RESEARCH

Association between beliefs in medical conspiracy theories and health behaviors among medical and healthcare students. Implications for professional practice

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Abstract

Background While conspiracy theories cover many different themes, medical conspiracy theories (MCTs) have become particularly prevalent in modern societies. As beliefs in MCTs can become a source of "infodemics", influence individual health behaviors and cause distrust in medical institutions and personnel, healthcare workers must find ways to overturn patients' conspiracy thinking. However, as the medical world is not free of these beliefs, in this study, we investigated beliefs in MCTs among medical and health science students and their association with reported health behaviors.

Methods Our sample was derived from a self-administered, anonymized, computer-assisted web survey conducted among 1,175 medical and health science students enrolled at the Poznan University of Medical Sciences, Poland.

Results From a set of twenty different MCTs, one-third of students rejected all of them, 18% believed in one, 15% in two, 10% in three, and 24% supported four or more conspiracy theories. In addition, many students were hesitant or unsure about MCTs. We also found that nursing and midwifery students were the most likely to believe in MCTs, while medical and dental students were the least supportive. Support for MCTs was higher among students in the early years of their studies and who declared themselves religious and conservative. This study also highlights the association between students' support for MCTs and their reported health behaviors, including avoiding vaccinations, using alternative medicine, taking vitamin C, or using social media as an essential source of health information.

Conclusions As medical and health science students are prone to conspiratorial thinking, they should be trained to act as a trusted and reliable source of medical information, to mitigate conspiratorial beliefs, and to act as role models for their patients and society, effectively shaping health behaviors in the population.

Keywords Attitudes, Future healthcare workers, Health behaviors, Medical conspiracy theories, Medical students

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Background

Conspiracy theories (CTs) are beliefs that explain social and political events or situations resulting from a secret plot made by a powerful group of people [1]. While there are many types of CTs [2, 3], medical conspiracy theories (MCTs) or health-related conspiracy theories (HCTs) have become particularly prevalent in modern societies [4–8]. A notable example is human immunodeficiency virus (HIV) denialism, which either denies the existence of HIV or claims that it is harmless and does not cause AIDS, which, in turn, can be cured by natural remedies or alternative medicine [9]. Additionally, some suggest that the United States federal government manufactured HIV as a bioweapon to control and ultimately kill ethnic minorities [10]. Another MCT suggests that fluoridation aims to poison and weaken the population by causing various disorders or calcification of the pineal gland and lowering IQ to make people docile [11]. Some MCTs claim that both the pharmaceutical industry and the "scientific establishment" are hiding research showing that modern drugs do not work and that natural cures for most human diseases are hidden from patients so that Big Pharma can promote their "quack products" (i.e., vaccines) and maximize their profits [4, 5, 12].

The most common MCTs, however, are those relating to vaccination. While they date back to the origins of the first cowpox vaccine invented by Edward Jenner [13], they gained momentum in the late 1990s when physician Andrew Wakefield published a paper claiming a causal link between the MMR vaccine and autism [14]. Although most anti-vaxxers' objections stem from their concerns over vaccines' safety, they also result from an institutional mistrust of government, the compulsory nature of vaccination or beliefs that the vaccination programs are part of a governmental conspiracy to sterilize ethnic minorities [15–18].

Significantly, although MCTs have always existed and are part of the history of medicine [3, 8, 19], they have become particularly prevalent since the outbreak of COVID-19. The widespread conspiracy beliefs associated with this pandemic suggest that the SARS-CoV-2 virus either does not exist or is harmless or that the "plandemic" was manufactured to spread global panic and facilitate human control as part of the "Great Reset" [20, 21]. Other theories claim that mRNA vaccines alter the human genome, contribute to infertility, and were engineered in a laboratory to enable depopulation plans, especially among minorities, orchestrated by the United Nations and Bill Gates [22, 23]. Finally, some suggest that the government is using COVID-19 vaccines to implant microchips to track and control people.

Because MCTs cover a wide range of topics, from vaccines and Big Pharma to disease denial, they have important social implications and can cause much harm. A growing body of research shows that mass medical conspiracy belief has significant social and medical implications [4–8, 24]. For example, it has been well documented that support for MCTs can influence people's distrust of government, science, and scientific and medical institutions [6, 21]. The role of MCTs as a source of "infodemics" and "moral panic" has also been highlighted [25, 26]. CTs can also become a source of "medical populism," defined by Lasco and Curato [27] as a political style based on performances of public health crises that pit 'the people' against 'the establishment, and exemplified by South African president Thabo Mbeki's HIV denialism, the vaccination scandal in the Philippines, the Ebola scare, and the drug wars in Southeast Asia. Similarly, downplaying the seriousness of SARS-CoV-2, Tanzanian president John Magufuli declared the country "COVID-19-free" thanks to three days of citizen prayers that had saved the country and argued that the country did not need coronavirus vaccines but should instead promote herbal remedies [28]. At the same time, Nattrass [8] rightly points out that while some CTs serve as rhetorical devices targeting the "elite" or the establishment, others target medical science.

What is equally important is that exposure to MCTs weakens support for public health programs and pro-health behaviours [24, 29–31] and is negatively associated with engagement in prosocial behavior. Additionally, it can have profound public health implications, especially during disease outbreaks. For example, while support for CTs related to AIDS has been linked to poor health behaviours, i.e. unprotected sex [8, 32], it is estimated that AIDS denialism, resulting from inappropriate health policies implemented by the South African government and inspired by CTs, has led to some 330,000 AIDS deaths and increased infant mortality [33]. Similarly, supporters of CTs declared that they were less likely to seek care for Ebola and supported less frequent quarantines of people returning from West Africa [34]. Finally, during the COVID-19 pandemic, belief in MCTs was strongly associated with lower adherence to a prescribed regimen, including the use of face masks and disinfectants, social distancing, and testing and vaccination for COVID-19 [7, 8, 31, 35–38].

Similarly, exposure to MCTs may also influence people's individual medical and health behaviors. For example, Oliver and Wood [24] showed that MCT believers were likelier than non-adherents to take herbal supplements, buy organic or farm-grown food, and take vitamins. On the other hand, MCT supporters were less likely to have regular health check-ups, visit the dentist, get the flu vaccine, or use sunscreen. Other research has shown that MCT supporters believe in mythical causes of cancer and are more sceptical of cancer screening [39]. In addition, they use alternative medicine, are more likely

to avoid conventional medicine, are less likely to rely on general practitioners, and are more likely to turn to the Internet and celebrity doctors for health information [24, 40]. Finally, they are less likely to be vaccinated.

