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RESEARCH ARTICLE

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Motivational interview-based health mediator interventions increase intent to vaccinate among disadvantaged individuals

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ABSTRACT

Coverage for recommended COVID-19 and diphtheria-tetanus-poliomyelitis (DTP) booster shots is often inadequate, especially among disadvantaged populations. To help health mediators (HMs) involved in outreach programs deal with the problems of vaccine hesitancy (VH) in these groups, we trained them in motivational interviewing (MI). We evaluated the effectiveness of this training among HMs on their MI knowledge and skills (objective 1) and among the interviewees on their vaccination readiness (VR) and intention to get vaccinated or accept a booster against COVID-19 and/or DTP (objective 2). Two MI specialists trained 16 HMs in a two-day workshop in May 2022. The validated MISI questionnaire evaluated HMs' acquisition of MI knowledge and skills (objective 1). Trained HMs offered an MI-based intervention on vaccination to people in disadvantaged neighborhoods of Marseille (France). Those who consented completed a questionnaire before and after the interview to measure VR with the 7C scale and intentions regarding vaccination/booster against COVID-19 and DTP (objective 2). The training resulted in HMs acquiring good MI skills (knowledge, application, self-confidence in using it). HMs enrolled 324 interviewees, 96% of whom completed both questionnaires. VR increased by 6%, and intentions to get vaccinated or update COVID-19 and DTP vaccination increased by 74% and 52% respectively. Nearly all interviewees were very satisfied with the interview, although 21% still had questions about vaccination. HMs assimilated MI principles well. MI use in outreach programs appears to show promise in improving vaccine confidence and intentions among disadvantaged people.

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Vaccine readiness; vaccine hesitancy; vaccine intention; motivational interviewing; health mediation; disadvantaged populations

Introduction

Background

The COVID-19 pandemic has reemphasized the importance of both adult vaccination and booster shots to maintain protection and reminded us that significant social health inequalities persist in Western countries for both primary vaccination and booster doses.[1,2] The World Health Organization (WHO) recommended a booster dose for adults six months after their primary COVID-19 vaccination, and a second booster dose three to six months later for the most at-risk patients.[3] By June 2022, 64% of adults living in the European Economic Area had received at least one booster dose.[4] Nonetheless, COVID-19 vaccination uptake was later or less frequent in socially and economically disadvantaged population categories (people with lower income, education, and/or employment than the general population) than in more well-to-do groups.[5,6] In the remainder of this manuscript, we will refer to the disadvantaged as people who are socially and/or economically disadvantaged. France shared these socioeconomic inequalities: 60% to 85% of adults, varying by age, education level and income, received at least one booster dose by the start of June 2022.[7,8]

Coverage of booster doses for other recommended vaccines was also unevenly distributed across social categories in European countries, even before the COVID-19 pandemic.[9] In France diphtheria-tetanus-poliomyelitis (DTP) boosters are recommended at the ages of 25 and 45, then every 10 years from age 65:[10] its coverage is often inadequate among those with low levels of education and income.[11,12]

Equal access to the health care system is a major driver of French policy, ensured theoretically and generally from a legal point of view, via a series of State social assistance programs. They offer, for example, free vaccinations to the most financially disadvantaged[13] as well as to illegal immigrants.[14] Nonetheless, equality and access to these rights of prevention and care are not fully available. Disadvantaged people are primarily affected by problems of access to vaccination centers, because, for example, of the remoteness of these centers, of transportation issues or the belief that they will have to pay for

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the vaccination.[2] In the specific case of undocumented migrants, the fear that personal information might be passed on to immigration authorities may also constitute a barrier to using these centers.[15] At the same time, disadvantaged people and migrants may have difficulty accessing clear information and navigating in the health care system due to low health literacy and language barriers.[2]

To overcome these obstacles, outreach programs have been implemented in various countries,[16] attempting to work with disadvantaged people to empower them and "bring them back to" primary health care services and thereby reduce health inequalities.[17,18] They "go toward" vulnerable and isolated populations, with the help of mobile teams of health and social professionals – community health workers or health mediators (HMs). Since 2020, such programs have been implemented to contain the spread of COVID-19 (screening, raising awareness about barrier gestures, vaccination, etc.) among disadvantaged groups, including refugees, racial and ethnic minorities, and incarcerated populations.[19–26] In France, health mediation has historically been initiated and implemented by the community sector. Its recognition in the Public Health Code in 2016[27] has enabled its support by public institutions and the development of a framework of skills, training and good practices.[18] Our study, which focuses on improving the skills of HMs, fits well within that framework.

When intervening to vaccinate inhabitants of disadvantaged areas, HMs may face high levels of vaccine hesitancy (VH) – "delay in acceptance or refusal of vaccination despite availability of vaccination services" because many individuals lack confidence in vaccines, do not perceive the need for vaccination, or anticipate strong difficulties will impede their vaccination.[28] It is therefore essential that professionals involved in outreach and social mediation strategies in the field of vaccination be trained in educational methods designed to address this hesitancy and improve individual vaccine readiness, i.e., the extent to which individuals are ready and willing to get vaccinated.

