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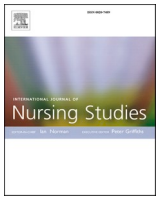

Dissatisfaction with working conditions associated with lower vaccine confidence, commitment and behaviors among nurses: A large scale cross-sectional survey in France

Anaïs Le Breton [a], Hugo Touzet [a], Lisa Fressard [b], Patrick Chamboredon [c], Patrick Peretti-Watel [b,d], Jeremy Ward [a], Pierre Verger [b,d,*]

[a] Cermes3 (INSERM, CNRS, EHESS, Université de Paris), Villejuif, France
[b] Observatoire régional de la santé PACA (Southeastern Health Regional Observatory), Marseille, France
[c] Conseil National de l'Ordre des Infirmiers, Paris, France
[d] Unité des Virus Émergents (UVE: Aix-Marseille Univ, Università di Corsica, IRD 190, Inserm 1207, IRBA), France

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ABSTRACT

Background: Before, during, and after the COVID-19 pandemic, doctor shortages led many countries to expand nurses' role in their mass vaccination programs. Nonetheless, nurses often express marked vaccine hesitancy. Simultaneously, their working conditions have been deteriorating.
Objectives: To study 1) the association between nurses' perceptions of their working conditions and their vaccination-related behaviors (vaccination recommendations to their patients), and 2) the mediating role in this associations of their trust in health authorities, vaccine confidence, and vaccine proactive efficacy.
Design: A cross-sectional survey.
Settings: Salaried, community (self-employed) and mixed nurses in France.
Participants: 18,888 nurses registered with the French national order of nurses (ONI, registration is mandatory) (N = 439,323).
Methods: In February 2023, this cross-sectional study used an online questionnaire to survey the nurses mandatorily registered with the French national order of nurses. Seven items adapted from models of psychosocial risk factors at work assessed their satisfaction with their working conditions. The international short version of the Pro-VC-Be (health professionals, vaccine confidence and behaviors), a validated instrument measuring psychosocial determinants of health-care professionals' vaccine behaviors) evaluated their vaccine-related attitudes and behaviors. Multiple group mediation analysis with structural equation modeling measured the associations between satisfaction at work, trust in health authorities, vaccine confidence, proactive efficacy (commitment and self-efficacy) in vaccination, and vaccination recommendations (against seasonal influenza for those with a chronic disease and against COVID-19 among adults).
Results: Among the 18,888 participants, satisfaction at work had generally deteriorated, and only 47 % considered vaccines safe. Among salaried nurses (61 %), satisfaction at work was statistically significantly associated ($p < 10^{-3}$) with trust in health authorities ($\beta = 0.26$ [0.24; 0.28]), vaccine confidence (total effect: $\beta = 0.35$ [0.31; 0.38]), proactive efficacy (total effect: $\beta = 0.18$ [0.16; 0.21]), and, to a smaller extent, with seasonal influenza and Covid-19 vaccine recommendations (total effect: $\beta = 0.13$ [0.09; 0.16]). Trust in health authorities played a statistically significant role ($p < 10^{-3}$) mediating the associations of satisfaction at work with vaccine confidence and proactive efficacy. These three dimensions in turn mediated the relation between satisfaction at work and frequency of vaccination recommendations. These relations were similar among community nurses.
Conclusions: Satisfaction at work appears to enhance nurses' vaccination attitudes and behaviors, which are likely to reinforce their capacity to promote their patients' vaccination. Significant improvement in their working conditions is needed to enable them to accomplish this role serenely.

* Corresponding author at: Observatoire Régional de la Santé – PACA, Faculté des Sciences Médicales et Paramédicales, 27 Boulevard Jean Moulin, 13005 Marseille, France.
E-mail address: pierre.verger@inserm.fr (P. Verger).

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What is already known

- Nurses have been granted increasing autonomy in vaccinating the population, often because of physician shortages; nevertheless, the prevalence of vaccine hesitancy remains high among them.
- Studies of nurses' working conditions have focused mainly on hospitals and have often indicated that these conditions are deteriorating.
- The influence of nurses' working conditions on their vaccination-related attitudes and behavior has been little studied.

What this paper adds

- Based on a large sample of nurses practicing either in hospitals as employees or as (self-employed) private practitioners in the community, we found that nurses perceive that their working conditions have deteriorated since the Covid-19 pandemic.
- Our results show that these perceptions are strongly associated with less trust in the health authorities, less confidence in and less commitment to vaccination, and less frequent recommendations of seasonal flu and Covid-19 vaccines to patients.

1. Background

Nurses, because of their close relationships with patients and the trust the latter place in them, play an essential role, along with doctors, in the vaccination of the general population (Verger et al., 2022a). They participated widely in the vaccination campaign against COVID-19 by counseling, prescribing, and/or administering these vaccines to the population. Many countries have long since enlarged the role of nurses by delegating vaccination prescriptions to them. French authorities have progressively followed this trend since the 2010s and accelerated it in 2023 (Décret n°2023-736, 2023).

Nurses in France can work in public or private hospitals as salaried employees, in the community as self-employed professionals, or combine both statuses. Hospital nurses, who represent a substantial majority of the nursing workforce (63 %) (Babet et al., 2024), are involved in curative patient care and, to a lesser extent, preventive care. Conversely, self-employed nurses work in solo or group practices — increasingly with doctors — mainly providing home care and are paid on a fee-for-service basis. They enjoy greater autonomy than salaried nurses but are subject to greater financial and administrative constraints (Rydenfält et al., 2023; Vilbrod and Douguet, 2006). They also play a much greater role in vaccinating the general population.

Vaccine hesitancy — "refusing some vaccines, delaying them, or being vaccinated despite doubts" (MacDonald and SAGE Working group on Vaccine Hesitancy, 2015) — affects the populations of many countries, including health-care professionals and especially nurses (Verger et al., 2022a). Nurses' rates of vaccine confidence and vaccination coverage (Wilson et al., 2020a), especially against influenza and COVID-19, are often lower than those of physicians (Kaur et al., 2023). Vaccine hesitancy among health-care professionals is an important issue because they are in regular contact with patients at risk and because it can impede their ability to answer patients' questions about vaccines or motivate them to be vaccinated, and can hinder their participation in vaccination (Verger et al., 2022a).

Nurses' substantial vaccine hesitancy is explained by their lack of adequate training on this topic, but also by other psychosocial and/or contextual factors (Karlsson et al., 2019). Trust in health authorities is an important factor in adherence to vaccines by health-care professionals as by the general population (Verger et al., 2022a). This trust depends on the sociopolitical context and on the existence of public controversies, such as those that have multiplied in France in recent years around various vaccines (e.g., those against hepatitis B, influenza A/H1N1, and COVID-19) (Verger et al., 2022a) and other medicinal products (Mediator) (Mullard, 2011).

