Psycho-Oncologie 2025, 19(1), 3605.
https://doi.org/10.18282/po3605

Article

A theory-based study on the vaccination behaviors of breast cancer patients during the COVID-19 pandemic in Taiwan

Hao-Yun Kao[1,2,*], Chi-Chang Chang[3,4], Ching-Hsiang Lai[5,*], I-Fei Chen[6], Chiu-Hsiang Lee[7,8], Chien-Lung Chan[9,10], Wen-Chien Ting[11,12,†], Yen-Chiao Angel Lu[7,8,*]

[1] Department of Healthcare Administraion and Medical Informatics, Kaohsiung Medical University, Kaohsiung 807378, Taiwan
[2] Department of Medical Research, Kaohsiung Medical University Hospital, Kaohsiung 807377, Taiwan
[3] Department of Medical Informatics, Chung Shan Medical University & IT Office, Chung Shan Medical University Hospital, Taichung 402306, Taiwan
[4] Department of Information Management, Ming Chuan University, Taoyuan City 111005, Taiwan
[5] Department of Medical Informatics, Chung-Shan Medical University, Taichung City 402306, Taiwan
[6] Department of Management Sciences, Tamkang University, New Taipei City 251301, Taiwan
[7] Department of Nursing, Chung Shan Medical University, Taichung City 402306, Taiwan
[8] Department of Nursing, Chung Shan Medical University Hospital, Taichung City 402306, Taiwan
[9] Department of Information Management, Yuan Ze University, Taoyuan 320315, Taiwan
[10] Innovation Center for Big Data and Digital Convergence, Yuan Ze University, Taoyuan 320315, Taiwan
[11] Division of Colorectal Surgery, Department of Surgery, Chung Shan Medical University Hospital, Taichung City 402306, Taiwan
[12] School of Medicine, Chung Shan Medical University, Taichung City 402306, Taiwan
*** Corresponding authors:** Hao-Yun Kao, haoyun@kmu.edu.tw; Yen-Chiao Angel Lu, angellu@csmu.edu.tw; Ching-Hsiang Lai, liay@csmu.edu.tw
[†] Wen-Chien Ting contributed equally with our first author Hao-Yun Kao.

CITATION

Kao HY, Chang CC, Lai CH, et al. A theory-based study on the vaccination behaviors of breast cancer patients during the COVID-19 pandemic in Taiwan. Psycho-Oncologie. 2025; 19(1): 3605. https://doi.org/10.18282/po3605

ARTICLE INFO

Received: 19 November 2024
Accepted: 30 December 2024
Available online: 7 January 2025

Abstract: The study aimed to expand the behavioral analysis of the Theory of Planned Behavior (TPB) to examine COVID-19 vaccine willingness among breast cancer patients. While both the WHO and the U.S. CDC have utilized adapted versions of the Increasing Vaccine Model to study vaccination trends across various populations and industries, limited research has explored vaccine acceptance in specific groups such as breast cancer patients. From May to July 2022, an online cross-sectional study was conducted in Taiwan, coinciding with the initial COVID-19 vaccination rollout. A total of 278 participants were included in the statistical analysis. Structural Equation Modeling (SEM) was employed to assess the conceptual validity of the measurements and test the proposed model. The analysis revealed that the model explained 36.8% of the variance in patients' willingness to receive the COVID-19 vaccine and 40.3% of the variance in predicting future vaccination behaviors based on regret following vaccination. Fear of COVID-19 was found to indirectly influence vaccination willingness through shared decision-making, highlighting the importance of discussions between patients and their physicians. Patients who had more opportunities to consult with their doctors were more inclined to get vaccinated. Moreover, fear of COVID-19 enhanced the trust breast cancer patients placed in their physicians. However, decision conflicts and shared decision-making impacted vaccine willingness independently and directly, rather than through the mediating effect of trust in physicians. Furthermore, the study confirmed that patients who hesitated to get vaccinated were more likely to experience regret. These findings provide valuable insights into the behavioral aspects of vaccination among cancer patients, offering strategies to mitigate fear and improve preventive health measures.

Keywords: willingness of vaccination; decision conflict; share decision making; decision regret; COVID-19; breast cancer

1. Introduction

The COVID-19 pandemic has had an extraordinary impact on global health, societal dynamics, and the economic landscape. The emergence of variant strains has posed significant physical and mental challenges, inducing stress, fear, and anxiety among individuals, particularly those with underlying conditions. Numerous studies have applied theoretical frameworks such as the Health Belief Model, Protection Motivation Theory, and the Theory of Planned Behavior to investigate factors influencing COVID-19 vaccination decisions. These models, grounded in behavioral science and social cognition theories, have demonstrated substantial explanatory power and yielded compelling insights [1,2]. Intervention strategies, including information dissemination and the provision of supportive messaging, have been shown to foster trust in medical interventions, improve vaccine-related attitudes, and ultimately influence behavioral intentions [2]. Both the World Health Organization (WHO) and the U.S. Centers for Disease Control and Prevention (CDC) have utilized adapted versions of the Increasing Vaccine Model to assess vaccination behaviors across various demographics, professions, and age groups. This approach has not only validated the cognition-affection-behavior effector pathway but also elucidated the decision-making processes underpinning vaccine uptake [3]. Despite these advancements, research remains limited concerning vaccine acceptance among specific populations, such as breast cancer patients. This knowledge gap highlights the need for targeted studies to better understand the unique factors influencing vaccination behaviors in this vulnerable group.

