		2021	3	668	75.4 (50.4–99.1)	196.14	<0.001	99.0%	0.0480
		2022	6	1293	47.0 (25.5–68.4)	428.23	<0.001	99.5%	0.0957

Abbreviations: 95% CI, 95% confidence interval; COVID-19, coronavirus disease 2019; NA, not applicable.

The subgroup analysis showed that the degree of a favorable attitude was 30.7% in Europe, 64.0% in Asia, and 62.8% in Africa (Figure 5). Furthermore, patients with rheumatism and arthritis had the lowest percentage of attitude (49.8%), whereas those with diabetes had the highest proportion (90.8%). The proportion of attitude fell over time, dropping to 64.1% (95% CI: 42.7%–85.6%), 60.3% (95% CI: 37.4%–83.3%), and 57.9% (95% CI: 28.3%–87.5%) in 2020, 2021, and 2022, respectively (Table 3).

3.5 | COVID-19 preventive behaviors

The analysis of practice among chronic disease patients included a total of 12 studies with 4126 individuals from Asia (1919 individuals in six studies), Africa (1506 individuals in four studies), and Europe (172 individuals in one study).

The random-effect model with *I–V* heterogeneity estimated that practice among chronic disease patients were 58.3% (95% CI: 39.5%–77.0%) (Figure 6). However, the studies had significant heterogeneity (I^2 = 99.6%, Q statistic = 3027.73, df = 11, p < 0.0001).

According to the results of the univariate meta-regression analysis, none of the characteristics that were looked at, including the sort of chronic disease, the continent, the country, the year, and the sample size, were proven to be substantially linked with the heterogeneity detected (p > 0.05). However, the findings of multivariable meta-regression showed that year (B = 0.164, p = 0.039) and the sample size (B = −0.001, p = 0.037) might be possible causes of heterogeneity causes (Table 2).

Based on the subgroup analysis, the preventive behaviors was 60.6% in Africa, 56.7% in Asia, and 56.2% in Europe (Figure 7). Among different patient groups, the highest proportion was observed in diabetes patients (77.2%), whereas the lowest was found in rheumatoid arthritis patients (10.4%).

The proportion of COVID-19 preventive behaviors fluctuates, with the rates of 63.7% (95% CI: 28.6%–98.8%), 75.4% (95% CI: 50.4%–99.1%), and 47% (95% CI: 25.5%–68.4%) in 2020, 2021, and 2022, respectively (Table 3).