Motivational interviewing (MI) is a collaborative conversational style intended to reinforce a person's own motivation and commitment to behavior change. Developed in the 1990s by Miller and Rollnick,[29] it has been successfully tested in multiple domains related to health behavior change and adapted to vaccination by Gagneur et al., applying the principles of trust, empathic listening, a non-judgmental attitude, understanding, partnership, and respect for autonomy.[30] A specific MI training program in immunization using these principles developed for and assessed among health care professionals has been successfully used among nurses in Quebec[31] and family medicine interns in France.[32] It was also tested successfully in Quebec maternity wards with postpartum mothers (PromoVac and PromoVaQ studies).[33–35] To date, a successful program, introduced by the Quebec Ministry of Health using vaccination counselors previously trained in MI implemented in each maternity ward in Quebec, has led to a significant decrease in parental vaccine hesitancy and a 10% increase in vaccine coverage in infants.[36]

As the principles of MI are consistent with those applied by HMs in their daily work, we aimed to set up an MI-in-immunization training for HMs involved in an outreach immunization program to help them improve vaccine readiness in disadvantaged populations.[37]

Objectives

We sought to evaluate the impact of this MI-in-immunization training on the acquisition by HMs of MI skills and knowledge (objective 1) and of an MI-based intervention conducted by trained HMs on the general vaccine readiness and vaccination intention of disadvantaged people contacted by HMs (objective 2).

Material and methods

Objective 1

Study-design

We implemented an observational before/after design among HMs to compare their MI skills before and after MI training.

Participants

We trained HMs who have been involved in outreach programs in socially disadvantaged areas of Marseilles for COVID-19 screening, prevention, and information activities since 2020 and for vaccination since 2021. They had been enrolled by two community associations (CORHESAN and SEPT), partners of the Southeastern Regional Health Agency.

HM training

Two MI specialists (AG and PB) trained the HMs at the beginning of May 2022, during a two-day workshop including a presentation of MI's theoretical foundations, its adaptation to the field of vaccination, and role-playing exercises for practice. In addition, HMs attended two three-hour training sessions conducted by an infectious disease specialist (SR) including vaccination principles, French vaccine policy, and specific modules for the vaccines involved in the study (COVID-19 and DTP). HMs also received a 72-page guide containing vaccination information useful for answering the questions of their target population[38] and a four-page leaflet summarizing the main messages as a reminder during the interviews.[39] The trained HMs then put MI into practice during a three-week field-pilot study in May and attended a second group MI workshop, this time lasting three hours, at the end of the pilot study. The actual survey ran from June 8 through July 8, 2022.

Questionnaire used to assess MI skill acquisition in HMs

The HMs completed the same MISI (Motivational Interviewing Skills in Immunization) questionnaire,[40] just before the 2-day practice training and again at its end. The MISI is a validated instrument previously used in a similar training program for general medicine residents in France[32] and among nurses in Quebec.[31] It assesses three key dimensions of MI: 1/knowledge of MI theory and principles (in 6 closed questions), 2/self-confidence in using MI (in 7 confidence scales on its general use, application of MI techniques, and perceived self-efficacy), and 3/MI-related skills, both self-perceived (in 12 closed questions concerning the frequency of

some of their discussion behaviors) and measured (with an open question asking them to write a hypothetical discussion between themselves and a person receiving the intervention, and recorded by a trainer).

Statistical methods

We used means with standard deviations and the Wilcoxon signed-rank test for comparative analyses of the MISI scores between the pre- and post-training questionnaires. Analyses used IBM SPSS Statistics 23.0 (SPSS Inc., Chicago, IL, USA), with statistical significance set at 0.05.

Objective 2

Study-design

We conducted an observational before/after survey among individuals receiving the MI-based intervention performed by trained HMs (hereafter referred as to interviewees), which compared their attitudes related to vaccination in general and their intention to get vaccinated against COVID-19 (initial or booster dose) and DTP (booster dose) before and after the interview.

Participants

Interviewees met the following inclusion criteria: aged 18 or over, speaking French, English, or Arabic, encountered by the HMs in 7 (of 16) districts of Marseille and providing written consent to participate. Marseille, a port city in southeastern France, is the second largest city in France with population of nearly 900,000, as well as one with the greatest income inequalities. These 7 districts have the highest level of social deprivation in Marseille and are also among the areas with the greatest poverty in France.[41]

Interview and data collection procedure

Eight professional survey investigators with solid experience in field surveys collected interviewees' consent and questionnaire data before and after the HMs' interviews. HMs and investigators worked in the field in pairs and were fluent in French; some were also fluent in Arabic and/or English.

HMs approached people by street canvassing, going door-to-door, or visiting specific locations (health centers, food pantries, local associations, social shelters, etc.). They asked people to take part in a survey of their opinions about vaccination. If the person agreed, the survey investigator took over to explain the research, get the consent form signed, and immediately afterward used a tablet computer to administer the first questionnaire face-to-face in French, English, or Arabic. Then the HM conducted the MI-based discussion with the interviewee in the same language. The interview was supposed to follow the MI process and techniques that the HMs had learned during the training, namely: 1) establish, as the initial objective, a trusting relationship by listening carefully and without judgment to individuals' concerns, without trying to correct or counter certain beliefs; 2) understand the specific reasons for their hesitancy to be able to ascertain what information would improve their perception of vaccination's importance; 3) deliver this information in collaboration with them and with their consent, to support their personal choice; 4) respect their personal autonomy while trying to direct the conversation to a more favorable position toward vaccination, as well as promoting partnership and avoiding discord. Finally, the investigator administered the second questionnaire. While interviewees completed the questionnaires, the HMs remained at a distance, to avoid interfering in this phase. Similarly, the investigators remained at a distance during the interview.