At the same time, although it is often suggested that people who believe in MCTs tend to be less educated, less wealthy, right-wing, and members of minority groups, MCTs are widely regarded in many societies around the world, and their adherents come from across the social and political spectrum [5–7, 35, 41]. For example, Oliver and Wood [4] showed that almost half of American adults believed in at least one MCT (49%) and 18% agreed with three or more. Simultaneously, prior studies on CTs have primarily concentrated on psychological, political, or structural factors. For example, some studies have argued that people's support for CTs stems from psychological factors such as biases, emotions, intuitive and paranoid thinking styles, "us versus them" or "black versus white" worldviews, and various personality traits, including Machiavellianism, psychopathy, and narcissism [42–45]. Others argue that conspiracy thinking is more associated with political and ideological self-identification, mainly populism, political extremism and institutional distrust [46–49]. Finally, research stresses individuals' adverse social status and suggests that those with lower socioeconomic status or ethnic background are more prone to support CTs [1, 50, 51]. On the other hand, some studies argue that beliefs in CTs are closely correlated to several sociodemographic factors, including age, gender, education, religiosity (fundamentalism) and political orientation [35, 43, 51, 52].

Significantly, among all these factors, education is considered by many as a crucial component that influences personal beliefs in CTs [35, 51, 53, 54]. According to some research, people with higher levels of education are more knowledgeable in science and biotechnology, are better at analytical and critical thinking, making it easier for them to spot opposing viewpoints and less vulnerable to CTs [53]. Others claim that higher education leads to scepticism towards CTs because it lessens the inclination to attribute agency and purpose when none exists and equips individuals with a greater feeling of control over their social environments, making them less eager to believe that complex social issues can have easy answers [51, 54].

Following the footsteps of earlier research, this study focuses on the influence of education on a person's belief in MCTs. At the same time, while research often focuses on MCT belief in the general public, much less is known about the views of future healthcare workers. This is important because while public health officials and healthcare workers try to find ways to overturn beliefs in MCTs, the medical world is not free of these beliefs. Meanwhile, due to their high social status and authority, healthcare professionals significantly impact society and are essential in promoting patients' health literacy and lifestyles and preventing unhealthy behaviors and infectious and lifestyle diseases [55, 56]. Consequently, medical and healthcare students should strive to become role models for their patients, be reliable sources of medical information and be able to find efficient ways to communicate with them on medical and health issues and effectively combat conspiratorial beliefs, and thus, build trusting relationships with them and positively influence their health behaviors and lifestyle choices [7, 57].

However, the problem is that medical students are frequently exposed to various settings that may harm the knowledge they gain during their education and training, mainly since they have grown up with technology and often perceive social media as an essential source of (health) information. Meanwhile, the Internet, particularly social media, has been identified as critical platforms that disseminate medical misinformation and spread the MCTs [58–62]. Thus, although medical and healthcare students frequently exhibit very high levels of medical knowledge due to the specialised nature of their studies, it can be undermined by the influence of misinformation [58–62]. Consequently, while future healthcare workers may find it challenging to apply that knowledge to everyday practice, their beliefs in and support of MCTs can affect not only their health practices, including smoking, alcohol drinking or vaccination intention, but can also affect the beliefs, attitudes and health behaviours of everyone seeking medical attention from professionals [63, 64].

Thus, only by understanding the interrelationship between beliefs in MCTs, their social determinants, and personal behaviors can effective educational measures be implemented to prevent the spread of CTs. This study, therefore, seeks to explore (1) support for MCTs among medical and health science students, (2) socio-demographic factors, including gender, year of study, faculty, size of the community, the role of religion in life, political orientation and declared worldview, associated with future healthcare workers support for MCTs, and (3) the association between these beliefs and students' reported health behaviors.

Methods
Study design
Although some studies on Polish medical students' vaccine hesitancy, particularly during the COVID-19 pandemic, have been conducted [65, 66], little is known about future healthcare workers' beliefs in MCTs and how they influence their health behaviors. Therefore, this study presents data from a self-administered, anonymized, computer-assisted web survey on the association between medical students' beliefs in MCTs and their

medical and health behaviors. A quantitative approach was selected to facilitate data analysis from a large sample size, thereby enabling the implementation of robust statistical procedures to identify patterns and correlations between different variables. The CAWI (Computer-Assisted Web Interviewing) technique was employed to reach the target population while ensuring respondents' anonymity efficiently. This mode of data collection facilitated easy access to the target respondents, allowed for the standardization of the data collection process, and minimized interviewer bias to ensure consistency of responses across survey participants.

Participants and setting
By implementing convenience sampling, students were recruited through an online communication platform used for educational purposes at the Poznan University of Medical Sciences (PUMS) – Microsoft Teams, and administered by PUMS.

The eligibility criteria for participation included being a student enrolled at PUMS, being willing to participate in the study, providing written informed consent before completing the survey, and being able to take part in an online survey and use electronic devices.

In the first stage of the recruitment process, the research coordinator (JD) sent the invitation letter with the link to the online questionnaire to group leaders, who were asked to distribute it among their fellow students. Similar invitations were also sent to all students enrolled at PUMS via the Microsoft Teams online communication platform. Of the 5,937 students invited to the study during the three months, 1175 responded and completed the survey (response rate 19.8%). It should be stressed, however, that while this response rate refers to the number of emails sent, many students either do not use university communication channels or do so with a considerable delay. Therefore, the actual response rate is undoubtedly higher.

Research tool
The questionnaire used for this survey was elaborated based on a tool created by Oliver and Wood [24] and designed following the guidelines of the European Statistical System [67]. After a preliminary questionnaire was drafted, it was reviewed by three experts in medical sociology and public health and pretested with a group of 20 students in a pilot study via an online communication platform for students used at PUMS for educational purposes (Microsoft Teams), which led to a reformulation of five items.

The questionnaire comprised closed-ended, single-choice questions to explore medical students' beliefs in MCTs and declared health behaviors. It was divided into three sections. The first section included questions regarding twenty different MCTs relating to HIV/ AIDS denialism, fluoridation, Big Pharma, anti-vax, and COVID-19. Additionally, although usually not classified as a strict CT, we have included two items related to the denial of mental illness and its treatment with medications [68]. Students were asked to agree or disagree with these statements using a five-point Likert scale: "definitely not," "rather not," "rather yes," and "definitely yes," with any "Neither agree nor disagree" responses considered as the midpoint of the response scale. The second section of the questionnaire addressed students' various medical and health behaviors, including vaccination status, use of dietary supplements, preference for organic foods, and reliance on nonconventional medicine or home remedies. The respondents were asked to indicate whether they engaged in each behavior by selecting "Yes" or "No". This set of items examined potential correlations between respondents' health practices and beliefs in medical conspiracy theories. The final section of the questionnaire addressed students' demographic characteristics, including gender, year of study, size of community, role of religion in life, left-right political orientation, and liberal-conservative orientation.

Data collection
This survey was conducted among medical students at PUMS during the winter semester between December 2023 and February 2024. Before completing the survey, all study participants received an invitation letter from the research coordinator (JD). They were instructed about the study's purpose and its voluntary, anonymous, confidential, and non-compensatory character. Additionally, the letter contained a link to the online version of the questionnaire, which was made available online via a communication platform. Thus, participants could complete the survey anytime and place using their mobile devices (e.g., smartphones or tablets). After providing written informed consent, every participant willing to participate in the survey received a link to the online questionnaire. Completing the study took approximately 12–15 min.

