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Review Paper

Knowledge, attitudes, and practices of the general population about Coronavirus disease 2019 (COVID-19): a systematic review and meta-analysis with policy recommendations

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ABSTRACT

Objectives: This study aimed to investigate and synthesize the current evidence on knowledge, attitudes, and practices (KAPs) of the general population regarding COVID-19.
Study design: This is a systematic review and meta-analysis.
Methods: We conducted a systematic search on PubMed/LitCovid, Scopus, and Web of Sciences databases for papers in the English language only, up to 1 January 2021. We used the Joanna Briggs Institute checklist developed for cross-sectional studies to appraise the quality of the included studies. All stages of the review conducted by two independent reviewers and potential discrepancies were solved with a consultation with a third reviewer. We reported the result as number and percentage. A meta-analysis conducted using a random effect model with a 95% confidence interval.
Results: Forty-eight studies encompassing 76,848 participants were included in this review. 56.53% of the participants were female. The mean age of the participants was 33.7 years. 85.42% of the included studies were scored as good quality, 12.50% as fair quality, and the remaining (2.08%) as low quality. About 87.5% examined all three components of the KAPs model. The knowledge component was reported as good and poor in 89.5% and 10.5% of the included studies, respectively. Of the studies that examined the attitude component, 100% reported a positive attitude. For the practice component, 93.2% reported satisfactory practice, and 6.8% poor practice. The result of the meta-analysis showed that the overall score of KAPs components about COVID-19 were 78.9, 79.8, and 74.1, respectively.
Conclusions: This systematic review and meta-analysis showed that the overall KAP components in the included studies were at an acceptable level. In general, knowledge was at a good level, the attitude was positive and practice was at a satisfactory level. Using an integrated international system can help better evaluate these components and compare them between countries.
PROSPERO registration code: (CRD42020186755).

Introduction

Coronavirus disease 2019 (COVID-19) was reported on 31st December 2019 from Wuhan, China, and announced by the World Health Organization (WHO) as a pandemic on 11th March 2020.[1,2] To date (27 January 2021), it was estimated that about 100 million people were infected with COVID-19 worldwide, of which about two million have died.[3]

COVID-19 is characterized by several flu-like symptoms including fever, respiratory problems (dry cough, shortness of

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breath or difficulty breathing, sore throat), chills, headache, and loss of taste. In addition, this disease is much more severe with men, higher age groups, and patients with other pre-existing conditions, such as cardiovascular disease, chronic respiratory disease, diabetes, and hypertension.[4,5] Based on existing evidence, about 81% of COVID-19 cases are mild, 14% are severe, and 5% are critical. The median time from symptoms onset to clinical recovery is approximately two weeks for mild cases and three to six weeks for severe or critical cases.[6] The incubation period for this disease was reported as 2–14 days based on WHO reports. The mortality rate for this disease is different among countries and was reported between 2% and 5%.[7,8] The most important ways to prevent this disease are to use a mask and maintain social distance.[9–11] So far, there have been several cases of infection in the general public, especially doctors and medical staff, some of which have led to death.[12–14]

Considering the extent and progress of COVID-19 disease and its major effects on economic, social, political, and cultural dimensions of all countries,[15,16] people with COVID-19 must be motivated, informed, and engaged in all aspects of the disease. From the onset of the disease until now, various studies conducted worldwide have investigated this disease and some of these studies have examined the knowledge, attitudes, and practices (KAPs) of people with COVID-19. Having enough knowledge about a disease can always affect people's attitudes and practices, and on the other hand, negative attitudes and practices can increase the risk of disease and death. Therefore, understanding the general population' KAPs and knowing potential risk factors can help to achieve the outcomes of planned behavior.[17,18]

Given the importance of the issue, conducting a review of studies that have examined the KAPs of individuals and summarizing the results can provide solid evidence for decision-makers in all countries to better manage the disease. Thus, this study aimed at conducting a systematic review to synthesize current evidence on KAPs of the general population with COVID-19 worldwide.

Materials and methods

Protocol and registration

We conducted a systematic review of the existing evidence related to KAPs of COVID-19 patients worldwide following Preferred Reporting Items for Systematic Reviews and Meta-analyses (PRISMA) statements (Appendix Supplementary file 1).[19] We also registered a protocol for this systematic review in the International Prospective Register of Systematic Reviews.[20]

Eligibility criteria

We included all studies which met the following inclusion criteria: 1) cross-sectional survey; 2) investigate at least one component of the KAPs model regarding COVID-19 disease worldwide; 3) published or in-press original paper; 4) in English; 5) with a sample representative general population. No restrictions were applied to the setting, time, or quality of the study.

Information sources, search and study selection

We search the PubMed/LitCovid, Scopus, and Web of Sciences for papers in the English language only, up to 1 January 2021. We conducted a search in Google Scholar for retrieving studies that were not cited in the abovementioned databases. In addition, the reference lists of the final included articles were hand-searched. The keywords used in the search were attitude, knowledge, practice, awareness, perception, action, COVID-19, coronavirus disease, SARS-CoV-2, and severe acute respiratory syndrome coronavirus 2. The full search strategy for the PubMed database is provided in Supplementary file 2. When the search was complete, all records were transferred to the Endnote software (V. X8; Clarivate Analytics, Philadelphia, PA) and duplicates were removed. Then, studies based on the title, abstract, and full text were screened by two researchers independently by considering the prespecified eligibility criteria. Disagreements were solved through consultation with a third researcher.