The COVID-19 pandemic has significantly disrupted the treatment management of breast cancer patients [4,5]. Recent research has examined breast cancer patients' attitudes toward COVID-19 vaccines and their acceptance rates, shedding light on predictors of vaccination [6,7]. While receiving the COVID-19 vaccine is critical for breast cancer patients, there is limited research explaining their vaccination intentions and health-seeking behaviors.

Taiwan's COVID-19 vaccination policy, guided by the Ministry of Health and Welfare (MOHW) [8], emphasizes voluntary participation based on informed consent, reflecting the nation's commitment to public health and individual autonomy. Vaccination is prioritized for healthcare workers, individuals at higher risk of severe illness, and specific occupational groups such as airport staff, airline crew, and care institution workers. Vaccines such as AstraZeneca, Moderna, and Medigen were approved under emergency use authorization by the Taiwan Food and Drug Administration (TFDA) during the study period. Citizens can schedule appointments through a centralized platform, selecting their preferred vaccine type and time. While vaccination is not mandatory, booster doses are recommended for high-risk groups, including individuals with chronic illnesses or cancers. The policy ensures that participants are fully informed of the benefits and risks before providing consent.

Understanding the health-seeking behavior of breast cancer patients is crucial for several reasons. Breast cancer remains the most prevalent cancer among Taiwanese women [9]. Additionally, the diverse clinical treatment options for breast cancer patients are further complicated by the introduction of the COVID-19 vaccine, emphasizing the need to integrate vaccination into optimal treatment models [10].

Medical decisions often dominate in life-threatening situations, with patients seeking solutions that address unmet needs. Encouraging shared decision-making between patients and physicians allows for a clearer understanding of the risks and benefits of interventions, facilitating informed choices [7].

Studies have consistently highlighted the importance of trust in clinical treatment [11–13] for effective risk communication and managing decision conflicts among breast cancer patients [14,15]. Trust not only strengthens physician-patient dialogues but also improves treatment adherence [15,16]. However, most prior research has focused on short-term vaccination predictors, with few studies addressing the medium- and long-term impacts of vaccination on attitudes and emotional well-being [16].

Furthermore, integrating quality-of-life observations for breast cancer patients into clinical decision-making processes remains underexplored. Future research must consider how subjective and objective threats influence decision regret behaviors and identify factors that could modify these dynamics to enhance prognosis in the post-pandemic era.

Numerous studies have validated and demonstrated the predictive utility of the Theory of Planned Behavior (TPB) in understanding various health behaviors [4–7, 9]. For example, Fan et al. applied TPB to investigate factors influencing Chinese undergraduate students' intentions to receive the COVID-19 vaccine. Their findings highlighted that attitudes, knowledge, risk perception, and previous influenza vaccination behaviors satisfactorily explained students' vaccination intentions. Similarly, other researchers have combined TPB with the Health Belief Model (HBM) to explore the general public's health-related behaviors and intentions to receive influenza vaccines. These studies identified key characteristics influencing individuals' decisions to accept the COVID-19 vaccine [9, 17–19].

Building on this foundation, the present study aims to examine the antecedents of vaccination intentions among breast cancer patients, focusing on the mediating effects of quality of life and demographic factors within a social decision-making framework. Additionally, this research seeks to explore potential changes in patients' emotional responses during the post-vaccination period, offering valuable insights to enhance the overall well-being of breast cancer patients.

2. Materials and methods

2.1. Research framework

The Theory of Planned Behavior (TPB) delineates three stages of behavior formation: An individual's behavior is guided by their behavioral intention (Intention), which is shaped by their attitude towards the behavior (Attitude), perceived social pressure (Subjective Norms), and perceived control over the behavior (Perceived Behavioral Control, PBC). Since its introduction by Ajzen, PBC has served as a core element of TPB, with subsequent studies incorporating concepts such as self-efficacy and controllability to refine its framework.

TPB provides a robust theoretical foundation for exploring the factors influencing vaccination decisions among breast cancer patients during the COVID-19 pandemic. **Figure 1** presents the research framework, developed through an integration of literature review and practical considerations. This study examines the behavioral

determinants of vaccination, focusing on how fear of vaccination (Fear) impacts decision conflict (DC), trust, and shared decision-making (SDM). These factors, in turn, precede the willingness to vaccinate and may result in decision regret (DR) following vaccination.

Additionally, the study investigates whether decision regret (DR) is influenced by personal characteristics, as assessed using the Ten-Item Personality Inventory (TIPI). By employing a modified TPB framework and incorporating expert guidance, this research seeks to uncover the factors shaping breast cancer patients' COVID-19 vaccination behaviors, including their potential for regret. These insights aim to provide a comprehensive understanding of the psychological and behavioral processes involved in vaccination decision-making for this vulnerable population.