Nurses' trust in health authorities has been undermined in France as elsewhere by the progressive deterioration of nurses' working conditions, both in hospitals (Juven et al., 2019) and in the community (Moi et al., 2022). It has most particularly affected their workload and created strong dissatisfaction at work (Estryn-Béhar, 2008; Galanis et al., 2023). Earlier studies reported a negative association between nurses' dissatisfaction at work and their adherence to vaccination guidelines for themselves (Mignot et al., 2020). Health-care professionals' vaccine hesitancy not only results from their beliefs and attitudes toward vaccination, but is also influenced by systemic issues within the health-care system (Ward et al., 2024). When they perceive working conditions, communication by health authorities, and support from their superiors (for those practicing in hospitals) as poor, these professionals are also likely to perceive preventive measures as additional constraints in an already restrictive environment. Studies focusing on hospitals have shown the deleterious effects on salaried nurses of the consequences of budget restrictions on resources, nursing staff, working conditions, and job satisfaction (Galanis et al., 2023; Sainsaulieu, 2008). Furthermore, the perception that institutional management is dysfunctional or even abusive can negatively impact hospital health-care workers' vaccination decisions for themselves: they may refuse or delay an injection for their own sake as part of a protest reaction (Gur-Arie et al., 2022; Mignot et al., 2020). Community nurses too are exposed to sources of dissatisfaction (Vilbrod and Douguet, 2006): the complexity of coordinating their activities with other local health-care workers (medical, paramedical, and social workers) (Feyfant, 2017), income uncertainties, daily travel for home visits, and a sense of loneliness in the practice of their profession (Vilbrod and Douguet, 2006) all weigh heavily on their working conditions and their perception of them. These constraints were exacerbated during the Covid-19 pandemic, as community nurses were massively mobilized to make house calls to vaccinate patients (Rydenfält et al., 2023).

Because earlier studies of the links between nurses' perceptions of their working conditions and their vaccination attitudes and behaviors (Gur-Arie et al., 2022; Mignot et al., 2020) focused on small samples, questioned only nurses working in hospitals, and asked them about their own, rather than their patients', vaccinations, these studies have a limited capacity to understand these relations. Other studies have shown that psychosocial resources (trust in authorities, vaccine confidence, vaccination-related proactive efficacy, that is, commitment to and self-efficacy in vaccinating patients) may influence health-care professionals' involvement in promoting vaccination (Verger et al., 2022b).

We surveyed a large sample of nurses in February 2023 throughout France (including overseas territories) to study the associations between their perceptions of their working conditions and their behavior recommending vaccines to their patients; we also examined the mediating role played in these associations by their trust in health authorities, vaccine confidence, and vaccination-related proactive efficacy. We sought to test the following hypotheses, summarized in Fig. 1): 1) nurses' satisfaction with their working conditions is positively associated with the frequency of their vaccine recommendations to patients (Hypothesis 1) and 2) this association is mediated by trust in authorities, vaccine confidence, and vaccination-related proactive efficacy (Hypothesis 2) (Raude et al., 2016). This second hypothesis was subdivided into three subhypotheses, according to a path analysis logic. Hypothesis 2A assumes that nurses' perceptions of their working conditions are associated with their trust in health authorities. It is based on the general observation in hospitals (Ministère des affaires sociales et de la santé, 2013) — but also applicable to the primary care sector (Wilson et al., 2020b) — that health-care professionals have lost confidence in regulatory authorities. This distrust stems from the nurses' feelings that they are under constant and ever-increasing pressure by economic constraints and requirements about the quality and quantity of care they must provide, that their efforts are inadequately recognized, and that their working conditions are deteriorating. Hypothesis 2B assumes that their trust in authorities is positively associated with their confidence in vaccines and

proactive efficacy, while Hypothesis 2C assumes that the latter two factors are in turn associated with nurses' vaccine recommendations to patients. Hypotheses 2B and 2C are based on previous work in France and elsewhere (Verger et al., 2022a, 2022b).

2. Methods

2.1. Study design

In February 2023, all nurses registered with the French national order of nurses (*Ordre national des infirmiers*, registration is mandatory) (n = 439,323) received an invitation and link to complete a standardized questionnaire for this cross-sectional survey. The ethics committee of Aix-Marseille University approved this study (n° 2023-03-08-05), including the presumption that agreement to complete the online questionnaire after reading the information notice constituted informed consent.

2.2. Procedure and questionnaire

The national order of nurses transmitted to its members an email containing this invitation, with the link to access the questionnaire and an explanation of the study's objectives and its rules of confidentiality. This link allowed each participant to complete only one questionnaire only once. The questionnaire included a 5-item section, inspired by the psychosocial models of risk at work of Karasek and Theorell (1990) and Siegrist et al. (2004) to assess nurses' satisfaction with their working conditions (e.g. recognition of their skills, working time, and remuneration). Two supplementary items assessed changes in their satisfaction at work since the onset of the COVID-19 pandemic and their intention to remain in their profession for the year to come. The responses were collected by a four-point Likert scale ("Very satisfied"/"Agree strongly" to "Very dissatisfied"/"Disagree strongly", with a "Don't know" option).

Nurses' attitudes toward vaccination and their behavior in recommending vaccines to patients (which we will hereafter describe as frequency of vaccination recommendations) were measured with the short version of the International Health Professionals Vaccine Confidence and Behaviors "I-Pro-VC-Be" (supplementary material, Table S1), an instrument developed and validated in several European countries, including France, to assess the psychosocial determinants of health-care professionals' vaccination behaviors (Garrison et al., 2023); it is considered well validated (Akinsola et al., 2024). This instrument is based on the combination of three theoretical frameworks or models. The first is the 5C model for vaccine hesitancy, validated among the general population, from which we adopted the key dimensions of complacency (not perceiving infectious diseases to be at high risk), (lack of) trust (in vaccines and the system that delivers them), and collective responsibility (willingness to protect others) (Betsch et al., 2018). We added to it "trust in authorities", a paramount dimension in vaccine hesitancy (MacDonald and SAGE Working group on Vaccine Hesitancy, 2015). The second is the Health Belief Model, strongly predictive of both vaccine acceptance and uptake among the public and health-care professionals, from which we selected the perceived benefit–risk ratio dimension (Rosenstock and Strecher, 1997). The third is the Theoretical Domain Framework, relevant for vaccine-related intervention studies of health-care professionals and focused on evidence-based practices; from it we selected the dimensions of commitment and self-efficacy (McSherry et al., 2012). Finally, we used the following items from the I-Pro-VC-Be short form to measure these dimensions: trust in health authorities (1 item), vaccine confidence (4 items: perception of the safety of vaccines, complacency, vaccines' benefit-to-risk ratios, and the collective responsibility associated with them), and vaccination-related proactive efficacy (2 items: commitment and perceived self-efficacy in relation to vaccination). These dimensions constitute "immunization resources" that strengthen health-care professionals' capacity to promote vaccination (Garrison et al., 2023). Confirmatory factor analyses of the original Pro-VC-Be in 3 countries including France indicated good validity of its long- and short-form dimensions (Verger et al., 2022b; Garrison et al., 2022). Confirmatory factor analyses also found that the I-Pro-VC-Be structure fitted our data well for both salaried and community nurses in this sample (see paragraph Statistical analyses below).