Data collection process and data item

Two researchers independently engaged in the data collection process and extracted data including author, year, journal name, location, study design, data collection tools, sample size, focusing group, mean age or range, gender percent, and result related to KAPs model components. Potential disagreements were solved through consultation with a third researcher.

Quality appraisal

Included studies were critically appraised by two researchers independently. We used the Joanna Briggs Institute checklist developed for cross-sectional studies to appraise the quality of the included studies.[21] This checklist contains eight simple and clear questions that cover topics such as inclusion criteria for sample; details about study subjects and setting; validity and reliability; criteria for measurement of the condition; confounding variables; and statistical analysis.[22] The answer to each questions is yes, no, unclear, and not applicable. Potential discrepancies were resolved by consultation with a third researcher.

Synthesis of results

Descriptive analyses were carried out in most sections and the pooled data reported as a number or percentage for similar data items. We used Microsoft Excel software to design the charts. We categorized the result of each component based on the study by Bdair et al.[23] They categorized each component in two categories as follows: knowledge: (good $\geq$50) or (poor <50), attitude: (positive $\geq$50) or (negative <50), and practice: (satisfactory $\geq$50) or (unsatisfactory <50). The Q-value was applied to discover between-study heterogeneity, and the I^2 statistic was calculated to assess statistical heterogeneity.[24] Based on Cochrane criteria if the heterogeneity was $\geq$50, we used the random effect model.[25] Although there was heterogeneity between the studies above, this was negligible due to differences in settings as well as the use of different questionnaires. However, we used subgroup analysis based on regions to reduce this heterogeneity.[26] In addition, a meta-analysis using a random effect model with a 95% confidence interval (CI) was conducted via CMA software (Version 2) based on the percent reported for each component of the KAPs model of the included studies. Publication bias was assessed using Begg's and Egger's tests and visual inspection of the funnel plot.

Additional analysis

We contacted ten experts in the related field including health promotion, public health, health policy, epidemiology, and behavioral science via email and asked for their opinions on how to increase the levels of these components in the community. Comments were translated verbatim and then analyzed using content analysis. The results of this section are presented as policy recommendations.

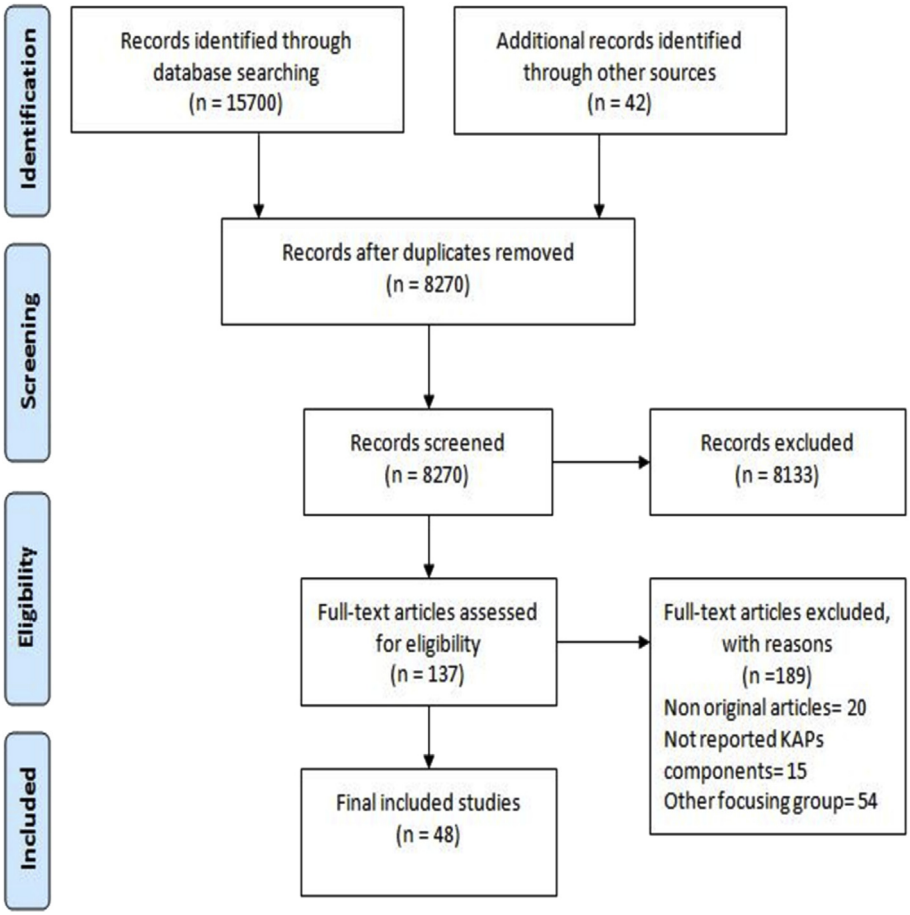

Fig. 1. PRISMA flow diagram.