Questionnaires

Two short standardized questionnaires – pre-intervention (T0) and post-intervention (T1, see Supplementary material A & B) – were used to collect data on interviewees' characteristics and vaccination attitudes and intentions. The T0 questionnaire was administered to all who agreed to participate in the study, and the T1 questionnaire to all who completed the interview.

Questions included only in the T0 questionnaire. The T0 questionnaire included questions on sociodemographic characteristics, whether or not the interviewee had a valid COVID-19 vaccine pass (a form delivered by the French government to vaccinated people that was then necessary for access to certain places, including health establishments, bars and restaurants, leisure activities, interregional transport, etc.), and DTP vaccination status (Table 1).

Questions included in both the T0 and T1 questionnaires. T0 and T1 questionnaires both included items to measure outcome variables: vaccination intention (VI) and general

Table 1. Means and comparisons of the health mediators' pre- and post-training scores for motivational interviewing (MI) skills.

Section	n	Mean score before training	Mean score after training	Change	Before/After comparison* *(p-value)*
MI knowledge (Q1-Q6)/100	16	**51.5 ± 19.5**	**76.0 ± 16.5**	+48%	.001
Perceived application of MI skills (Q8)/100	15[a]	**53.6 ± 23.4**	**78.4 ± 15.5**	+46%	.003
Self-confidence in using MI (Q9)/100	13[b]	**65.7 ± 10.9**	**77.8 ± 8.2**	+18%	.011
Application of MI skills (open-response item) (Q7)[c]	16	**3.3 ± 3.1**	**7.8 ± 3.5**	+4.5 points	.006

*Wilcoxon Signed Ranks Test.
[a]Perceived MI skill application scores were not calculated when three or more answers were missing for an individual.
[b]Self-confidence in using MI scores were not calculated when three or more answers were missing for an individual.
[c]Unlike the other three components, which have a score out of 100, the score for this component has no upper bound. The calculation of the "application of skills" score was the sum of two components: 1/ a point count for each of the four MI-related skills (open-ended question (1 point), reflective-listening statement (between 1 and 2 points depending on complexity level), affirmative statement (1 point), "elicit-provide-elicit" feature (between 1 and 3 points depending on the completion status) and 2/ an overall MI spirit score called "adherence," which ranges from 1 (behaviors incompatible with MI) to 5 (respect for the motivational spirit).

vaccination readiness (VR). We measured the intention of those who were not at all or incompletely vaccinated against COVID-19 (no valid vaccine pass) to get vaccinated against it (primary inoculation or booster) within the next 3 months (*Yes, definitely/Yes, probably/Don't know/No, probably not/No, definitely not*). For those who were not up-to-date with DTP vaccination or did not know their status, we measured their intention to get a booster within the next 3 months (same answer scale as above). For all participants, we used the 7C scale short form,[42] validated in French[43] and including seven items measuring seven dimensions of VR: "confidence" in health authorities to ensure vaccine safety and efficacy; "complacency," i.e., low perception of risks associated with developing an infectious disease; structural or psychological "constraints" making vaccination difficult or costly; "calculation," i.e., perceived personal benefit/risk balance of vaccines; "collective responsibility," i.e., willingness to protect others acting collectively; "compliance," i.e., support for sanctioning unvaccinated people; "conspiracy," i.e., believing that vaccines are more dangerous than the diseases they ought to protect from). This survey uses a five-level agreement Likert scale (1="Strongly disagree" to 5="Strongly agree," with a "don't know" option placed in the middle of the scale). We adapted it slightly to improve the target audience's understanding (see Supplementary material C).

Questions included only in the T1 questionnaire. Finally, the T1 questionnaire included satisfaction questions about the interview and the language used (French, English, or Arabic, see Supplementary material C).

Sample size

We estimated the required number of interviewees to ensure statistical power of at least 80% for testing changes in indicators before and after the intervention on the basis of the following criteria: 1) average of the individual mean scores of the 7C items (calculated from the database of the parent article:[42] 5.308/7 ± 1.03; 2) hypothesis of a 5% increase in this score after MI; 3) 5% risk of a type I (α) error and 80% statistical power (1-β); 4) several assumptions for this score's standard deviation: 0.9, 1.2, or 1.5; and 5) before/after score correlations of 0.5, 0.7, or 0.8 (0.7 and 0.8 being more likely because the before-and-after data were collected from the same individuals). The sample size analysis, conducted with SAS PROC POWER,[44] led to the following range of 45–303 interviewees required depending on the hypotheses tested. To ensure the statistical power of the analyses, we aimed for the upper limit.

Outcome construction

Answers to the VI items were dichotomized as follows: "Yes, definitely or probably" vs "don't know, probably not or definitely not." Internal consistency of the 7C was checked with Cronbach's alpha, calculated on the seven items before intervention. Cronbach's alpha was 0.6 when inverting items 4 (calculation) and 7 (conspiracy), as recommended by the authors;[42] it increased to 0.8 when inverting only item 7 (conspiracy). We thus calculated a cumulative VR score pre- and post-intervention by summing the seven items, after reversing only the coding of item 7, and then linearized it from 0 to 100: the higher the score, the greater the VR (Supplementary material D).