To study nurses' vaccination recommendations, we focused on the vaccines against seasonal influenza for persons younger than 65 years with a chronic disease and against COVID-19 for adults. Three reasons led us to group these two vaccines together as a measure of nurses' recommendation behavior: these are the only two vaccines they were entitled to prescribe at the time of the survey; their confidence in and/or vaccination coverage for these vaccines are modest and significantly lower than those of doctors (Kaur et al., 2023; Wilson et al., 2019); and their combined administration is now recommended in future vaccination campaigns (Haute Autorité de Santé, 2024). The responses were collected on a 4-point Likert scale from 1 (=Never) to 4 (=Always), with options to respond "Don't know", "Don't want to answer", and "Not applicable to my practice".

Finally, we collected the following social, demographic, and professional characteristics: gender, children at home, region of professional activity, type of employment status (salaried, self-employed in the community, and mixed, i.e., a combination of the two, or other), duration of practice, and specialization.

2.3. Statistical analyses

Data were weighted for sex and region of practice in the descriptive analyses. As French Census surveys do not collect gender identity, we used a "sex" (male versus female) variable by combining female and other genders (nonbinary or other) into one category and considered a

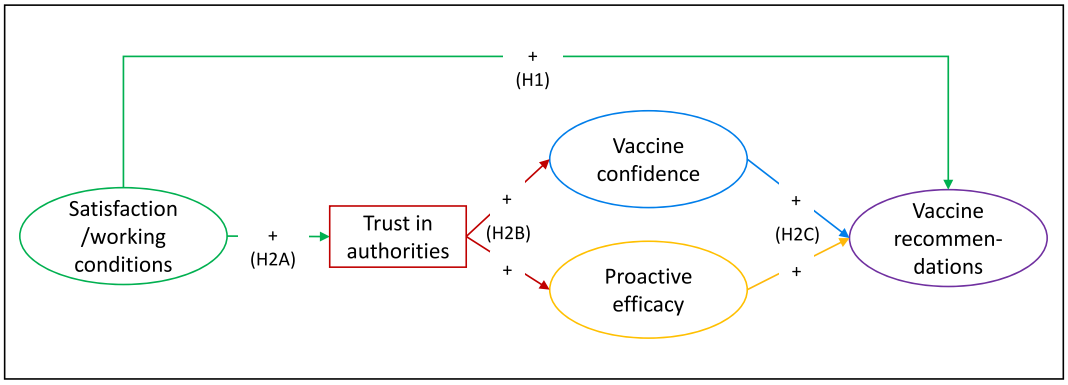


Fig. 1. Hypothesized model of associations among nurses between satisfaction at work, psychosocial resources, and vaccination recommendations to patients (Icovac, Survey of nurses).

binary variable "male" (yes/no) on the assumption that participants identifying themselves as nonbinary or other gender (0.3 % of our sample) would have outcomes more similar to those of females than those of males (Kennedy et al., 2022).

Descriptive analyses did not reveal any anomalies in the distribution of any variable. In the preliminary analyses of the 7 items concerning satisfaction with working conditions, we recoded the "Don't know" responses using multiple correspondence analyses (supplementary material, Fig. S1). Cronbach alpha and principal component analysis then allowed us to establish their very satisfactory internal consistency ($\alpha = 0.81$) (Bland and Altman, 1997; Tavakol and Dennick, 2011) and unidimensionality (1 factor retained, 47 % of variance explained; supplementary material, Table S2). To study the associations between perceived working conditions and vaccination-related behaviors (outcome variable) and to test the mediating role of trust in authorities, vaccine confidence, and vaccination-related proactive efficacy, a mediation analysis was conducted by applying a system of structural equations. Because the roles and conditions of practice differed between salaried and community nurses, these analyses were performed by multiple group analyses to compare the associations observed in each group. The nurses with a "mixed" hospital-community (combining employment and self-employment) practice were regrouped with the community nurses, according to the usual procedure of the French Health Ministry statistical office (Barlet and Marbot, 2016).

Invariance analyses then allowed us to verify that the latent dimensions of satisfaction at work, vaccine confidence, vaccination-related proactive efficacy, and frequency of vaccination recommendations were correctly measured by the items that constituted them and were comparable between the salaried and the community (self-employed) nurses (supplementary material, confirmatory multiple group factor analysis). Next, a structural equation model enabled us to separate out:

- The "effect" of satisfaction at work on trust in authorities;
- The total effects (i.e., before the introduction of the mediating variables) of satisfaction at work on vaccine confidence, vaccination-related proactive efficacy, and vaccination recommendations;
- The indirect effects (those explained by the mediating variables) in the preceding relations;
- And the direct effects, i.e., the remaining effects not explained by the mediating variables.

The "Not applicable to my practice", "Don't know", and "Don't want to answer" responses to the items for vaccination recommendations were considered as missing and treated with the full information maximum likelihood procedure by using all available data. A sensitivity analysis excluding the nurses who gave these responses was performed to test the robustness of our results (supplementary material, Table S3).

Because the mediation analyses were performed on the unweighted data, we adjusted them for potential confounders: gender (male: yes/no), duration of practice, and region of practice (supplementary material, confirmatory multiple group factor analysis); a sensitivity analysis was performed without adjustment. To test the significance of the effects accurately, bias-corrected bootstrapping (1000 iterations) provided their 95 % confidence intervals (MacKinnon et al., 2004). The model fit was assessed with the following criteria: root mean square error of approximation (RMSEA), comparative fit index (CFI), Tucker-Lewis index (TLI), and standardized root mean square residual (SRMR). Models with CFI ≥ 0.90, TLI ≥ 0.90, RMSEA < 0.06, and SRMR < 0.08 were considered to fit reasonably or well (Hu and Bentler, 1999). Effect sizes (unstandardized regression coefficients) were considered to be very small for coefficients < 0.1, fairly small for 0.1–0.2, moderate for > 0.2- ≤ 0.5, large for 0.5–0.7 and very large for > 0.7. All analyses were based on two-sided p-values, with $p \leq 0.05$ indicating statistical significance. They were conducted with SAS, version 9.4 and Mplus, version 7.2 for invariance analyses and structural equation models.