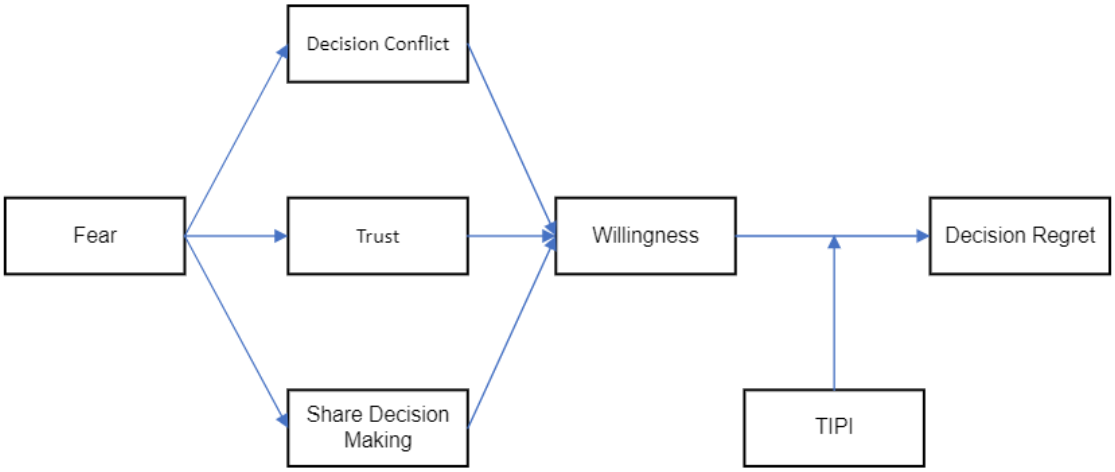

Figure 1. The research framework.

2.2. Data collection

An online cross-sectional study was conducted in Taiwan from May to July 2022, coinciding with the initial COVID-19 vaccination rollout in the region. The study received ethical approval from the Institutional Review Board (IRB) of Chung Shan Medical University, Taiwan (IRB code: CS2-21150, 10/07/2021). To ensure completeness, all survey items were mandatory in the Google Forms platform, preventing submission unless all questions were answered. Participants were required to meet the inclusion criteria of being Taiwanese, aged 20 years or older, and having a history of breast cancer. Patients must have a confirmed diagnosis of breast cancer within the past five years. Patients in different stages of treatment (e.g., newly diagnosed, undergoing treatment, in remission, metastatic disease) will be included to account for variation in clinical and psychological factors. Informed consent was obtained from all participants, who were also required to provide valid email addresses. Measures were taken to verify that each respondent completed the survey only once. Based on these criteria, a total of 278 participants were included for statistical analysis (**Figure 2**: Strobe flow diagram).

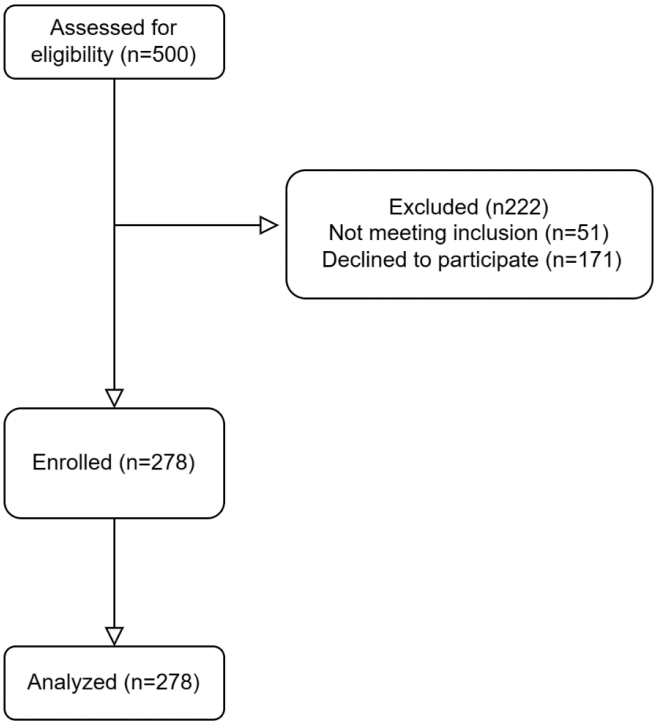

Figure 2. Flow diagram for subject enrollment.

2.3. Measurements development

An online cross-sectional study was conducted in Taiwan from May to July 2022, coinciding with the initial COVID-19 vaccination rollout in the region. The study received ethical approval from the Institutional Review Board (IRB) of Chung Shan Medical University, Taiwan (IRB code: CS2-21150, 10/07/2021). To ensure completeness, all survey items were mandatory in the Google Forms platform, preventing submission unless all questions were answered.

Participants were required to meet the inclusion criteria of being Taiwanese, aged 20 years or older, and having a history of breast cancer. Informed consent was obtained from all participants, who were also required to provide valid email addresses. Measures were taken to verify that each respondent completed the survey only once. Based on these criteria, a total of 278 participants were included for statistical analysis (**Figure 2**: Strobe flow diagram).

This study utilized questionnaires adapted from established theoretical frameworks, with fear considered as a key antecedent. All constructs were measured using a five-point Likert scale. The Fear scale, comprising 12 items, assessed the extent of COVID-19-related anxiety and fear. Attitude was reflected through Decisional Conflict, measured by a 15-item scale that evaluated uncertainty in choices and its underlying causes. Additionally, the subjective norm from the original TPB framework was replaced with Confidence, defined as the degree of protection patients perceive when making vaccination decisions based on their trust in the vaccine's reliability, benefits, and safety.

