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Vaccine hesitancy is strongly associated with distrust of conventional medicine, and only weakly associated with trust in alternative medicine

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Abstract

It is well established that people who use complementary and alternative medicines (CAM) are, on the whole, more vaccine hesitant. One possible conclusion that can be drawn from this is that trusting CAM results in people becoming more vaccine hesitant. An alternative possibility is that vaccine hesitancy and use of CAM are both downstream consequences of a third factor: distrust in conventional treatments. To examine this, we measured vaccine hesitancy and CAM use in a representative sample of Spanish residents ($N = 5200$). We also measured their trust in three CAM interventions (acupuncture, reiki, homeopathy) and two conventional medical interventions (chemotherapy and antidepressants). Results showed that vaccine hesitancy was strongly associated with (dis)trust in conventional medicine, and this relationship was particularly strong among CAM users. In contrast, trust in CAM was a relatively weak predictor of vaccine hesitancy, and the relationship was equally weak regardless of whether or not participants themselves had a history of using CAM. The implication for practitioners and policy makers is that CAM is not necessarily a major obstacle to people's willingness to vaccinate, and that the more proximal obstacle is people's mistrust of conventional treatments.

KEYWORDS: vaccine hesitancy; complementary and alternative medicine; trust in science

Introduction

There have been worrying signs in the last decade that some infectious diseases – such as measles, mumps and pertussis – have risen in parts of the world that had previously witnessed long declines in infection rates (Centers for Disease Control and Prevention, 2019; World Health Organisation, 2018). Although the causes of these outbreaks are likely to be multi-faceted, many have observed that it has coincided with an increase in anti-vaccination advocacy, and an associated plateauing or reduction in vaccination rates for some diseases (Betsch, Renkewitz, Betsch, & Ulshöfer, 2010). This is why vaccine hesitancy has been listed by the world health organization as one of the top ten threats to global health in 2019 (World Health Organisation, 2019). Learning about why people are vaccine hesitant is an important precondition for developing interventions to reduce the problem.

One factor that has been frequently identified as a correlate of vaccine hesitancy is use of complementary and alternative medicines (CAM). Some early research documenting that CAM believers and users were more vaccine hesitant did so using bivariate statistical techniques (e.g., Cassell et al., 2006; Fong & Fong, 2002; Gellin, Maibach, & Marcuse, 2000; Wilson et al., 2005; Zuzak, Zuzak-Siegrist, Rist, Staubli, Simoes-Wust, 2008). As expressed in a critical review of the literature, this leads to the concern that the link between CAM use and vaccination hesitancy “may be confounded by other factors associated with CAM use ... and may not necessarily indicate independent or predictive relationships” (Wardle, Frawley, Steel, & Sullivan, 2016, p. 4484). However, a growing number of studies have now examined the relationship using regression techniques that control for various demographic factors, and have reached the same conclusion (Browne, Thomson, Rockloff, & Pennycook, 2015; Bryden, Browne, Rockloff, & Unsworth, 2018; Jessop et al., 2010; Repalust, Šević, Rihtar, & Štulhofer, 2017; Rozbroj, Lyons, & Lucke, 2019; Wardle et al., 2017). Although the contributors to vaccine hesitancy are understood to be multi-dimensional - and vary

according to context, type of CAM use, and type of vaccine - it now seems clear that pro-CAM people are, on the whole, more vaccine hesitant.

What is less clear is what lessons can be learned from this information. One possibility is that CAM users and believers are socialized into a style of thinking that leads them to believe that many conventional interventions are unnecessary. It is also possible that pro-CAM individuals become introduced to an information environment that discourages them – implicitly or explicitly – from using vaccinations. Consistent with this possibility, there is evidence that a relatively high proportion of CAM websites feature vaccine-skeptical information (Arif et al., 2018; Caulfield, Marcon, & Murdoch, 2017) and that CAM practitioners themselves tend to frame vaccination decisions as personal choices rather than focusing on public health benefits (Deml et al., 2019). In sum, this explanation presumes that trust in CAM is an active ingredient that promotes vaccine hesitancy.