3. Results

3.1. Characteristics of the sample

Of the 439,323 nurses registered with the national order of nurses who were asked to participate in February 2023, 19,332 (4.4 %) agreed to do so and completed the questionnaire (during the one week it was available online). Nurses who were retired, volunteers, or not currently working were excluded (n = 444/19,332 (2 %)). The analyses thus concerned 18,888 nurses; 86 % were women and 61 % salaried employees (Table 1).

3.2. Satisfaction with their working conditions

Most participants reported dissatisfaction with their working conditions (Table 2), specifically their remuneration (80 %), the recognition of their skills (68 %), the (inadequate) time spent with patients (53 %), and their personal/work life balance (52 %). Although 56 % of participants reported they were satisfied with their working hours, 77 % reported their working conditions had deteriorated since the COVID-19 pandemic began, and 27 % envisioned changing professions in the year to come (Table 2). Dissatisfaction was more frequently reported among the self-employed nurses than in those working in hospitals (e.g., 52 % versus 37 % were dissatisfied with their working time), except the latter were more dissatisfied with the time they could spend with patients (56 % versus 48 % for the community nurses).

3.3. Vaccination-related attitudes and behaviors

The vaccine confidence of nurses varied by criterion (Table 3): 80 % adhered to the principle of collective responsibility (vaccination to promote collective immunity) and 77 % considered that vaccines' benefits exceeded their risks. Nonetheless, only 47 % considered that

Table 1
Characteristics of the study population (Icovac, Survey of nurses, February 2023, n = 18,888).

	N	%	% weighted[a]
Gender			
Men	2,904	15.4	13.4
Women	15,920	84.3	86.2
Nonbinary	38	0.2	0.2
Other	26	0.1	0.1
Your household includes children younger than 18 years			
Yes	9,162	48.5	48.5
No	9,594	50.8	50.8
Doesn't say	132	0.7	0.7
What type of practice do you work in?			
Salaried (Public sector)	6,290	33.3	34.3
Salaried (Private-sector)	4,952	26.2	26.8
Community (Self-employed)	7,153	37.9	36.3
Mixed[b]	493	2.6	2.6
How many years ago did you receive your national nursing diploma?			
Less than 5 years ago	1,959	10.4	10.5
From 5 to 10 years ago	2,604	13.8	13.9
From 10 to 15 years ago	3,212	17.0	17.0
More than 15 years ago	11,113	58.8	58.6
Do you have a specialty in addition to or beyond nursing?			
Yes[c]	2,705	14.3	14.6
No	16,183	85.7	85.4

[a] The data were weighted for sex and region of practice to be representative of French nurses younger than 62 years. Due to rounding, the sum of percentages may not be equal to 100.

[b] Mixed type of practice: professionals who practice during the same period as employees and as self-employed nurses.

[c] Nurse anesthetist with a national diploma, surgical nurse with a national diploma, pediatric nurse with a national diploma, nurse-manager, advanced practice nurse.

Table 2
Satisfaction with working conditions according to type of employment status (Icovac, Survey of nurses, February 2023, n = 18,888).

WORKING CONDITIONS	All		Salaried (n = 11,242)	Self-employed/ Mixed (n = 7,646)	Chi² *p* value
	N = 18,888 % weighted[a]				
Are you satisfied with:					
Your life/work balance?					<0.0001
Very satisfied-Somewhat satisfied	8,842	46.9	48.2	45.0	
Don't know	249	1.3	1.2	1.6	
Somewhat dissatisfied-Very dissatisfied	9,797	51.7	50.7	53.4	
The recognition of your skills in your work place/ area?					<0.0001
Very satisfied-Somewhat satisfied	5,677	30.4	33.5	25.6	
Don't know	232	1.2	1.1	1.5	
Somewhat dissatisfied-Very dissatisfied	12,979	68.3	65.4	72.9	
Your working time?					<0.0001
Very satisfied-Somewhat satisfied	10,511	56.2	62.0	47.0	
Don't know	169	0.9	0.7	1.3	
Somewhat dissatisfied-Very dissatisfied	8,208	42.9	37.3	51.8	
The time you spend with patients?					<0.0001
Very satisfied-Somewhat satisfied	8,454	45.0	41.4	50.7	
Don't know	415	2.3	3.1	1.0	
Somewhat dissatisfied-Very dissatisfied	10,019	52.7	55.5	48.4	
Your remuneration?					<0.0001
Very satisfied-Somewhat satisfied	3,643	19.5	21.2	16.8	
Don't know	124	0.7	0.6	0.9	
Somewhat dissatisfied-Very dissatisfied	15,121	79.9	78.3	82.3	
Your working conditions have deteriorated since the COVID-19 pandemic					<0.0001
Agree strongly-Agree somewhat	14,675	77.4	76.6	78.6	
Don't know	807	4.4	5.0	3.5	
Disagree somewhat-Disagree strongly	3,406	18.2	18.4	18.0	
You are considering quitting your occupation/ nursing in the 12 months to come					<0.0001
Agree strongly-Agree somewhat	5,180	27.2	26.7	28.1	
Don't know	4,845	25.7	24.4	27.7	
Disagree somewhat-Disagree strongly	8,863	47.1	48.9	44.3	

[a] The data have been weighted for sex and region of practice to be representative of French nurses younger than 62 years. Due to rounding, the sum of percentages may not be equal to 100.

vaccines present no serious risks, and only 46 % reported trusting the Ministry of health to ensure vaccine safety. Finally, 57 % reported they were committed to motivating patients to be vaccinated, but only 36 % felt sufficiently at ease to discuss this topic with vaccine-hesitant patients (self-efficacy). In relation to vaccination-related behaviors, 14 % reported that recommendation of influenza vaccine to their patients younger than 65 years with chronic diseases was not applicable to their practice. Among the remaining 86 %, only 41 % (i.e., 35 % of the sample) reported recommending it systematically to these patients. Ten percent reported that the recommendation for the vaccine against COVID-19 for adults was not applicable to their practice, and among the remaining 90 %, only 26 % (i.e., 22 % of the sample) reported recommending it to them systematically. Smaller proportions of community nurses reported confidence in vaccine safety (44 %, $p \leq 10^{-3}$) and trust in authorities (45 %, $p = 0.003$) than among salaried nurses (49 % and 46 % respectively Table 3). However, community nurses were more frequently involved in vaccinating their patients than salaried nurses (61 % versus 54 %, $p \leq 10^{-3}$), and they more often reported recommending influenza (often or always: 83 % vs 62 %, $p \leq 10^{-3}$) or COVID-19 vaccines (often or always: 63 % versus 54 %, $p \leq 10^{-3}$) than their salaried counterparts. For these two vaccines, responses "not applicable to my practice" were rare for community nurses (1 %) and ranged from 16 % to 22 % for salaried nurses.