Social disadvantage score construction

We performed a multiple correspondence analysis (MCA) on the items describing the interviewees' socioeconomic characteristics (Table 2). "Don't know" answers and refusals were excluded from the analysis ($n = 5$). The first axis of the MCA returned 85% of the Benzécri adjusted inertia[45] and was interpreted as an axis of social disadvantage (Supplementary material E). The coordinates of the interviewees on this axis were extracted and categorized into quartiles (the first quartile included the most advantaged 25% of interviewees, the fourth the 25% most disadvantaged) to study the links between categories of social disadvantage, VI and VR scores, and their trends.

Statistical analyses

For descriptive analyses at T0 and T1, we used frequencies and percentages for categorical variables, and means with standard deviations for continuous scores.

For paired analyses between the pre- and post-questionnaires, we used the Bowker symmetry test for categorical variables and the Wilcoxon signed rank test for continuous variables.

For analyses exploring whether the MI-based intervention impact on VI or VR varied according to social disadvantage categories, we used difference-in-difference (D-I-D) models. These models allow changes over time (pre/post-intervention) of an outcome to be compared across several groups while taking into account the repeated nature of the data.[46,47] We applied GEE binomial models for VI (categorical outcomes) and mixed models with random intercepts for the VR score (continuous outcome). The models were adjusted for gender and age and were performed by intention-to-treat (ITT): all patients who agreed to participate and completed the baseline questionnaire were included, with missing post-questionnaire data handled by the D-I-D models without imputation.[48]

Analyses used SAS 9.4 (SAS Institute Inc., Cary, NC, USA), with statistical significance set at 0.05.

Ethical statement

The ethics committee of the University of Aix-Marseille (France) approved the project on 24 June 2021 (ref. 2022-06-16-008). Informed consent of HMs and interviewees was obtained after the nature and possible consequences of the studies had been fully explained.

Results

Objective 1: evaluation of MI knowledge and skills acquired by HMs

Participation and baseline data

Sixteen HMs (from both associations – all 9 working at CORHESAN and all 7 at SEPT) participated in the training sessions, completed both questionnaires, and participated in

Table 2. Main characteristics of the interviewees (persons undergoing motivational interviews with the health mediators) ($n = 324$).

	N	%[†]
Questionnaire and interview language		
French	316	97.5
English	5	1.5
Arabic	3	0.9
Gender		
Woman	156	48.2
Man	168	51.9
Age category (years)		
18–24	40	12.4
25–34	50	15.4
35–44	72	22.2
45–54	72	22.2
55–64	51	15.7
65 or older	39	12.0
Indicators of social deprivation (in bold)		
Born in France		
Yes	150	46.3
No	174	53.7
What is the highest degree you have received?		
No degree	71	21.9
Degree inferior to a high school diploma (CEP, *brevet des collèges*, CAP, BEP or equivalent from another country)	107	33.0
High school diploma (Baccalaureate or equivalent from another country)	55	17.0
First cycle university diploma (*license*, BTS, BA, BS/BSc. or equivalent from another country)	67	20.7
Second cycle university diploma or higher (Master's, PhD., or equivalent from another country)	24	7.4
What is your current employment status?[a]		
Employed	127	39.3
Apprenticeship or paid internship	5	1.6
Student (high school, university, higher education), in training, or in unpaid internship	25	7.7
Unemployed (whether or not registered with *Pôle Emploi*)	54	16.7
Retired or pre-retired	47	14.6
Stay-at-home spouse/parent	27	8.4
Other (long-term leave, disabled, etc.)	38	11.8
In your household currently, you would say that financially . . . [b]		
You cannot manage without being in debt	22	6.9
You can barely manage	54	16.9
You have to be careful	67	20.9
Things are tight or borderline	46	14.4
Things are OK	110	34.4
You are comfortable	21	6.6
Do you have social security coverage (health insurance)?		
No	26	8.0
Yes	298	92.0
Social deprivation score[c] [−0.84; 1.93] – *mean (SD)*	319	0.0 (0.6)
First quartile (25% most advantaged interviewees): [−0.84;-0.45]	77	24.1
Second quartile [−0.45;-0.05]	88	27.6
Third quartile [−0.05;0.31]	72	22.6
Fourth quartile (25% most disadvantaged interviewees) [0.31;1.93]	82	25.7
Do you have a valid COVID-19 vaccine pass[d]?		
No	122	38.4
Yes	196	61.6
Are you up to date with your DTP (diphtheria, tetanus and polio) vaccination?		
Don't know	13	4.0
Yes, definitely	135	41.7
Yes, probably	98	30.3
No, probably not	40	12.4
No, definitely not	38	11.7

[†]Except as otherwise stated.

[a]1 participant (0.3%) did not wish to respond and was excluded from construction of the social disadvantage score.

[b]1 participant (0.3%) did not know and 3 (0.9%) did not wish to respond; they were excluded from construction of the social disadvantage score.

[c]5 missing values. Score constructed by extracting the first axis of the multiple correspondence analysis run on items in bold regarding birth in France (yes/no), level of education, employment status, perceived financial situation, has health insurance social security coverage (yes/no). Positive values of the score indicate social disadvantage.