Another possibility is that vaccine hesitancy is shaped by *distrust* in conventional, “techno-medical” treatments. A convergence of research has already identified mistrust of official accounts of reality (Hornsey, Harris, & Fielding, 2018) and mistrust of conventional medicine and medical providers (e.g., Gaudino & Robinson, 2012; Gilles et al., 2011; Rozbroj et al., 2019) as predictors of vaccine hesitancy. From this position of mistrust, it is possible that people are “pushed” into CAM as a refuge from an orthodox medical tradition that might not have their interests at heart, and simultaneously turn away from interventions – such as vaccinations – that are advocated within that “official” tradition. Crucially, this explanation does not rely on there being a direct link between trust in CAM and vaccine hesitancy: it opens the possibility that they are both downstream consequences of mistrust of Western medicine, and that empirical links between CAM use and vaccine hesitancy are indirect. If this is the case, it suggests quite different interventions than if trust in CAM was a mechanism driving vaccination hesitancy.

The current paper provides a preliminary attempt to examine these possibilities. A large, representative sample of Spanish residents rated (a) their trust in three CAM interventions (acupuncture, reiki, homeopathy), and (2) their trust in two conventional medical interventions (chemotherapy and antidepressants). On the basis of previous research (e.g., Gaudino & Robinson, 2012; Gilles et al., 2011; Rozbroj et al., 2019) one can reasonably expect that mistrust of conventional medical interventions might be associated with vaccine hesitancy. What is less clear is if trust in CAM is positively correlated with vaccine hesitancy, as might be expected if pro-CAM attitudes was an active ingredient that were shaping anti-vaccination attitudes.

Method

Sampling and Participants

We analyzed data collected as part of the 9th Survey on the Social Perception of Science and Technology, conducted by the Spanish Foundation for Science and Technology and the Ministry of Science. A total of 5,200 personal interviews (face to face) were carried out on people who had been residents in Spain for five or more years and were 15 years of age or older between May 14 and July 2, 2018. The interviews were conducted in the house of the respondent either on-the-spot or at a scheduled date. No incentives were offered to encourage participation. Informed consent was obtained after the nature and possible consequences of the studies had been fully explained.

The sampling procedure was multi-staged and stratified, with selection of primary units (municipality) and secondary units (census tracts) conducted through proportional random sampling and the last units (individuals) by random routes and quotas for gender and age. The sampling error for the total sample is $\pm 1.25\%$ for a confidence level of 95.5%, with the assumption of simple random sampling, calculated considering non-proportional samples.

Measures

To measure CAM use, we asked participants “Have you ever used alternative treatments such as homeopathy or acupuncture?” (Yes or No). To measure vaccine hesitancy, we combined responses to four items. Two items asked people to rate the costs and benefits of childhood vaccines. Participants were told “Now I’m going to ask you about childhood vaccines like measles, mumps and rubella”. They were then asked “How would you rate their benefit in preventing disease?” and “How would you rate their risk of serious side-effects?” Both items were responded to using a 5-point scale (1=very high, 5=very low). Participants also rated their level of trust in “childhood vaccines” (1=none, 5=very high) and how “scientific” they found vaccines (1=not scientific at all, 5=totally scientific). The three positively worded items were reversed - such that high scores indicated high vaccine hesitancy – and the four items were then combined into a single scale of vaccine hesitancy ($\alpha=.64$).

To measure trust, we were mindful of using questions that shared the same wording in the stem, but differed only in the type of intervention that was the target of trust. Doing so puts us in the best position to make like-for-like comparisons across scales. With this aim in mind, participants were asked to “please indicate your level of trust in the following in regard to their usefulness for health and general well-being”. Included were three CAM interventions - acupuncture, reiki, and homeopathy - and two conventional medical interventions: chemotherapy and antidepressants. Participants responded to each of the items using a 5-point scale (1=none, 5=very high). Inspection of the correlations among the items revealed high intercorrelations among the three CAM interventions (all $r_s > .54$) and so they were combined into a single scale of trust in CAM ($\alpha=.82$). The other two items – trust in chemotherapy and antidepressants – were also high correlated ($r=.40$, $p < .001$, $\alpha=.56$) and so were combined into a single scale of trust in conventional medicines.