Ethical issues
Both the design and collection of the survey complied with the guidelines of the Declaration of Helsinki (revised in 2000) [69]. It was also approved by the Poznan University of Medical Sciences (PUMS) Bioethics Committee (KB −75/24, granted on January 16, 2024). Additionally, before completing the survey, all students who volunteered and agreed to participate were presented with the online consent form at the beginning of the survey and requested to select an "I agree" or "I do not agree" checkbox. Filling out an online written consent form to participate was necessary to access the questionnaire. Informed

consent was obtained from all students enrolled in the study.

Data analysis

Analyses were performed using the R project for statistical computing [70]. The core part of our analysis employs OLS linear regressions to assess relationships between beliefs in MCTs (the higher the value, the greater the support for MCTs) and four sociodemographic characteristics of survey participants (namely gender, size of the community, year of study, and field of study), their political orientation, social and cultural values, as well as the role of religion in life. To mitigate the potential collinearity issue among specific covariates, following the approach suggested by Midi et al. [71], distinct regression models were constructed for the dependent variable. Model 1 includes all four sociodemographic characteristics of respondents. Models 2, 3, and 4 add political orientation, social and cultural values, and the role of religion in life to the variables included in Model 1.

Results

Of 5,937 students enrolled at PUMS, 1,175 completed the survey (response rate: 19.8%). The sample consisted of 898 women (76.4%) and 263 men (22.4%), all of Polish origin (Table 1). Although the students represented a variety of courses and years of study, the majority were enrolled in their first or second year (58.4%), with a predominance of medical (35.7%), nursing and midwifery (16.2%), pharmacy (13.6%), and physiotherapy (11.5%) students. Additionally, representatives of several other majors participated in the survey, including cosmetology, dental techniques, dietetics, electroradiology, forensic analysis, hearing aid, medical analytics, medical biotechnology, medical rescue, occupational therapy, optometry, and public health. However, since their number was too small, they were combined into a separate category: "Other" (*n* = 268; 22.8%).

Figure 1 shows the percentage of respondents agreeing, disagreeing, or having no opinion with each of the twenty statements related to MCTs (the complete statements and response distributions are included in Table S1 in the supplementary materials). Although the proportion of respondents who reported believing in MCTs was generally low, some conspiracy theories appeared more popular than others. The five MCTs with the highest support were as follows: (1) scientists hide information from the public (22.5%), (2) COVID-19 was developed as a biological weapon (9.7%), (3) most diseases can be treated by natural remedies (7.0%), (4) the COVID-19 pandemic was invented to spread global panic (4.9%), and (5) mental disorders are not actual diseases (5.0%). On the other hand, the least supported MCTs were HIV denialism (0.5%), the belief that the COVID-19 vaccine contains

Table 1 Study participants

| Characteristics	Total (*n* = 1175)	Medicine and dentistry (*n* = 420)	Pharmacy (*n* = 162)	Physiotherapy (*n* = 135)	Nursing and midwifery (*n* = 190)	Others (*n* = 268)
Gender						
Female	898 (76.4%)	274 (65.2%)	128 (79.0%)	95 (70.4%)	181 (95.3%)	220 (82.1%)
Male	263 (22.4%)	144 (34.3%)	31 (19.1%)	37 (27.4%)	8 (4.2%)	43 (16.0%)
Did not answer	14 (1.2%)	2 (0.5%)	3 (1.9%)	3 (2.2%)	1 (0.5%)	5 (1.9%)
Year of study						
1st–2nd year	686 (58.4%)	240 (57.1%)	118 (72.8%)	74 (54.8%)	112 (58.9%)	142 (53.0%)
3rd–5th year	489 (41.6%)	180 (42.9%)	44 (27.2%)	61 (45.2%)	78 (41.1%)	126 (47.0%)
Size of community						
Up to 10,000	315 (26.8%)	92 (21.9%)	44 (27.2%)	31 (23.0%)	69 (36.3%)	79 (29.5%)
10,001–100,000	313 (26.6%)	99 (23.6%)	56 (34.6%)	36 (26.7%)	48 (25.3%)	74 (27.6%)
100,001–500,000	147 (12.5%)	59 (14.0%)	18 (11.1%)	18 (13.3%)	18 (9.5%)	34 (12.7%)
More than 500,000	400 (34.0%)	170 (40.5%)	44 (27.2%)	50 (37.0%)	55 (28.9%)	81 (30.2%)
Role of religion in life						
Important	308 (26.2%)	117 (27.9%)	47 (29.0%)	32 (23.7%)	52 (27.4%)	60 (22.4%)
Little	399 (34.0%)	124 (29.5%)	51 (31.5%)	53 (39.3%)	82 (43.2%)	89 (33.2%)
None	468 (39.8%)	179 (42.6%)	64 (39.5%)	50 (37.0%)	56 (29.5%)	119 (44.4%)
Left-right orientation						
Left	584 (49.7%)	213 (50.7%)	78 (48.1%)	63 (46.7%)	92 (48.4%)	138 (51.5%)
Center	461 (39.2%)	149 (35.5%)	63 (38.9%)	60 (44.4%)	86 (45.3%)	103 (38.4%)
Right	130 (11.1%)	58 (13.8%)	21 (13.0%)	12 (8.9%)	12 (6.3%)	27 (10.1%)
Liberal-conservative orientation						
Liberal	735 (62.6%)	285 (67.9%)	100 (61.7%)	82 (60.7%)	104 (54.7%)	164 (61.2%)
Center	335 (28.5%)	84 (20.0%)	46 (28.4%)	45 (33.3%)	72 (37.9%)	88 (32.8%)
Conservative	105 (8.9%)	51 (12.1%)	16 (9.9%)	8 (5.9%)	14 (7.4%)	16 (6.0%)
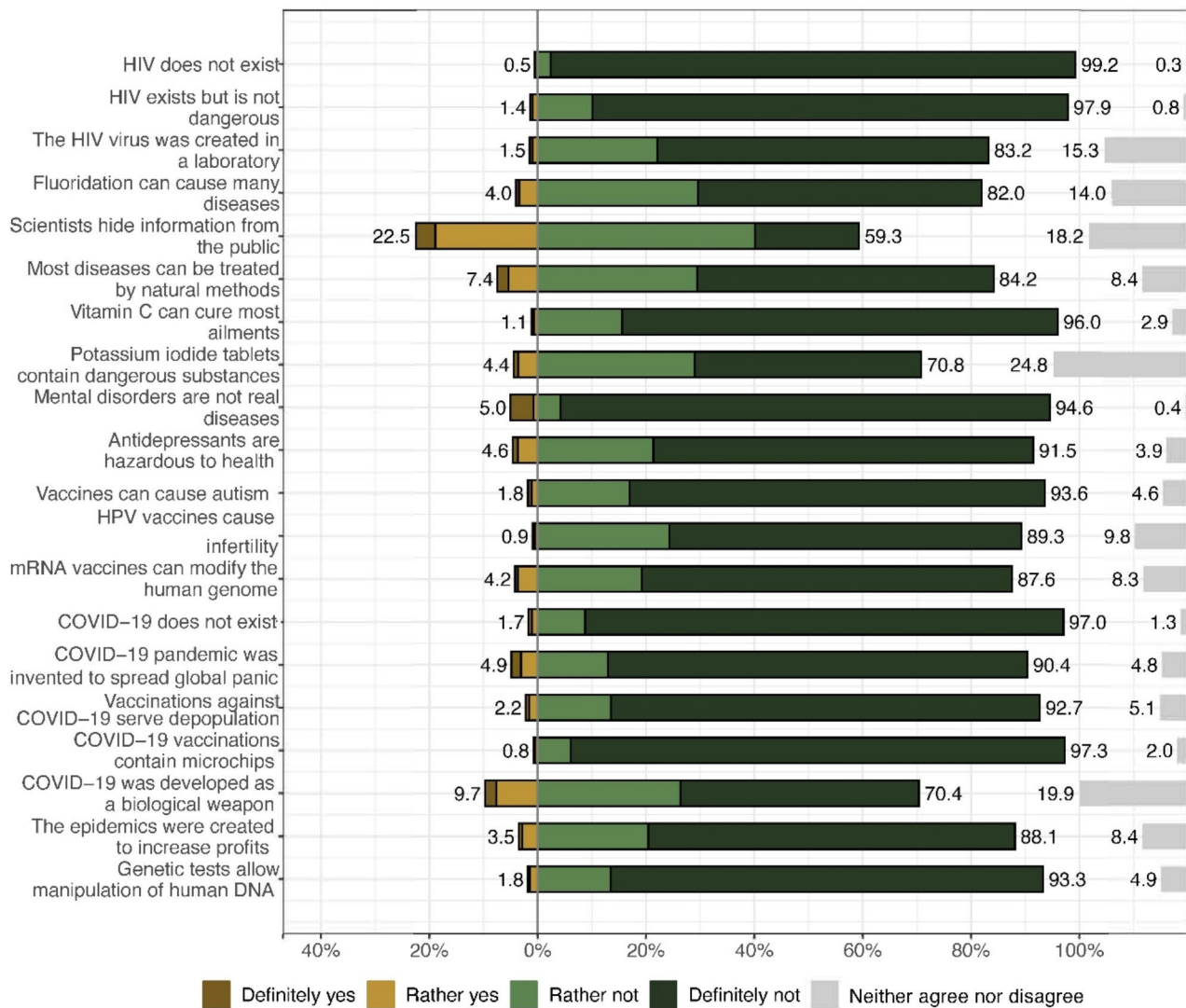
Fig. 1 Support for medical conspiracy theories

