Official Title: Effects of telephone intervention and nudging information on cancer screening behavior: A randomized clinical study

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Abstract

Objectives: Telephone interventions are often delivered to promote cancer screening for early detection and treatment. However, the effects of nudging information provided in telephone interventions on cancer screening behavior remain unclear. Accordingly, this study investigated the effects of telephone-delivered nudging information regarding screening benefits and social norms on cancer screening behavior.

Methods: This randomized controlled trial included 1,200 community-dwelling individuals meeting screening criteria for colorectal, breast, cervical, or oral cancer. Participants were assigned to one of four groups: telephone benefits, telephone social norms, telephone reminder, and letter reminder. The dependent variable was cancer screening behavior within 6 months after the intervention.

Significance: The expected results will provide evidence regarding the research objectives, enhance understanding of the study outcomes, and inform future research and clinical practice.

Keywords: cancer screening; health behavior; nudging information; telephone intervention

Introduction

Cancer has been the leading cause of death in Taiwan since 1970, and since 2022, approximately 130,000 new cases have been diagnosed in the region annually (Health Promotion Administration, 2025). Taiwan's government has implemented a cancer screening policy for at-risk individuals (Health Promotion Administration, 2024), which has facilitated early detection and led to positive treatment outcomes (Bouvard et al., 2021; Knudsen et al., 2021; Monticciolo et al., 2021).

Telephone intervention programs can promote cancer screening. Review studies have indicated that, compared with letter interventions, telephone interventions are more effective in increasing engagement in cancer screening (Agide, Sadeghi, Garmaroudi, & Tigabu, 2018; Tsipa et al., 2021). Two types of information are typically delivered by telephone. First, health-care professionals may provide detailed information and overcome barriers through telephone counseling, increasing participation in cancer screening (Champion et al., 2020; Oyalowo, Forde, Lamanna, & Kochman, 2022). However, such counseling sessions can be time-consuming, often lasting 30 to 60 minutes or more. Second, health-care professionals may provide screening reminders by telephone. Participants who received a telephone reminder had higher rates of cancer screening than those of participants who received a mailed reminder (Lin et al., 2020) or usual care (Jasurda, Danieli, Yamanaka, & Shaukat, 2022).

The phrase "nudging information" refers to the influence of cognitive beliefs or heuristics, rather than rational thinking, on individual behavior (Blumenthal-Barby & Krieger, 2015). For example, information about a treatment plan can influence individuals' choices and behavioral responses (Ploug & Holm, 2015). Nudging information related to cancer screening includes that with an emphasis on positive or

beneficial (rather than loss-related) information, default bias, minor monetary incentives, recommendations by authority figures, and appeals to individuals' fear or sense of responsibility, solidarity, and duty (Hofmann & Stanak, 2018; Ploug & Holm, 2015). In a study by Davey et al. on telephone interventions to promote breast cancer screening, three groups received one of the following messages: (1) relative risk: breast cancer screening every 2 years can reduce mortality by 34%; (2) absolute numbers: screening can reduce the mortality rate for breast cancer from 6 per 1,000 to 4 per 1,000; and (3) general information: screening can reduce mortality (no specific number provided). After the messages were delivered, willingness to undergo screening in these three groups was 88%, 78%, and 53%, respectively; that is, willingness was much higher in the first two groups. This finding suggests that providing explicit information about absolute or relative mortality reduction is more effective in promoting screening behavior than providing general information about screening benefits. However, the authors of that study measured intentions rather than actual behavior (Davey, White, Gattellari, & Ward, 2005).

Research indicates that providing information regarding benefits or the benefit–harm ratio significantly affects screening behavior (Hofmann & Stanak, 2018). In a national survey conducted across the United States, the benefits of cancer screening (i.e., early detection and treatment) were identified as the greatest determinant of screening behavior (Singer et al., 2014). The health belief model (Lau, Lim, Wong, & Tan, 2020) and the theory of planned behavior (Ritchie, Van den Broucke, & Van Hal, 2021) suggest that when individuals are aware of the benefits of a behavior, they are more likely to engage in that behavior. Accordingly, the first screening reminder developed in the present study focused on leading individuals to understand the benefits of cancer screening.

