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03 July 2024

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Fattori associati alla conoscenza autopercepita sul COVID-19: uno studio condotto tra le donne appartenenti alla coorte di nascita NINFEA

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Riassunto

Introduzione: L'alfabetizzazione sanitaria può favorire le strategie messe in atto per controllare la diffusione della malattia da coronavirus 2019 (COVID-19), poiché la popolazione necessita di acquisire tempestivamente le nuove informazioni sulla salute, comprendere le ragioni alla base delle raccomandazioni e adattare di conseguenza il proprio comportamento.

Obiettivi: Abbiamo studiato i fattori socio-demografici e relativi alla malattia che potrebbero influenzare la conoscenza autopercepita (medio/bassa vs. alta) sul COVID-19 tra le donne appartenenti alla coorte di nascita NINFEA (Nascita e Infanzia: gli Effetti dell'Ambiente).

Disegno: In totale, 3129 donne sono state incluse in uno studio trasversale.

Setting e partecipanti: Nell'aprile 2020 è stato somministrato via web un questionario anonimo contenente domande sul COVID-19 rivolte alle donne partecipanti alla coorte di nascita NINFEA.

Principali misure di outcome: Sono stati utilizzati modelli di regressione logistica mutivariata pesata per analizzare il livello di conoscenza autopercepita (medio/basso vs. alto) in relazione alle seguenti variabili: età, livello di istruzione, dimensione del nucleo familiare, incidenza cumulativa dei casi di sindrome respiratoria acuta da coronavirus 2 (SARS-CoV-2) per provincia al 7 aprile 2020, presenza di sintomi tipici del COVID-19, esposizione a test per SARS-CoV-2 ed aver ricevuto diagnosi di COVID-19.

Risultati: La prevalenza di un livello di conoscenza autopercepita medio/basso è del 57%. Le analisi condotte con regressione logistica multivariata hanno evidenziato un'associazione fra basso livello di istruzione e livello medio/basso di conoscenza autopercepita su COVID-19 (OR: 1,57; intervalli di confidenza al 95% (CI) 1,34-1,84). Inoltre è stata osservata un'associazione inversa fra conoscenza autopercepita medio/bassa ed esposizione a test per SARS-CoV-2 (OR: 0,25; IC95% 0,16-0,39) o a diagnosi di COVID-19 (OR: 0,20; IC95% 0,07-0,60. Non vi è associazione tra le altre variabili analizzate e il livello di conoscenza autopercepita.

Conclusione: In conclusione, i risultati suggeriscono che il basso livello di educazione sia un determinante del basso livello di conoscenza autopercepita su COVID-19 nelle donne di media età.

Parole chiave: COVID-19, conoscenza autopercepita, alfabetizzazione sanitaria, Italia, NINFEA

Abstract

Background: Health literacy may contribute to the strategies to control the coronavirus disease 2019 (COVID-19), as individuals need to acquire promptly new health information, understand the reasons behind recommendations, and adapt their behavior accordingly.

Objectives: We investigated socio-demographic- and disease-related factors that can influence self-perceived knowledge (poor/medium vs. high) about COVID-19 in women of the Italian NINFEA birth cohort.

Design: A total of 3129 women were included in a cross sectional study.

Setting and participants: A web-based anonymous survey onCOVID-19 was sent in April 2020 to women participating in the NINFEA cohort.

Main outcome measures: Using multiple weighted logistic regression models, we analysed self-perceived knowledge level in relation with the following variables: age, education level, family size, cumulative incidence of severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) cases until April 7th by province, presence of COVID-19-like symptoms, SARS-CoV-2 testing and COVID-19 diagnosis.

Results: The prevalence of self-perceived poor/medium knowledge was 57%. In multivariable logistic regression analyses, the odds ratio(OR) of self-perceived poor/medium COVID-19 knowledge level was increased for low/medium compared with high education level(OR: 1.57; 95% confidence intervals (CI) 1.34-1.84), and decreased for SARS-CoV-2 testing (OR: 0.25; 95%CI0.16-0.39) and COVID-19 diagnosis (OR:0.20; 95%CI 0.07-0.60). There was no evidence of association between the other analysed variables and self-perceived knowledge level.