In testing the relationship between CAM use and vaccine hesitancy, we sought to control for the following demographic variables: age, sex (1=male, 2=female), parental status (“Do you have children?” 0=no, 1=yes), education (1=“don’t know how to read” to 9=“third cycle university education (Doctorate)”, and city size (1=“less than 10,000 inhabitants” to 6=“more than 500,000 inhabitants”). These demographics were chosen because they had been implicated previously in predicting vaccine use and vaccine hesitancy (Larson, Jarrett, Eckersberger, Smith, & Paterson, 2014; Schmid, Rauber, Betsch, Lidolt, & Denker, 2017). We also included two items that measured (a) the extent to which respondents used the internet and (b) the extent to which the internet was the primary source of their information about science and technology. Results reported below were unchanged regardless of whether or not we controlled for these media-related variables. Demographics were measured at the end of the survey. For all measures in the survey, participants were given the option to not answer or to say they did not know: these responses were coded as missing values. These measures were part of a broader survey that examined issues relating to ideology, attitudes toward science, and media use (details can be obtained from the authors).

Missing Data

In Table 1 we summarize the descriptive statistics of the variables used in our analyses. Perhaps because the data were collected through face-to-face interviews, there were very few examples of respondents not answering or skipping questions. Overall, the proportion of missing data was only 0.83%, and overwhelmingly these was due to respondents answering “don’t know” (rather than not answering at all). The only variable for which missing data represented a non-trivial proportion of respondents was trust in CAM (5.3% missing data).

<INSERT TABLE 1 ABOUT HERE>

In the analyses below, we dealt with missing data using listwise deletion. This strategy is considered less biased than other strategies – such as multiple imputation or maximum likelihood – under the conditions we face here: (a) when the data set is large, (b) when the analysis is multiple regression, and (c) the missing value problem lies in a predictor (Allison, 2001). We emphasize, however, that the conclusions drawn from the results are identical regardless of whether we use listwise deletion or multiple imputation.

Results

Replicating the Link Between CAM Use and Vaccine Hesitancy

As a first step, we sought to replicate the previously established finding that CAM use is associated with vaccine hesitancy. To do so, we ran a multiple regression with vaccine hesitancy as the outcome variable and CAM use as the predictor, controlling for the five demographic variables (see Step 1 of Table 2). This analysis revealed that vaccine hesitancy was greater among men, younger respondents, respondents without children, respondents with poorer educations, and residents of smaller towns.

More relevant to the current study, CAM users were more vaccine hesitant (even after controlling for the demographics). Note that the predictive value of CAM use was relatively modest, but greater than any of the demographics except for education.

<INSERT TABLE 2 ABOUT HERE>

The Predictive Value of Trust in CAM Versus Trust in Conventional Medicine

We then turned to examining our key research question: the relative role of trust in CAM and trust in conventional medicine in predicting vaccine hesitancy. Figure 1 summarizes intercorrelations among vaccine hesitancy and trust in various interventions. This Figure provides a rough visual summary of the key pattern: both processes are important

contributors to understanding variance in vaccine hesitancy, but distrust in conventional medicine appears to be more predictive than trust in CAM.

<INSERT FIGURE 1 ABOUT HERE>

To formalize this observation, we entered trust in CAM and trust in conventional medicine as predictors at Step 2 in the regression described above. As can be seen in Table 2, trust in CAM was positively associated with vaccine hesitancy, and trust in conventional medicine was negatively associated with vaccine hesitancy, even after controlling for the demographic variables. Of the two predictors, however, (dis)trust in conventional medicine was clearly a bigger predictor of vaccine hesitancy than trust in CAM, dwarfing any other predictor in terms of effect size.

