# Research Paper
# The Associations Between Sources of Vaccine News and the Intention to Change Adherence to COVID-19 Preventive Health Measures

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## ABSTRACT

**Background:** Although the scientific literature has extensively discussed the impact of the media on people's health-related behaviors, there is little evidence of the effect of different sources of COVID-19 vaccine news on changing the intention to adhere to health protocols. Therefore, the present study was conducted to investigate the sources of news on the COVID-19 vaccine and the association of each of these sources with the intention of changing adherence to COVID-19 preventive health measures (ICA-COVID-19-PHM).

**Methods:** This cross-sectional study was conducted on 1000 public population (67.4% female and 32.6% male) of Mazandaran province (age range: 18 to 60 years). The data were collected between January and April 2021 by completing an unidentified online "Google form" questionnaire via social media platforms, such as Telegram, WhatsApp, Soroush, ETA, and Instagram. The two-level linear regression analysis was used to examine the association between the sources of news on the COVID-19 vaccine and the ICA-COVID-19-PHM (social and personal aspects).

**Results:** The most common sources of receiving news were mass media (radio and television with 54%) and virtual networks with 49%. The results showed the ICA-COVID-19-PHM for the news source via virtual workgroups was positive (B=1.36; 95% CI, 0.31%, 2.41%; P=0.01) and for the news sources via virtual networks (B=-0.83; 95% CI, -1.62%, -0.05%; P=0.04) and satellites and foreign news agencies (B=-1.50; 95% CI, -2.64%, -0.36%; P=0.01) was negative. While, the ICA-COVID-19-PHM was not significant (P>0.05) for other sources, such as groups of friends and neighbors, newspapers and magazines, radio and television, and news websites.

**Conclusion:** The management of news sources in epidemics is important because they have associations with adherence to preventive health measures. Policymakers should consider the distribution of vaccine news sources on the ICA-COVID-19-PHM.

**Keywords:** COVID-19, Vaccine, News, Adherence, Intention, Prevention

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## 1. Introduction

The COVID-19 pandemic has created various economic, social, and health challenges for all humans in the world [1]. From the beginning of the epidemic until now, different countries, depending on the extent of their involvement, have taken various preventive measures to prevent the infection and its attenuation at various public, institutional, and individual levels [2]. Before the arrival of the COVID-19 vaccine, adherence to health protocols, such as social distance, physical distancing, wearing face masks, and hand hygiene was recognized as the most important procedure to control the epidemic at the individual level [3]. In addition, it is still recommended to follow health protocols even after the vaccination of target groups [4]. Adherence to health measures varied in different populations and groups [5, 6]. Different factors were important in changing the level of adherence [7-9]. News plays an important role in risk communication and adherence to health protocols during the epidemic [10, 11], and also to reduce the spread of the virus [12, 13]. The news of vaccine development in various news sources and its subsequent injection among the target groups showed changes in adherence to health protocols. But there are very few studies in this regard. A review study in Western countries showed that among different groups, older women trusted the governments concerning COVID-19 news and their main source of access to COVID-19 information was traditional news media (radio and television) [14]. In addition, previous studies have demonstrated that news received from traditional and state media, such as radio and television has increased adherence to protocols, but news from social networks has reduced adherence [15]. However, no similar study has been found in the socio-political context of Iran concerning the effect of different sources of vaccine news on changing adherence to health protocols. Consequently, the present study was designed based on two specific objectives: 1) Determining the portion and number of people using a variety of news sources for vaccine-related news.

2) Investigating the relationship between the types of sources concerning COVID-19 vaccine news on the intention to change the adherence to COVID-19 preventive measures (ICA-COVID-19-PHM) in a sample of Iranian people in Mazandaran Province in the north of Iran.

## 2. Methods

### Procedure

This cross-sectional study was conducted using an anonymous online questionnaire (Google Form) to gather data from participants via social media platforms, such as Telegram, WhatsApp, Soroush, ETA, and Instagram, between January and April 2021 in the cities of Mazandaran Province in North of Iran. Informed consent was obtained from all respondents by asking if they are interested in completing the online questionnaire. The general objectives of the research were stated at the baseline, and those who agreed to participate were asked to complete the online questionnaire.

### Subjects

The participants of this study were 1000 individuals aged 18 to 60 years in Mazandaran Province. The snowball sampling method was used for more participation so that during the study period, those who were sent the questionnaire link for the first time, were asked to share with their contacts. The exclusion criterion was participants that received the COVID-19 vaccine.