microchips (0.8%) and that the HPV vaccine causes infertility (0.8%).

At the same time, a significant number of students were hesitant. For example, many students were unsure whether potassium iodide was safe (24.8%), whether the SARS-CoV-2 coronavirus was designed as a biological weapon (19.9%), or whether scientists would hide cures from the public (18.2%). In addition, 15.3% were unsure whether HIV was designed in a laboratory. Many were also concerned about the safety of fluoridation (14%) and HPV and mRNA vaccines (9.8% and 8.3%, respectively).

Notably, one-third of the study participants rejected all MCTs; around 18% believed in one, almost 15% believed in two, and 10% believed in three, indicating that the remaining 24% believed in four or more conspiracy theories (although none believed in all 20).

Figure 2 shows details of the support for each MCT across faculties. The dendrogram (Euclidean distance measure; complete linkage) highlights three groups of MCTs by their popularity among students (see individual cell labels for exact numbers). The group of *highly supported MCTs* consists of three beliefs, namely that (1) scientists hide information about the adverse effects of many treatments from the public; (2) potassium iodide tablets, which are administered in the event of a radiation emergency due to radioactive iodine, contain dangerous substances, including mercury, lead, and toxins; (3) COVID-19 was developed in the laboratory as a biological weapon. In turn, the group of *moderately supported MCTs* consists of five beliefs, namely (1) fluoridation of drinking water and teeth can lead to impaired intellectual development in children and can cause many diseases,
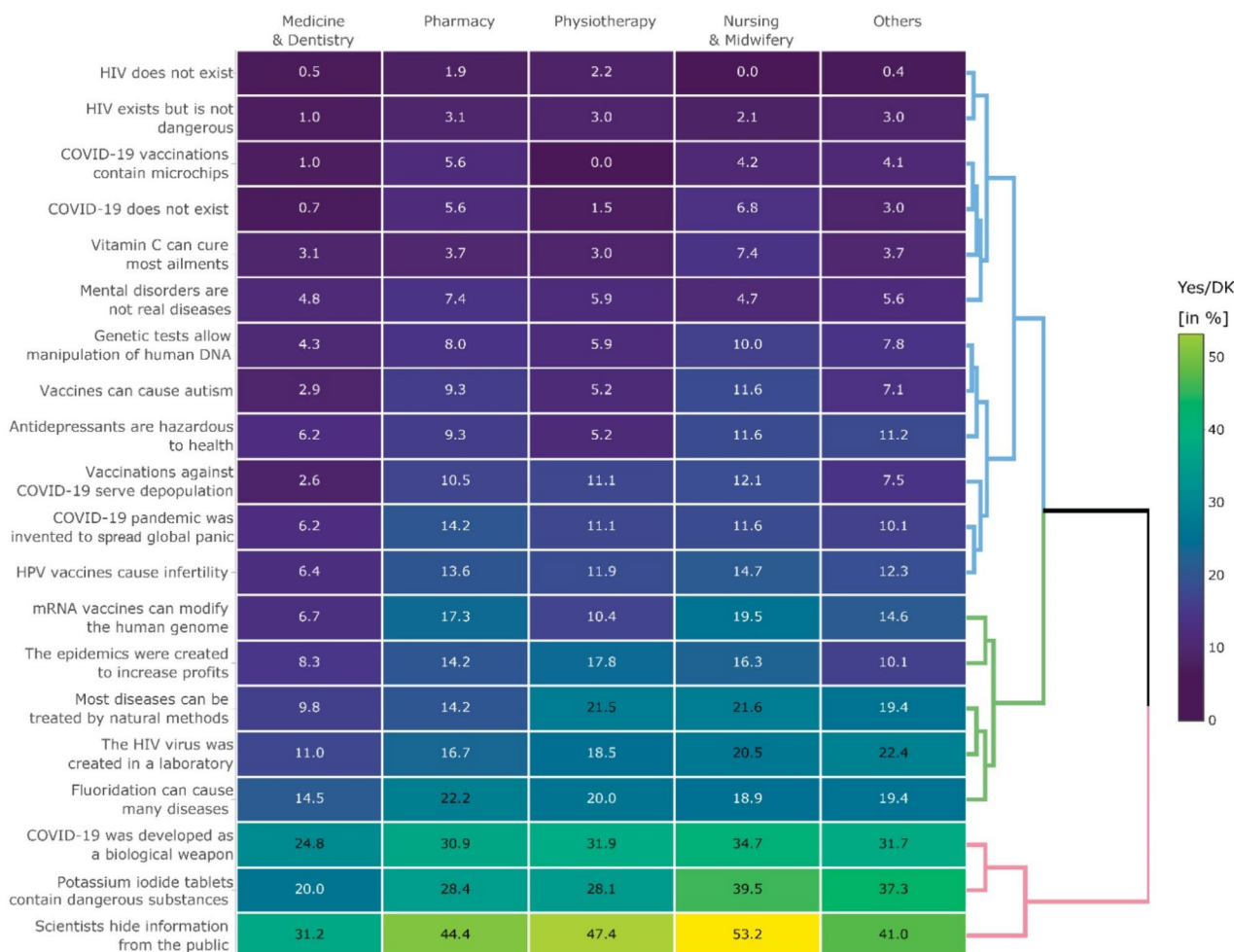
Fig. 2 Support for medical conspiracy theories by field of study