Conclusions: In conclusion, our findings suggest that low educational level is a determinant of low self-perceived knowledge on COVID-19 in middle-aged women.

Keywords: COVID-19, self-perceived knowledge, health literacy, Italy, NINFEA

BOX:

Cosa si sapeva già

- Health literacy is important for the recommendations comprehension and translation into adequate preventive behaviors.

- The objective COVID-19 knowledge level has been reported to be positively associated with compliance to recommended preventive practices against the virus.

Cosa si aggiunge di nuovo

- Education level and having been tested for SARS-CoV-2 and having been diagnosed for COVID-19 are important determinants of self-perceived knowledge in women from the NINFEA birth cohort.

- The magnitude of the outbreak and the presence of COVID-19-like symptoms were not associated with the perceived knowledge on COVID-19.

Introduction

It is important to investigate strategies to better control and contain the coronavirus disease 2019 (COVID-19). Early symptoms detection, timely access to care and preventive practices can slow down and limit the spread of the disease. Health literacy, as defined by World Health Organization (WHO), "implies the achievement of a level of knowledge, personal skills and confidence to take action to improve personal and community health by changing personal lifestyles and living conditions".[1]

Low health literacy is associated with more hospitalizations and use of emergency care, lower adherence to mammography screening, influenza vaccine, and medical prescriptions, poorer ability to interpret labels and health messages, and poorer overall health status and higher mortality rates among elderly people.[2]

Various definitions of health literacy available in literature are largely due to different understanding of the relation between health knowledge and health literacy. In health literacy theories the position of knowledge is variable; health knowledge has been investigated either as an antecedence, as a part of health literacy, or as its direct consequence; though it has been typically treated as an outcome of health literacy.

In contrast with actual knowledge, self-perceived knowledge is the personal confidence about acquired capacities to get access to, to understand or to apply health information, hence it is a self-reported perceived capability[3,4], and this perception can influence personal choices even more than the actual knowledge.[3]

Given the complex link between health literacy and knowledge in the health-care context, both are demanding requirements to reach good control and prevention of adverse health outcomes.

Health literacy might be especially relevant in the ongoing COVID-19 crisis because in this context of unprecedented information overload and uncertainty, individuals need to promptly acquire and critically assess new information, filter untrustworthy sources, change their behavior accordingly and act in socially responsible way, beyond personal interests.[5] Furthermore, people who are more susceptible and vulnerable to COVID-19 infection may be also those with lower health literacy.

The level of COVID-19 knowledge has been reported to be positively associated with compliance to recommended preventive practices against the virus, such as wearing masks when going out and avoiding crowded places, in two studies in China and the US.[6,7]

In this study, we investigated the level of self-perceived knowledge about COVID-19 and its relationship with socio-demographic, disease- and pandemic-related factors using data from a cross-sectional questionnaire sent to the women participating in the Italian birth cohort NINFEA (Nascita e Infanzia: gli Effetti dell'Ambiente).

Methods

The NINFEA study is an Italian internet-based mother-child cohort that recruited 7,500 pregnant women within the 2005-2016 period with the aim of studying the associations between early-life exposures and later childhood and adulthood health outcomes. Women were asked to complete questionnaires during pregnancy, 6 and 18 months after delivery and when the children turned 4, 7, 10 and 13 years. Details on the cohort are available in previous publications.[8,9] The NINFEA study was approved by the Ethical Committee of the

San Giovanni Battista Hospital and CTO/CRF/Maria Adelaide Hospital of Turin (project number 45).