### Measures

### Dependent variable

**The intention changing adherence to COVID-19 preventive health measures (ICA-COVID-19-PHM):** To measure this variable, the numerical difference of the score concerning two sub-scales, adherence to COVID-19 preventive health measures in the current situation (before vaccination of COVID-19) with Cronbach's α of 0.89 and the intention to adhere to the COVID-19 preventive health measures after receiving the vaccine with Cronbach's α of 0.92 was applied in this study. Each of these subscales consisted of two factors (social and personal aspects). The construct validity of the questionnaire was evaluated by confirmatory factor analysis (CFA) and showed acceptable fit indices ($χ^2$=346.4, df=33, CFI=0.94, TLI=0.92, RMSEA=0.08, and SRMR=0.04 for perceived adherence to prevention measures versus COVID-19 and $χ^2$=578.3, df=33, CFI=0.92, TLI=0.89, RMSEA=0.10, and SRMR=0.06 for intention for adherence to prevention measures versus COVID-19) [16].

Social aspects included physical distance, keeping a safe distance of at least six feet (approximately 2 m), avoiding leaving home except for essential work, isolat-

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ing myself at home, when I am sick, avoiding any non-essential travel (domestic or international), and avoiding crowded places (concerts, conferences, arenas, and festivals). Personal aspects included personal hygiene, hand and face wash, wearing a mask, use of disinfection, and use of gloves. The response options in the questionnaire were defined from 1: Weakest compliance to 5: Strongest compliance. The participants of the study were asked to determine their status in order to adhere to these behaviors.

**Independent variable**

A variety of sources to receive vaccination news. A question with several options was used to measure this variable. The question was as follows: "What are your main sources for COVID-19 news? (such as morbidity, mortality, and discovery of new vaccines and drugs for treatment and prevention)" The answer options were: 1) Relatives, friends, and neighbors; 2) Virtual networks such as WhatsApp and Instagram; 3) Newspapers and magazines; 4) Radio and television; 5) Satellites or foreign news agencies; 6) Virtual workgroups; 7) News websites; and 8) Other sources. Participants could choose more than one option.

**Control variables**

These variables included demographic and socio-economic information. The variables were age (quantitatively by year), gender (male and female), marital status (single, married, or divorced), degree (undergraduate, diploma, postgraduate, bachelor, master, and PhD), occupation (health, military, student, housewife, employee of other non-health organizations, others), income level (insufficient, sufficient but no savings, and sufficient with savings).

**Data analysis**

Descriptive statistics (relative frequency for categorical variables, the Mean±SD for quantitative variables) were presented for all variables. The chi-square test and ANOVA were used to determine the relationship between independent and dependent variables across control variables. Also, two-level linear regression models (first level: Individual characteristics and second level: Cities of residence) were run to examine the association between each news source and ICA-COVID-19-PHM (total, the personal aspect, and the social aspect).

Prior to running the full model for each of these outcomes, the unconditional model was run for the same outcome to compute intra-class correlation coefficients (ICCs) as an indicator of shared variance at the city level. The full model was run with all independent and control variables entering the model simultaneously. All analyzes were performed with Stata software, version 16. The significance threshold for all other tests was set at a $P<0.05$.

## 3. Results

Descriptive statistics of dependent, independent, and control variables are presented in Table 1. The most common sources to receive the news of the COVID-19 vaccine were the mass media, radio, and television with 54.2% (n=540) and virtual networks with 49.1% (n=489). The current sample population had mostly undergraduate education. The distribution of independent variables across the control variables is presented in Table 2. Except for the source of receiving mass media news (radio and television), the distribution of news sources was not significantly different according to gender and income level.

There was a significant difference in the distribution of COVID-19 news sources based on marital status, relatives, friends, virtual networks, mass media (radio and television), satellite, and foreign news agencies. Besides, there was a significant difference in the distribution of COVID-19 news sources according to education level in all sources except newspapers and magazines. Moreover, there was also a significant difference in the distribution of COVID-19 news sources based on the job in all sources except newspapers, magazines, satellites, foreign news agencies, and virtual workgroups.

Comparisons of the mean dependent variable score (ICA-COVID-19-PHM), social preventive measures, and personal preventive measures across the control variables are presented in Table 3. The changes in adherence to health protocols in general and social status were significantly different in terms of the subgroups of marital status, level of education, occupation, and age groups. While the change in adherence to personal preventive protocols was significantly different in terms of marital status subgroups, level of education, and age groups.