Results

Study selection

A total of 15,742 records were retrieved from our database search. After removing duplicate, 8270 records were screened by title, abstract, and full text based on eligibility criteria, of which forty-eight studies were included in the final review.[23,27–73] The PRISMA flow diagram for the complete study selection process is presented in Fig. 1.

Study characteristics

Forty-two studies encompassing 76,848 participants were included. In addition, 56.53% of the participants were female. The mean age of the participants was 33.7 years. Most studies were from Asia, Africa, and America, (Fig. 2A). The most important method of data collection was online questionnaires (Fig. 2B). Most studies examined all three components of the KAPs model, but some studies examined two components or one component. More details about the characteristics of included studies are presented in Table 1.

Quality appraisal

The overall mean quality score of the included studies was 5.70. Of the included studies, 41 studies (85.42%) were scored as good quality (score ≥6), 6 (12.50%) as fair quality (score 3–5), and remaining (2.08%) as low quality (score <3) (Fig. 3). The lowest and highest quality scores in the studies were two and six, respectively. None of the studies scored on questions 5 and 6, which were related to identification and deal with confounding variables in the studies (for more details about items see Appendix Supplementary file 3).

Synthesis of results

Among the included studies, 87.5% examined all three components of the KAPs model simultaneously. The most studied component in the studies was the knowledge component with about 100%, followed by attitude and practice with 95.8% and 91.6%, respectively (Table 2, Fig. 4).

Of the studies that examined the knowledge component, 89.5% reported good knowledge, and 10.5% poor knowledge. As well as, of the studies that examined the attitude component, 100% reported a positive attitude. For the practice component, 93.2% reported satisfactory practice, and 6.8% unsatisfactory practice (Table 2, Fig. 5).

Meta-analysis

Based on the meta-analysis, the pooled overall score of KAPs components were 78.9 (95% CI: 96.1, 86.2, $P = 0.001$), 79.8 (95% CI: 80.8, 88.4, $P = 0.001$), and 74.1 (95% CI: 56.0, 86.5, $P = 0.011$), respectively. The results of subgroup analysis based on different continents of Africa, America, and Asia were 74.1, 74, and 83.8% for knowledge, 78.7, 63.2, and 85% for attitude, and 59.6, 78.5, and 81.5

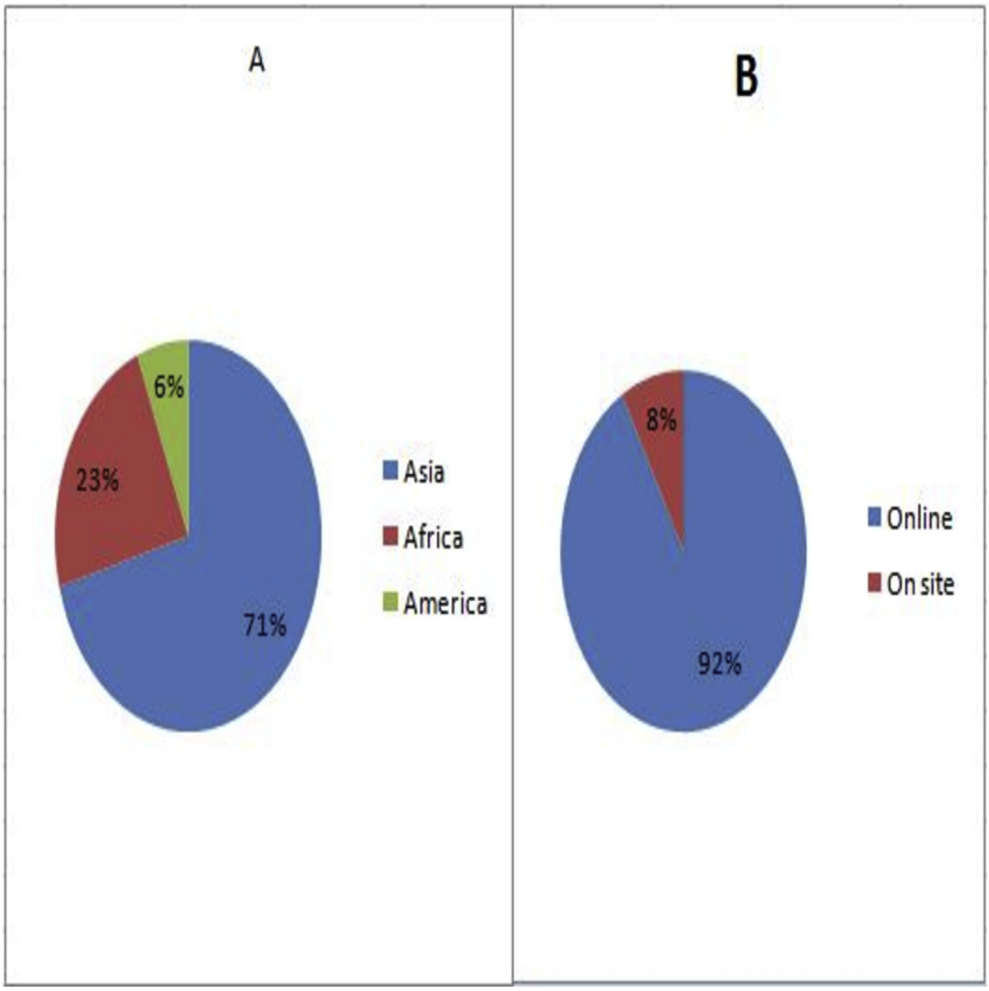

Fig. 2. The percentage of the included studies based on location (A) and data collection methods (B).

for practice components, respectively. The Asia continent had the highest percentage in all three components. The America continent had the lowest percentage in terms of knowledge and attitude, and the Africa continent had the lowest percentage in terms of practice (Table 3). Visual inspection of the funnel plot and results of Begg's (0.068) and Egger's test (0.082) did not showed significant evidence of publication bias (Appendix Supplementary file 4).