Women participating in the NINFEA cohort with at least one available follow-up questionnaire were asked to answer an anonymous online COVID-19 survey. The questionnaire was launched on April 7th 2020, and remained open for 13 days, during which two reminders were sent. The questionnaire collected information on basic socio-demographic characteristics (sex, education level, region, province and area of residence, year of participation in the NINFEA study), self-perceived knowledge level and sources of information on COVID-19, COVID-19-like symptoms, acute respiratory syndrome coronavirus 2 (SARS-CoV-2) testing and COVID-19 diagnosis within the household. Results on symptoms, testing and diagnosis are reported in a separate manuscript, in a preprint version at present.[10]

We assessed self-perceived knowledge on COVID-19 using the following question: "How would you rate your knowledge about COVID-19?". The level of self-perceived knowledge was self-rated by the participants using a five-level score: 1= very poor knowledge, 2= poor knowledge, 3=medium knowledge, 4= wide knowledge, 5= very wide knowledge. Our aim was to investigate the determinants of poor self-perceived knowledge, which had a rather low prevalence in our study, with only 93 women (3%) reporting very poor and poor COVID-19 knowledge level. Hence, we combined very poor, poor and medium vs. wide and very wide knowledge level to obtain a binary variable of poor/medium vs. high self-perceived knowledge level. The survey variables are described in Tables 1 and 2. We also obtained information on the population cumulative incidence of SARS-CoV-2 positive cases until April 7th 2020 by province from the national Surveillance System,[11] and the province population size (all residents as of January 1st 2020) from the Italian National Institute of Statistics.[12] The information on the province of residence of each participant to the survey was then used to assign to each participant the province COVID-19 cumulative incidence per 1000 inhabitants, which is considered as an indicator of the magnitude of the outbreak to which the participant was exposed to.

To adjust for non-response, we weighted the respondents using iterative proportional fitting,[13] allowing the distribution of the survey variables to resemble closely the NINFEA population margins (S1 Table). The weights were calculated using the following maternal characteristics: age (<35 years, 35-40 years, 40-45 years, 45-50 years and ≥50 years), education level (low - primary school or less, medium - secondary school, and high - university degree or higher), and period of enrollment into the NINFEA study (2005-2008, 2009-2012, 2013-2016).

We used weighted logistic regression models to estimate crude and mutually adjusted odds ratios (ORs) and 95% confidence intervals (CIs) of poor/medium vs. high self-perceived knowledge, for each socio-demographic variable and the province-specific cumulative incidence of COVID-19 per 1000 inhabitants. We also analyzed the association of self-perceived knowledge with COVID-19-like symptoms, testing for SARS-CoV-2 and diagnosis of COVID-19, adjusting for maternal age at compilation of the survey and maternal education level.

All analyses were conducted using Stata version 15.1 (College Station, Texas, USA).

Results

In total, the respondents to the survey were 3184, with a 54.2% response proportion. The respondents were similar to the baseline population invited in almost all of the baseline characteristics. We excluded fathers who completed the questionnaire (N=14), subjects resident abroad (N=26), and participants who had missing data in any of the analysed variables (N=15). The final sample size was of 3129 women. Socio-demographic characteristics are reported in Table 1, the prevalences of COVID-19-like symptoms, SARS-CoV-2 testing and COVID-19 diagnosis are shown in Table 2.

Tabella 1. Associazione tra le caratteristiche socio-demografiche e la dimensione contestuale dell'epidemia con il livello di conoscenza autopercepito medio/basso di COVID-19, tra 3129 donne partecipanti alla coorte di nascita italiana NINFEA

Table 1. Association of socio-demographic characteristics and the contextual magnitude of the outbreak with poor/medium self-perceived knowledge about COVID-19, among 3129 women participating in the Italian NINFEA birth cohort