including Alzheimer's disease; (2) HIV was created in a laboratory and was intended to be used as a biological weapon; (3) most diseases, including cancer and AIDS, can be treated by natural methods, but these are not allowed because it would be detrimental to the profits of pharmaceutical companies; (4) biotechnology companies created the Zika, Ebola, MERS, and SARS-CoV-2 epidemics to increase profits; and (5) mRNA vaccines can modify the human genome. The remaining 12 beliefs fall into the group of *poorly supported MCTs*, with persistent differences between fields of study as described previously. The differences between the five selected fields of the study demonstrate that students of medicine and dentistry are least likely to believe MCTs and nursing and midwifery students are most likely to accept them.

Figures 3 and 4 visualize the regression results to facilitate the interpretation of relationships between students' sociodemographic characteristics, their sociopolitical attitudes, and the support for three extracted groups of MCTs (detailed results of all OLS regressions are presented in Tables S2, S3, and S4 in the supplementary materials). Figure 3 shows that male students expressed slightly less belief in MCTs than their female counterparts. However, as shown in supplementary Tables S2, S3, and S4, these differences were negligible in most models. Support for MCTs decreased as the size of the place of residence increased. Still, only those living in large cities (i.e., over 500,000 inhabitants) differed significantly from those living in small settlements (up to 10,000 inhabitants). On the other hand, in all models, the year of study significantly differentiated the students' belief in MCTs, with respondents from the 3rd to the 5th year of study showing less support for MCTs than those in the first two years of study. Moreover, medicine and dentistry students were the least supportive of MCTs and differed significantly from all other groups of students, while nursing and midwifery students were the most supportive.

Figure 4 visualizes the regression results for the sociopolitical variables. It shows that support for MCTs was lower among students who identified themselves
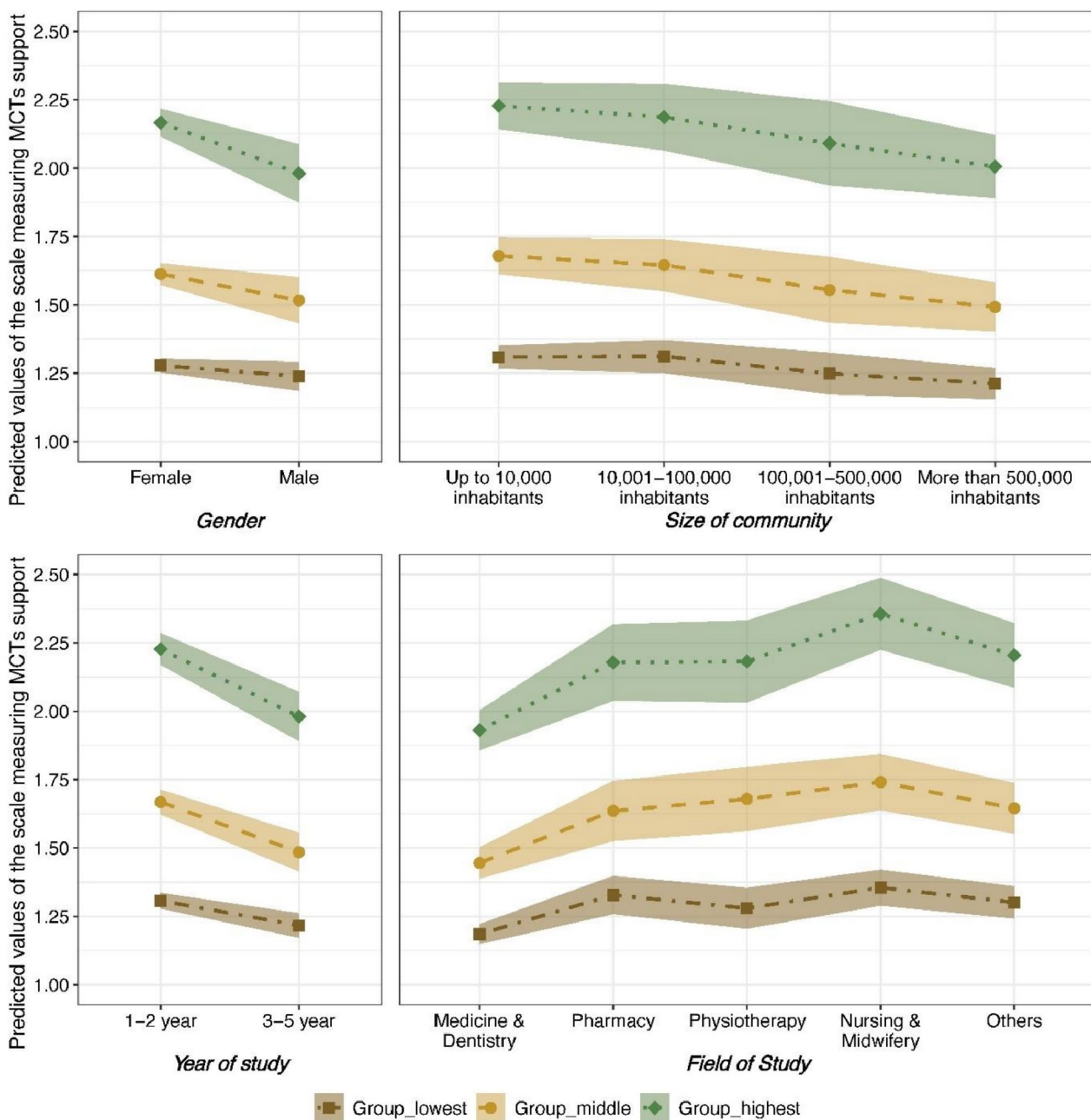
Fig. 3 Summary of OLS regression results for sociodemographic variables

as nonbelievers, liberal, and on the left of the political spectrum.