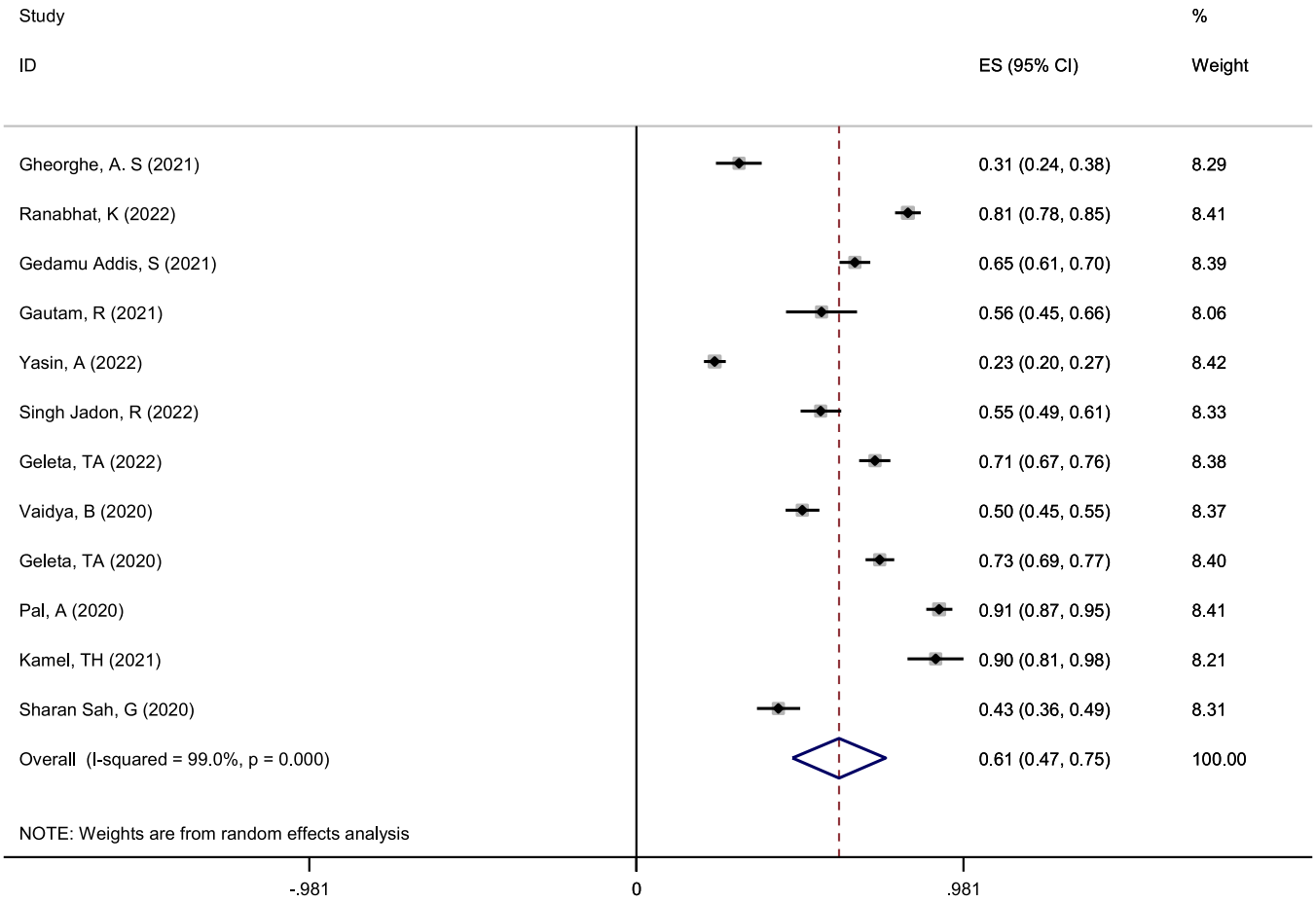

FIGURE 4 Forest plot of *I–V* heterogeneity random-effect meta-analysis for the positive attitude of coronavirus disease 2019 among chronic disease patients. 95% CI, 95% confidence interval.

3.6 | Publication bias

We used funnel plots and Egger's regression test to look for possible publication bias in the meta-analysis. The research results, shown in Figure 8A, panel A, show that the publication bias did not substantially affect the degree of knowledge. Egger's test showed no significant association between good attitude and bias (bias = 0.6572, 95% CI: −21.977 to −23.291, $p = 0.950$). The symmetric distribution of studies in the funnel plot analysis (Figure 8B) did not confirm the presence of publication bias, further supporting the robustness of study's findings.

Similarly, Egger's test statistical analysis found no significant association between preventive behaviors, and bias (bias = −18.22236, 95% CI: −45.524 to −9.079, $p = 0.168$). The funnel plot analysis indicated a symmetric distribution of studies (Figure 8C), further suggesting the absence of publication bias in the study.

4 | DISCUSSION

This study's results showed that the levels of good knowledge, positive attitudes, and COVID-19 preventive behaviors among chronic disease patients were calculated as 48.2, 60.8, and 58.3, respectively. The study's findings offered the practical guidance for healthcare providers and public health efforts. Patient education can be improved and the protection of people with chronic illnesses during the ongoing COVID-19 pandemic can be strengthened by implementing targeted interventions, monitoring progress, fostering collaboration, advocating for healthcare access, tailoring education, being culturally sensitive, and utilizing digital health tools.

A study in Ethiopia reported a good knowledge of COVID-19 by 61.78% of general population.[36] In comparison, another meta-analysis study reported 75% good knowledge among the general population 38, which is higher than the good knowledge observed in the chronic disease patients in this study.[37] Having a chronic illness has made it more challenging to understand COVID-19. The analysis of the level of knowledge about COVID-19 by continent showed that, compared with Asia, and Europe, Africa has a higher level of knowledge.