[d]From August 2021 to March 2022, French government provided a health pass, and then a vaccine pass, to people up to date with COVID-19 vaccination. These passes allowed access to certain places (health establishments, bars and restaurants, leisure activities, interregional transport, etc.). Six participants (1.9%) reported not knowing whether they had a valid vaccine pass or not.

the interviewee survey. Among them, 11 were women, 9 were aged 30 years or younger, 4 from 31–49, and 3 were 50 years or more. With the exception of a nurse and a pharmacist's assistant, HMs had no initial medical training. They had several years of experience in health mediation, mainly involving street work, door-to-door visits, and meetings in social centers to assist people needing general health information or help with their administrative procedures. Since 2020, they have been working specifically on the issue of COVID-19: information, raising awareness of barrier measures, then support for vaccination by answering people's questions about vaccines (vaccination recommendations according to age and health status, effectiveness, danger) and helping them to get vaccinated (directing them to vaccination centers, making appointments).

Changes in HMs' knowledge and skills

The before/after training comparisons showed a significant increase in MI knowledge (+48%, $p = .001$), perceived MI skill application (+46%, $p = .003$), and self-confidence in using MI (+18%, $p = .011$) (Table 1). A significant increase was also observed for the MI skill application score, by 4.5 points after the initial training session ($p = .006$).

Objective 2: evaluation of the impact of HM interviews on interviewees' VR and VI

Participation and baseline data

The HMs enrolled 324 interviewees in the survey; 310 (96%) completed both questionnaires and 14 only the first – the interviews lasted an average of 16 minutes. The latter group had a lower educational level than the former ($p = .03$), but other characteristics did not differ significantly between them. Among the 324 interviewees, 52% were men (Table 2), 50% aged younger than 45 years, and 54% born outside France. The social deprivation score varied from −0.84 (least deprivation, score obtained by 9% of the sample) to 1.93 (highest deprivation, 1%), with a median of −0.05 (interquartile range, −0.45 to 0.31); 41% had a social deprivation score greater than 0, which indicates significant social deprivation.

Almost three quarters of the interviewees reported that they were up-to-date with their DTP vaccination (certainly: 42%; probably: 30%), and 62% that they had a valid COVID-19 vaccine pass at the time of the survey.

Change of intention to update COVID-19/DTP vaccination among interviewees

Among the interviewees who reported they did not have a valid COVID-19 vaccine pass, intention to get vaccinated/updated in the next three months increased by 74% after the MI-based interview by an HM (17% baseline, 30% post-intervention, $p = .001$, Figure 1). This increase was particularly marked in the first two quartiles (+104%) and the fourth quartile (+116%) of the social deprivation score, but the D-I-D analysis showed no significant difference in VI changes between the social deprivation categories ($p = .37$, Table 3).

Among the interviewees who reported they were not up to date with their DTP vaccination or who did not know, intention to receive a booster dose within the next three months increased by 52% after the MI-based interview by an HM (36% baseline, 54% post-intervention, $p = .001$, Figure 1). This increase varied from + 42% to + 69% according to the social disadvantage category, but with no significant difference in VI changes between them according to the D-I-D analysis ($p = .72$, Table 3).

The socioeconomic characteristics of participants whose VI increased significantly did not differ from those for whom it did not change.

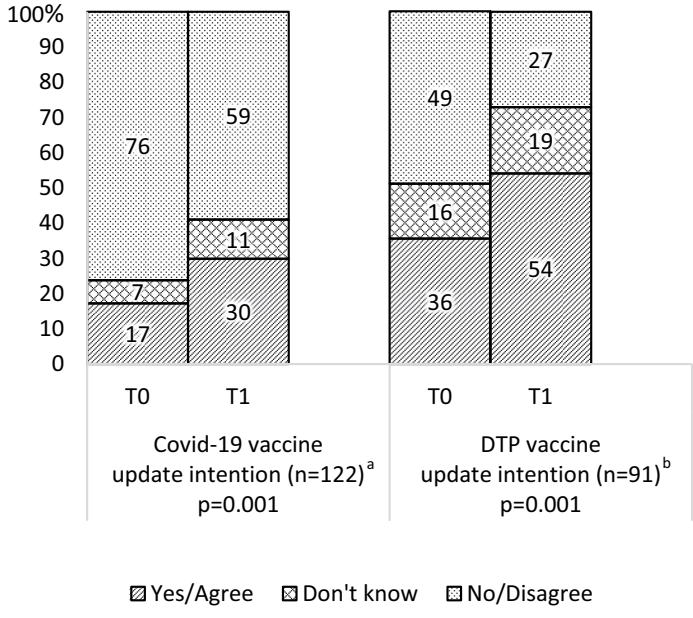

Figure 1. Changes in vaccination intention.
p-values for Bowker test of symmetry of proportions (i.e., equivalence of proportions) for paired samples (equivalent of McNemar's test for binary variables). Test run on the sample of participants who answered both questionnaires, refusals excluded
[a]198 participants did not answered the question because they had a valid vaccination pass ($n = 193$) or they did not know about it ($n = 5$); 5 missing data in T1.
[b]228 participants did not answer the question because they were already up-to-date; 5 missing data in T1.

Table 3. Changes of VI and VR according to the social deprivation score.