Perceived Behavioral Control (PBC) was replaced by Shared Decision-Making (SDM), which measured the extent to which patients were encouraged to engage in

clinical decision-making. SDM emphasized patient autonomy by promoting information sharing and aligning decisions with individual needs and values. Vaccination intention was redefined as Willingness, representing the degree to which an individual was inclined to receive the vaccine. Finally, Decision Regret (DR) replaced perceptions of vaccination, capturing the distress or remorse experienced after making a vaccine decision.

The adapted measures based on TPB demonstrated satisfactory psychometric properties, ensuring reliability and validity in assessing the behavioral factors influencing COVID-19 vaccination decisions among breast cancer patients.

2.4. Data analysis

Participant characteristics were analyzed using descriptive statistics, including means and frequencies. Pearson correlation coefficients were calculated to explore the relationships between the key constructs in the model. Structural Equation Modeling (SEM) was employed to validate the conceptual framework and assess the proposed relationships. Confirmatory Factor Analysis (CFA) was conducted to ensure construct validity, verifying that each measurement item appropriately represented its intended domain. Reliability coefficients, factor loadings, and average variance extracted (AVE) values were computed for all measurement tools.

Given the sample size, the analysis utilized the partial least square (PLS) estimation method within the Smart-PLS 4.0 software, supplemented by bootstrapping for robust statistical testing. Missing data were addressed through imputation, preserving all cases by substituting missing values with estimates based on available information.

The model tested the effects of Decision Conflict (DC), Trust, Shared Decision-Making (SDM), and Fear as antecedent factors. Additionally, the role of personal characteristics, assessed using the Ten-Item Personality Inventory (TIPI), was evaluated as a moderating variable in the relationship between vaccination willingness and Decision Regret (DR).

3. Results

3.1. Descriptive analysis

Between April and June 2022, an online survey targeting women diagnosed with breast cancer was conducted. Of the 500 invited participants, 278 completed the survey, resulting in a response rate of 55.6%. Detailed respondent characteristics are provided in **Table S1** (Supplementary file). The respondent characteristics are as follows: Most participants had an education level of senior high school or above (81%), were married (69.1%), and employed (54.3%). A majority identified as religious (61.5%), while only 1.8% reported chronic diseases, including hypertension (60%) and asthma or mitral valve prolapse (20% each).

3.2. Common method bias

Multiple respondents were involved in data collection to minimize the threat of common method bias. A single self-reported informant approach was adopted for

survey data collection; therefore, the risk of common method bias was carefully considered. Two statistical analyses were conducted to evaluate the severity of common method bias. All constructs in the model were included in the factorial analysis of the main components. Despite the small sample size and the insignificance of method variables, the results indicated no substantial variance attributable to common method bias. Thus, common method bias is not expected to pose a significant issue in this study.

3.3. Measurement model

Factor scores for integrative antecedents and latent representations of "willingness" and "decision regret" were utilized for further analysis. All concepts and sub-concepts in the model were assessed using multiple indicators. The measurement properties in the PLS were evaluated based on scale reliability, convergent validity, discriminant validity, and element reliability. The reliability of an individual item was determined by examining its structural loadings. A factor loading of 0.707 or higher indicates that 50% or more of the variance in the item is shared with the latent construct, as shown in **Table S2** (Supplementary file). Items with factor loadings below 0.5 were excluded from the analysis [20].

Convergent validity can be assessed through construct reliability, composite reliability, and average variance extracted (AVE) by constructs [21]. Cronbach's alpha is used to evaluate construct reliability, measuring the homogeneity of items within a construct based on the assumption that each item contributes equally to the latent construct. Composite reliability employs item loadings from the measurement model to determine internal consistency [20]. We evaluated both convergent and discriminant validity for the construct scales before testing the hypothesized structural relationships. **Tables S2** and **S3** (Supplementary) present the composite reliability, Cronbach's alpha, and AVE values for all constructs in the research model. Cronbach's alpha values and composite reliabilities exceeded the recommended threshold of 0.7 [21], while AVE values were all above 0.50 [22], confirming internal consistency and convergent validity.

As shown in **Table S3**, discriminant validity was also supported because (1) all indicators loaded more strongly on their corresponding construct than on other constructs in the model; and (2) the square root of the AVE for each major construct exceeded the inter-construct correlations [23]. These findings indicate that the measurement model demonstrates adequate convergent and discriminant validity.

3.4. Structural model

The proposed research model was evaluated by analyzing the significance of the paths within the structural model. Using the PLS method, a bootstrap procedure with 500 subsamples was employed to generate t-statistics and standard errors [23]. **Figure 3** illustrates the estimated path coefficients and the explained variance in the structural model. Several path coefficients were significant, providing support for the research objectives. The results demonstrated positive associations between "fear" and "trust" as well as between "fear" and "shared decision-making" (SDM). From the perspective of "willingness", there was a negative association with "decision conflict".

Additionally, "willingness" negatively influenced "decision regret" (DR) with moderation by the Ten-Item Personality Inventory (TIPI). Since "quality of life" did not moderate the relationship between "willingness" and "decision regret", it was removed from the structural model.

The path coefficients for all constructs are presented in **Figure 2**, with significance tested using bootstrapping at a *p*-value below 0.05. The explained variances (R^2) for the endogenous variables including Decision Conflict (DC), Trust, SDM, Willingness, and DR were 36.8% and 40.3%, respectively. Regarding the control variables included in the model, these findings support the research framework and indicate that significant variances in the dependent variables are well explained by the proposed independent and control variables.