Policy recommendations

In accordance with experts, the policy recommendations for promoting the KAP components were as follow: holding training courses through virtual mass media; increase the commitment of government officials and policymakers to help conduct training courses; providing appropriate and evidence-based training content to enhance the components of the KAP; designing an integrated international system for measuring cup levels and comparing it between countries.

Discussion

COVID-19 has had serious, long-term, and sometimes irreparable effects on all aspects of the daily lives of individuals and society.[74,75] Getting informed from the knowledge, attitude, and practice of different general population can play a vital role in shaping the prevention behavior against COVID-19,[76,77] so the study of these components in different communities and between different groups seems necessary.

Strength and weakness

One of the most important strengths of this study was that all stages of the study were conducted with two researchers and in all stages, in cases of disagreement, the third person and consensus were used. In addition, registering the protocol of this study and reviewing and modifying it in the PROSPERO platform is the strength of this study. A large number of the included studies did not report the validity and reliability of the questionnaires. The main reason for this is the rush to publish articles related to coronavirus disease. The included studies were from both high- and low-income countries and therefore generalization of results to all countries should be done with caution. On the other hand, owing to the high speed of publication of articles in this field, some other studies may be published at the time of writing the article and the review process, which has been missed. Of course, owing to the high speed of publishing articles, this limitation is inevitable.

Summary of study findings

We found that about 90% of the samples had good knowledge of COVID-19 (overall score: 78.9%). In addition, 100% of the samples were reported positive attitudes regarding COVID-19 (overall score:

Table 1
Summary characteristics of the included studies.

Reference (Author, Year)	Journal	Location	Study Design	Data Collection tool	Sample Size	Male (%)	Mean Age or range
Adesegun et al., 2020[27]	American Journal of Tropical Medicine and Hygiene	Nigeria	Cross-sectional	Online questionnaire/ Google Form	1015	45.9	26.6
Alahdal et al., 2020[28]	Journal of Infection and Public Health	Saudi Arabia	Cross-sectional	Online questionnaire/ Google Form	1767	25	18-60+
Al-Hanawi et al., 2020[29]	Frontiers in Public Health	Saudi Arabia	Cross-sectional	Online questionnaire/ SurveyMonkey	3388	41.9	18-60+
Alhazmi et al., 2020[30]	Journal of Public Health Research	Saudi Arabia	Cross-sectional	Online questionnaire/ Google Form	1513	45	18-60+
Alobuia et al., 2020[31]	Journal of Public Health	USA	Cross-sectional	Telephone survey	1216	48	18-60+
Amalakanti et al., 2020[32]	Indian Journal of Medical Microbiology	India	Cross-sectional	Online questionnaire/ Google Form	1837	56.5	16-50+
Ashiq et al., 2020[33]	Bangladesh Journal of Medical Science	Pakistan	Cross-sectional	Online questionnaire/ Google Form	316	46.5	16-40+
Azlan et al., 2020[34]	PLOS ONE	Malaysia	Cross-sectional	Online questionnaire/ Survey Monkey	4850	42.1	34
Baig et al., 2020[35]	PLOS ONE	Saudi Arabia	Cross-sectional	Online questionnaire/ Google Form	2117	52.5	18-61+
Bates et al., 2020[36]	Journal of Communication in Healthcare	Colombia	Cross-sectional	Online questionnaire	482	28.1	18-50+
Bdair et al., 2020[23]	Asia Pacific Journal of Public Health	Saudi Arabia	Cross-sectional	Questionnaire	575	57.4	NR
Clements, 2020[37]	JIMIR public health and surveillance	USA	Cross-sectional	Online questionnaire/ MTurk platform	1034	58.2	37.11
Domiati et al., 2020[38]	Frontiers in Medicine	Lebanon	Cross-sectional	Online questionnaire/ Google form	410	42	−18-65+
Elayeh et al., 2020[39]	PLOS ONE	Jordan	Cross-sectional	Online questionnaire/ Google Form	2104	24.6	18-55+
Fallahi et al., 2020[40]	Journal of Military Medicine	Iran	Cross-sectional	Online questionnaire	836	27.5	−25-55+
Ferdous et al., 2020[41]	PLOS ONE	Bangladesh	Cross-sectional	Online questionnaire/ Google form	2017	59.8	12−64
Gao et al., 2020[42]	BMC Public Health	China	Cross-sectional	Online questionnaire survey/Wenjuanxing platform	2136	21.9	33.1 ± 8.8
Ghazi et al., 2020[43]	Public Health Education and Training	Iraq	Cross-sectional	Online questionnaire/ Google Form	272	58.1	36.35 ± 7.87
Haftom et al., 2020[44]	Infection and Drug Resistance	Northern Ethiopia	Cross-sectional	In site/Self-administered questionnaire	331	69.5	18−69
Hager et al., 2020[45]	PLOS ONE	Egypt, Nigeria	Cross-sectional	Online survey/Google Form	1437	52.5	18−59+
Hezima et al., 2020[46]	Eastern Mediterranean Health Journal	Sudan	Cross-sectional	Online survey/Google Form	812	54.2	18+
Honarvar et al., 2020[47]	International Journal of Public Health	Iran	Cross-sectional	In site/interview	1331	47.3	36 ± 13.9
Hossain et al., 2020[48]	PLOS ONE	Bangladesh	Cross-sectional	Online/email,public groups on Facebook	2157	54.1	33.48 ± 14.65
Jadoo et al., 2020[49]	Journal of Ideas in Health	Iraq	Cross-sectional	Online questionnaire/ Google Form/	877	41.7	all
Kakemam et al., 2020[50]	Frontiers in Public health	Iran	Cross-sectional	Online questionnaire/ Porsline	1480	42.8	31.29
Kasemy et al., 2020[51]	Journal of Epidemiology and Global Health	Egypt	Cross-sectional	Online questionnaire/ Google Form	3712	47.8	23.31 ± 13.28
Lau et al., 2020[52]	Journal of global health	Philippines	Cross-sectional	Online questionnaire/ SurveyCTO platform	2224	7.3	41.3
Mousa et al., 2020[53]	Sudan Journal of Medical Sciences	Sudan	Cross-sectional	Online questionnaire/ WhatsApp, Telegram groups, Facebook, and Twitter	2336	39.3	17-51+
Ngwewondo et al., 2020[54]	PLOS neglected tropical diseases	Cameroon	Cross-sectional	Online questionnaire/ WhatsApp, email, websites accounts	1006	46.9	33 ± 11.2
Nicholas et al., 2020[55]	The Pan African Medical Journal	Cameroon	Cross-sectional	In site/questionnaire	545	56	18-50+
Pascawati et al., 2020[56]	International Journal of Public Health Science	Indonesia	Cross-sectional	Online survey/ WhatsApp	155	49.7	11-60+
Paul et al., 2020[57]	PLoS ONE	Bangladesh	Cross-sectional	Online survey/ Facebook and email	1589	60.5	18-45+
Roy et al., 2020[61]		India	Cross-sectional		662	48.6	29.9