Table 2 shows the proportion of respondents who engaged in different health behaviors according to the number of MCTs they believed. It shows that belief in MCTs significantly correlates with most health behaviors. Students who believed in four or more MCTs were generally more supportive of alternative medicine or home remedies, reported taking vitamin C and avoiding vaccinations more often, and considered social media an essential source of health information. For example,

while almost 46% of all students who did not believe in any MCTs said they had been vaccinated against flu, the figure was 26.2% for those who believed in four or more MCTs. Similarly, 45.2% of MCTs supporters reported using traditional/nonconventional medicine, compared with 22.8% of non-supporters. Significantly, the differences were negligible for only four health behaviors (taking dietary supplements, buying organic food regularly, preferring organic food to supermarket food, and always going to the doctor when sick).
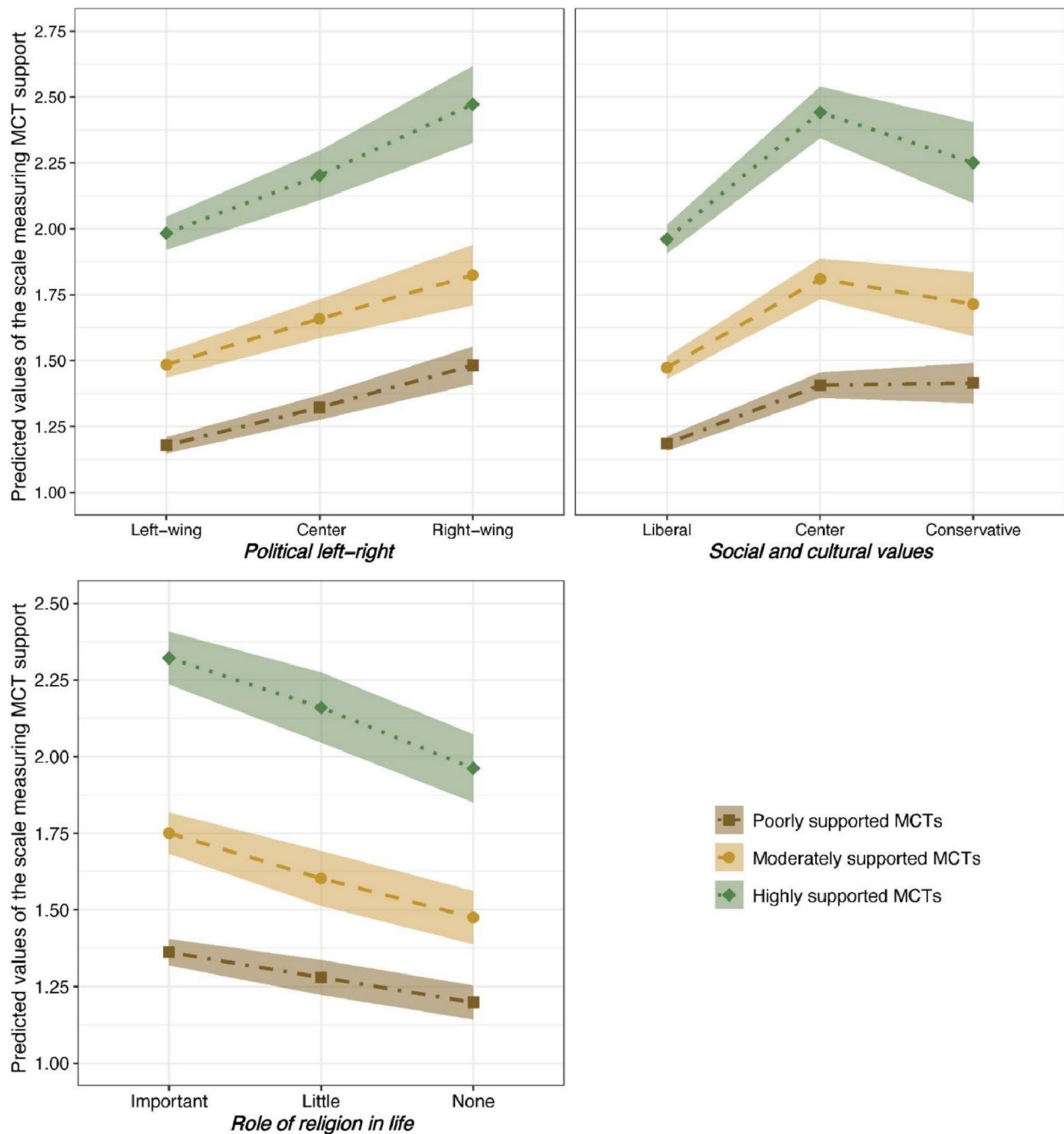
Fig. 4 Summary of OLS regression results for sociopolitical variables

Discussion

This article reports six significant findings. Firstly, it shows that although the percentage of respondents who believed in MCTs was generally low, some students expressed hesitancy. Secondly, while a third of prospective healthcare professionals rejected all MCTs, 24% believed in four or more CTs, with almost 20% believing in one, nearly 15% in two, and 10% in three. Thirdly, the research reveals that the most popular MCTs include the beliefs that scientists conceal information from the public, that COVID-19 was created as a biological weapon, that most diseases can be treated naturally, that the COVID-19 pandemic was designed to incite global fear, and that mental illnesses are not genuine diseases. Fourthly, nursing and midwifery students were more likely to accept MCTs, while those studying medicine

Table 2 The proportion of students engaging in various health behaviors by the number of medical conspiracy theories they agree with

Behaviors	Total	Number of MCTs agreed with				Paired comparison p-value[2]		
		None	1–3	4 or more	p-value[1]	None vs. 1–3	None vs. 4 or more	1–3 vs. 4 or more
1: Taking dietary supplements	70.2	70.5	68.8	72.4	0.772	0.583	0.586	0.287
2: Regularly buy organic food	28.0	28.2	28.6	26.5	0.913	0.898	0.625	0.530
3: Prefer organic foods over those bought in supermarkets	20.2	21.5	17.9	22.6	0.524	0.186	0.740	0.119
4: Take vitamin C regularly	39.9	32.4	41.3	47.7	**0.024**[3]	**0.006**	**< 0.001**	0.088
5: When sick, always go to the doctor	14.8	15.8	15.1	12.9	0.773	0.781	0.296	0.398
6: Vaccinated against influenza	36.0	45.9	33.9	26.2	**0.001**	**< 0.001**	**< 0.001**	**0.026**
7: Regularly go to the dentist	72.1	76.7	70.2	69.2	0.254	**0.030**	**0.030**	0.774
8: When sunbathing, use sunscreen	91.0	94.3	91.7	84.9	**0.022**	0.142	**< 0.001**	**0.003**
9: Vaccinated against COVID-19	93.4	97.7	95.8	83.2	**< 0.001**	0.122	**< 0.001**	**< 0.001**
10: Use traditional/nonconventional medicine	31.9	22.8	31.5	45.2	**< 0.001**	**0.004**	**< 0.001**	**< 0.001**
11: When sick, use homeopathy	5.6	2.8	6.0	8.6	0.104	**0.025**	**0.001**	0.180
12: When sick, prefer to treat with home remedies	29.2	21.5	27.4	43.0	**< 0.001**	**0.044**	**< 0.001**	**< 0.001**
13: Social media is an important source of health knowledge	25.3	18.4	26.2	33.3	**0.013**	**0.006**	**< 0.001**	**0.035**
14: Read horoscopes	2.0	1.0	2.0	3.2	0.429	0.248	**0.044**	0.296

Notes:

[1] F-test for equality of proportions in three categories defined by the number of MCTs agreed with

[2] Two sample z-tests for equality of proportions

[3] Statistically significant differences are in bold

and dentistry were less likely to do so. Fifthly, students who identified as religious and conservative in the earlier years of their studies showed greater support for MCTs. Finally, there was a strong association between students' support for MCTs and several self-reported health behaviors, including avoiding vaccinations, using alternative medicine, taking vitamin C, and using social media as a primary source of health information.