Table 4 presents unconditional models (without any variables) for each of the outcomes. The results illustrated that the ICA-COVID-19-PHM (total, social, and personal) at the city level (ICCs) was negligible (ICCs <0.008). Table 5 provides the associations of each vaccine

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**Table 1.** Descriptive statistics of the dependent, independent, and control variables in samples

| Variables | | Mean±SD (Min, Max)/No. (%) |
|---|---|---|
| ICA-COVID-19-PHM (dependent variables) | Total | -2.1±6.1 (-31, 31) |
| | Social aspect | 1.4±3.7 (-17, 18) |
| | Personal aspect | 0.71±2.9 (-15, 15) |
| Sources of news (independent variables) | Relatives, friends, and neighbors | 154(15.5) |
| | Virtual networks (WhatsApp, Instagram, …) | 489(49.1) |
| | Newspapers and magazines | 38(3.8) |
| | Radio and TV | 540(54.2) |
| | Satellites or foreign news agencies | 129(13.0) |
| | Virtual workgroups | 170(17.1) |
| | News websites | 246(24.7) |
| | Others | 81(8.1) |
| Gender (control variable) | Female | 674(67.4) |
| | Male | 326(32.6) |
| Marital status (control variable) | Single | 371(37.1) |
| | Married | 600(60) |
| | Divorce | 22(2.2) |
| Education level (control variable) | Under diploma | 77(7.7) |
| | Diploma | 265(26.5) |
| | Associate degree | 70(7) |
| | BS | 355(35.5) |
| | MSc | 156(15.6) |
| | PhD | 77(7.7) |
| Income (control variable) | Not enough | 497(49.7) |
| | Enough but without savings | 388(38.8) |
| | Enough and have savings | 115(11.5) |
| Job (control variable) | Health workers | 251(25.1) |
| | Military | 8(0.8) |
| | Students | 216(21.6) |
| | Housewives | 180(18) |
| | Employees of other organizations | 111(11.1) |
| | Others | 234(23.4) |
| Age groups (y) (control variable) | <25 | 331(33.2) |
| | 25-40 | 354(35.5) |
| | 41-55 | 270(27.0) |
| | >56 | 43(4.3) |

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**Table 2.** Comparison of the independent and dependent variables across control variables in samples

| Control Variables | | Relatives, Friends, and Neighbors | Virtual Networks (WhatsApp, Instagram, …) | Newspapers and Magazines | Radio and TV | Satellites or Foreign News Agencies | Virtual Workgroups | News Websites | Others |
|---|---|---|---|---|---|---|---|---|---|
| Frequency of independent variables | | 154(15.5) | 489(49.1) | 38(3.8) | 540(54.2) | 129(13.0) | 170(17.1) | 246(24.7) | 81(8.1) |
| Chi-square test | | 2.89 | 0.0471 | 1.1 | 7.56** | 1.95 | 0.08 | 2.1 | 0.7 |
| Gender | Female | 60(38.46) | 330(67.07) | 22(59.46) | 345(63.65) | 80(62.02) | 113(66.47) | 157(63.56) | 58(71.6) |
| | Male | 96(61.54) | 162(32.93) | 15(40.54) | 197(36.35) | 49(37.98) | 57(33.53) | 90(36.44) | 23(28.4) |
| Chi-square test | | 11.2* | 15.48*** | 2.5 | 12.8** | 10.2* | 7.19 | 5.1 | 0.43 |
| Marital status | Single | 76(48.72) | 211(42.89) | 12(32.43) | 176(32.47) | 49(37.98) | 51(30.0) | 102(41.3) | 29(35.8) |
| | Married | 75(48.08) | 267(54.27) | 23(62.16) | 351(64.76) | 71(55.04) | 111(65.29) | 142(57.49) | 49(60.49) |
| | Divorce | 4(2.56) | 12(2.44) | 1(2.7) | 10(1.85) | 6(4.65) | 7(4.12) | 2(0.81) | 2(2.47) |
| Chi-square test | | 29.01*** | 16.16** | 6.9 | 16.4** | 8.47 | 20.85*** | 27.0*** | 20.8*** |
| Education level | Under Diploma | 22(14.1) | 25(5.08) | 2(5.41) | 41(7.56) | 5(3.88) | 6(3.53) | 11(4.45) | 6(7.41) |
| | Diploma | 56(35.9) | 148(30.08) | 8(21.62) | 159(29.34) | 32(24.81) | 37(21.76) | 51(20.65) | 10(12.35) |
| | Associate degree | 10(6.41) | 33(6.71) | 3(8.11) | 37(6.83) | 7(5.43) | 14(8.24) | 15(6.07) | 5(6.17) |
| | BS | 48(30.77) | 175(35.57) | 9(24.32) | 187(34.5) | 50(38.76) | 65(38.24) | 85(34.41) | 33(40.74) |
| | MSc | 18(11.54) | 80(16.26) | 10(27.03) | 91(16.79) | 28(21.71) | 23(13.53) | 55(22.27) | 12(14.81) |
| | PhD | 2(1.28) | 31(6.3) | 5(13.51) | 27(4.98) | 7(5.43) | 25(14.71) | 30(12.15) | 15(18.52) |
| Chi-square test | | 1.28 | 2.56 | 0.86 | 6.05* | 2.2 | 1.52 | 0.48 | 3.6 |
| Income | Not Enough | 84(53.85) | 257(52.24) | 17(45.95) | 283(52.21) | 66(51.16) | 78(45.88) | 119(48.18) | 37(45.68) |
| | Enough but without savings | 56(35.9) | 180(36.59) | 14(37.84) | 208(38.38) | 44(34.11) | 73(42.94) | 97(39.27) | 38(46.91) |
| | Enough and have savings | 16(10.26) | 55(11.18) | 6(16.22) | 51(9.41) | 19(14.73) | 19(11.18) | 31(12.55) | 6(7.41) |