(continued on next page)

Table 1 (*continued*)

Reference (Author, Year)	Journal	Location	Study Design	Data Collection tool	Sample Size	Male (%)	Mean Age or range
	Asian Journal of Psychiatry			Online questionnaire/ Google Forms			
Rahman et al., 2020[58]	Bangladesh Medical Research Council Bulletin	Bangladesh	Cross-sectional	Online/Facebook, WhatsApp, Viber self-administered and face to face interview	1549	58	18-60+
Rajeh, 2020[59]	The Open Dentistry Journal	Saudi Arabia	Cross-sectional	Online survey/ Facebook, WhatsApp, and Twitter	521	31.7	36.24
Reuben et al., 2020[60]	Journal of Community Health	Nigeria.	Cross-sectional	Online survey/emails, WhatsApp and other social media	589	59.6	18–59
Sari et al., 2020[62]	Journal of Community Health	Indonesia	Cross-sectional	Online questionnaire/ Google Forms/ WhatsApp	201	46.3	35.5
Sayedahmed et al., 2020[63]	Scientific African	Sudan	Cross-sectional	Online questionnaire/ via Google	1718	38	12-50+
Sengeh et al., 2020[64]	BMJ Open	Sierra Leone	Cross-sectional	In site/questionnaire	1253	52	18-60+
Susilkumar et al., 2020[65]	International Journal Of Research In Pharmaceutical Sciences	India	Cross-sectional	Online questionnaire/ Google Forms	1015	49.3	20-60+
Tariq et al., 2020[67]	Disaster Medicine and Public Health	Pakistan	Cross-sectional	Online survey/social media and authors own network	2121	13.7	21.8 ± 4.13
Tandon et al., 2020[66]	Journal of Family Medicine and Primary Care	India	Cross-sectional	Online questionnaire/ online via mail and social media platforms	323	45.6	33.8
Van Nhu et al., 2020[68]	Journal of Community Health	Vietnamese	Cross-sectional	Online survey questionnaire	1999	21.7	18–59
Xu et al., 2020[69]	Journal Of Medical Internet Research	China	Cross-sectional	Online survey/ WhatsApp, Twitter	8158	37	18-60+
Yang et al., 2020[70]	Journal of Advanced Nursing	China	Cross-sectional	Online questionnaire/ WeChat, Sina Weibo, QQ	919	21.7	18+
Yousaf et al., 2020[71]	Social Work in Public Health	India	Cross-sectional	Online questionnaire/ WhatsApp, Facebook, and Instagram	516	32.6	16-45+
Yue et al., 2020[72]	Journal of Community Health	China	Cross-sectional	Online questionnaire/ WeChat, QQ	517	46.23	15–60
Zhong et al., 2020[73]	International Journal of Biological Sciences	China	Cross-sectional	Online questionnaire	6910	34.3	16–50≤

*NR: not reported.