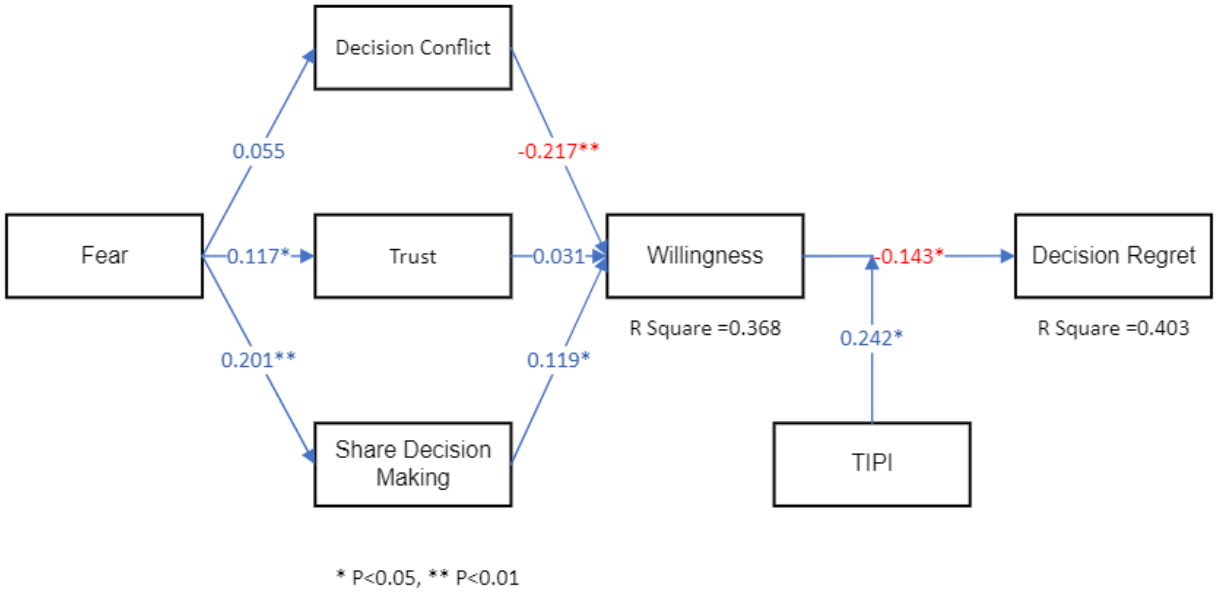

Figure 3. The results of structure model test.

4. Discussion

As a result, our study demonstrates that TPB is an effective tool for addressing the vaccination behavior of Taiwanese breast cancer patients in relation to COVID-19. The proposed model expands existing knowledge by incorporating the impact of personality traits on the behavior of breast cancer patients receiving future COVID-19 booster shots. The aim of this study was to extend the behavioral analysis of TPB concerning the willingness to be vaccinated against COVID-19 in breast cancer patients. The following discussion addresses Intention, Attitude (Subjective Norms), and Perceived Behavior Control. The model explains approximately 36.8% of the total variance in breast cancer patients' willingness to receive the COVID-19 vaccine and 40.3% of the variance in predicting their future vaccination behaviors, including whether they regret their decision to get vaccinated. Compared to the original TPB, which explained about 34.0% variance, our model demonstrated better explanatory power [24]. Collectively, our theoretical framework provides strong evidence for understanding breast cancer patients' vaccination behaviors and predicting future vaccination behaviors for COVID-19.

This study suggests that breast cancer patients' fear of COVID-19 does not influence their decision conflicts regarding cancer treatment. Consequently, their concerns about COVID-19 have not affected their choices of cancer treatment options. However, fear of COVID-19 indirectly affects their willingness to receive vaccination through shared decision-making. Patients are more likely to get vaccinated if they have increased opportunities to discuss their treatment with their physicians. These findings contrast with previous studies indicating that cancer patients may use less healthcare during the pandemic [25,26].

Furthermore, fear of COVID-19 has increased the trust breast cancer patients place in their physicians. As fear intensifies, physicians become more trusted. A recent study in five European countries on nurses' intentions to get vaccinated against COVID-19 found that nurses who trusted the government and physicians for COVID-19-related information were more likely to get vaccinated than those who did not [27]. However, this study did not investigate the relationship between trust in physicians and fear of COVID-19. Another study examining institutional trust and attitudes toward COVID-19 vaccination found that trust and fear positively influenced vaccination attitudes in the general population. Li et al. also found that physicians' advice is a critical factor in shaping public vaccination intentions [28]. Similar observations were reported by other researchers [29–33].

Additionally, our findings indicate that fear of COVID-19 significantly impacts breast cancer patients' vaccination decision-making. An Iranian study showed that fear of COVID-19 and the perception of its infectivity positively influenced public willingness to vaccinate. However, to the best of our knowledge, no previous study has explored the link between fear of COVID-19 and shared decision-making. Results from our study revealed that decision conflicts and shared decision-making directly and independently affect breast cancer patients' willingness (or reluctance) to get vaccinated, rather than being mediated through trust in physicians.