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| Control Variables | | Relatives, Friends, and Neighbors | Virtual Networks (WhatsApp, Instagram, ...) | Newspapers and Magazines | Radio and TV | Satellites or Foreign News Agencies | Virtual Workgroups | News Websites | Others |
|---|---|---|---|---|---|---|---|---|---|
| | Chi-square test | 15.2*** | 12.5* | 7.6 | 24.3*** | 10.1 | 8.28 | 13.04* | 67.3*** |
| Job | Health workers | 28(17.95) | 110(22.36) | 15(40.54) | 121(22.32) | 28(21.71) | 54(31.76) | 71(28.74) | 49(60.49) |
| | Military | 4(2.56) | 6(1.22) | 0(0) | 5(0.92) | 1(0.78) | 3(1.76) | 2(0.81) | 2(2.47) |
| | Students | 38(24.36) | 125(25.41) | 4(10.81) | 105(19.37) | 26(20.16) | 31(18.24) | 65(26.32) | 15(18.52) |
| | Housewives | 28(17.95) | 82(16.67) | 5(13.51) | 116(21.4) | 17(13.18) | 30(17.65) | 29(11.74) | 5(6.17) |
| | Employees of other organizations | 13(8.33) | 54(10.98) | 6(16.22) | 76(14.02) | 13(10.08) | 15(8.82) | 28(11.34) | 1(1.23) |
| | Others | 45(28.85) | 115(23.37) | 7(18.92) | 119(21.96) | 44(34.11) | 37(21.76) | 52(21.05) | 9(11.11) |
| | Chi-square test | 23.15*** | 18.53*** | 3.61 | 10.46* | 18.43*** | 9.44* | 1.52 | 5.27 |
| Age categories (y) | <25 | 76(49.03) | 191(38.9) | 10(27.03) | 160(29.52) | 41(31.78) | 42(24.85) | 88(35.63) | 21(26.25) |
| | 25-40 | 48(30.97) | 172(35.03) | 11(29.73) | 196(36.16) | 32(24.81) | 70(41.42) | 80(32.39) | 30(37.5) |
| | 41-55 | 25(16.13) | 112(22.81) | 15(40.54) | 165(30.44) | 43(33.33) | 53(31.36) | 68(27.53) | 28(35) |
| | >56 | 6(3.87) | 16(3.26) | 1(2.7) | 21(3.87) | 13(10.08) | 4(2.37) | 11(4.45) | 1(1.25) |

*$P<0.05$, **$P<0.01$, ***$P<0.001$.

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**Table 3.** Comparisons of the dependent variables across control variables in samples