	T0 (BEFORE)	T1 (AFTER)		*p* for D-I-D effect‡
	% (SD) or mean (SD)		Change	
Intention to update COVID-19 vaccination in the next 3 months (n = 121[a] with no valid vaccine pass, ref. No)				
Social deprivation score				
Two first quartiles[b] (most advantaged 50% of interviewees): [−0.84;-0.05] (*n* = 57)	8.8 (2.6)	17.9 (3.6)	+104%	.37
Third quartile [−0.05;0.31] (*n* = 24)	33.3 (4.3)	39.1 (4.5)	+17%	
Fourth quartile (most disadvantaged 25% of interviewees) [0.31;1.93] (*n* = 40)	20.0 (3.6)	43.2 (4.6)	+116%	
Intention to update DTP vaccination in the next 3 months (n = 91 not up-to-date or does not know, ref. No)				
Social disadvantage score				
First quartile (most advantaged 50% of interviewees): [−0.84;-0.45] (*n* = 12)	16.7 (3.9)	25.0 (4.7)	+50%	.72
Second quartile [−0.45;-0.05] (*n* = 24)	45.8 (5.2)	68.0 (5.0)	+48%	
Third quartile [−0.05;0.31] (*n* = 27)	29.6 (4.8)	50.0 (5.4)	+69%	
Fourth quartile (most disadvantaged 25% of interviewees) [0.31;1.93] (*n* = 28)	39.3 (5.1)	56.0 (5.4)	+42%	
Vaccination readiness score [0;100] (n = 319)				
Social disadvantage score				
First quartile (most advantaged 25% of interviewees): [−0.84;-0.45] (*n* = 76)	50.5 (19.7)	51.8 (21.6)	+3%	.72
Second quartile [−0.45;-0.05] (*n* = 88)	58.6 (20.1)	62.6 (20.0)	+7%	
Third quartile [−0.05;0.31] (*n* = 71)	58.0 (25.2)	61.9 (28.1)	+7%	
Fourth quartile (most disadvantaged 25% of interviewees) [0.31;1.93] (*n* = 82)	60.1 (24.8)	64.4 (20.7)	+7%	

Abbreviations. D-I-D = difference-in-difference; DTP = diphtheria, tetanus, poliomyelitis.

‡GEE binomial regressions or mixed models with random intercept testing for magnitudes of the pre-to-post-interview change of respectively vaccine intentions or readiness. Models adjusted for age (continuous) and gender. Test for differences in changes between categories (D-I-D effect).

[a]One missing value.

[b]The two first quartiles were merged for change testing because of insufficient numbers of participants intending to update their Covid vaccine in the first quartile.

Reading: Before the intervention, 8.8% of the most advantaged interviewees who were not up-to-date with COVID-19 vaccination intended to get it. After the intervention, VR was estimated at 17.9%, an increase of 104%. This change did not differ significantly from the changes estimated in the other social disadvantage categories ($p = .37$).

Before the intervention, the VI score was 50.5/100 among the most advantaged interviewees. After the intervention, it was 51.8, an increase of 3%. This change was not significantly different from those estimated in the other social disadvantage categories ($p = .72$).

Change in vaccine readiness items (7C scale) among interviewees

The results (Figure 2) indicate a 22% increase in confidence in the authorities after HM interviews (36% agreement before, 45% after HM interview, $p < .0001$), and a 9% increase in agreement with collective responsibility (70% before, 76% after, $p = .01$), while the endorsement of conspiracy beliefs decreased by 26% (19% before, 14% after, $p = .02$). We found nonsignificant increases or decreases, after intervention, for the other items relating to complacency ($p = .32$), perceived constraints ($p = .14$), compliance ($p = .99$), and calculation ($p = .29$).

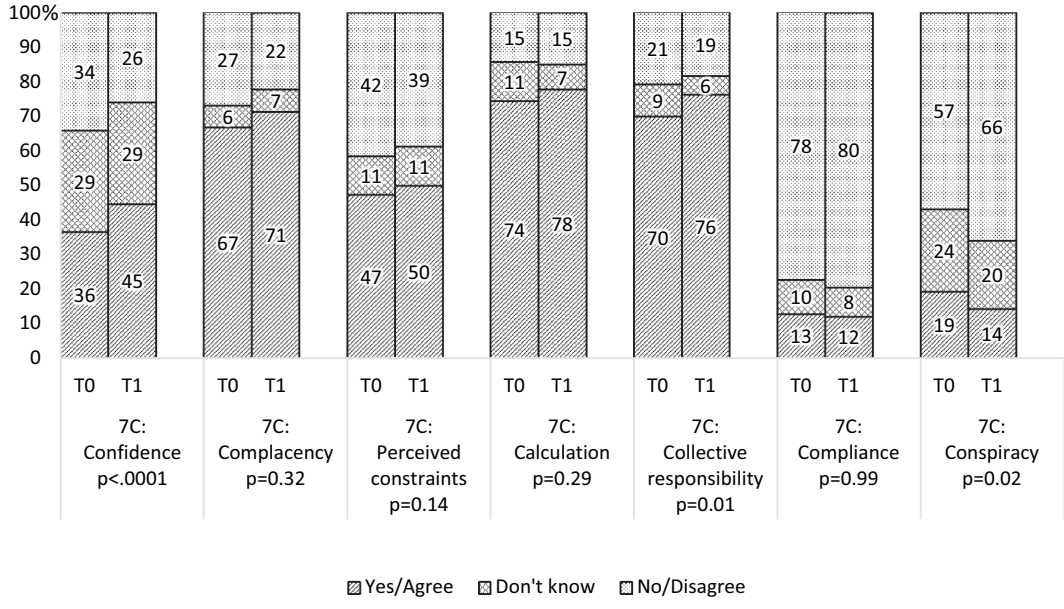

Figure 2. Changes in the vaccine readiness items (7C scale) among interviewees ($n = 324$)[a].

p-values for Bowker test of symmetry of proportions (i.e., equivalence of proportions) for paired samples (equivalent of McNemar's test for binary variables). Test run on the sample of participants who answered both questionnaires, refusals excluded.