Knowledge level about Covid-19		N or median (IQR)	Weighted[a] percentage of poor/medium knowledge (%)	OR(95%CI)	OR$_{adj}$[b](95%CI)
Knowledge level	Very Low	2	/	/	/
	Low	91			
	Medium	1674			
	High	1085			
	Very high	277			
Age(years)		42 (7)	-	0.95(0.88;1.02)[c]	0.97 (0.90; 1.04)[c]
Maternal education	High	2097	57.0	1.00(*reference*)	
	Medium/low	1032	43.0	1.61 (1.37;1.87)	1.57 (1.34; 1.84)
Residential area	Urban	973	28.5	1.00(*reference*)	
	Suburban	1479	49.5	1.23 (1.05;1.46)	1.15 (0.97;1.35)
	Rural	677	22.0	1.14 (1.02; 1.32)	1.05 (0.86;1.29)
Family size (n. of members)		4 (1)	-	1.03 (0.95;1.11)	1.03 (0.95;1.11)
COVID-19 cumulative incidence[d] per 1000 inhabitants		2.8 (0.8)	-	0.97(0.91;1.03)	0.97 (0.89;1.05)

OR: Odds Ratio

CI: Confidence interval

[a]Weighted using the marginal distribution of all women participating in the NINFEA study.

[b]OddsRatiomutually adjusted for allvariables in the table, and for region of residence (Piedmont, Tuscany, other regions of Northern Italy, Central and Southern Italian regions).

[c] Odds Ratio per 5 year increase.

[d]Cumulative incidence of Covid-19 until April 7th 2020 by province was calculated from the daily reported cumulative number of cases by province and province population size.

[a] Pesato utilizzando la distribuzione marginale di tutte le donne che partecipano allo studio NINFEA.

[b] Odds Ratio reciprocamente aggiustato per tutte le variabili in tabella e per la regione di residenza (Piemonte, Toscana, altre regioni del Nord Italia, regioni del Centro e Sud Italia).

[c] Odds Ratio per un aumento di 5 anni.

[d] L'incidenza cumulativa di COVID-19 al 7 aprile 2020 per ogni provincia è stata calcolata dal numero cumulativo giornaliero di casi per provincia e dalla dimensione della popolazione della provincia.

Tabella 2. Associazione tra i fattori relativi alla malattia ed conoscenza autopercepita medio/scarsa di COVID-19, tra 3129 donne partecipanti alla coorte di nascita italiana NINFEA

Table 2. Association ofdisease-related factors with poor/mediumself-perceived knowledge about COVID-19, among 3129 women partipating in the Italian NINFEA birth cohort

COVID-19-like symptoms, SARS-CoV-2 testing and COVID-19 diagnosis		Self-perceived knowledge level about COVID-19	
		Symptom prevalence[a] N	OR$_{adj}$[b] of poor/medium knowledge
Nasal congestion	No	2628	1.00 *(reference)*
	Yes	501	0.88 (0.72;1.07)
Fever 37-37.5°C	No	2887	1.00 *(reference)*
	Yes	242	0.94 (0.72;1.24)
Fever >37.5°C	No	2934	1.00 *(reference)*
	Yes	195	0.82 (0.61;1.11)
Sore throat	No	2566	1.00 *(reference)*
	Yes	563	0.89 (0.74;1.07)
Cough	No	2613	1.00 *(reference)*
	Yes	516	0.86 (0.71;1.04)
Muscle pain	No	2715	1.00 *(reference)*
	Yes	414	0.87 (0.71;1.08)
Fatigue	No	2505	1.00 *(reference)*
	Yes	624	0.96 (0.80;1.15)
Nausea/ Vomiting	No	2997	1.00 *(reference)*
	Yes	132	0.82 (0.57;1.18)
Diarrhea	No	2852	1.00 *(reference)*
	Yes	277	0.93 (0.72;1.20)
Anosmia/ Dysgeusia[c]	No	1944	1.00 *(reference)*
	Yes	59	1.12 (0.66;1.89)
Breathing difficulties[c]	No	1937	1.00 *(reference)*
	Yes	66	0.67 (0.41;1.12)
At least one symptom[d]	No	1801	1.00 *(reference)*
	Yes	1328	1.00 (0.87;1.16)
Tested for COVID-19[e]	No	3015	1.00 *(reference)*
	Yes	114	0.25 (0.16;0.39)
Positive/ COVID-19 diagnosis	No	3109	1.00 *(reference)*
	Yes	20	0.20 (0.07;0.60)