To quantify the relative predictive value of our key variables, we re-ran the analyses, paying attention to the change in variance explained (R^2_{ch}). First, we examined the change in variance explained when trust in conventional medicine was included in Step 1 along with the demographics, and trust in CAM was entered on its own at Step 2. These analyses showed that the addition of trust in CAM explained only 2% additional variance, $R^2_{ch}=.02$, $F_{ch}=94.02$, $p<.001$. Second, we examined the change in variance explained when trust in CAM was included in Step 1 along with the demographics, and trust in conventional medicine was entered on its own at Step 2. The addition of trust in conventional medicine explained 12% additional variance, $R^2_{ch}=.12$, $F_{ch}=686.22$, $p<.001$.

Finally, in Step 3 of the regression reported in Table 2, we tested whether CAM use moderates the extent to which the two measures of trust predict vaccine hesitancy. The interaction between CAM use and trust in CAM was not significant, demonstrating that the (relatively weak) relationship between trust in CAM and vaccine hesitancy was statistically equivalent regardless of whether or not respondents personally used CAM.

In contrast, the interaction between CAM use and trust in conventional medicine was significant. To follow up this interaction, we ran separate regressions for CAM users and CAM non-users. As can be seen in Table 3, the relationship between (dis)trust in conventional medicine and vaccine hesitancy was significant for both CAM users and CAM non-users, although the effect was larger for the former.

<INSERT TABLE 3 ABOUT HERE>

Discussion

We drew on a large, representative sample of Spanish nationals to compare the extent to which levels of vaccine hesitancy could be predicted by people's trust in CAM interventions versus their (mis)trust in conventional medical interventions. The results were clear: both trust in CAM *and* mistrust in conventional medical interventions were uniquely predictive of vaccine hesitancy. However, it was also clear that the latter played a much greater role in predicting vaccine hesitancy than the former. Indeed, one striking aspect of the results is just how weakly associated trust in CAM was with vaccine hesitancy. Overall, people's preparedness to trust CAM interventions explained 1-2% of variance in vaccine hesitancy, and the predictive value of trust in CAM was equally weak regardless of whether participants themselves had a history of using CAM or not. In contrast, distrust in conventional medicine explained 16% of additional variance among CAM users, and 11% additional variance among CAM non-users.

The current study replicated the previously established finding that CAM users tend to be more vaccine hesitant than CAM non-users. However, the trust data help us achieve a more focused understanding of what this relationship might represent psychologically. The implication of these findings for practitioners and policy makers is that CAM is not

necessarily a major threat to people's willingness to vaccinate. Rather, the more proximal threat is people's distrust of conventional medicine.

From an intervention point of view, the key question becomes: what might be causing this distrust toward conventional medicine? Although the current data are not well-equipped to answer this question, it can rule out one possible reason: there was no evidence that mistrust in conventional medicine is associated with trust in CAM. Indeed, trust in CAM treatments was *positively* correlated with trust in conventional treatments, a pattern that was true both among CAM users ($r = .12$) and CAM non-users ($r = .25$). In other words, one cannot point to the allure of CAM as a major reason for mistrusting conventional treatments such as chemotherapy and anti-depressants.

Although the current data do not have a clear answer to the question of what causes mistrust in conventional treatments, the very high correlations found in previous research between conspiracist thinking and vaccine hesitancy (Hornsey et al., 2018; Lewandowsky, Gignac, & Oberauer, 2013) suggests one candidate: the belief that vested interests in the medical community (e.g., "Big Pharma") have participated in an orchestrated campaign to exaggerate the benefits of medical interventions and to minimize their dangers (see also Dredze, Broniatowski, Smith, & Hilyard, 2016; Jolley & Douglas, 2014). A related factor is the cognitive style of "experiential", "intuitive", or "magical" thinking, which is correlated with belief in conspiracies and rejection of some mainstream science (Oliver & Thomas, 2018; Swami, Voracek, Stieger, Tran, & Furnham, 2014). Thus, we are reminded that there are explanations for vaccine hesitancy that cannot be directly addressed by the current data, and that more could be done to unpack the mechanisms through which mistrust of conventional medicine is associated with both CAM use and vaccine hesitancy.