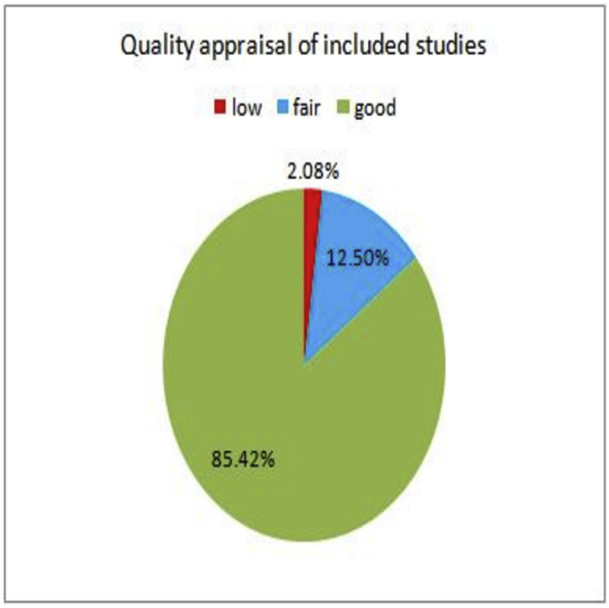

Fig. 3. The percentage of included studies based on quality score.

79.8%) and slightly more than 93% of samples performed satisfactory practices (overall score: 74.1%). The level of knowledge, attitudes, and practices is slightly high in the Asia continent. About 90% of the studies used an online questionnaire to collect data, and the most used platforms included Google form, SurveyMonkey, and Qualtrics. The most important social media through which the questionnaires were distributed were Facebook, WhatsApp, and Telegram. The most important sources for learning and staying up to date about COVID-19 mentioned in the studies were television, social media, the internet, radio, and friend and relatives.

Our result showed a high percentage of knowledge, attitudes, and practices in Asian countries. The probable reason for these higher percentages could be related to the factors such as the initial spread of the virus from this continent and the emergency acts that were taken earlier than other continents in this continent.[78,79] However, owing to the lack of studies in developed countries and the change of some factors related to knowledge, attitude, and practice over the past year, the generalizability of these results is low.

The finding of our systematic review demonstrated good knowledge about COVID-19. In most studies, more than 80% of the participants had a good knowledge of issues such as causes, symptoms, ways of transmission, and ways of prevention. In addition, most participants had a high level of

Table 2
Results related to coronavirus-related KAPs components of the included studies.