| Control Variables | | ICA-COVID-19-PHM | | |
|---|---|---|---|---|
| | | Total | Social | Personal |
| Gender | T-statistics | 0.0.5 | 0.5 | 0.5 |
| | Female | -2.12±5.9 | 1.45±0.1 | 0.67±0.1 |
| | Male | -2.10±6.4 | 1.32±0.2 | 0.77±0.17 |
| Marital status | F-statistics | 3.63* | 3.26* | 3.13* |
| | Single | -2.93±6.5 | 1.87±3.9 | 1.05±3.2 |
| | Married | -1.63±5.7 | 1.14±3.5 | 0.51±2.6 |
| | Divorce | -1.50±8.4 | 0.73±5.4 | 0.77±0.9 |
| Education level | F-statistics | 4.74*** | 4.84*** | 3.61** |
| | Under diploma | -0.15±6.4 | 0.14±3.5 | 0.01±3.6 |
| | Diploma | -2.51±6.5 | 1.69±4.1 | 0.81±3.0 |
| | Associate degree | 0.06±4.9 | -0.04±2.9 | -0.01±2.4 |
| | BS | -2.80±6.2 | 1.72±3.7 | 1.07±2.9 |
| | MSc | -1.75±5.4 | 1.44±3.5 | 0.31±2.3 |
| | PhD | -2.28±5.1 | 1.53±2.9 | 0.75±2.5 |
| Income | F-statistics | 0.12 | 0.01 | 0.32 |
| | Not enough | -2.11±5.7 | 1.41±3.7 | 0.70±2.6 |
| | Enough but without savings | -2.04±6.3 | 1.39±3.7 | 0.64±3.0 |
| | Enough and have savings | -2.35±6.8 | 1.46±3.8 | 0.89±3.53 |
| Job | F-statistics | 3.13** | 3.50** | 2.09 |
| | Health workers | -1.72±4.9 | 1.15±3.2 | 0.56±2.2 |
| | Military | 0.50±3.1 | -0.5±2.8 | 0±2.2 |
| | Students | -3.36±5.8 | 2.15±3.6 | 1.20±2.7 |
| | Housewives | -1.67±6.3 | 1.31±3.6 | 0.36±3.1 |
| | Employees of other organizations | -2.67±6.2 | 1.83±4.0 | 0.83±2.7 |
| | Others | -1.6±7.1 | 0.94±4.1 | 0.62±3.6 |
| Age categories (y) | F-statistics | 4.26** | 2.93* | 4.48** |
| | <25 | -2.9±6.4 | 1.79±3.9 | 1.07±3.1 |
| | 25-40 | -2.2±6.1 | 1.46±3.7 | 0.75±2.8 |
| | 41-55 | -1.1±5.8 | 0.89±3.5 | 0.21±2.7 |
| | >56 | -1.9±4.3 | 1.39±2.8 | 0.58±1.9 |

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*P<0.05, **P<0.01, ***P<0.001.

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**Table 4.** Variance components (and intra-class correlation coefficient) of the at the city level

| ICA-COVID-19-PHM | | Total | Social | Person |
|---|---|---|---|---|
| Intercept | | -2.10 (-2.58, -1.62)*** | -1.41 (-1.68, -1.13)*** | -0.68 (-0.92, -0.45)*** |
| Variance components | Intercept for city variance | 0.26 (0.02, 2.98) | 0.06 (0.001, 3.45) | 0.07 (0.01, 0.47) |
| | Residual variance | 36.71 (33.60, 40.10) | 13.83 (12.66, 15.12) | 8.37 (7.66, 9.14) |
| | Intra-class correlation coefficient | 0.007 | 0.004 | 0.008 |

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news source and the ICA-COVID-19-PHM (total, social, and personal) by adjusting control variables. The results showed that virtual networks, satellites, foreign news agencies, and virtual workgroups were significant sources for the ICA-COVID-19-PHM (total, social, and personal). The latter case (virtual workgroups) was effective in increasing compliance with protocols (β=1.36, P<0.05 for total; β=0.65, P<0.05 for social aspect; and β=0.71, P<0.01 for personal aspect). While, virtual networks, satellites, and foreign news agencies were effective in reducing the intention to adhere. But, the source of the virtual network was not a significant source for the ICA-COVID-19-PHM in the social aspect (β=-0.34, P>0.05).

## 4. Discussion

The results of the present study showed that radio and television and also virtual social networks were the most common sources to receive vaccine news. Unlike virtual workgroups, receiving vaccine news from virtual networks, satellites, and foreign news agencies had affected the reduction in adherence to health protocols. It is worth pointing out that other vaccine news sources did not have a significant effect on the change in adherence.

In addition, the findings of the present research are in line with those of Niu et al. [17] in China in 2020. They assessed the effects of media usage throughout a pandemic on health behaviors and showed that media literacy was positively associated with preventive manners and negatively related to intervening behaviors. These results recommended that individuals with a developed ability to differentiate media messages were more probable to engage in preventive behaviors.

In addition, this study supports evidence from Hosseini et al.'s [18] study, which was conducted in Yazd Province in Iran in 2019 on 399 general people. They showed that 49.3% of the study population used mass media to receive COVID-19 news, 47.2% used virtual networks, and the rest of the population used other news sources. Although apprehension

about the use of social media is high due to unverified news concerning COVID-19 and its various aspects [19, 20], the previous study and our finding showed a higher percentage of virtual networks for COVID-19 news and vaccines than other studies in other countries. For example, Fridman et al.in the United States [12] showed that only 36% of people use and trust information in social networks. Perhaps one of the reasons for this difference is the lack of trust among Iranian people in the state media [21]; however, this issue requires further study. Also, the results of this investigation are consistent with those of Jahanbakhsh et al. [22]. They showed that the use of virtual social networks enhanced significantly (40%) after the COVID-19 pandemic [22]. In addition, they mentioned that the main psychological impact of virtual social networks was the creation of anxiety in users.