3.4. Mediation analyses

The adjustment criteria of the multiple group models of the mediation analyses (Fig. 2) were satisfactory: root mean square error of approximation = 0.043 (95 % CI 0.042–0.044); comparative fit index = 0.94; Tucker-Lewis index = 0.92; and standardized root mean square residual = 0.03. All the indicators of association presented with their 95 % confidence intervals in square brackets hereinafter were statistically significant at $p < 10^{-3}$, unless otherwise specified.

Among the salaried nurses, satisfaction with working conditions was moderately associated with trust in the authorities (β = 0.26 [0.24; 0.28]), vaccine confidence (total effect: β = 0.35 [0.31; 0.38]), vaccination-related proactive efficacy (total effect: β = 0.18 [0.16; 0.21]), and, to a smaller extent, with vaccination recommendations (total effect: β = 0.13 [0.09; 0.16]). Their trust in the authorities was associated strongly to very strongly with vaccine confidence (β = 1.13 [1.09; 1.17]), vaccination-related proactive efficacy (β = 0.57 [0.54; 0.61]), and frequency of vaccination recommendations (total effect: β = 0.68 [0.64; 0.72]).

The association between satisfaction at work and vaccine confidence was largely mediated by trust in authorities (indirect mediated effect: β = 0.30 [0.27; 0.32]; direct effect, not explained by this variable: β = 0.05 [0.02; 0.08]); the same was true for the association between working conditions and vaccination-related proactive efficacy (indirect effect: β = 0.15 [0.14; 0.16]; direct effect: β = 0.04 [0.01; 0.06], $p = 0.008$). Moreover, vaccine confidence and vaccination-related proactive efficacy played a large role in mediating the relation between trust in authorities and vaccination recommendations (Fig. 2). Overall, trust in

Table 3
Vaccine confidence, proactive efficacy, and vaccination-related behaviors according to type of employment status (Icovac, Survey of nurses, February 2023, n = 18,888).

	All		Salaried (n = 11,242)	Self-employed/ Mixed (n = 7,646)	Chi² p-value
	N = 18,888 % weighted[a]				
VACCINE CONFIDENCE[b]					
Vaccines are safe.					**<0.0001**
Disagree strongly-Disagree somewhat	3,934	20.7	20.6	20.9	
Uncertain-dont agree or disagree	6,054	32.1	30.5	34.7	
Agree somewhat-Agree strongly	8,900	47.2	48.9	44.4	
Some vaccines recommended by the authorities are not useful, because the diseases they prevent are not serious.					**<0.0001**
Disagree strongly-Disagree somewhat	12,983	69.0	70.3	66.9	
Uncertain-don't agree or disagree	3,881	20.6	19.4	22.4	
Agree somewhat-Agree strongly	2,024	10.5	10.3	10.7	
The benefit of vaccines outweigh their potential risks.					0.09
Disagree strongly-Disagree somewhat	1,135	6.0	6.3	5.5	
Uncertain-don't agree or disagree	3,240	17.1	16.9	17.5	
Agree somewhat-Agree strongly	14,513	76.9	76.9	77.0	
I recommend the vaccines on the vaccination schedule to my patients because it's essential to contribute to protection of the population (community immunity).					**0.01**
Disagree strongly-Disagree somewhat	813	4.3	4.5	3.9	
Uncertain-don't agree or disagree	3,006	15.8	16.1	15.2	
Agree somewhat-Agree strongly	15,069	80.0	79.3	80.9	
TRUST IN THE AUTHORITIES					
I trust the ministry of health to ensure that vaccines are safe.					**0.003**
Disagree strongly-Disagree somewhat	4,623	24.0	24.3	23.5	
Uncertain-don't agree or disagree	5,714	30.3	29.4	31.8	
Agree somewhat-Agree strongly	8,551	45.7	46.3	44.8	
PROACTIVE EFFICACY					
I am committed to ensuring that my patients are vaccinated.					**<0.0001**
Disagree strongly-Disagree somewhat	2,169	11.4	12.5	9.6	
Uncertain-don't agree or disagree	6,009	31.8	33.6	29.1	
Agree somewhat-Agree strongly	10,710	56.8	53.9	61.3	
I feel sufficiently trained on how to bring up the question of vaccines with hesitant patients.					0.53
Disagree strongly-Disagree somewhat	7,016	37.2	37.5	36.7	
Uncertain-don't agree or disagree	5,056	26.9	26.8	26.9	
Agree somewhat-Agree strongly	6,816	36.0	35.7	36.4	
VACCINATION-RELATED BEHAVIORS					
Frequency of vaccination recommendations:					
Vaccine against seasonal influenza in adults younger than 65 years with a chronic disease					**<0.0001**
Never	1,364	8.6	12.2	4.1	
Sometimes	3,192	19.9	25.8	12.7	
Often	4,946	30.6	29.0	32.5	
Always	6,687	41.0	33.1	50.7	
Not applicable to my practice	*2,527*	*14.0*	*22.0*	*1.3*	
I don't know	*53*	*0.3*	*0.3*	*0.2*	
I don't want to answer[c]	*119*	*0.6*	*0.6*	*0.6*	
Vaccine against COVID-19 for adults					**<0.0001**
Never	2,564	15.7	19.2	11.1	
Sometimes	4,410	26.6	26.9	26.3	
Often	5,239	31.9	28.1	37.0	
Always	4,283	25.8	25.9	25.7	
Not applicable to my practice	*1,832*	*10.1*	*15.8*	*1.2*	
I don't know	*136*	*0.7*	*0.8*	*0.6*	
I don't want to answer[c]	424	2.3	2.1	2.5	