Moreover, Asia had a higher degree of good knowledge than Europe. The most knowledge is related to an African country (Rwanda 97%),[15] and the least is associated with a European country (Romania 10.8%).[26] Among Asian countries, two studies in India showed very low values for good knowledge.[17,29] Given that knowledge levels might differ significantly across countries and

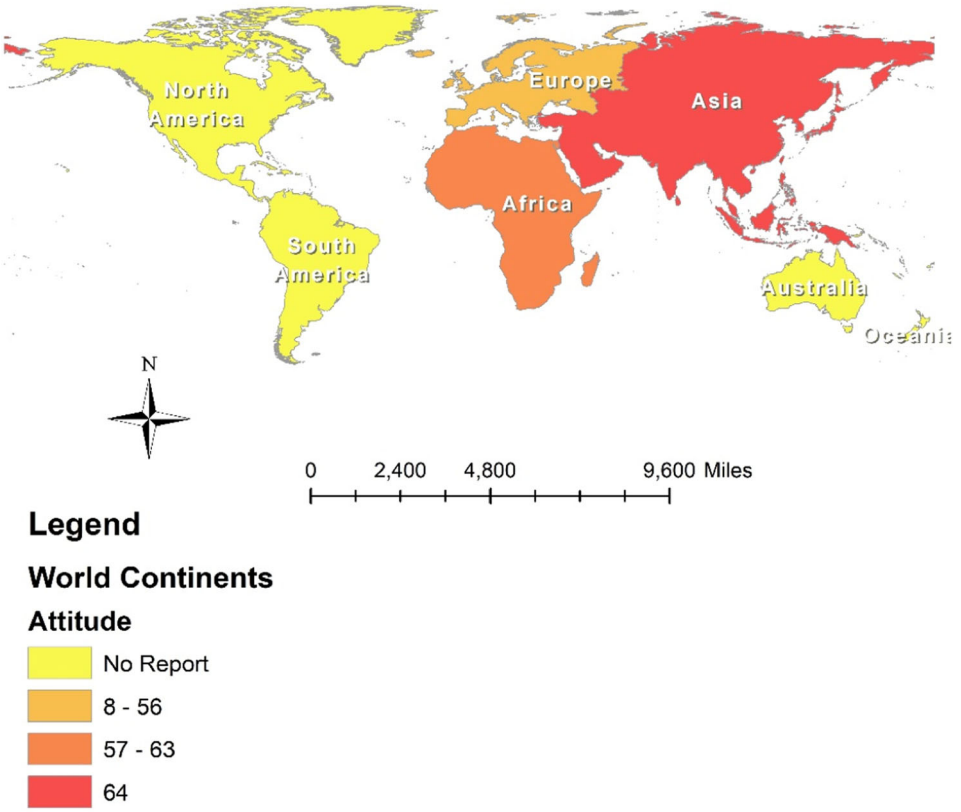

FIGURE 5 The percentage of coronavirus disease 2019 good attitudes among chronic disease patients across continents.

continents; it is possible that a COVID-19 education program that is designed to accommodate all students won't be successful. Rather, initiatives should be modified to meet the distinct requirements and difficulties that people with chronic illnesses encounter globally. Moreover, based on the type of disease, the highest good knowledge was observed in cancer patients (53%), and the lowest in obese people (13%). Cancer patients have paid more attention, and follow-up to receive health knowledge about COVID-19 regarding their serious health condition; meanwhile, it seems that health is not a priority for many obese people, and obesity itself is one of its results. Obesity is one of the factors associated with COVID-19-induced anxiety, so it is necessary to assess the knowledge of obese individuals.[38–40] Weight loss in obese people should be considered one of the prevention goals during the COVID-19 pandemic because obesity is associated with increased mortality among these patients.[41]

This study's results showed that 60.8% of chronic disease patients have a positive attitude. In Bekele et al.'s[42] and Saadatjoo et al.'s[43] studies, a highly positive attitude toward COVID-19 was obtained, which can be attributed to the fact that the studies were conducted during disease's peak. Based on the results, positive attitudes in Africa have been better than those in Asia and Europe, with Asia ranked second. Therefore, the highest level of attitude was related to the Asian country of Nepal (98.6%),[21] and the lowest level was associated with the African country of Ethiopia (10.4%).[30] These findings highlight how crucial it is to take into account geographical differences in attitudes among people with chronic illnesses. Although favorable opinions were more common in Asia and Africa, the stark differences between Nepal and Ethiopia indicate that healthcare, social, and cultural variables play a significant role in influencing people's attitudes. The highest level of positive attitude was related to diabetic patients (90.8%), and the lowest was in rheumatic arthritis patients (49.8%). In chronic disease patients, COVID-19 preventive behaviors were calculated as 58.3%, which is in line with the previous studies[26,44]