Individuals are embedded in social contexts where they interact with others; information from their social groups can influence their behavior. Individuals may change their behavior when they realize how many others engage in that same behavior (Nolan, Schultz, Cialdini, Goldstein, & Griskevicius, 2008). Social norms motivate behavioral engagement, with individuals seeking to achieve a sense of social acceptance or control (Klein & Stefanek, 2007). Research indicates that information regarding social comparison also shapes perceived cancer risk and cancer screening behavior (Klein, 2003). The theory of planned behavior addresses the social norms surrounding individuals' beliefs regarding the behaviors others think they should engage in (Ritchie et al., 2021). When they perceive that many people agree with or perform the behavior, they may be more likely to do so. Thus, the second reminder in the present study informed participants of the number of individuals who had undergone cancer screening in the previous year.

Telephone communication offers several advantages as a means of promoting cancer screening. The method enables timely interaction with individuals and the delivery of numerous forms of information. Accordingly, we manipulated the content of screening reminders to investigate differences in the effects of different content on cancer screening behavior. We explored the effects of nudging information (benefits and social norms) delivered by telephone on cancer screening behavior compared with the effects of reminders delivered by letter.

Methods

Participants

Community-dwelling individuals who met the criteria for cancer screening outlined by the Health Promotion Administration under Taiwan's Ministry of Health

and Welfare were recruited. Participants were required to have sufficient communication ability and the ability to receive a telephone interview. According to Taiwan's national criteria for cancer screening, the following individuals should undergo regular tests: (1) colorectal cancer: people aged 50 to 74 years who have not received a fecal occult blood test within the past 2 years; (2) breast cancer: women aged 45 to 69 years or those aged 40 to 44 years with a family history of breast cancer who have not received a mammography within the previous 2 years; (3) cervical cancer: women aged over 30 years who have not received a pap smear test within the past 3 years; and (4) oral cancer: the general people aged over 30 years or indigenous residents of Taiwan aged over 18 years with a history of chewing betel nut or smoking who have not received an oral mucosal examination within the past 2 years. This study did not consider individuals with severe cognitive impairment or a previous cancer diagnosis, as indicated by chart records.

Study design

We conducted the current randomized controlled study. The clinical information of participants was collected from electronic medical records. These participants were then randomly assigned to four groups by computer. Nurses in a community health department provided information to participants in three groups over the telephone and information to one group through a letter. If participants did not answer the telephone, nurses called them again within 1 week. Before we conducted the study, ethical approval was obtained from the institutional review board of the institution (IRB2021031). Because this was a field study, and the intervention was regular reminder based on the policy and the risk to research participants was less than that of daily activities, therefore, the participants did not sign the informed consents.

Intervention

In the intervention, participants were provided with three categories of information: (1) the reasons why they were receiving the information (delivered by telephone or letter), that is, information regarding the criteria they met, such as their age or lack of screening history within a certain time period; (2) reasons why they should undergo screening, including nudging information related to benefits or social norms; and (3) a description of how they could make cancer screening appointments. The telephone reminder and letter reminder groups only received the first and third types of information.

In the telephone benefits group, key information regarding the benefits of cancer screening was provided with consideration of the health belief model (Lau et al., 2020): (1) colorectal cancer: the 5-year survival rate in stage 0 or 1 is 24% higher than that in stage 3 and 70% higher than that in stage 4; (2) breast cancer: the 5-year survival rate in stage 0 or 1 is 20% higher than that in stage 3 and 60% higher than that in stage 4; (3) cervical cancer: the 5-year survival rate in stage 0 or 1 is 40% higher than that in stage 3 and 66% higher than that in stage 4; and (4) oral cancer: the 5-year survival rate in stage 0 or 1 is 40% higher than that in stage 3 or 4.

