Promoting Influenza Prevention for Older Adults Using the Health Action Process Approach: A Randomized Controlled Trial

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Abstract

Older adults are at greater risk of complications from seasonal influenza, and promoting uptake and adherence to preventive behaviors is key to attenuating this risk. The current study examined the efficacy of a theory-based telephone-delivered intervention to promote uptake and maintenance pf influenza preventive behaviors in a sample of Hong Kong residents 65 years and older. The intervention adopted a three-group randomized controlled design (*n*=312) with two intervention conditions, motivational and motivational + volitional, and a measurement-only control condition. The primary outcome variable was self-reported compliance with influenza preventive behaviors (washing hands; avoid touching eyes, nose, or mouth; wearing facemasks). Secondary outcomes were theory-based psychological variables. Influenza preventive behaviors in participants in the the motivational + volitional intervention group were significantly improved three months post-intervention relative to those in the control codnition. However, participants in the intervention group demontrated no difference in behavior at six and twelve months post-intervention relative to the participants in the control group. Intervention effects were observed on the theory-based social support, action planning, and coping planning variables. Although short-term benefits of the intervention were observed, effects appeared to be short lived and future research should investigate more intensive interventions that lead to greater behavioral maintenance.

Keywords*:* Flu prevention; motivational intervention; volitional intervention; hand hygiene; facemask wearing.

Seasonal influenza has the potential to cause severe illness, or even death, among adults aged 65 years and older. Estimates indicate the mean global seasonal influenza-associated respiratory deaths per annum range from 4 to 8.8 per 100,000 individuals in the general population, but much higher mortality rates of 51.3 to 99.4 per 100,000 individuals are observed in older adults aged 75 or older (Iuliano et al., 2018). Given that older adults are at a particularly high risk of seasonal influenza-related complications, it is key to promote adoption of means to prevent seasonal influenza infection. Beyond getting vaccinated against influenza, older people are advised to adopt a series of additional preventive behaviors that include as hand washing, avoiding touching eyes, nose or mouth with unwashed hands, and facemask wearing (Agüero et al., 2011). However, low behavioral compliance with these recommended health actions is considered one of the main factors contributing to the extensive community transmission of influenza (REF).

Low compliance rates has led to the advocacy of developing efficacious behavioral interventions aimed at promoting uptake and maintenance of multiple influenza preventive behaviors for older adults (Miller & Iris, 2002). Although a number of evidence-based behavioral interventions have been conducted to promote influenza preventive behaviors, many have not been based on behavioral theory (e.g., Aiello et al., 2010; Cowling et al., 2009). Research has suggested that a theoretical basis is important to identify the behavior change techniques that are most effective in affecting change in behavioral outcomes and mechanisms by which those changes occur through the theory-based constructs they are purported to activate or change (Hagger et al., 2020; Rothman, 2009). Specifically, this means identifying potentially modifiable theory-based constructs that are reliably relared to behavior, through formative research and theory, and the techniques likely to affect change in behavior through activation or change in these constructs – together these form the ‘mechanism of action’ of the intervention. A theory basis may lead to more efficient interventions by eliminating techniques that may be less effective (McEwan et al., 2019) and also may facilitate the development of

an evidence base of which techniques have efficacy in changing behavior in interventions applied in different contexts, behaviors, and populations (Glanz & Bishop, 2010).

In the context of promoting influenza prevention behaviors, prior interventions have adopted techniques that explicitly target change in constructs from social cognition theories such as Health Belief Model (Rosenstock, 1974) and the Theory of Planned Behavior (Ajzen, 1991; Hagger, 2019). For example, Keshavarz and colleagues (2022) showed that a four-session education intervention was efficacious in increasing older adults' perceived susceptibility, severity, barriers, benefits, and intentions to get vaccinated and wearing face coverings, but not the intentions to perform other influenza preventive behaviors. Similarly, Yardley and colleagues (2011) demonstrated the efficacy of an intervention in increasing hand washing frequency to prevent respiratory infection transmission during a pandemic. However, a key limitation of these previous studies is that they have tended to focus on one particular influenza preventive behavior, while optimal prevention necessitates uptake of multiple preventive behaviors including hand washing after going out and before touching food, avoiding touching eyes, nose or mouth with unwashed hands, and facemask wearing. In addition, previous interventions have mainly adopted techniques that target change in behavior through change in constructs designated to operate in a *motivational* phase of action (e.g., Keshavarz et al., 2022), but have generally not encompassed techniques targeting behavior change through change in constructs operating in a *volitional* phase of action (for a review of action phases see Heckhausen & Gollwitzer, 1991; Schwarzer, 2008). Given that that individuals do not always act on their intentions, an issue widley known as the intention-behavior gap (Sheeran & Webb, 2016), it has been suggested that behavioral interventions, such as those aiming to promote influenza prevention behaviors in older adults, need to include techniques that promote intention formation for the target behavior in the target population *and* techniques that lead them to act on those intentions (Ziegelmann & Knoll, 2015).