Concerning the descriptive section, women and men did not differ in receiving vaccine news from different sources except for mass media (radio and television) and women used them significantly more than men. This finding was consistent with previous studies in Yazd [18] and Isfahan [22] of Iran. Marital status was an important variable in receiving vaccine news from sources, such as relatives, friends, neighbors, and virtual networks, such as WhatsApp, Instagram, mass media, and satellite networks. Married people received news from virtual networks, such as WhatsApp, Instagram, mass media, and satellite networks more than other groups, such as single and divorced ones. This difference seems to be due to the participation of more married people in our study.

Consistent with a previous study [18], the relationship between COVID-19 vaccine news sources and education and age was significant in this study so that the contribution of virtual networks was higher among people younger than 40 years old. In addition, this study showed the age group of 25 to 40 years mostly received news from all sources. While inconsistent with a previous study [18], the age group over 56 years mostly received news from foreign satellite sources and a small percentage of them (3.87%) used radio and television.

**Table 5.** Multilevel linear regression estimates for association vaccine News sources and ICA-COVID-19-PHM with sdjusting control variables

| Variables | | ICA-COVID-19-PHM (Total) | | ICA-COVID-19-PHM (Social) | | ICA-COVID-19-PHM (Personal) | |
|---|---|---|---|---|---|---|---|
| | | B (95% CI) | P | B (95% CI) | P | B (95% CI) | P |
| Intercept | | 0.78(-1.18, 2.74) | 0.54 | 0.40(-0.81, 1.61) | 0.52 | 0.23(-0.73, 1.18) | 0.64 |
| News Sources | Relatives, friends, and neighbors | -0.32(-1.39,0.75) | 0.55 | -0.14(-0.79, 0.52) | 0.69 | -0.11(-0.62, 0.41) | 0.68 |
| | Virtual networks (WhatsApp, Instagram, …) | -0.83(-1.62,-0.05) | 0.04 | -0.34(-0.83, 0.14) | 0.16 | -0.42(-0.80, -0.05) | 0.03 |
| | Newspapers and magazines | -1.29(-3.35, 0.76) | 0.22 | -0.92(-2.18, 0.35) | 0.16 | -0.45(-1.44, 0.54) | 0.37 |
| | Radio and TV | -0.67(-1.45,0.12) | 0.10 | -0.45(-0.93, 0.03) | 0.07 | -0.29(-0.67, 0.09) | 0.13 |
| | Satellites or foreign news agencies | -1.5(-2.64, -0.36) | 0.01 | -1.01(-1.72, -0.30) | 0.01 | -0.64(-1.20, -0.09) | 0.02 |
| | Virtual workgroups | 1.36(0.31, 2.41) | 0.01 | 0.65(0.01, 1.30) | 0.05 | 0.71(0.20, 1.22) | 0.01 |
| | News websites | -0.68(-1.57,0.21) | 0.13 | -0.50(-1.05, 0.05) | 0.07 | -0.17(-0.60, 0.26) | 0.44 |
| | Other sources | 0.05(-1.42,1.52) | 0.95 | -0.21(-1.11, 0.70) | 0.66 | 0.19(-0.52, 0.90) | 0.6 |
| Education level (ref: under Diploma) | Diploma | -1.97(-3.59, -0.35) | 0.02 | -1.38(-2.38, -0.380) | 0.01 | -0.63(-1.42, 0.16) | 0.12 |
| | Master diploma | -0.2(-2.23,1.82) | 0.85 | -0.16(-1.42, 1.10) | 0.81 | -0.18(-1.16, 0.81) | 0.73 |
| | BS | -2.84(-4.46, -1.23) | <0.001 | -1.76(-2.79, -0.73) | <0.001 | -1.14(-1.95, -0.33) | 0.01 |
| | MSc | -1.55(-3.37,0.26) | 0.09 | -1.42(-2.60, -0.24) | 0.02 | -0.28(-1.20, 0.65) | 0.56 |
| | PhD | -3.18(-5.36, -1.00) | <0.001 | -2.23(-3.62, -0.84) | <0.001 | -1.32(-2.41, -0.23) | 0.02 |
| Job (ref: Health worker) | Military | 2.13(-2.17, 6.43) | 0.33 | 1.44(-1.20, 4.09) | 0.28 | 0.63(-1.44, 2.70) | 0.55 |
| | Students | -0.93(-2.31, 0.45) | 0.18 | -0.49(-1.40, 0.42) | 0.29 | -0.17(-0.88, 0.55) | 0.65 |
| | Housewives | -0.95(-2.29, 0.38) | 0.16 | -0.69(-1.52, 0.15) | 0.11 | -0.03(-0.69, 0.62) | 0.92 |
| | Employees of other organizations | -1.17(-2.61, 0.27) | 0.11 | -0.91(-1.80, -0.02) | 0.04 | -0.5(-1.19, 0.20) | 0.16 |
| | Others | -0.18(-1.37, 1.01) | 0.77 | 0.04(-0.70, 0.77) | 0.92 | -0.08(-0.66, 0.49) | 0.77 |