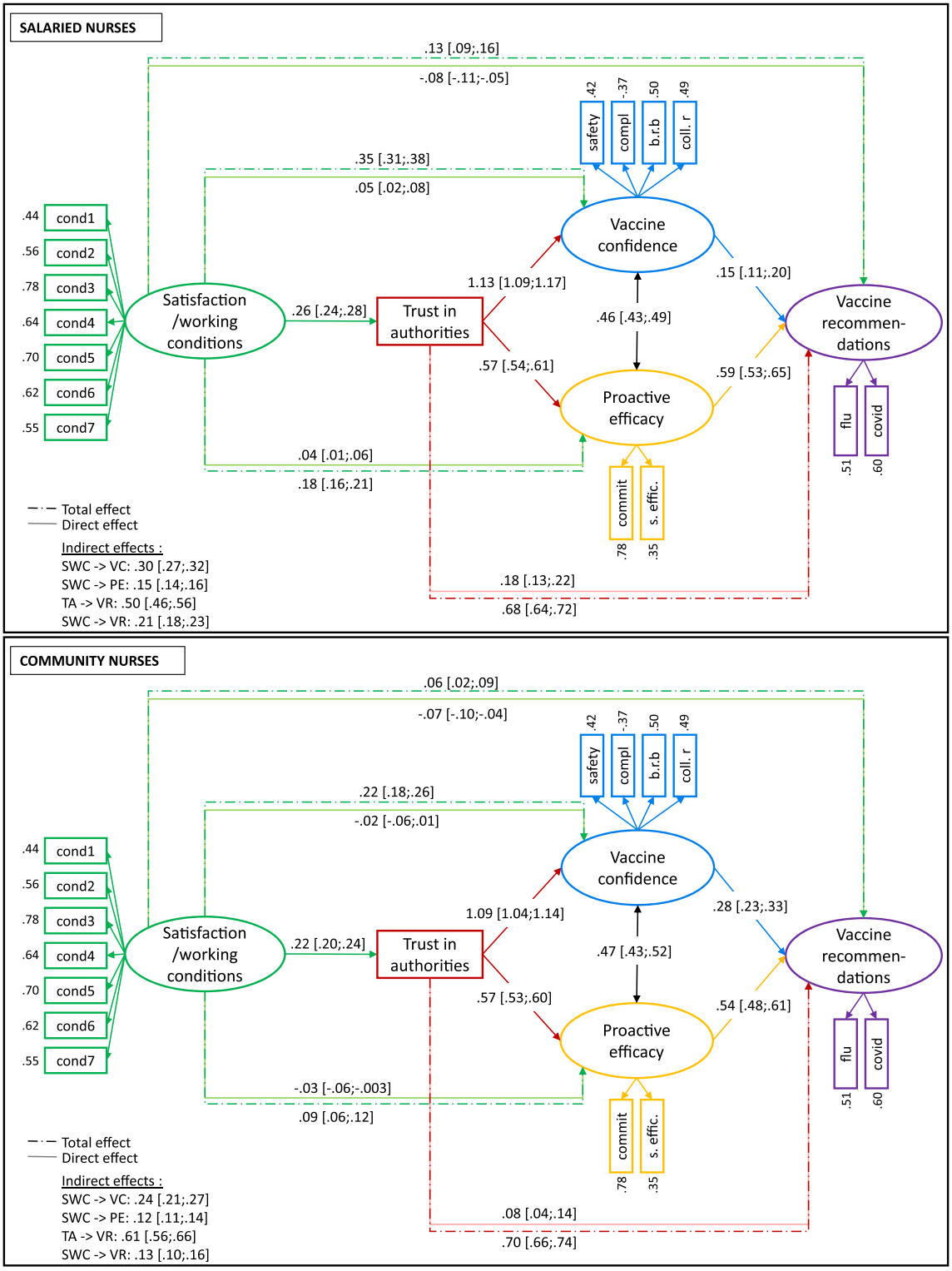
[a] The data were weighted for sex and region of practice to be representative of French nurses younger than 62 years. Due to rounding, the sum of percentages may not be equal to 100.

[b] I-Pro-VC-Be: International Health Professionals Vaccine Confidence and Behaviors, instrument developed and validated in several countries in Europe, including France, to evaluate the psychosocial determinants of health-care professionals' vaccination behaviors (Garrison et al., 2023).

[c] The responses in italics were excluded from the calculation of the percentages of the frequency of vaccination recommendations.

authorities, vaccine confidence, and vaccination-related proactive efficacy mediated the relation between satisfaction at work and vaccination recommendations (total indirect effect: β = 0.21 [0.18;0.23], direct effect: −0.08 [−0.11;-0.05]). Finally, the association of the frequency of vaccination recommendations with vaccination-related proactive efficacy was stronger (β = 0.59 [0.53; 0.65]) than that with vaccine confidence (β = 0.15 [0.11; 0.20]).

Relations for the community nurses were similar, but with a lower amplitude for the relation of satisfaction at work with frequency of vaccination recommendations to patients (total effect: β = 0.06 [0.02;0.09], total indirect effect: β = 0.13 [0.10;0.16]), as well as with vaccine confidence (total effect: β = 0.22 [0.18;0.26], indirect effect: β



(caption on next page)

Fig. 2. Associations between satisfaction at work, psychosocial resources, and vaccination recommendations: results from a multiple group multiple mediation model[a] (Icovac, Survey of nurses, n = 18,888).
Root mean square error of approximation = 0.043 (95 % CI 0.042–0.044); comparative fit index = 0.94; Tucker-Lewis index = 0.92; standardized root mean square residual = 0.03
Notes: Single-headed arrows illustrate the linear-regression coefficient; double-headed arrows illustrate Pearson's correlation coefficient.
The nurses with a "mixed" hospital-community (combining employment and self-employment) practice were regrouped with the community nurses, according to the usual procedure of the French Health Ministry statistics office.
All factor loadings were statistically significant at $p < 0.0001$.
Abbreviations
SWC: **Satisfaction with working conditions**, latent variable measured by 7 observed items: **cond1** Are you satisfied with: Your life/work balance?; **cond2** Are you satisfied with: The recognition of your skills in your work place/area?; **cond3** Are you satisfied with: Your working time?; **cond4** Are you satisfied with: The time you spend with patients?; **cond5** Are you satisfied with: Your remuneration?; **cond6** Your working conditions have deteriorated since the COVID-19 pandemic (reversed); **cond7** You are considering quitting your occupation/nursing in the 12 months to come (reversed);
VC: **Vaccine confidence**, latent variable measured by 4 observed items: **safety**: Vaccines are safe; **compl** Complacency: Some vaccines recommended by the authorities are not useful, because the diseases they prevent are not serious; **b.r.b** Benefits-Risks Balance: The benefit of vaccines outweigh their potential risks; **coll. r** Collective responsibility: I recommend the vaccines on the vaccination schedule to my patients because it's essential to contribute to protection of the population (community immunity);
PE**: Proactive efficacy**, latent variable measured by 2 observed items: **commit** Commitment to vaccination: I am committed to ensuring that my patients are vaccinated; **s. effic.** Self-efficacy: I feel sufficiently trained on how to bring up the question of vaccines with hesitant patients.
VR: **Vaccination recommendations**, Frequency of vaccination recommendations, latent variable measured by 2 observed items: **flu** Vaccine against seasonal influenza in adults younger than 65 years with a chronic disease; **covid** Vaccine against COVID-19 for adults.
TA: **Trust in authorities**: observed item: I trust the ministry of health to ensure that vaccines are safe.
Total "effects": effects of satisfaction at work on vaccine confidence, proactive efficacy, and vaccination recommendations before the introduction of mediating variables.
Indirect effects: Effects explained by the mediating variables in the preceding relations.
Direct effects: Effects not explained by the introduction of the corresponding mediators.
[a]The model was adjusted for gender (male: yes/no), time since nursing diploma, and region of practice.
Effect sizes of the regression coefficients: very small <0.1; fairly small 0.1–0.2; moderate >0.2- < 0.5; strong 0.5–07; very strong >0.7.