In the telephone social norms group, the following were provided with consideration of the theory of planned behavior (Ritchie et al., 2021): (1) 1,310,000 individuals were screened for colorectal cancer, which is 41% of individuals eligible for screening; (2) 860,000 individuals were screened for breast cancer, which is 40% of individuals eligible for screening; (3) 2,180,000 individuals were screened for cervical cancer, which is 73% of individuals eligible for screening; and (4) 740,000 individuals were screened for oral cancer, which is 50% of those eligible for screening. These data were extrapolated from health statistics provided by the Health

Promotion Administration, Ministry of Health and Welfare.(Health Promotion Administration, 2024; Health Promotion Administration, 2025)

Participants who met multiple cancer screening criteria received information about all screenings for which they were eligible. For example, if a participant met the criteria for both colorectal and breast cancer screening, that participant received information about both.

Data collection

The primary outcome was cancer screening behavior, defined as participation in cancer screening at some point after the 6-month intervention, and the type of cancer screening the participants underwent. The sociodemographic characteristics considered in our analysis were participant age, sex, education level, and marital status. Information was also collected on the following health behaviors: (1) smoking history: never smoked, ceased smoking, or currently smoking; (2) betel nut chewing: never chewed, ceased chewing, or currently chewing betel nut; and (3) exercise: engaging in exercise three times per week for over 30 minutes each time or not. Family cancer history was defined as a recorded cancer diagnosis for a third-degree relative (grandparent, parent, sibling, child, or grandchild). Health status was evaluated using a single item (“In general, how would you rate your health”), with participants assigning a rating on a three-point scale (1, bad; 2, general; and 3, good). Demographic and clinical characteristics and history of cancer screening were obtained from the participants’ medical records.

Statistical analysis

The demographic and health behavior characteristics are summarized for the

total sample and each group as descriptive statistics. One-way ANOVA was performed to evaluate differences in age and self-rated health between the four groups, and chi-square tests were performed for sex, education level, marital status, smoking history, betel nut chewing, exercise, and familial cancer history. A chi-square test was also performed to evaluate differences in overall cancer screening and screening for specific cancers between groups. In the subsequent logistic regression analysis, the dependent variable was participant engagement in cancer screening. Some participants received information on multiple cancer screenings; these participants were considered to have undergone screening if they received any one cancer screening. The predictors of screening that were considered included sociodemographic characteristics, health behaviors, and intervention types. The covariables considered included age, sex, education level, marital status, smoking history, betel nut chewing, familial cancer history, and exercise. The reference group was the telephone benefits group, against which we compared the effects of information on benefits versus social norms and delivery by telephone versus letter. SPSS 17.0 version was used for all analyses, and a p value of <0.05 was considered significant. The CONSORT (Consolidated Standards of Reporting Trials) statement was used to report this study (Hopewell et al., 2025).

Significance

This study is expected to address the research objectives, generate evidence to inform clinical practice, and identify opportunities to improve healthcare delivery and health outcomes. The findings may also guide future research and the development of evidence-based interventions.

Declarations

Ethics approval and consent to participate

The ethical approval was obtained from the institutional review board of Ditmanson Medical Foundation Chia-Yi Christian Hospital (IRB2021031). The study adheres to the Helsinki Declaration. Because this was a field study, and the intervention was regular reminder for cancer screening based on the policy and the risk to research participants was less than that of daily activities, therefore, the participants did not sign the informed consents.

Consent for publication

Not applicable.

Availability of data and materials

The authors confirm that the data supporting the findings of this study are available within the article.

Competing interests

None of the authors have relevant conflicts of interest to declare.

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Authors' contributions

Conceptualization: PCC, SYF; Methodology: PCC, CYW, CMT; Formal analysis: CCW, SYF; Funding acquisition SYF; Project administration CYW, CMT; Writing-original draft: PCC, SYF; Writing review and editing: PCC, CCW, SYF. All authors have read and approved the final version of the manuscript.

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