This degree of COVID-19 preventive behaviors is expected, given the positive attitude attained (60.8%). Thus, the lack of good knowledge raises the worry that good behavior, and attitude will decline and the ground will be ready for the disease's detrimental impacts. Regarding the level of COVID-19 preventive behaviors, the first to third place was assigned to Africa, Asia, and Europe, respectively. Furthermore, the highest level of COVID-19 preventive behaviors belonged to the Asian country of Vietnam (90.8),[23] and the lowest level to the Asian country of India (23.5).[29] Various factors, including government policies, public health campaigns, and cultural norms, may affect these variations.

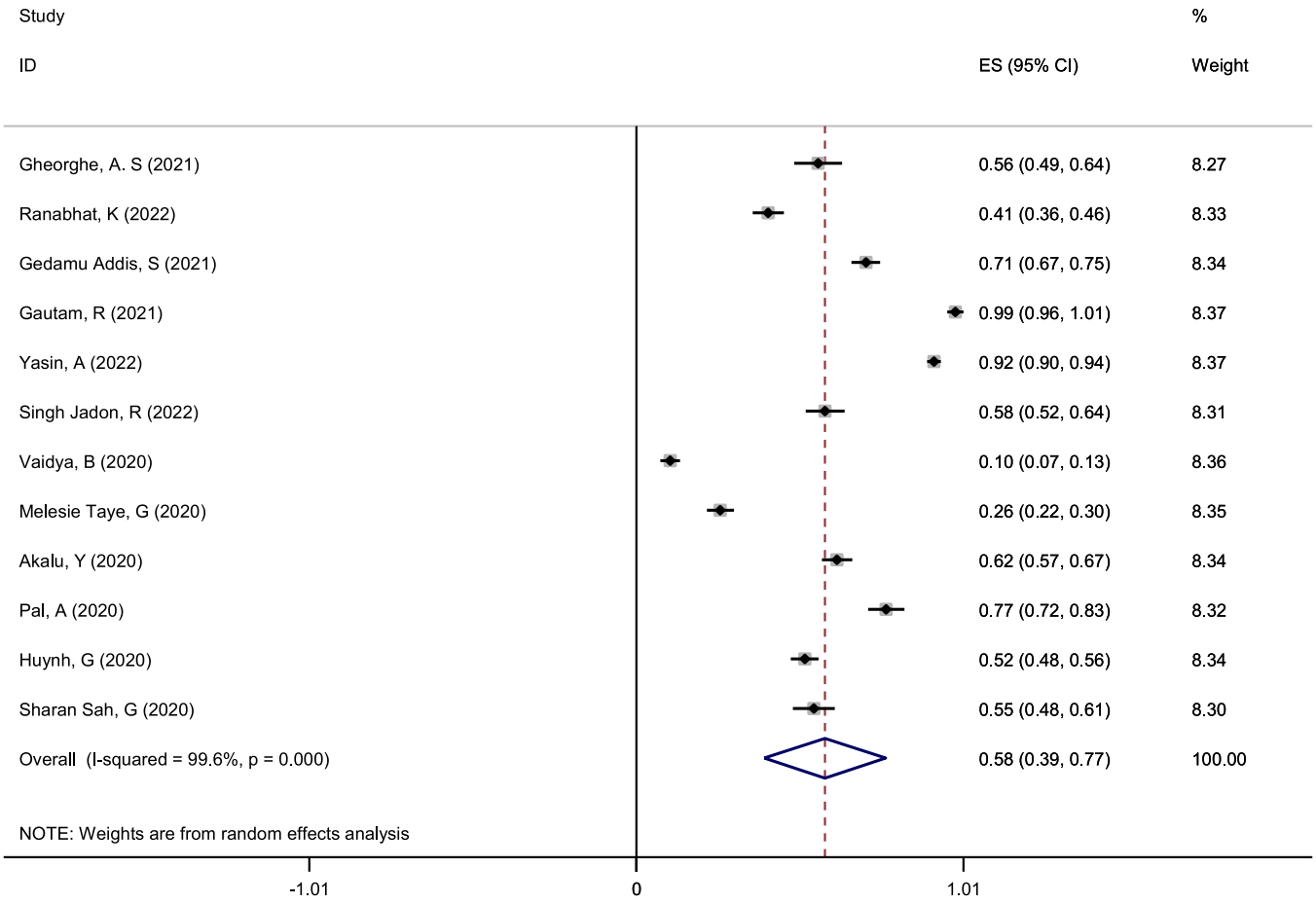

FIGURE 6 Forest plot of *I–V* heterogeneity random-effect meta-analysis for coronavirus disease 2019 preventive behaviors among chronic disease patients. 95% CI, 95% confidence interval.

Among different groups of patients, COVID-19 preventive behaviors were in the diabetic patients (77.2%) and the lowest in rheumatoid arthritis patients (10.4%), which is consistent with the findings related to the positive attitude of patients. Considering the characteristics of diabetes, and its possible wide complications, and as a result of continuous education for these patients, the concern about COVID-19 and, as a result, their COVID-19 preventive behaviors is more than those with other diseases.

Other findings from the current study indicate a decline in good knowledge, positive attitudes, and COVID-19 preventive behaviors over time. There might be a number of reasons for this drop in knowledge, attitudes, and COVID-19 behaviors. First, individuals may have become complacent or information fatigued as the pandemic progressed and more information became accessible, which would have diminished their focus on COVID-19-related measures. Therefore, the changes in public health guidelines and messaging, and the emergence of new variants could have contributed to confusion and decreased adherence to recommended practices. Moreover, as time passes, the community's overall perception of the risk associated with COVID-19 diminishes. This change is influenced by the normalization of circumstances and reduced frequent exposure for both oneself and others. It is important to note that this perception naturally evolves and may not align with the heightened awareness present at the beginning of the epidemic.

The generalizability of study's findings should be interpreted in the context of potential cultural and contextual influences on knowledge, attitudes, and practices (KAP) among the individuals with chronic diseases. It's essential to recognize that the research, primarily conducted in Asia and Africa, may not fully capture the nuances of other cultural settings or regional variations. Cultural factors, such as diverse healthcare beliefs, societal norms, and communication styles, can significantly impact how individuals perceive and respond to health-related information.

Recommendations for further study, such as longitudinal studies, will provide important new information on the durability of trends and possible catalysts for altering the preventative behaviors, attitudes, and awareness of COVID-19 among people with chronic illnesses. Exploring the effectiveness of interventions, including educational programs, healthcare provider engagement, and supportive environments, can enhance our understanding of strategies to improve COVID-19-related KAP in this vulnerable population.