= 0.24 [0.21;0.27]) and vaccination-related proactive efficacy (total effect: β = 0.09 [0.06;0.12], indirect effect: β = 0.12 [0.11;0.14]). The amplitude of the relations between trust in authorities, vaccine confidence, vaccination-related proactive efficacy, and vaccination recommendations were similar to those among salaried nurses (Fig. 2). The results before and after adjustment for confounding factors did not differ (supplementary material, Fig. S2); those of the multiple group mediation model with missing vaccine recommendation data excluded from the analyses (listwise deletion, n = 15,312) were very similar to those presented here with missing data handled by the model (supplementary material, Table S3).

4. Discussion

The results of this cross-sectional study of a large national sample indicate for the first time an association between nurses' satisfaction with their working conditions and the frequency of their recommendations of the vaccines against seasonal influenza and COVID-19 to patients (hypothesis 1 confirmed). Consistent with hypothesis 2, it was almost entirely mediated by their trust in authorities, vaccine confidence, and vaccination-related proactive efficacy via the following pathway: satisfaction at work was associated with trust in authorities (hypothesis 2A confirmed), which was in turn associated with vaccine confidence and vaccination-related proactive efficacy (hypothesis 2B confirmed), which in turn again were associated with the frequency of their vaccination recommendations (hypothesis 2C confirmed – Fig. 2). The model tested (Fig. 1) fitted the data well for both salaried and community nurses, although the regression coefficients were slightly lower for the latter.

A large majority of participants considered vaccination useful and adhered to the principle of collective responsibility for it. Nonetheless, nurses' substantial mistrust of the safety of vaccines, as observed in our study (Table 3), is consistent both with the results of reports published before the COVID-19 pandemic in France and elsewhere (Verger et al., 2022a) showing their frequent, notable vaccine hesitancy and with their low or moderate vaccination coverage against seasonal influenza (Kaur et al., 2023). Numerous studies report similar results for marked vaccine hesitancy among nurses in the context of COVID-19 (Biswas et al., 2021). Given the recent extension of nurses' role in mass population vaccination in France (2023), these findings raise questions about their capacity to commit adequately to this role and to motivate hesitant patients.

Several studies have shown that health-care professionals' confidence in vaccines and their trust in authorities both fluctuate with public controversies, which in turn depend on the sociopolitical context (Verger et al., 2022a). Like all health-care professionals, nurses in France have been exposed to multiple public controversies about vaccines over the past 30 years, most recently during the vaccination campaign against COVID-19, notable for the protests against the requirement that health-care professionals be vaccinated against it (Ward et al., 2024). These controversies have raised questions about the associations between health authorities and the pharmaceutical industry, the trustworthiness of the knowledge of vaccine side effects, as well as the legitimacy of mandatory measures, in France and elsewhere (Verger et al., 2021, 2022a). They have contributed to weakening health-care professionals' trust in public health authorities (Wilson et al., 2020a).

The effect size of the relationship found in this study between nurses' work satisfaction and their vaccine recommendation behavior (hypothesis 1) is fairly small. But it is of the same order of magnitude as those obtained in studies of much smaller size than ours that studied the links between job satisfaction among nurses and other health-care professionals and global job performance indicators (global multidimensional scales of nursing care quality, or job performance (Koy et al., 2020; Wang et al., 2022). From this perspective, it suggests that the very specific association highlighted in our study related to vaccine recommendations is far from negligible. The size of the effect observed may be linked to the complexity of the factors associated with working conditions and their significant variability in different settings and different individuals.

Our results suggest that the perception of working conditions may moderately affect (i.e., have moderate size effects on) nurses' trust in health authorities (hypothesis 2A) and in vaccine confidence (Fig. 2), strengthening the results of previous studies (Gur-Arie et al., 2022; Mignot et al., 2020). The association between trust in authorities and vaccine confidence was stronger among salaried (β = 0.35) than

community nurses (β = 0.22), possibly because the role and routine practices of community nurses involve patient vaccination more often than those of salaried nurses, as our results suggest (Table 3): sociological studies suggest that a routine practice may be more automated and less sensitive to variations in working conditions or even to perceptions relating to the practice than a less routine practice (Strauss et al., 1985; Reynaud, 1989).

Nurses' strong dissatisfaction with their working conditions in our study (Table 2) is consistent with findings elsewhere in Europe (Galanis et al., 2023). While its extent was similar for salaried and self-employed nurses, the reasons for it differed. For the first group, mostly hospital nurses, the social conflicts in hospitals between health-care professionals and both the hospital administration and health authorities (Juven et al., 2019) have gone on for years in France, due to health-care professionals' perception of a discrepancy between the increased demand for care and the inadequate resources provided to meet it (Juven et al., 2019; Ministère des affaires sociales et de la santé, 2013). Extended working hours, unattractive remuneration, lack of trained staff, and some decisions over several decades by the health authorities during various public health crises have strongly damaged health-care workers' trust in the authorities (Sainsaulieu, 2012; Wilson et al., 2020a). This is particularly true for nurses, whose workload and work pace have intensified greatly as a consequence of budgetary limitation and rising patient-staff ratios in hospitals (Galanis et al., 2023; Loquet and Ricroch, 2014). Some of them perceive that their care tasks are considered unimportant, and they express a loss of meaning in their work (Estryn-Béhar et al., 2007): stress and burnout are particularly frequent in this occupation (Moss et al., 2016).