Thus, while previous research demonstrated that beliefs in MCT are present in the general public, this study confirms the observation made by others that also (future) healthcare professionals are prone to believing in CTs. For example, while most physicians, pharmacists, and nurses in Lebanon were knowledgeable about monkeypox and supported MPOX vaccination in disease prevention, a quarter still endorsed monkeypox CTs (25.4%) [64]. In Nigeria, 26.4% of healthcare workers believed COVID-19 vaccines contained digital microchips, and 30% believed that the vaccines could alter an individual's DNA or genetic information, which resulted in only 76.2% declaring the wish to be vaccinated [63]. Similarly, medical students were also reported to exhibit vaccine hesitancy [66, 67, 72, 73]. This study indicates that while the percentage of respondents who fully believed in MCTs was generally low, a significant portion of students believed in at least one MCT, nearly a quarter believed in four or more, and many others showed hesitancy or partial acceptance. This distribution suggests that susceptibility to MCTs is not limited to a small minority but is present to varying degrees among a broader cohort of

students and that there is an urgent need for targeted educational interventions to address and correct these misconceptions before they manifest in clinical practice. It is also concerning because it highlights a vulnerability among future healthcare professionals to misinformation, which could undermine evidence-based practice. Despite the availability of accurate medical information, hesitancy or partial belief in MCTs among students indicates that even a minority of healthcare professionals might be susceptible to such theories, potentially impacting their professional decisions and patient care [73, 74]. Thus, it also suggests that apart from the official knowledge acquired during university education, many students base their beliefs on other sources of information, mainly from the Internet and social media, which were shown to be the main sources of misinformation [58–62].

Interestingly, our research identifies that medical students tend to believe in some MCTs but not others. The fact that the most popular MCTs include the belief that scientists conceal critical information from the public, that most diseases can be treated naturally, that COVID-19 was engineered as a biological weapon and that the pandemic was deliberately designed to incite global fear suggests a broader mistrust of government, scientific and medical institutions, which could have serious implications for public health initiatives. This aligns with previous studies showing that medical professionals influenced by MCTs often harbour suspicions toward pharmaceutical companies and conventional medical practices, potentially undermining trust

in evidence-based treatments and interventions [63, 64, 73, 74]. The endorsement of such beliefs by future healthcare professionals is particularly concerning, as it may lead to resistance to public health measures, a reluctance to endorse vaccinations, or a general distrust of medical guidelines, thereby undermining the effectiveness of health interventions [29–31].

Equally important is that this study highlights significant differences in MCT endorsement across different fields of study. In particular, it shows nursing and midwifery students are more susceptible to conspiracy thinking than their medicine and dentistry peers. While it confirms previous studies showing that nurses are more prone to believing in CTs than physicians, pharmacists and laboratory scientists [63], this disciplinary divide might reflect differences in educational content, critical thinking training, or exposure to CTs during their studies. Additionally, this trend may be related to the socioeconomic structure of students in these fields, including their gender, religious beliefs, or political views. The fact that certain groups of students are more susceptible to MCTs raises essential questions about the adequacy of current educational approaches in fostering critical appraisal skills across all healthcare disciplines [75–77]. Moreover, regardless of the underlying cause, knowing that this discrepancy exists should prompt the implementation of appropriate measures tailored to each student group's specific needs and characteristics to ensure that all future healthcare professionals are equally prepared to critically evaluate and reject misinformation.

Our findings indicate a strong association between support for MCTs and specific demographic and personal characteristics, such as being in the earlier years of study, identifying as religious, and holding conservative political views. This correlation suggests that personal beliefs are associated with social background [35, 43, 51, 52] and significantly influence susceptibility to MCTs, even among those undergoing rigorous scientific training. These findings reflect broader societal trends, where certain ideological groups are more prone to conspiracy thinking [3, 7, 35, 41]. The persistence of these factors, even in the face of medical training, highlights the need for targeted educational strategies that address these predispositions [63–66]. Early intervention in medical education is essential to cultivate a professional identity that prioritizes patient care and ethical practice, balancing technical competence with humanistic values to mitigate potential conflicts that may arise during medical education [53, 54]. The association between MCTs and these demographic factors underscores the importance of considering students' cultural and ideological backgrounds when designing educational programs to reduce the influence of CTs in healthcare.

The results of our research highlight another interesting aspect in this context. The association between belief in MCTs, right-wing political orientation, and the role of religion in an individual's life has been extensively analyzed in the general population for many years [4, 24, 35, 78]. Our study shows that this phenomenon extends to the medical field. While it is not surprising that doctors, nurses or pharmacists hold different political views or religious beliefs, the unexpected aspect is the persistence of these factors in their approach to important issues despite being trained in the principles of evidence-based medicine. This finding highlights the importance of reassessing the effectiveness of countering CTs among health professionals and suggests the need for personalized educational tools and methods [53, 54]. The latter is crucial because many of our respondents believe scientists hide information from the public and may be influenced by interactions with pharmaceutical representatives. However, the inexplicable belief that mRNA vaccines can alter the human genome raises concerns.

Our study demonstrates a strong link between students' support for MCTs and several self-reported health behaviors, such as avoiding vaccinations [65, 66, 76, 79–81], using alternative medicine [29], taking vitamin C, and depending on social media as a primary source of health information [58–61]. This finding is particularly alarming, as it suggests that belief in MCTs may translate into harmful health behaviors for the students and the patients they will eventually care for. The significant link between MCT belief and lower vaccination rates, particularly for influenza and COVID-19, highlights the critical need for interventions to promote accurate health information and encourage evidence-based practices among healthcare students. The results of our study suggest that belief in MCTs among medical students also translates into specific actions or omissions in health-promoting behaviors [65, 66, 76, 79–81]. This phenomenon has also been observed in the general population [24]. For example, within the study group, more individuals who did not believe in any MCTs were vaccinated against influenza and COVID-19 compared to those who believed in multiple MCTs. This apparent association between vaccination behaviors and belief in CTs emphasizes the need for targeted educational interventions that address these misconceptions and promote vaccine uptake among healthcare students.

Belief in MCTs, such as the notion that pharmaceutical companies conceal cancer cures, is linked to embracing other pseudoscientific ideas like astrology and homoeopathy [82]. For instance, a Polish study found a negative correlation between trust in horoscopes and trust in vaccines [79], highlighting a broader connection between MCTs and alternative health practices. In the general population, MCT believers tend to favour alternative

medicine over biomedical approaches and show less engagement in preventive health measures, such as regular check-ups, dental visits, and vaccinations [24, 40, 78]. Oliver and Wood [24] reported that 35% of MCT believers used herbal supplements, compared to 13% of non-believers. Similarly, vaccine hesitancy, influenced by complex factors [83, 84], is more prevalent among those who endorse MCTs. Our study observed a stark contrast in vaccination rates: 45.9% of students who rejected MCTs were vaccinated against influenza, compared to only 26.2% of those who believed in four or more MCTs. This pattern also extends to COVID-19 vaccination rates, underscoring the significant impact of MCT beliefs on health behaviour [29, 76, 80, 81]. Furthermore, Juanchich et al. [38] and Enders et al. [85] emphasized that these beliefs often stem from the same factors driving vaccine hesitancy rather than purely exogenous causes. Earnshaw et al. [31] found that individuals endorsing conspiracy beliefs were 3.9 times less likely to intend to vaccinate and showed less support for COVID-19 public health policies.