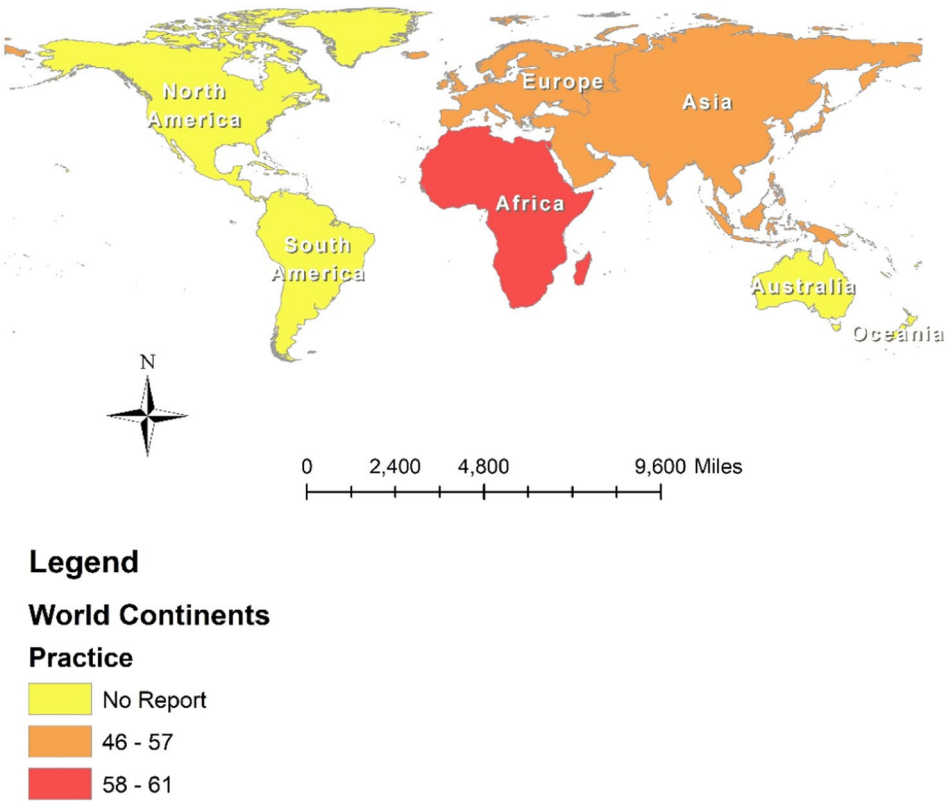

FIGURE 7 The percentage of coronavirus disease 2019 preventive behaviors among chronic disease patients across continents.

5 | LIMITATIONS

First, we only included research published in English, which means we might have missed relevant studies in other languages, possibly introducing bias, and limiting how broadly we can apply our findings. We encourage future research to adopt a more inclusive approach by incorporating studies published in languages other than English.

Second, there's a lack of studies on the knowledge, attitudes, and practices related to COVID-19 among chronic disease patients in the developed nations. This makes it difficult to estimate these rates for the chronic disease patients worldwide and makes it challenging to compare between different countries and continents. We recommend promoting targeted research in developed nations to fill the existing gap in understanding the knowledge, attitudes, and practices related to COVID-19 among chronic disease patients.

Third, there was substantial heterogeneity across the research we considered, which may have compromised our ability to generalize our results. Using statistical methods, we attempted to determine the source of this difference; nevertheless, it is possible that important confounding variables were overlooked. We recommend developing and disseminating guidelines for researchers conducting studies on COVID-19 and chronic disease patients. Emphasize standardized data collection tools, survey questions, and research methodologies.

Finally, even though we checked for publication bias using statistical tests, it's possible that studies with statistically significant or positive results were more likely to be published, which could affect our overall findings. We encourage researchers to pre-register their studies in public databases before conducting research. Journals can adopt policies that prioritize the publication of well-conducted studies, regardless of the statistical significance of results, to promote transparency in reporting negative or null findings.

6 | CONCLUSION

This meta-analysis highlights a concerning trend of decreasing knowledge, attitudes, and preventive behaviors related to COVID-19 among chronic disease patients. Addressing declining KAP related to COVID-19 among chronic disease patients demands a collaborative and multifaceted approach. We can strengthen public health resilience in the face of the growing pandemic by empowering people, including healthcare professionals, and putting into practice context-specific treatments that are guided by current research.