Reference (Author, Year)	Overall level of KAP components		
	Knowledge[a] Level (%)	Attitudes[b] Level (%)	Practices[c] Level (%)
Adesegun et al., 2020[27]	Good (78)	Positive (66)	Satisfactory (60.4)
Alahdal et al., 2020[28]	Good (58)	Positive (95)	Satisfactory (81)
Al-Hanawi et al., 2020[29]	Good (81.6)	Positive (77.5)	Satisfactory (52.3)
Alhazmi et al., 2020[30]	Good (81.3)	Positive (86.6)	Satisfactory (81.9)
Alobuia et al., 2020[31]	Good (59)	Positive (63)	Satisfactory (67)
Amalakanti et al., 2020[32]	Good (94.4)	Positive (70)	Satisfactory (77)
Ashiq et al., 2020[33]	Good (95.8)	Positive (87.6)	Satisfactory (94.3)
Azlan et al., 2020[34]	Good (80.5)	Positive (83.1)	Satisfactory (73.4)
Baig et al., 2020[35]	Good (68.1)	Positive (93.1)	Satisfactory (97.7)
Bates et al., 2020[36]	Good (79.3)	Positive (63.5)	Satisfactory (91.7)
Bdair et al., 2020[23]	Poor (51.1)	Positive (51.8)	Satisfactory (76.2)
Clements, 2020[37]	Good (80.8)	NR	Satisfactory (69.5)
Domiati et al., 2020[38]	Good (75)	Positive (78.4)	NR
Elayeh et al., 2020[39]	Good (60.9)	Positive (50.7)	Satisfactory (66.7)
Fallahi et al., 2020[40]	Good (74.2)	Positive (80.2)	Satisfactory (67.5)
Ferdous et al., 2020[41]	Poor (48.3)	Positive (62.3)	Satisfactory (55.1)
Gao et al., 2020[42]	Good (91.2)	Positive (98)	Satisfactory (96.8)
Ghazi et al., 2020[43]	Good (95.2)	NR	Satisfactory (NR)
Haftom et al., 2020[44]	Poor (42.9)	Positive (NA)	Satisfactory (NA)
Hager et al., 2020[45]	Good (61.6)	Positive (68.9)	Satisfactory (62.1)
Hezima et al., 2020[46]	Good (78.2)	Positive (89.2)	Satisfactory (53.1)
Honarvar et al., 2020[47]	Good (63)	Positive (54)	Satisfactory (78)
Hossain et al., 2020[48]	Good (86)	Positive (NR)	Satisfactory (NR)
Jadoo et al., 2020[49]	Good (77.8)	Positive (70.1)	Satisfactory (85.5)
Kakemam et al., 2020[50]	Good (87.5)	Positive (67.6)	Satisfactory (75.2)
Kasemy et al., 2020[51]	Good (64.1)	Positive (75.9)	Satisfactory (50.1)
Lau et al., 2020[52]	Good (85.3)	Positive (67)	Satisfactory (82.2)
Mousa et al., 2020[53]	Good (84.7)	Positive (80.2)	Satisfactory (72.2)
Ngwewondo et al., 2020[54]	Good (84.1)	Positive (69)	Satisfactory (60.8)
Nicholas et al., 2020[55]	Good (53.7)	Positive (73.5)	Satisfactory (60.9)
Pascawati et al., 2020[56]	Good (97.4)	Positive (68.3)	Satisfactory (82.5)
Paul et al., 2020[57]	Poor (67)	Positive (52.4)	Unsatisfactory (44.8)
Roy et al., 2020[61]	Good (NR)	Positive (86.7)	NR
Rahman et al., 2020[58]	Good (57.6)	Positive (80.5)	Satisfactory (76.1)
Rajeh, 2020[59]	Good (99)	Positive (99.6)	Satisfactory (73.3)
Reuben et al., 2020[60]	Good (99.5)	Positive (79.5)	Satisfactory (81.1)
Sari et al., 2020[62]	Good (98)	Positive (96)	Satisfactory (NA)
Sayedahmed et al., 2020[63]	Good (68.3)	Positive (89.9)	Unsatisfactory (48.5)
Sengeh et al., 2020[64]	Good (51.5)	Positive (83)	Unsatisfactory (41.1)
Susilkumar et al., 2020[65]	Good (81)	Positive (91.1)	Satisfactory (87.7)
Tariq et al., 2020[67]	Poor (49.2)	Positive (NR)	Satisfactory (NR)
Tandon et al., 2020[66]	Good (99)	Positive (97)	NR
Van Nhu et al., 2020[68]	Good (92.2)	Positive (68.6)	Satisfactory (75.8)
Xu et al., 2020[69]	Good (93.7)	Positive (99.2)	NR
Yang et al., 2020[70]	Good (85.2)	Positive (92.9)	Satisfactory (84.4)
Yousaf et al., 2020[71]	Good (88.9)	Positive (73.3)	Satisfactory (93)
Yue et al., 2020[72]	Good (57)	Positive (93.3)	Satisfactory (68)
Zhong et al., 2020[73]	Good (90)	Positive (94.1)	Satisfactory (97.2)

*NA: not report.
[a] Knowledge: (good ≥50), (poor <50).
[b] Attitude: (positive ≥50), (negative <50).
[c] Practice: (satisfactory ≥50), (unsatisfactory <50).

knowledge about symptoms such as high fever and dry cough, breathing difficulty and a small number had sufficient knowledge about other symptoms such as chills, headache, muscle pain, sore throat, and loss of taste or smell.[28,33,34,41,49,50,57,63] More than 90% of the participants considered air droplets as a way to spread. This good level of knowledge can be due to widespread information through various means such as public media (television and radio), social media, and government announcements. In addition, preparing several guidelines and reports by WHO, CDC, and local government in times of outbreak and easy access to them have increased the level of information and knowledge of individuals regarding COVID-19.[28,29,37,45,50,53,60,69] On the other hand, factors such as low literacy level, older age, and the presence of the rural population in the samples were among the factors that have reduced the level of knowledge in the studies.[31,35,64]

In this review, participants showed a positive attitude regarding COVID-19. Almost all participants believed in the importance of handwashing, disinfecting surfaces, using masks to prevent the spread of infection, resting at home in the event of symptoms, and maintaining social distance and limited contact. Of course, in some cases, there was a negative belief that it could be due to differences in instructions and guidelines by different institutions, such as what was about wearing a face mask at the beginning of the pandemic, and then it was recommended that the whole population should use a mask.[23,34,38,41,80,81] Such cases show the importance of integrated guidelines and the focus of decision-making in times of crisis.[39,82–85] Although having a responsible organization can help make better and faster

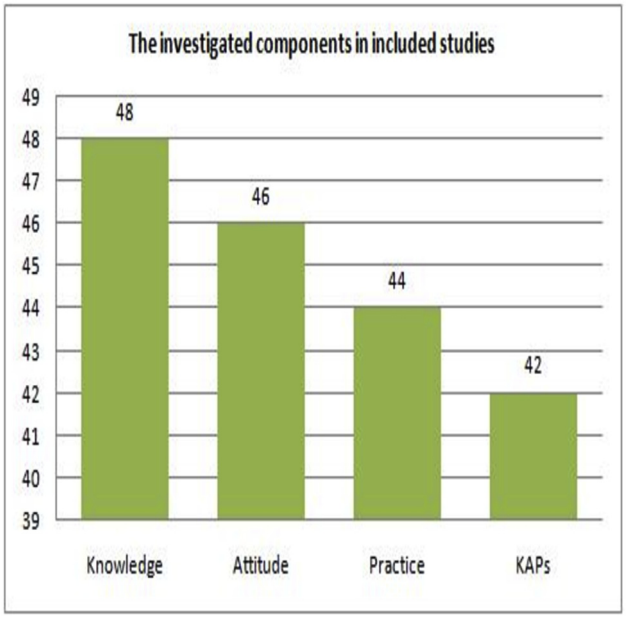

Fig. 4. The number of investigated components in the included studies.