The strong dissatisfaction at work of community nurses is a new result, as prior work has principally concerned hospital nurses. These self-employed nurses frequently experience isolation in their practice; they face numerous home visits required daily, the difficulty of reconciling the constraints of both care and time, administrative requirements, and uncertain monthly income (Vilbrod and Douguet, 2006). The shortages of general practitioners in France and in Europe (de Vries et al., 2023) and the shortening of hospital stays associated with the transfer of care to first-line health-care professionals have also added to their workload.

The dissatisfaction at work of the participants in our study was also accentuated during and after the COVID-19 pandemic, as elsewhere in Europe (Galanis et al., 2023). During this health crisis, both groups of nurses were mobilized, including to vaccinate patients and the general population against COVID-19 (Rydenfält et al., 2023), despite their limited prior knowledge of these topics (Moi et al., 2022). Their difficult experiences with patients and the lack of staff and essential equipment (masks, gowns, beds, etc.) at the start of the pandemic may have reinforced some nurses' feelings that the health authorities were not respecting the "social contract" between them and health-care professionals (Wilson et al., 2020b). This may explain, in part, the high rates of intention to leave the nursing profession in our study, replicated internationally (de Vries et al., 2023).

This dissatisfaction at work may, as our results suggest, weaken, albeit only moderately, nurses' psychosocial resources for vaccination (trust in authorities, vaccine confidence, and vaccination-related proactive efficacy). Disquietingly, it could, with other factors, jeopardize their ability to promote vaccination among their patients. A large body of evidence describes the central role that trust in health authorities plays in health-care professionals' (physicians, nurses, etc.) vaccine confidence and in their vaccination behaviors (Verger et al., 2022b). Our article further suggests that nurses' confidence in their own ability to defend and promote vaccines (proactive efficacy) might have a more decisive influence on the frequency of their vaccination recommendations than their vaccine confidence does. For example, among salaried nurses, we found that the relation between proactive efficacy and patient recommendation behavior had a much greater effect (i.e., a much higher effect size) than that between vaccine confidence and this behavior (Fig. 2). One third of participating nurses felt inadequately trained to broach the topic of vaccines with their patients with vaccine hesitancy. Up until now, their initial training in France on vaccination has been fragmentary. It is essential to reinforce their vaccination-related proactive efficacy (and their vaccine confidence) by training them better to enable them to acquire solid knowledge and communication skills about vaccination.

Finally, the negative direct effects observed when the mediating variables were taken into account — between satisfaction at work and vaccination recommendations or vaccination-related proactive efficacy (only among the self-employed nurses) — were unexpected. We ensured that the negative direct effects were not an effect of model over-fitting, by introducing the mediator variables one by one: the significant negative direct effects were present, regardless of the mediators taken into account. These associations might reflect an inverse causality: the nurses less engaged in vaccination or even avoiding this subject (Heyerdahl et al., 2023), might be more satisfied at work, perhaps by avoiding conflictual discussions about vaccines, especially those against COVID-19, which were still inducing doubts in 2023 even in persons already vaccinated (Ward et al., 2024).

4.1. Limitations

Our study has some limitations. Although salaried hospital nurses were underrepresented in the national order of nurses sampling base, they were well represented in our sample. As in most studies with volunteer participants, and especially those conducted online, nonresponse is likely to be nonrandom, which could lead to selection bias. Moreover, the self-reported responses might have engendered reporting biases, in particular by overestimation of dissatisfaction at work and/or underestimation of vaccine confidence. Caution is thus required in generalizing the results to the overall population of nurses. However, the consistency of our descriptive results with those of other studies in France and elsewhere suggest that any biases might be limited. It is moreover improbable that these biases affected the results of the mediation analyses. Given the large size of our sample, for which even small effect sizes proved significant, the magnitude of the regression coefficients merits more attention than the *p*-values. The sizes of the associations between satisfaction with working conditions, trust in authorities, vaccine confidence, vaccine-related proactive efficacy, and frequency of vaccination recommendations indicate fairly small to strong or very strong effects; however, even small to moderate effects may involve significant public health consequences when applied to a population. As discussed above, the magnitude of these effect sizes is similar to those observed in other studies investigating associations between job satisfaction and job performance (Koy et al., 2020; Wang et al., 2022). Finally, our results suggest highly plausible causal interpretations, but the data do not allow us to demonstrate any of them conclusively.

Research is necessary to ascertain if the associations observed in this study exist in other countries and with other vaccines. It is also necessary to better understand the causes of nurses' mistrust of health authorities and the associations between this mistrust and their perception of the legitimacy of guidelines in the field of vaccination and other domains (for example, nosocomial infection control in hospitals) (Tarantini et al., 2019). By analogy with the work of anthropologists of conspiracy theories (Harambam and Aupers, 2015), what must be determined is the extent to which nurses' vaccine hesitancy is part of a political repertoire by which they express their social discontent.

5. Conclusions

To conclude, given the current tension over the funding of the health-care system and the issues related to medical demography, health-care policies increasingly tend to empower nurses to vaccinate patients to free doctors of this task (Décret n° 2023-736, 2023). Nonetheless, in view

of this study's results, the extension of vaccine-related responsibilities to nurses raises questions about their preparation for and adherence to this expanded responsibility. In terms of preparation, our results underline the need to improve nurses' academic, clinical, and practical knowledge about vaccines to cope with the variety of patients and their possible reluctance. Training modules for nurses in France are currently being redesigned to bring their scientific knowledge up to standard, particularly in the field of vaccination. Our results about adherence suggest that their trust in the health authorities and, consequently, their vaccine confidence and vaccination-related proactive efficacy may be sensitive to the effects on their working conditions of some health policy choices made to control health-care costs in recent decades. A sustainable improvement in nurses' trust of health authorities requires a holistic and systematic approach that fully considers the issues of nurses' working conditions, the reinforcement of their autonomy, levels of remuneration, and their participation in the decision-making processes that affect their workload and their professional prospects.

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Credit authorship contribution statement

Anaïs Le Breton: Writing – original draft, Methodology, Investigation, Formal analysis. **Hugo Touzet:** Writing – review & editing, Formal analysis. **Lisa Fressard:** Writing – review & editing, Methodology, Investigation, Formal analysis. **Patrick Chamboredon:** Writing – review & editing, Conceptualization. **Patrick Peretti-Watel:** Writing – review & editing, Formal analysis. **Jeremy Ward:** Writing – review & editing, Formal analysis. **Pierre Verger:** Writing – original draft, Validation, Supervision, Methodology, Investigation, Formal analysis, Conceptualization.

Declaration of competing interest

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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Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.ijnurstu.2024.104935.

Data availability

Information on the national order of nurses database is available at the following link: https://osf.io/bncdj/

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