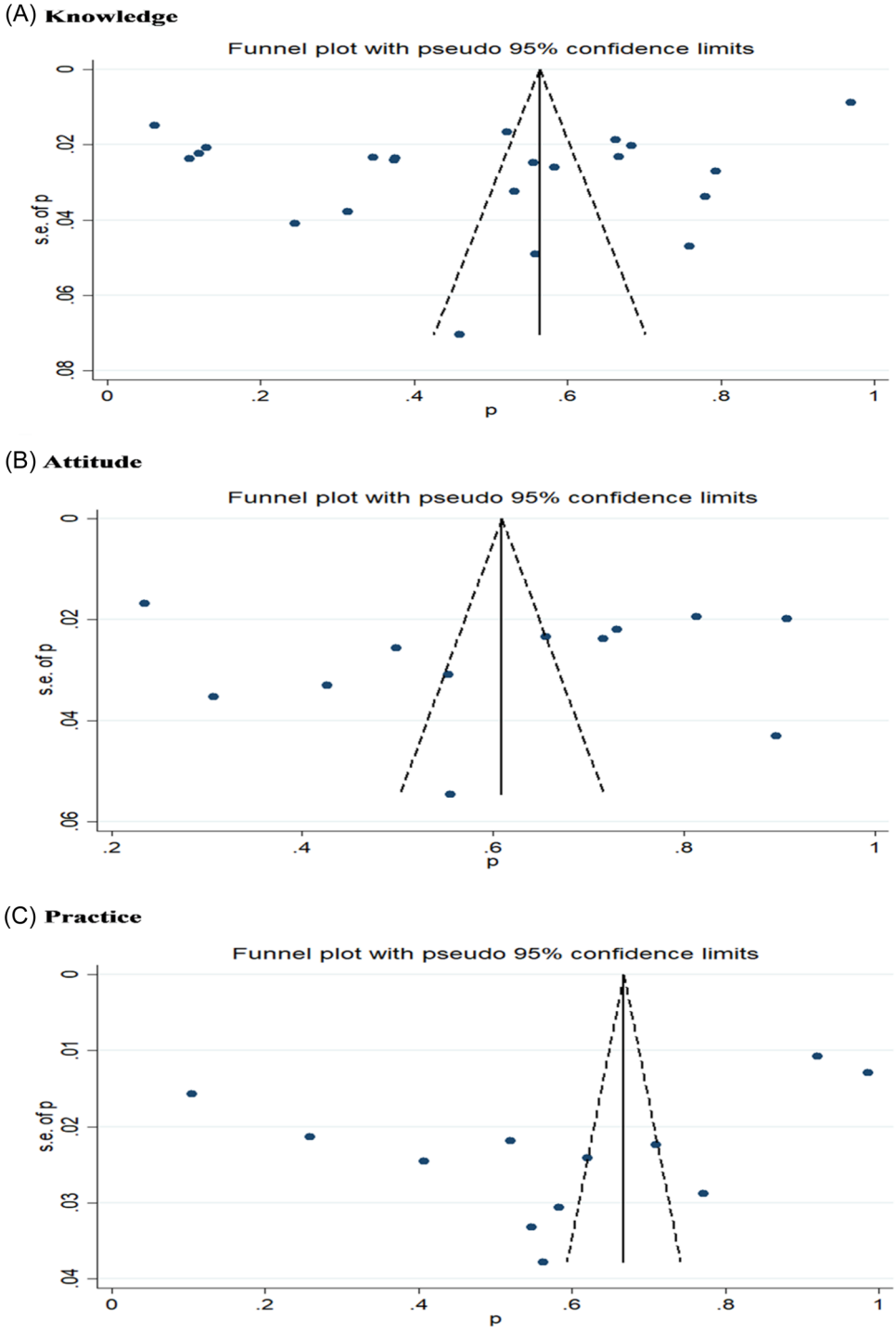

FIGURE 8 Funnel plot with pseudo 95% confidence limits for detection of publication bias among included studies.

AUTHOR CONTRIBUTIONS

Abdolreza Sotoodeh Jahromi: Data curation, funding acquisition, investigation, project administration, supervision, validation, visualization, writing—original draft. **Mohammad Jokar**: Data curation, formal analysis, investigation, methodology, writing—original draft. **Nader Sharifi**: Data curation, investigation, methodology, writing—original draft. **Amir E. Zahernasab**: Data curation, investigation, software. **Negin Kariminezhad**: Data curation, investigation, software. **Vahid Rahmanian**: Conceptualization, data curation, formal analysis, investigation, methodology, project administration, resources, software, supervision, validation, visualization, writing—original draft, writing—review and editing.

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Not applicable.

CONFLICT OF INTEREST STATEMENT

The authors declare no conflict of interest.

DATA AVAILABILITY STATEMENT

The authors recognize that the article, and its supplementary material contain the necessary data to support the findings presented in this research.

ETHICS STATEMENT

We diligently adhered to ethical principles for our systematic review and meta-analysis studies throughout this research. The study protocol obtained official approval from Ethics Committee of Jahrom University of Medical Sciences, with the assigned code IR.JUMS.REC.1401.115.

TRANSPARENCY STATEMENT

The lead author Vahid Rahmanian affirms that this manuscript is an honest, accurate, and transparent account of the study being reported; that no important aspects of the study have been omitted; and that any discrepancies from the study as planned (and, if relevant, registered) have been explained.

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SUPPORTING INFORMATION

Additional supporting information can be found online in the Supporting Information section at the end of this article.

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