The study further emphasizes the role of social media in perpetuating MCTs, as frequent use of social media for health information was associated with a higher likelihood of believing in CTs. This finding aligns with previous research [58, 85] and suggests that the digital environment plays a significant role in shaping the beliefs of medical students. As such, enhancing digital literacy and the critical evaluation of online content should be essential components of medical education. Addressing the influence of social media on students' beliefs is crucial, as it may not only shape their understanding of health-related issues but also influence their future professional behavior and the advice they provide to patients.

Medical students' beliefs in MCTs are linked to their epistemological beliefs and cognitive dispositions and are shaped by their cultural and educational backgrounds [5, 86]. Early intervention in medical education is essential to cultivate a professional identity that prioritizes patient care and ethical practice [87]. Balancing technical competence with humanistic values is essential, given the potential conflicts that may arise during medical education. The emergence and resonance of CTs in the natural sciences, including medicine, present significant challenges. These theories can profoundly influence individuals' health decisions and behaviors [8, 24, 31, 36], ultimately affecting patient safety and public health. As we explore the association between future healthcare workers' beliefs in MCTs and their health behaviors, it becomes evident that addressing this issue is crucial for ensuring informed, evidence-based healthcare practices [7]. The findings suggest that addressing MCTs within the curriculum, mainly through enhanced critical thinking and digital literacy training, is essential. Moreover,

understanding the demographic and personal factors that contribute to the acceptance of MCTs can inform more personalized and effective educational interventions. As healthcare systems continue to grapple with the challenges posed by misinformation, ensuring that future professionals are equipped to resist and counteract CTs will be crucial for maintaining public trust in medicine and science.

Limitations

This study has limitations that should be considered when interpreting the results. First, although 1175 students completed the questionnaire, the response rate was still relatively low. Second, this study has a local dimension, as students enrolled in only one Polish university were approached. Consequently, it only represents the opinions of those students who agreed to participate in the study and cannot be extrapolated to the entire population of medical students in Poznan or Poland. Third, although medical and health studies in Poland are strongly gendered, with women accounting for 75.61% of all students enrolled at PUMS in 2023 alone, there is a risk of implicit gender bias as the majority of study participants were female and male students were under-represented. Fourth, although the questionnaire was reviewed by three experts in medical sociology and public health and pretested in a pilot study, it was not validated. Consequently, measurement error is possible, and caution should be exercised when interpreting the results. Fifth, future studies should use published scales to assess conspiracy thinking. Additionally, since this research poses essential questions on why some students, including females, nursing and midwifery, who declared themselves religious and conservative, were more prone to believing in MCTs, conducting more in-depth qualitative that would help to understand students' motivations and personal experiences is desirable. Finally, as this research was conducted as an online survey, some students may not have been invited to participate.

Beyond these limitations, however, it should be acknowledged that, to the best of our knowledge, this is the first study of the association between medical and health science students' beliefs in MCTs and their health behaviors. While it identifies the main MCTs that are particularly popular among medical students, it also sheds light on the relationship between these beliefs and students' reported health behaviors. Thus, although this survey is limited in size, scope, and sample composition, we believe that it fills the gap in research on this topic and can stimulate further research that will help understand future health professionals' support for MCTs.

Conclusions and implications

Our study has the following implications. First, while the majority of students rejected most MCTs, as many as 67% of medical and healthcare students reported believing in at least one such theory, and nearly a quarter believed in four or more. Equally importantly, for some MCTs, many future health professionals reported being unsure or hesitant. As medical students will not only be responsible for treating their patients but also serve as trusted and reliable sources of medical information, this finding argues for more education for healthcare students about MCTs and effective ways to communicate with their patients to mitigate patients' conspiratorial beliefs. A second important finding suggests that nursing and midwifery students, in particular, are vulnerable to conspiratorial thinking and should be targeted for medical education. Moreover, the study underscores the importance of understanding the demographic and personal factors contributing to the acceptance of MCTs, as these insights can inform more personalized and effective educational interventions. Third, although future health professionals will also be responsible for shaping the population's health behaviors, we found a strong association between students' beliefs in MCTs and their reported health behaviors. Students should, therefore, also be trained to act as role models for their patients and society.

Thus, we suggest that to overcome these challenges, the following recommendations should be implemented:

1. To help future healthcare professionals critically assess the validity of information and resist misinformation, modules on critical thinking, logical reasoning, and (digital) media literacy should be integrated into medical curricula. Additionally, to teach students how to identify and debunk false claims, educators should use real-world examples of the social implications of MCTs.
2. Teachers continuously emphasize the importance of evidence-based medicine in medical training and practice. Healthcare professionals should be regularly updated on the latest research findings, especially those debunking common MCTs. At the same time, medical educators should use clear, understandable language to avoid confusion while talking about recent advances in science.
3. Simultaneously, medical educators should be transparent about the limitations and uncertainties in medical science and research. This builds trust and reduces the likelihood of patients turning to conspiracy theories.
4. Creating an environment where students and professionals feel comfortable asking questions and expressing doubts is important, as this openness can prevent the acceptance of false information due to unaddressed concerns. Additionally, open discussion forums should be established where healthcare professionals can discuss controversial topics and receive expert guidance.
5. As digital natives, medical students could use social media platforms to promote evidence-based science by creating reliable and accessible online content (blogs, videos, infographics) to counter misinformation and debunk MCTs.
6. Medical students should be encouraged to engage in continuous education, including workshops and courses on handling misinformation and MCTs. Additionally, a peer review and mentorship culture should be promoted at medical universities so that experienced professionals can guide younger colleagues in understanding and addressing MCTs.
7. To ensure that future patient communication is based on science rather than personal opinions, future healthcare professionals should be encouraged to self-reflect on possible cognitive biases and the impact of personal beliefs on their acceptance of MCTs.
8. Medical educators should always use empathetic communication and customize education strategies based on individual beliefs and concerns to address students' concerns and misconceptions.

Abbreviations
CTs   Conspiracy theories
MCTs   Medical Conspiracy Theories
PUMS   Poznan University of Medical Sciences

Supplementary Information
The online version contains supplementary material available at https://doi.org/10.1186/s12909-024-06057-y.

Supplementary Material 1

Declarations

Ethics approval and consent to participate
This study was performed in line with the principles of the Declaration of Helsinki. Ethics and research governance approval were obtained from the Poznan University of Medical Sciences Bioethics Committee (KB – 75/24). All participants provided written informed consent before completing the survey.

Consent for publication
Not applicable.

Competing interests
The authors declare no competing interests.

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