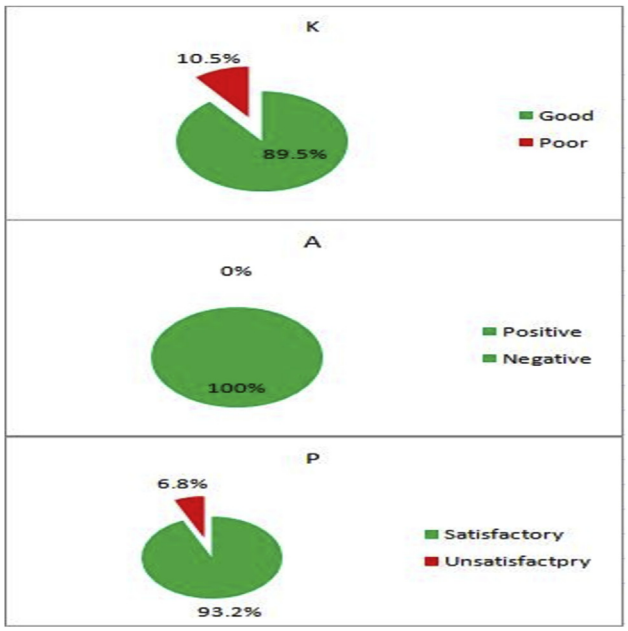

Fig. 5. The percentage of studies based on the knowledge (K), attitudes (A), and practices (P).

decisions, in such cases, political pressure is exerted by governments that such organizations should put the health of the people at the top and not refuse to make the right decisions due to political pressures.[11,31,86–88]

In general, the level of practice of the participants in the studies was satisfactory. However, despite the good knowledge and positive attitude of the participants, the level of practice was still sometimes lower than expected. Numerous reasons for unsatisfactory practices have been cited in studies. Lack of availability (for example, masks and disinfectants), imposing financial costs on participants, ambiguity in instructions, not getting used to new conditions such as staying home and wearing a mask, exhaustion from existing conditions, and anxiety and stress of disease were among the causes mentioned in the studies.[41,56,73,89–91] In this regard, some countries have imposed strict laws and penalties on people who do not follow the guidelines to improve their performance, but in many countries under study, such laws do not exist and have not been applied.[38,50,61,92,93] Another factor that affects the performance of individuals was the presence of decision-makers in public and social media. Seeing a person without a mask at the height of a pandemic hurt a person's good practices.

Given the diversity of settings and questionnaires, the authors of this article recommend that there be a need to design an integrated online system to assess the knowledge, attitudes, and practices of the population about health-related crises. Designing such an integrated system can help better compare countries because integrated items are used for comparison. On the other hand, designing such a system and disseminating its results can accelerate integrated decision-making and improve crisis management. On the other hand, the existence of such an integrated system can lead to an increase in solidarity, which was emphasized by the World Health Organization during the corona pandemic.[94,95]

Conclusion

This systematic review showed that the KAP components in the participants are at an acceptable level. In general, knowledge was at a good level, the attitude was positive and practice was at a satisfactory level. Providing accurate and up-to-date information in times of crisis and disseminating them through responsible institutions and the mass media and holding online training

Table 3
Meta-analysis of the pooled overall score of KAP components.

Component	Location	Number of studies	Score (%)	95% CI	Z-value	*P*-value
Knowledge	Africa	11	74.1	63.5, 82.5	4.13	0.001
	America	3	74.0	52.6, 88.0	2.17	0.001
	Asia	33	83.8	79.5, 87.4	11.1	0.001
	Overall	47	78.9	96.1, 86.2	5.02	0.001
Attitude	Africa	10	78.7	68.7, 86.1	4.93	0.001
	America	2	63.2	35.1, 84.6	0.91	0.359
	Asia	31	85.0	80.8, 88.4	11.4	0.001
	Overall	43	79.8	96.1, 87.5	4.70	0.001
Practice	Africa	10	59.6	48.5, 69.9	1.69	0.090
	America	3	78.5	61.5, 89.3	3.06	0.002
	Asia	26	81.5	76.9, 85.4	10.3	0.001
	Overall	39	74.1	56.0, 86.5	2.55	0.011

CI, confidence interval; KAP, knowledge, attitudes, and practices.

courses can help increase people's knowledge, attitudes, and practices.

Author statements

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Competing interest

The authors have declared that no competing interests exist.

Author contributions

MA-Z contributed to conception and design. MM, SS, and SH contributed to screen the records, data extraction, and quality appraisal. MA-Z and HA contributed to data analysis. MA-Z contributed to draft manuscript. SH and HA contributed to critical review. All authors approved the final version of the manuscript for publication.

Data availability statement

All relevant data are with the article and the attached supplementary information.

Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.puhe.2021.03.005.

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