Notably, decision conflicts strongly undermined willingness to vaccinate. These results contradict Zhang et al.'s findings, which suggested that decision conflict was not a barrier to COVID-19 vaccination [18]. However, Wang et al. found that uncertainty about which type of booster vaccine to receive reduced individuals' likelihood of getting a booster dose [19]. Regarding shared decision-making, Durand et al. argued that discussions with multidisciplinary healthcare teams positively impact vaccination rates, particularly in influenza vaccination [34]. Our study provides empirical evidence supporting Durand's findings. However, we observed that decision conflicts and shared decision-making did not significantly affect trust in physicians.

Finally, our results confirmed that breast cancer patients hesitant to get vaccinated are more likely to experience regret. Previous studies primarily examined the relationship between vaccine hesitancy and vaccination rates among oncologic patients [35–37]. To the best of our knowledge, this study is the first to assess COVID-19 vaccination decision regret among breast cancer patients, highlighting its potential influence on their future willingness to be vaccinated.

5. Conclusions

The findings from this study demonstrate that TPB is an effective tool for

addressing the complex vaccination behaviors associated with COVID-19 in Taiwanese breast cancer patients. The aim of this study was to extend the behavioral analysis of breast cancer patients' willingness to receive the COVID-19 vaccine. The structure of the model explained 36.8% of the variance in willingness to be vaccinated. Additionally, it explained 40.3% of the variance in predicting future vaccination behaviors. The theoretical framework of this study provides robust evidence for understanding the vaccination behaviors of breast cancer patients and predicting their future responses to COVID-19 vaccination.

The study also found that patients who were given more opportunities to discuss their treatment with their physicians were more likely to be vaccinated against COVID-19. While previous studies have explored the relationship between fear of COVID-19 and vaccination decisions, this study investigated whether the trust relationship between cancer patients and their physicians influenced their willingness to be vaccinated. The findings suggest that this trust did not significantly impact vaccination decisions during the pandemic.

Finally, the research confirms that breast cancer patients who hesitate to get vaccinated are more likely to experience regret. These findings provide valuable insights into the behavioral aspects of cancer patients' vaccination decisions, offering strategies to reduce fear and enhance the effectiveness of preventive measures in the future.

5.1. Limitations

The study acknowledges several limitations that may influence the interpretation of the findings. First, the lack of stratification by treatment stage (e.g., newly diagnosed, in remission, metastatic disease) may limit the generalizability of the results. Patients at different stages of treatment often experience varying psychological and physical challenges, which could impact their decision-making processes regarding vaccination. Future research should include stratified analyses to explore how treatment stages influence shared decision-making, decisional conflict, and vaccination willingness; Second, while the study modeled key psychosocial factors, it did not include trust in physicians as a formal mediator or moderator in the structural equation modeling.

In addition, although the model supports direct effects of SDM and decisional conflicts, limitations in the design prevent us from excluding potential underlying mediators or moderators, such as trust or other unmeasured psychosocial factors. These findings should be interpreted in light of this limitation, with a need for future investigations to confirm and refine these relationships.

5.2. Recommendations for future research

Stratified Analyses by Treatment Stage: To address the limitation of not accounting for the treatment stage, future studies should stratify participants based on their treatment status (e.g., newly diagnosed, in remission, or metastatic disease). This approach can provide insights into how the psychological and physical challenges at each stage affect shared decision-making (SDM), decisional conflict, and vaccination

behaviors. Comparing these subgroups can help identify tailored interventions that address the unique needs of each patient category.

Incorporating Trust in Physicians: Given the importance of trust in healthcare providers, future research should explicitly include trust in physicians as a potential mediator or moderator in the structural equation modeling. By doing so, researchers can better understand how trust influences the relationship between SDM, decisional conflict, and vaccination willingness, thereby providing a more nuanced view of patient decision-making.

Exploration of Additional Mediators and Moderators: To overcome the design limitations related to unmeasured psychosocial factors, future studies should explore other potential mediators or moderators, such as health literacy, social support, or cultural influences. These factors may offer valuable insights into the mechanisms driving vaccination behaviors among cancer patients.

Longitudinal Study Design: A longitudinal study could address the current limitations by examining how SDM, decisional conflict, trust in physicians, and other psychosocial factors evolve over time. Such an approach would enable researchers to capture changes in vaccination willingness and identify causal pathways.

Qualitative Insights: Incorporating qualitative methods, such as interviews or focus groups, could provide deeper insights into the subjective experiences of patients at different treatment stages. This can complement quantitative findings and offer a more comprehensive understanding of the barriers and facilitators to vaccination.

Cross-Cultural Studies: To enhance the generalizability of findings, future research should include diverse populations from different cultural and healthcare settings. Examining variations across these contexts can help identify universal and context-specific factors influencing vaccination behaviors.

Supplementary materials: Supplementary materials include detailed respondent characteristics (Supplementary **Table S1**), reliability metrics (Supplementary **Table S2**), and AVE for constructs (Supplementary **Table S3**), available online.

Author contributions: Conceptualization, HYK and WCT; study design, HYK and WCT; data analysis, HYK and WCT; writing the initial draft of the manuscript, HYK and YCAL; revising the initial draft of the manuscript, HYK and YCAL; manuscript submission, YCAL; addressing the reviewers' comments, YCAL; funding, WCT and CCC; project administration, WCT and CCC; data collection, WCT and CCC; supervised the research, CHL (Ching-Hsiang Lai); facilitated execution of research, CHL (Ching-Hsiang Lai); data analysis, IFC; assisted with the initial draft, IFC; literature review, CHL (Chiu-Hsiang Lee) and CLC; data validation, CHL (Chiu-Hsiang Lee) and CLC; manuscript refinement, CHL (Chiu-Hsiang Lee) and CLC. All authors have read and agreed to the published version of the manuscript.