[a]Unweighted
[b]Odds Ratio adjusted for maternal age and educational level, and weighted for baseline population characteristics(95%confidence intervals in parentheses)
[c] Based on 2003 women
[d]Excluding anosmia/dysgeusia and breathing difficulties

The overall weighted prevalence of self-perceived poor/medium knowledge was 57%. As reported in Table 1, having a lower education level was associated with an increased odds ratio of self-perceived poor/medium knowledge (OR:1.57; 95%CI 1.34-1.84). In the crude analysis, women living in a suburban or rural residential area compared to an urban area had, respectively, a 23% and a 14% increased risk of poor/medium self-perceived knowledge, but this association was attenuated after adjustment for the other covariates, and in particular for education level. We found no evidence of association between the province cumulative incidence of COVID-19 and self-perceived knowledge of COVID-19 (OR: 0.97; 95%CI 0.89-1.05).

Overall, there was a weak or no association between the analysed COVID-19-like symptoms and self-perceived knowledge of COVID-19 (Table 2). There was a very low odds ratio of self-perceived low/medium knowledge for being tested vs. not tested for SARS-CoV-2 (OR:0.25;95%CI 0.16-0.39) and for COVID-19 diagnosis (OR:0.20; 95%CI 0.07-0.60).

Discussion
This study aimed at exploring factors associated with self-perceived knowledge on COVID-19 among women participating in the Italian NINFEA birth cohort. We found an inverse association between education level and self-perceived knowledge, while there was a weak or no association for the other socio-demographic factors. The magnitude of the outbreak in the province of residence was not associated with the perceived knowledge, probably because the lockdown in Italy had a national extension and people were indistinctly exposed to COVID-19-related information.
Conversely, SARS-CoV-2 testing and COVID-19 diagnosis were strongly associated with a better perceived knowledge. The latter result is in line with expectation and supports the study validity because people tested for SARS-CoV-2 or diagnosed with COVID-19 were probably informed by the health care personnel and/or more actively engaged in information-seeking behaviors than other participants, that resulted in their higher self-perceived knowledge.
Even if our study was based on a selected population of women who participate in a birth cohort study with, on average, a high education level, our results are consistent with findings of previous studies, [6,14,15] supporting that education level has a positive and strong effect on prior knowledge and health literacy and suggesting the importance of implementing citizens' education to improve population health literacy.[16]We only evaluated self-perceived knowledge, and had no information on the actual knowledge. It has been previously shown that the correlation between actual and self-perceived knowledge is moderate[17,18] and that self-perceived knowledge can influence all phases of the decision making process and information search,[3] even more than the actual knowledge. Factors influencing self-perceived knowledge on COVID-19 are therefore of particular interest, as the level of self-perceived knowledge is an indirect indicator of what people think about a particular argument. It has also been shown that self-perceived knowledge may influence perceived benefits of adopting preventative behaviors.[18]

Actual and self-perceived knowledge act differently in the decision-making process. The actual knowledge is important to make people aware and to promote informed decision making, while self-perceived knowledge affects the confidence in individuals' knowledge which would translate into correct decisions or seeking for more information.[18,19]

It should be considered that knowledge does not necessarily translate into practices, as being aware of the risks and the correct behaviors does not imply following the recommendations. This has been shown also in some studies on COVID-19 carried out in different contexts and different population subgroups. [20,21,22] Nevertheless, a Chinese study reported that COVID-19 knowledge was associated with a lower likelihood of negative behaviors investigated, such as going to a crowded place and not wearing a mask outside, and, despite optimistic attitudes towards COVID-19, the majority of study participants took necessary precautions to prevent infection.[6]