Limitations

As with any dataset, the current study carries limitations, particularly around measurement. For example, we measured just three CAM treatments and two conventional treatments. This represents a potential challenge to the generalizability of the findings. It is possible, for example, that the negative perceptions people have of cancer and depression become imbued in the conventional medicines that seek to treat them (by contrast, acupuncture, reiki, and homeopathy may not have the same negative associations). Although Figure 1 suggests that the key pattern is consistent across all five treatment choices, future research would benefit from using a broader array of treatments to ensure that the findings are robust.

Furthermore, we did not use a standard measure of vaccine hesitancy. However, we ran secondary analyses to check if the results replicated when each of the individual items were used as the criterion variable on their own. Reassuringly, the conclusions drawn from the analyses reported in this article do not change regardless of which vaccine hesitancy item was used in the analyses. Thus, there is no evidence that the conclusions are hostage to the wording of any one particular question in the scale. We also acknowledge that the measures of vaccine hesitancy are framed around attitudes and beliefs, rather than toward behaviors or behavioral intentions.

Finally, our cross-sectional correlational study cannot demonstrate causality. Even if we could, we acknowledge that faith in CAM and distrust in conventional Western medicine such as vaccinations might co-evolve in a complex and recursive way, such that it becomes difficult to disentangle what the original drivers are. Finally, it should be noted that the sample was a community sample which was, on the whole, broadly supportive of vaccinations. It remains to be seen whether the conclusions drawn from the current study would be replicated if applied to a group of committed anti-vaccination advocates.

Conclusions

Despite the limitations described above, the current study is useful in sharpening our understanding of the role CAM plays in predicting vaccine hesitancy. CAM users are more vaccine hesitant than CAM non-users, but there is little evidence that trust in CAM per se is a major predictor of vaccine hesitancy. A far bigger predictor of vaccine hesitancy is (dis)trust of conventional medicine. In short, rather than being “pulled” toward vaccine hesitancy because of trust in CAM, people seem to be “pushed” into vaccine hesitancy via *mistrust* of conventional medicine.

The implication for practitioners and policy makers is that CAM is not necessarily a major obstacle to people’s willingness to vaccinate, and that the more proximal obstacle is people’s mistrust of conventional treatments. This implies that intervention attempts would be best designed to understand and intercept the reasons why people are suspicious of conventional Western medicine, rather than to understand and intercept the reasons why people are trusting of CAM.

In sum, attitudes towards vaccination are not isolated from the perception of other conventional treatments. Specifically, our results suggest that improvements in the public perception of other conventional treatments (e.g. through communication efforts, publication of effectiveness results, etc.) might pay off in terms of more favorable attitudes towards vaccination.

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Table 1.

Sample demographics.

Variable	Categories and Statistics
<i>Sociodemographics</i>	
Gender	0 = Men: 48.6% 1 = Women: 51.4%
Age	$M = 43.95, SD = 17.951$
Education	1 = Cannot read, illiterate: 0.2 % 2 = Without studies, he/she knows how to read: 2.7 % 3 = Incomplete Primary Education: 3% 4 = Primary education: 8.9% 5 = Lower secondary education: 29.2% 6 = Upper secondary education and Post-secondary non-tertiary: 35% 7 = Short-cycle tertiary education: 8% 8 = Bachelor and Master: 12.4% 9 = Doctorate: 0.5%
Parental status	Do you have children? 0 = 44.5% No 1 = 55.5% Yes
City size	1 = Less than 10,000 inhabitants: 20.4% 2 = From 10,001 to 20,000 inhabitants: 10.8% 3 = From 20,001 to 50,000 inhabitants: 15.7% 4 = From 50,001 to 100,000 inhabitants: 12.8% 5 = From 100,001 to 500,000 inhabitants: 24.1% 6 = More than 500,000 inhabitants: 16.3%
<i>Beliefs and attitudes towards vaccines</i>	
Level of trust in childhood vaccines	1 = none: 1.1% 2 = low: 2.1% 3 = some: 7.2% 4 = quite high: 30.5% 5 = very high: 57.0% don't know: 1.9% did not answer: 0.1%
How "scientific" are vaccines	1 (Not scientific at all): 0.7% 2 : 1.3% 3 : 5.1% 4 : 19.1% 5 (Totally scientific) : 71.8% don't know: 2.0%
Childhood vaccines' benefit in preventing diseases	1 = very low: 1.2% 2 = low: 2.4% 3 = medium: 8.6% 4 = high: 32.7% 5 = very high: 53.8% don't know: 1.1% did not answer: 0.2%