Funding: This work was supported by Chung Shan Medical University Hospital (grant number: CSH-2022-D-010).

Acknowledgments: The authors wish to express their gratitude to all participants and collaborators who contributed to this study. Their valuable input and support were instrumental in the successful completion of this research. Wen-Chien Ting made an equal contribution alongside the first author, Hao-Yun Kao, in the conceptualization,

design, and execution of this study. The authors acknowledge their shared efforts and dedication to the success of this manuscript. We would also like to thank Chung Shan Medical University Hospital for their funding support.

Ethical approval: This study was conducted in accordance with the Declaration of Helsinki. Ethical approval for this study was obtained from the Institutional Review Board (IRB) of Sun Yat-sen University of Medical Sciences, Taiwan, with IRB code CS2-21150. All procedures involving human participants complied with the ethical standards of the Institutional Research Board, and informed consent was obtained from all participants.

Conflict of interest: The authors declare no conflict of interest.

References

1. Albarracin D, Jung H. A research agenda for the post-COVID-19 world: Theory and research in social psychology. Asian Journal of Social Psychology. 2021; 24(1): 10–17. doi: 10.1111/ajsp.12469
2. Hagger MS, Hamilton K. Social cognition theories and behavior change in COVID-19: A conceptual review. Behaviour Research and Therapy. 2022; 154: 104095. doi: 10.1016/j.brat.2022.104095
3. Huang Q, Gilkey MB, Thompson P, et al. Explaining higher Covid-19 vaccination among some US primary care professionals. Social Science & Medicine. 2022; 301: 114935. doi: 10.1016/j.socscimed.2022.114935
4. Kuderer NM, Choueiri TK, Shah DP, et al. Clinical impact of COVID-19 on patients with cancer (CCC19): a cohort study. The Lancet. 2020; 395(10241): 1907–1918. doi: 10.1016/s0140-6736(20)31187-9
5. Rüthrich MM, Giessen-Jung C, Borgmann S, et al. COVID-19 in cancer patients: clinical characteristics and outcome—an analysis of the LEOSS registry. Annals of Hematology. 2020; 100(2): 383–393. doi: 10.1007/s00277-020-04328-4
6. Gheorghe AS, Negru ȘM, Nițipir C, et al. Knowledge, attitudes and practices related to the COVID-19 outbreak among Romanian adults with cancer: a cross-sectional national survey. ESMO Open. 2021; 6(1): 100027. doi: 10.1016/j.esmoop.2020.100027
7. Chun JY, Kim SI, Park EY, et al. Cancer Patients' Willingness to Take COVID-19 Vaccination: A Nationwide Multicenter Survey in Korea. Cancers. 2021; 13(15): 3883. doi: 10.3390/cancers13153883
8. Centers for Disease Control, Ministry of Health and Welfare, Taiwan. COVID-19 Vaccination Guidelines. Available online: https://www.cdc.gov.tw/En (accessed on 24 October 2024).
9. Chen YC, Su SY, Jhuang JR, et al. Forecast of a future leveling of the incidence trends of female breast cancer in Taiwan: an age-period-cohort analysis. Scientific Reports. 2022; 12(1): 12481. doi: 10.1038/s41598-022-16056-y
10. National Comprehensive Cancer Network. Recommendations of the NCCN COVID-19 Vaccination Advisory Committee. Available online: https://www.cdc.gov.tw/En (accessed on 24 October 2024).
11. Chang CC. Developing the First Validity of Shared Medical Decision-Making Questionnaire in Taiwan. Global Journal of Medical Research. 2014; 14(K2): 9–15.
12. Epstein RM, Shields CG, Franks P, et al. Exploring and validating patient concerns: relation to prescribing for depression. The Annals of Family Medicine. 2007; 5(1): 21–28. doi: 10.1370/afm.621
13. Cheng SL, Liao HH, Shueng PW, et al. Exploring Oral Cancer Patients' Preference in Medical Decision Making and Quality of Life. Stud Health Technol Inform. 2017; 238: 32–35.
14. O'Connor AM. Validation of a decisional conflict scale. Med Decis Making. 1995; 15(1): 25–30. doi: 10.1177/0272989x9501500105
15. Liao HH, Cheng SL, Chang CC, et al. Decisional trust and regret mediate the HRQL in work-related hand injury patients. European Psychiatry. 2016; 33(S1): S479–S479. doi: 10.1016/j.eurpsy.2016.01.1753
16. Thom DH, Kravitz RL, Bell RA, et al. Patient trust in the physician: relationship to patient requests. Family Practice. 2002; 19(5): 476–483. doi: 10.1093/fampra/19.5.476
17. Fan CW, Chen IH, Ko NY, et al. Extended theory of planned behavior in explaining the intention to COVID-19 vaccination uptake among mainland Chinese university students: an online survey study. Human vaccines & immunotherapeutics. 2021; 17(10): 3413–3420. doi: 10.1080/21645515.2021.1933687