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| Variables | | ICA-COVID-19-PHM (Total) | | ICA-COVID-19-PHM (Social) | | ICA-COVID-19-PHM (Personal) | |
|---|---|---|---|---|---|---|---|
| | | B (95% CI) | P | B (95% CI) | P | B (95% CI) | P |
| Gender (ref: Female) | Male | -0.03 (-0.92, 0.85) | 0.94 | 0.04 (-0.50, 0.58) | 0.89 | -0.06 (-0.49, 0.36) | 0.77 |
| Marital status (ref: Single) | Married | 1.24 (0.18, 2.30) | 0.02 | 0.59 (-0.17, 1.35) | 0.13 | 0.28 (-0.32, 0.87) | 0.36 |
| | Divorced | 1.24 (-1.43, 3.90) | 0.36 | 0.90 (-0.76, 2.56) | 0.29 | -0.06 (-1.36, 1.25) | 0.93 |
| Income (not enough) | Enough but without savings | -0.08 (-0.91, 0.76) | 0.86 | -0.10 (-0.61, 0.41) | 0.70 | -0.02 (-0.42, 0.38) | 0.92 |
| | Enough and have savings | -0.34 (-1.59, 0.92) | 0.60 | -0.19 (-0.96, 0.59) | 0.64 | -0.24 (-0.84, 0.37) | 0.44 |
| Age groups (ref: <25 y) | 25–40 | 0.03 (-1.45, 1.53) | 0.97 | 0.01 (-0.91, 0.91) | 0.99 | 0.04 (-0.68, 0.75) | 0.92 |
| | 41–55 | 1.42 (-0.23, 3.08) | 0.09 | 0.71 (-0.30, 1.72) | 0.17 | 0.72 (-0.08, 1.51) | 0.08 |
| | >56 | 0.55 (-1.75, 2.82) | 0.64 | 0.22 (-1.19, 1.63) | 0.76 | 0.34 (-0.77, 1.45) | 0.55 |
| Variance components | Intercept for city variance | 0.26 (0.02, 2.57) | | 0.05 (0.001, 2.41) | | 0.08 (0.01, 0.48) | |
| | Residual variance | 35.24 (32.22, 38.53) | | 13.26 (12.12, 14.51) | | 8.11 (7.42, 8.87) | |
| | Intra-class correlation coefficient (ICC) | 0.007 | | 0.004 | | 0.009 | |

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The rate for receiving news based on education varied in this study so that under diploma participants had a higher portion of news received from friends, while undergraduate and graduate participants showed almost identical rates.

Consistent with a previous study in Germany [10], radio and television were the most common sources, and receiving news from them had an increasing effect on the understanding of COVID-19 risk in our study. Receiving news from radio and television did not have a significant effect on changing intention to adhere to health measures after receiving the vaccine news and this can be considered as a positive factor. In other words, this finding can be considered a positive relationship between exposure to mass media news, such as television, and health behaviors so that exposure to television news correlated positively with preventive behaviors in public spaces against COVID-19 infection [23, 24]. Government intelligence sources are possibly more trusted by the public and it was highly noticed by the elderly, while younger individuals more trust in private news sources. In line with this justification, a previous study in the United States [12] showed that confidence in government resources was positively correlated with accurate knowledge of COVID-19 and observing social distancing. While, in Mexico, the fake news (news spread on unfiltered social media) about COVID-19 significantly reduced adherence to preventive measures [15].

In the present study, the multi-level regression model showed the ICA-COVID-19-PHM is explained more at the individual level. Because the ICC community level (cites) was very low (<0.01). It seems logical because the outcome is perceived adherence behaviors in the current situation (before receiving the vaccine) and intention to adhere to the protocols (after receiving the vaccine).