Childhood vaccines' risk of serious side-effects	1 = very low: 23.8% 2 = low: 36.9% 3 = medium: 23.7% 4 = high: 8.6% 5 = very high: 3.3% don't know: 3.5% did not answer: 0.3%
<i>Trust in evidence-based treatments</i>	
Level of trust in chemotherapy	1 = none: 2.7% 2 = low: 3.0% 3 = some: 11.4% 4 = high: 29.5% 5 = very high: 48.1% don't know: 4.9% did not answer: 0.5%
Level of trust in antidepressants	1 = none: 11.2% 2 = low: 12.1% 3 = some: 25.4% 4 = high: 29.8% 5 = very high: 17.0% don't know: 4.2% did not answer: 0.4%
<i>Trust in non-evidence-based treatments</i>	
Level of trust in reiki	1 = none: 33.2% 2 = low: 17.8% 3 = some: 14.3% 4 = high: 10.2% 5 = very high: 6.1% don't know: 17.6% did not answer: 0.8%
Level of trust in homeopathy	1 = none: 20.5% 2 = low: 19.2% 3 = some: 24.0% 4 = high: 17.7% 5 = very high: 7.7% don't know: 10.5% did not answer: 0.3%
Level of trust in acupuncture	1 = none: 15.9% 2 = low: 16.7% 3 = some: 25.8% 4 = high: 22.2% 5 = very high: 10.7% don't know: 8.4% did not answer: 0.3%
<i>Non-evidence-based treatments behavior</i>	
CAM use (e.g. Homeopathy or Acupuncture)	0 = Never used CAM 80.1% 1 = Has used CAM 19.6% don't know / did not answer: 0.3%

Note. CAM = Complementary and alternative medicine.

Table 2.

Predictors of vaccine hesitancy for full sample.

	<i>B</i>	<i>SE</i>	β	<i>t</i>	<i>p</i>
1 Age	-.002	.001	-.07	-3.88	< .001
Gender (1 = male, 2 = female)	-.062	.017	-.05	-3.59	< .001
Education	-.073	.007	-.17	-11.20	< .001
Parental status	-.054	.022	-.05	-2.50	.013
City size	-.016	.005	-.05	-3.32	.001
CAM use (0 = no, 1 = yes)	.160	.021	.11	7.54	< .001
2 Trust in CAM	.075	.008	.14	9.70	.003
Trust in conventional treatments	-.222	.008	-.36	-26.20	< .001
3 CAM use x Trust in CAM	-.006	.021	-.01	-0.27	.788
CAM use x Trust in conventional treatments	-.065	.020	-.17	-3.30	.001

Note. CAM refers to complementary and alternative medicine

Table 3.

Predictors of vaccine hesitancy among CAM users and CAM non-users.

	<i>B</i>	<i>SE</i>	β	<i>t</i>	<i>p</i>
CAM USERS (<i>n</i> = 999)					
Age	-.002	.002	-.04	-0.98	.326
Gender (1 = male, 2 = female)	-.059	.042	-.04	-1.41	.159
Education	-.073	.016	-.14	-4.69	< .001
Parental status	-.126	.050	-.09	-2.51	.012
City size	-.019	.012	-.05	-1.68	.094
Trust in CAM	.065	.022	.09	2.96	.003
Trust in conventional treatments	-.273	.020	-.40	-13.89	< .001
CAM NON-USERS (<i>N</i> = 3874)					
Age	-.001	.001	-.04	-2.06	.040
Gender (1 = male, 2 = female)	-.047	.017	-.04	-2.73	.006
Education	-.058	.007	-.14	-8.75	< .001
Parental status	-.043	.022	-.04	-1.96	.050
City size	-.014	.005	-.05	-3.00	.003
Trust in CAM	.074	.008	.14	9.14	< .001
Trust in conventional treatments	-.207	.009	-.34	-22.01	< .001