[a]14 missing data items at T1 Confidence: I am convinced that the state only authorizes vaccines that are safe and effective.

(Lack of) complacency: I get vaccinated because it is too dangerous to get sick from diseases.

(Lack of) perceived constraints: Vaccinations are so important to me that I prioritize getting vaccinated over other things.

Calculation: I only get vaccinated when I am sure that the benefits are greater than the risks.

Collective responsibility: I see vaccination as a responsibility in order to protect others.

Compliance: It should be possible to punish people by law if they are not vaccinated.

Conspiracy: Vaccines are more dangerous than diseases ($n = 324$).

Changes in the general vaccine readiness (VR) score (7C scale) among interviewees

The VR score was 57/100 before the intervention and 60/100 afterward, a significant 6% increase ($p < .001$). This increase varied from + 3% among the 25% most advantaged interviewees (first quartile of social disadvantage score) to + 7% in the other categories, with no significant difference in VR changes between them ($p = .72$, Table 3). The socioeconomic characteristics of participants whose VR increased significantly did not differ from those for whom it did not change.

Interviewees' satisfaction

Almost all interviewees (96%) reported high satisfaction about the MI-based conversation ("somewhat yes:" 9%; "yes:" 87%); 94% found it useful ("somewhat yes:" 7%; "yes:" 87%); 79% had no more questions about vaccination afterward; 96% considered that the intervention was performed at a convenient time ("somewhat yes:" 6%; "yes:" 90%); 96% reported that it had respected their views on vaccination ("somewhat yes:" 6%; "yes:" 90%), and 92% that its duration was appropriate. None reported harm.

Discussion

Main results

Our study is the first to evaluate the impact of an educational intervention based on MI, conducted by trained HMs, as part of an immunization outreach program, among populations of socially disadvantaged neighborhoods. It showed that HMs' acquisition of MI skills was good after a two-day workshop. VR among the target population rose by 6% and COVID-19 and DTP VI by 74% and 52% respectively. Most interviewees were very satisfied with the interview with the HMs, both in terms of content (interest, usefulness, respect) and form (convenient time and place); 21% still had questions about vaccination after the interview, however.

Strengths

HMs received high quality face-to-face training that enabled feedback, discussion, and role-playing to practice MI techniques. Supervision of the MISI questionnaire completion within a time limit prevented outside factors or distractions from influencing the results. HMs successfully recruited the targeted population of disadvantaged individuals; compared to the French general population, the sample of interviewees included twice as many unemployed people and five times as many people born abroad.[49,50]

Limitations

The evaluation of the application of the MI skills with the MISI questionnaire was limited to a written reproduction of a dialogue between an HM and an interviewee; the conversation was supposed to demonstrate application of MI principles and HMs' perception of their ability to apply these skills. Although this method has been validated,[40] it only partially reflects how HMs would perform MI in real life. The HMs recruited volunteer interviewees from among the people they met in their usual outreach work. A random recruitment procedure was therefore not followed, which could have led to selection biases that are difficult to quantify, partly due to the HMs' choices of people to approach. The diversification of recruitment sources should, however, have made it possible to include a diverse collection of socially vulnerable Marseillais. Although the overall number of interviewees ($n = 324$) ensured a statistical power of 80% ([45–303]), it did not allow us to perform certain stratified analyses, for example, for intention to update DTP vaccination.

The study measured intention to update vaccinations and not vaccination itself. Intention is nevertheless known to be a strong predictor of vaccination.[51,52] Given the conditions of this study, we did not have a control group; caution is therefore required in interpreting the results. The immediacy of the post-questionnaire following the MI-based intervention limited the possibility that responses were influenced by external factors. A Hawthorn effect – that is, bias related to a change in the interviewees' behavior/attitudes due to their recognition that they were being observed[53] – is however possible. Participants completed the questionnaire face-to-face with a professional investigator, which might have favored social desirability. However, the investigators were not at all involved in the interview, which may have limited this bias. Finally, the study area was limited to a single city. However, the characteristics of the Marseille neighborhoods targeted here are close to those of disadvantaged neighborhoods in other major French cities, and we can reasonably assume that an outreach intervention based on the MI relating to vaccination could work there too. This should nonetheless be confirmed.

Improvement in HMs' MI skills

The improvement in HMs' skills in MI was notable in each MISI dimension and similar to the results of a previous study with the same methodology conducted among general medicine residents,[32] in particular, in terms of knowledge acquisition and skill application (measured *via* the written dialogue). While the residents showed greater improvement in their perceived application of skills and self-confidence in using MI than HMs did, the latter had higher initial (and thus less room for improvement) and final scores.[32] Our results about the improvement of HMs' skills as well as the interviewees' strong satisfaction suggest the HMs absorb and understand MI principles well. In particular, the interviewees perceived that the HMs respected their autonomy, an essential MI skill for building trust.[30] These subjects' strong satisfaction with the circumstances (time/place) of the interview suggests that performing MI through outreach approaches is feasible. This point should be assessed in more detail with qualitative approaches for both the HMs and the interviewees.