18. Zhang K, Fang Y, Chan PS, et al. Behavioral Intention to Get a Booster Dose of COVID-19 Vaccine among Chinese Factory Workers. International Journal of Environmental Research and Public Health. 2022; 19(9): 5245. doi: 10.3390/ijerph19095245
19. Wang XY, Liu Q, Zhang WX, et al. External Supports Are Associated With the COVID-19 Vaccination in Chinese Breast Cancer Patients: A Cross-Sectional Survey. World Journal of Oncology. 2022; 13(4): 172–184. doi: 10.14740/wjon1460
20. Werts CE, Linn RL, Jöreskog KG. Intraclass Reliability Estimates: Testing Structural Assumptions. Educational and Psychological Measurement. 1974; 34(1): 25–33. doi: 10.1177/001316447403400104
21. Nunnally JC, Bernstein IH. In: Psychometric Theory, 3rd ed. McGraw-Hill; 1967.
22. Fornell C, Larcker DF. Structural Equation Models with Unobservable Variables and Measurement Error: Algebra and Statistics. Journal of Marketing Research. 1981; 18(3): 382–388. doi: 10.2307/3150980
23. Chin WW. The partial least squares approach for structural equation modeling. In: Modern methods for business research. Lawrence Erlbaum Associates Publishers; 1998. pp. 295–336.
24. Han H, Al-Ansi A, Chua BL, et al. The Post-Coronavirus World in the International Tourism Industry: Application of the Theory of Planned Behavior to Safer Destination Choices in the Case of US Outbound Tourism. International Journal of Environmental Research and Public Health. 2020; 17(18): 6485. doi: 10.3390/ijerph17186485
25. Patt D, Gordan L, Diaz M, et al. Impact of COVID-19 on Cancer Care: How the Pandemic Is Delaying Cancer Diagnosis and Treatment for American Seniors. JCO Clinical Cancer Informatics. 2020; 4: 1059–1071. doi: 10.1200/cci.20.00134
26. Caston NE, Lawhon VM, Smith KL, et al. Examining the association among fear of COVID-19, psychological distress, and delays in cancer care. Cancer Medicine. 2021; 10(24): 8854–8865. doi: 10.1002/cam4.4391
27. Patelarou A, Saliaj A, Galanis P, et al. Predictors of nurses' intention to accept COVID-19 vaccination: A cross-sectional study in five European countries. Journal of Clinical Nursing. 2021; 31(9–10): 1258–1266. doi: 10.1111/jocn.15980
28. Li Z, Ji Y, Sun X. The impact of vaccine hesitation on the intentions to get COVID-19 vaccines: The use of the health belief model and the theory of planned behavior model. Frontiers in Public Health. 2022; 10: 882909. doi: 10.3389/fpubh.2022.882909
29. Chu A, Gupta V, Unni EJ. Utilizing the Theory of Planned Behavior to determine the intentions to receive the influenza vaccine during COVID-19: A cross-sectional survey of US adults. Preventive Medicine Reports. 2021; 23: 101417. doi: 10.1016/j.pmedr.2021.101417
30. Patwary MM, Bardhan M, Disha AS, et al. Determinants of COVID-19 Vaccine Acceptance among the Adult Population of Bangladesh Using the Health Belief Model and the Theory of Planned Behavior Model. Vaccines. 2021; 9(12): 1393. doi: 10.3390/vaccines9121393
31. Servidio R, Malvaso A, Vizza D, et al. The intention to get COVID-19 vaccine and vaccine uptake among cancer patients: An extension of the theory of planned behaviour (TPB). Supportive Care in Cancer. 2022; 30(10): 7973–7982. doi: 10.1007/s00520-022-07238-5
32. Liu W, Wu Y, Yang R, et al. COVID-19 Vaccination Status and Hesitancy among Breast Cancer Patients after Two Years of Pandemic: A Cross-Sectional Survey. Vaccines. 2022; 10(9): 1530. doi: 10.3390/vaccines10091530
33. Wang XY, Liu Q, Zhang WX, et al. External Supports Are Associated With the COVID-19 Vaccination in Chinese Breast Cancer Patients: A Cross-Sectional Survey. World Journal of Oncology. 2022; 13(4): 172–184. doi: 10.14740/wjon1460
34. Durand MA, Scalia P, Elwyn G. Can shared decision making address COVID-19 vaccine hesitancy? BMJ Evidence-Based Medicine. 2022; 27(3): 159–161. doi: 10.1136/bmjebm-2021-111695
35. Villarreal-Garza C, Vaca-Cartagena BF, Becerril-Gaitan A, et al. Attitudes and Factors Associated With COVID-19 Vaccine Hesitancy Among Patients With Breast Cancer. JAMA Oncology. 2021; 7(8): 1242–1244. doi: 10.1001/jamaoncol.2021.1962
36. Hossain MB, Alam MdZ, Islam MdS, et al. Health Belief Model, Theory of Planned Behavior, or Psychological Antecedents: What Predicts COVID-19 Vaccine Hesitancy Better Among the Bangladeshi Adults? Frontiers in Public Health. 2021; 9. doi: 10.3389/fpubh.2021.711066
37. An PL, Nguyen HTN, Dang HTB, et al. Integrating Health Behavior Theories to Predict Intention to Get a COVID-19 Vaccine. Health Services Insights. 2021; 14. doi: 10.1177/11786329211060130