Note. CAM refers to complementary and alternative medicine

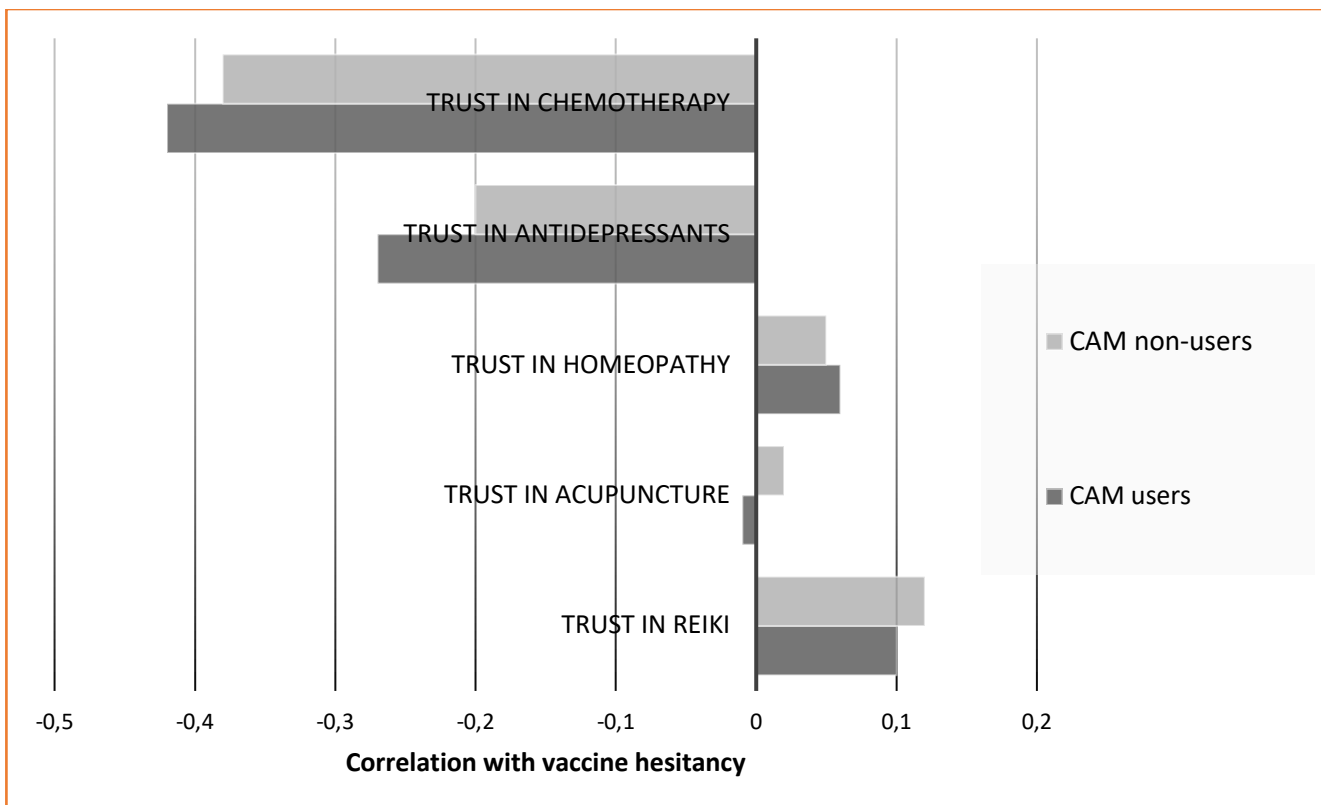


Fig. 1. Correlations between vaccine hesitancy and trust in various treatments, reported separately for complementary and alternative medicine (CAM) users and non-users.