The main strength of our study is the use of an established birth cohort for the collection of information about COVID-19. This setting minimizes the risk of selection bias due to outcome-driven participation. The response rate was 54.2% that is in line with the response proportion typically seen in follow-up questionnaires of birth cohort studies at 10-15 years after the initial recruitment. Although the population baseline characteristics were similar between respondents and non-respondents, we weighted all the estimates for socio-demographic determinants of non-response, and the reweighting had only a marginal impact on the estimates. One of the limitations of our study is the lack of information about actual knowledge level and about possible factors related to knowledge, like attitudes, practices towards COVID-19 and risk perception, which were found to be positively associated with knowledge level.[6,7,23]

Knowledge level, acceptance and implementation of preventive measures and correct behaviors are country-specific, but education is recognized as a strong factor influencing health literacy and correct health behaviors.[24,16,25] Clear, tailored and personalized communication resources targeting low health-literacy populations, such as a presentation of only essential information, avoidance of distracting data, graphical and video support, could improve comprehension of health-related information and help development of optimal educational programs.[26] Therefore, educational and behavioral programs to fight against COVID-19 could specifically target population subgroups with lower education level, and measures and dissemination for prevention purposes may be personalized on the basis of the a-priori knowledge and country-specific needs.

Conclusion

In conclusion, our findings suggest that low educational level is a determinant of low self-perceived knowledge on Covid-19 in middle-aged women.

Competing interests

The authors declare that they have no competing interests.