General changes in interviewees' vaccine intentions and readiness

Vaccination coverage among the sample of interviewees appeared to be similar to, although somewhat lower than, that of the general population: 42% of the respondents reported they

were definitely up-to-date with their DTP vaccination (in France in 2002, 71% of adults had been vaccinated for less than 15 years against tetanus, 42% against poliomyelitis, and 34% against diphtheria),[11] and 60% had a valid COVID-19 vaccine pass on the day of the survey. By comparison, in June, 2022, in France, 60% to 85% of adults, depending on age and social category, had received at least one booster dose.[7] Changes in vaccination intentions after MI (by 74% for COVID-19 and 52% for DTP) were notable compared with the results of another study in France (+8%) that was similar in some ways (MI training of healthcare workers to reduce VH, with the same program and trainers).[54] However, the marked difference in the context (midwives' intervention at maternity wards after women have given birth), the target population (parents of newborns with already high intentions to have their infants vaccinated), and the vaccines targeted (those in early childhood, mandatory in France) prevents any direct comparison.

The 6% increase in the VR score, constructed from the 7C scale, seems moderate compared to the study at the maternity ward mentioned above, where a VH score, measured with the modified Parents Attitudes about Childhood Vaccines (PACV),[33,35,55–57] decreased by 33% in the MI group.[54] The more modest trend here may be explained in part by the fact that the responses to only three items changed after the MI-based intervention: those measuring "confidence" in authorities (+22% agreement, 36% before intervention), "collective responsibility" (+9% agreement, already at 70% before intervention), and "conspiracy" (−26% agreement, 19% before intervention). These three items correspond to opinions on the kind of topics discussed in the MI-based conversations on vaccination and were expected to improve after intervention. The lack of change on the "compliance" dimension (thinking that the law should sanction people who refuse to get vaccinated) may be related to its contradiction with the spirit of MI. On the other hand, the "constraint" dimension (prioritizing vaccination over other constraints) is hard to change among disadvantaged people who may have many difficulties in meeting their basic daily needs.

In contrast, the lack of effect on the "calculation" and "complacency" dimensions, when we expected an attenuation of both attitudes, is more surprising and might partly explain the moderate impact on the VR score. Investigators reported that interviewees often said concerning "calculation" that they were unable to grasp in detail the vaccination's relative benefits and risks. "Complacency," that is, the perception that the vaccine-preventable diseases is not really dangerous, is a concern that should be addressable with MI. A possible explanation for these unexpected results could be that the HMs' training on vaccine-preventable diseases and vaccines might not have been sufficient, given their lack of medical background. This might have limited their ability to answer interviewees' questions about the dangerousness of diseases and on the benefits and risks of vaccination. The HMs expressed some difficulties with these issues during the study and one in five interviewees reported they still had questions about vaccination at the end of interviews. Other explanations can also be considered. Although the pilot phase lasted 1 month, some of the HMs were unable to carry out many interviews and may not have had time to become sufficiently comfortable in practice.

In addition, only 15% of the interviews took place in people's homes. Of the remainder, a third were conducted in indoor public spaces (health centers, food pantries, local associations, social shelters, etc.) and half outside (in the street, parks or squares, bus stops, etc.). These conditions, which enable HMs to approach populations otherwise difficult to encounter, may have limited the impact of the interviews. The interview conditions could be improved by, for example, setting up a temporary stand/truck to provide a more private space to sit and talk.

Changes according to interviewees' socioeconomic situations

The initial VR score was higher among the most disadvantaged interviewees (60/100 vs 51/100 among the most advantaged) – a result suggesting that the most deprived categories with no up-to-date vaccines may be impeded more by issues of access to vaccination services than by concerns regarding vaccine benefits and risks. Nonetheless, their VR score increased after MI, as it did in the other social categories. This was also the case for VI, with more variations in increases, possibly due to the small number of interviewees not up-to-date across social categories. These results suggest that MI-based approaches may be especially appropriate to populations usually "left behind."

Conclusions

Our results suggest that training HMs to use MI in outreach programs designed for disadvantaged groups is a promising avenue for addressing their vaccination concerns and probably other topics. Moreover, in Marseille, both associations (CORHESAN and SEPT) have been involved since July 2022 in interventional research about MI for health promotion, including for human papilloma virus vaccination and cancer screening among women residing in deprived districts. MI seems to dovetail well with the principles they are supposed to follow, i.e., empowerment of these populations.[37] Our results also suggest that to be effective, this approach should ensure that HMs are given solid knowledge about vaccination. This raises the question of structured training. Further research is needed with more robust designs – ideally based on randomized controlled trials and using uptake indicators. Qualitative research is also warranted to examine the perception of HMs and their target populations regarding intervention conditions (including respect for confidentiality and privacy). Despite their recognition and the existence of a theoretical implementation frame,[18] the question of including outreach approaches for disadvantaged populations in routine strategies must also be considered: to be effective in times of crisis, this type of approach should be well identified in health policy, undertaken by well-identified actors and institutions that receive support (training, resources, sustainability, and recognition) over the long term.[37]

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Disclosure statement

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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