## Strengths and limitations

The first strength of this study is the time of conducting this investigation. The information was obtained from sources from March to May 2021. It seems that there is greater stability and maturity among people to receive COVID-19 news, especially vaccine news. Besides, the resources used during this period seem to have created a higher level of trust for their users. Previous studies have shown that sources at the beginning of epidemics, especially for COVID-19, can have large fluctuations both in terms of luck and content (e.g. misinformation and conspiracy theories) [25, 26]. Thus, the time of this study after a year of a pandemic for describing the portion of news sources about COVID-19 can be considered a strong point for the current study. Another strength of this study was the

multi-level analysis of evaluating the role of the community level in explaining the intention to change adherence to COVID-19 after receiving the COVID-19 vaccine. Finally, the sample size from a province in Iran was relatively high.

The current study had several limitations. The study was cross-sectional and causal explanations could not be made. The effect of COVID-19 vaccine news on the intention to change adherence to health protocols was measured directly without considering mediator variables (such as fear of infection or death) or moderators (such as levels of access to news sources). It seems that to investigate the net effect of news sources on the change of adherence in future studies, these variables should be focused on via longitudinal studies. For each participant, we considered receiving news from different sources independently. As participants wish to receive vaccine news from multiple sources, rather than from a single source, it is suggested that the overlap of news sources and its relationship with adherence changes be investigated in future studies. Also, based on previous studies [15], news received from virtual networks mostly played a mediating and moderating role in the relationship between receiving news from official media. Therefore, it is suggested that other studies focus on the moderating effect of receiving the news. In addition, the role of moderating trust in news sources concerning COVID-19 was considered in examining the relationship between news sources and changing adherence to health protocols. Thus, considering the relationship between vaccine news sources and changes incorrect adherence would be a better procedure. Therefore, probing news sources and trust in news sources should be investigated in future studies. Although it seems that the continuous use of specific news sources can be a proxy of people's trust in that news source, in the social context of Iran, there are rare studies in this regard. Also, in studies conducted in Western countries, the mass media is private and public and completely state-owned. But in the present study, radio and television were considered the official representatives of the mass media. Besides, concerning COVID-19 news, the sources of Iran, such as radio and television are consistent with the Ministry of Health and Disease Management Organization. On the other hand, the satellite was consistent with other related sources that have not been specifically identified in the present study. In the present study, a general question was presented to measure the use of social media news sources. It is suggested that future studies, separate items be included in the questionnaire for each of these specific news sources, and that receiving news from them be investigated in future studies. The aim of the present study was to investigate the contribution of vaccine news sources and their relationship to change

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adherence. Future studies can focus on the accuracy of news sources. Finally, although the study population of the present study was from all over Mazandaran Province, the participants entered through social media; therefore, it does not cover all age and occupational groups in the society. Thus, it seems to be prone to selection bias. It is worth mentioning that caution should be exercised in generalizing the outcome to the whole population.

## 5. Conclusion

Identifying the sources, distribution, and role of vaccine news sources is essential to changing the intention to adhere to health protocols. The present study revealed that different sources of vaccine news have different effects on the intention to adhere to the health protocols. In other words, sources, such as virtual networks and satellites had a negative impact on adherence to the health protocols. While receiving news from virtual work groups (joint trade unions) had a positive effect on the intention to adhere to the health protocols after receiving the vaccine. Besides, receiving news from public media, such as radio and television did not indicate a change in intention to adhere to the health protocols. As a result, it can be considered as a positive aspect of adhering to the health protocols. It is worth noting that during epidemics, such as COVID-19, policymakers must carefully consider the quality of information broadcast via various sources and social networks. In addition, a variety of information sources should be used when broadcasting immediate health information. It will ensure that different populations have access to vital knowledge. Such studies may help to adjust effective interventions to improve response to the COVID-19 epidemic.

## Ethical Considerations

### Compliance with ethical guidelines

Ethical approval for the study was obtained from the Research Ethics Committee of the Mazandaran University of Medical Sciences (Code: IR.MAZUMS. REC.1400.069).

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### Authors' contributions

Conceptualisation and study design: Maysam Rezapour; Data acquisition: Zahra Pormehdi Ganji and Amirmohammad Ahmadzadeh; Data analysis and data interpretation: Maysam Rezapour; Administrative, technical, and material support: Zahra Pormehdi Ganji; Critical revision of the manuscript for important intellectual content: Shahabeddin Abhari; Writing the original draft, review, revision and final approval: All authors.

### Conflict of interest

The authors declared no conflict of interest.

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