Reference

1. WHO | The WHO Health Promotion Glossary. *WHO*. 2019. http://www.who.int/healthpromotion/HPG/en/. Accessed July 31, 2020.
2. Berkman ND, Donahue K, Berkman ND, et al. Low Health Literacy and Health Outcomes⊡: An Annals of Internal Medicine Review Low Health Literacy aBerkman, N. D., Donahue, K., Berkman, N. D., Sheridan, S. L., Donahue, K. E., Halpern, D. J., & Crotty, K. (2011). Low Health Literacy and Health Outcomes. 2011;155(July). doi:10.1059/0003-4819-155-2-201107190-00005
3. Park CW, Gardner MP, Thukral VK. Self-Perceived Knowledge: Some Effects on Information Processing for a Choice Task. *Am J Psychol*. 1988;101(3):401. doi:10.2307/1423087
4. Gellert P, Tille F. What do we know so far? The role of health knowledge within theories of health literacy. *Eur Heal Psychol*. 2015;17(6):266-274. https://pdfs.semanticscholar.org/091c/9f58a507fd7a60ce14aee2e7397da7b9a26e.pdf?_ga=2.2344457 90.1557863600.1589130400-1802008879.1589130400.
5. Paakkari L, Okan O. COVID-19: health literacy is an underestimated problem. *Lancet Public Heal*. 2020;5:e249-e250. doi:10.1016/S2468-2667(20)30086-4
6. Zhong BL, Luo W, Li HM, et al. Knowledge, attitudes, and practices towards COVID-19 among chinese residents during the rapid rise period of the COVID-19 outbreak: A quick online cross-sectional survey. *Int J Biol Sci*. 2020;16(10):1745-1752. doi:10.7150/ijbs.45221
7. Clements JM. Knowledge and behaviors toward COVID-19 among us residents during the early days of the pandemic: Cross-sectional online questionnaire. *J Med Internet Res*. 2020;22(5):1-11. doi:10.2196/19161
8. Richiardi L, Baussano I, Vizzini L, Douwes J, Pearce N, Merletti F. Feasibility of recruiting a birth cohort through the Internet: The experience of the NINFEA cohort. *Eur J Epidemiol*. 2007;22(12):831-837. doi:10.1007/s10654-007-9194-2
9. Blumenberg C, Zugna D, Popovic M, Pizzi C, Barros AJD, Richiardi L. Questionnaire breakoff and item nonresponse in web-based questionnaires: Multilevel analysis of person-level and item design factors in a birth cohort. *J Med Internet Res*. 2018;20(12). doi:10.2196/11046
10. COVID-19-like symptoms and their relation to SARS-CoV-2 epidemic in children and adults of an Italian birth cohort. June 2020. doi:10.21203/RS.3.RS-34027/V1
11. COVID-19 Italia - Monitoraggio situazione. https://github.com/pcm-dpc/COVID-19. Accessed June 11, 2020.
12. Italian National Institute of Statistics (ISTAT). http://dati.istat.it/ (2020).
13. Battaglia MP, Frankel MR, Link MW. Improving Standard Poststratification Techniques For Random-Digit-Dialing Telephone Surveys. *Surv Res Methods*. 2008;2(1):11-19. doi:10.18148/SRM/2008.V2I1.597
14. Zegarra-Valdivia JA, Chino-Vilca BN, Ames-Guerrero R. Knowledge, perception and attitudes in Regard to COVID-19 Pandemic in Peruvian Population. *PsyArXiv*. 2020;(April). doi:10.31234/osf.io/kr9ya
15. Samir Abdelhafiz A, Mohammed Z, Maha ·, et al. Knowledge, Perceptions, and Attitude of Egyptians Towards the Novel Coronavirus Disease (COVID-19). doi:10.1007/s10900-020-00827-7
16. Sun X, Shi Y, Zeng Q, et al. Determinants of health literacy and health behavior regarding infectious respiratory diseases: A pathway model. *BMC Public Health*. 2013;13(1). doi:10.1186/1471-2458-13-261
17. Flynn LR. A Short , Reliable Measure of Subjective Knowledge. 1999;2963(February). doi:10.1016/S0148-2963(98)00057-5
18. Krawczyk A, Stephenson E, Perez S, Lau E, Rosberger Z, Lau Jewish General Hospital Zeev Rosberger E. Deconstructing Human Papillomavirus (HPV) Knowledge: Objective and Perceived Knowledge in Males' Intentions to Receive the HPV Vaccine. *Am J Heal Educ*. 2013;44(1):26-31. doi:10.1080/19325037.2012.749714
19. Selnes F, Gr°nhaug K. Subjective and Objective Measures of Product Knowledge Contrasted. *ACR North Am Adv*. 1986;NA-13.
20. Kebede Y, Yitayih Y, Birhanu Z, Mekonen S, Ambelu A. Knowledge, perceptions and preventive practices towards COVID-19 early in the outbreak among Jimma university medical center visitors, Southwest Ethiopia. Tu W-J, ed. *PLoS One*. 2020;15(5):e0233744. doi:10.1371/journal.pone.0233744
21. Mubeen S, Kamal S, Kamal S, Balkhi F. Knowledge and awareness regarding spread and prevention of COVID-19 among the young adults of Karachi. *J Pak Med Assoc*. 2020;70(Suppl 3(0):1.

doi:10.5455/JPMA.40

22.   Bhagavathula AS, Aldhaleei WA, Rahmani J, Mahabadi MA, Bandari DK. Knowledge and Perceptions of COVID-19 Among Health Care Workers: Cross-Sectional Study. *JMIR Public Heal Surveill.* 2020;6(2):e19160. doi:10.2196/19160

23.   Iorfa SK, Ottu IFA, Oguntayo R, et al. COVID-19 knowledge, risk perception and precautionary behaviour among Nigerians: A moderated mediation approach. doi:10.1101/2020.05.20.20104786

24.   Dewalt DA, Berkman ND, Sheridan S, Lohr KN, Pignone MP. *Literacy and Health Outcomes A Systematic Review of the Literature.* Vol 19.; 2004. www.ahrq.gov,. Accessed June 22, 2020.

25.   Pandit AU, Tang JW, Bailey SC, et al. Education, literacy, and health: Mediating effects on hypertension knowledge and control. *Patient Educ Couns.* 2009;75(3):381-385. doi:10.1016/j.pec.2009.04.006