One model that extends social cognition theories to encompass a volitional phase and specify the processes by which intentions are formed and enacted is the Health Action Process Approach

(HAPA; Schwarzer, 2008). Specifically, the model specifies two action phases: a motivational phase in which individuals form intentions to perform the target behavior in future, and a volitional phase in which individuals enact their intentions. Motivation is considered a necessary but insufficient condition for action initiation and persistence; people need to augment their intentions with plans and action control strategies to enact them. The motivational phase outlines the determinants of intentions, that include risk perceptions, outcome expectancies, and self-efficacy, while the volitional phase outlines the self-regulatory processes required to enact intentions (Schwarzer & Hamilton, 2020). Although social support is not explicitly included in the HAPA as a determinant of intentions, a lack of social support is likely to be a salient barrier to adopting or maintaining a health behavior (Schwarzer et al., 2011). Therefore, it is suggested that social support is incorporated into the HAPA as an additional determinant of intention (Teleki et al., 2021).

The HAPA has been used as a theoretical basis for interventions aimed at promoting the adoption and maintenance of health behaviors. HAPA-based interventions have been efficacious in promoting behavior change in clinical and non-clinical populations in a number of domains (Asgari et al., 2021; Duan et al., 2018; Lin et al., 2017). In the context of influenza vaccine uptake, a HAPA-based intervention reported by Payaprom and colleagues (2011) was efficacious in increasing intentions to get vaccinated, with concomitant change in outcome expectancies, perceived self-efficacy, and planning, but did not increase actual vaccination rates (Payaprom et al., 2011). Notable limitations of this study included lack of a randomized controlled design, and a lack of techniques targeting change in constructs representing the volitional phase of HAPA. In fact, few studies have tested of the efficacy of interventions based on the HAPA in promoting influenza preventive behaviors using such designs and incorporating techniques targeting change in the volitional constructs. In addition, many theory-based studies have aimed to promote upake and short term adoption of influenza prevention behaviors, and relatively few, by contrast have focused on behavioral maintenance. The HAPA is particularly suited as a theoretical basis for such interventions, given its specification of forms of self-efficacy specific to the

volitional stage that represent the processes by which individuals maintain their behavior and prevent relapse to prior behavioral patterns, such as maintenance and relapse self-efficacy.

The Current Study

Extending previous studies that have tended to focus on behavior uptake and short term adoption of influenza prevention behaviors, and on one type of preventive behavior (e.g., Keshavarz et al., 2022; Payaprom et al., 2011; Yardley et al., 2011), the current study aimed to examine the efficacy of a HAPA-based telephone-delivered intervention to promote adoption and maintenance of a series of influenza preventive behaviors (hand washing, avoid touching eyes, nose, or mouth, wearing facemasks) in a sample of Hong Kong older adults. The intervention adopted a randomized controlled design with participants allocated to one of three groups: (a) a motivational intervention group; (b) a motivational + volitional intervention group; and (c) a measurement-only control group. Specifically, the motivational intervention group received an intervention with techniques targeting change in constructs from the motivational phase of the HAPA for three months. The motivational + volitional intervention group received two sequential interventions, a 3-month intervention targeting change the motivational constructs followed by another 3-month intervention targeting change in constructs from the volitational phase of the HAPA. Full details of the intervention and design has been published elsewhere (masked for review)[1].

In line with HAPA hypotheses (Schwarzer, 2008; Schwarzer & Hamilton, 2020), we predicted that: (a) at the 3-month follow-up occasion, participants assigned to the motivational intervention group and motivational + volitional intervention group would report greater participation in influenza preventive behaviors, and higher levels on the HAPA constructs relative to participants assigned to the measurement-only control group- we also expected no differences on the behavior and theory constructs between participants allocated to the two intervention groups; (b) at the 6-month follow-up

[1]It should be noted that in the published protocol we referred to the motivational intervention group as the "behavior initiation only" group, while the motivational + volitional intervention group was referred to as the "behavior initiation + maintenance group". The two intervention groups were renamed so that they more accurately represented the actual contents of the HAPA-based intervention.

occasion, participants assigned to the motivational + volitional intervention group would report greater participation in the influenza preventive behaviors and higher levels on the HAPA constructs than those assigned to the motivational intervention group and the measurement-only control group – we alsop expected participants assigned to the motivational intervention group would report greater influenza preventive behaviors and higher levels on the HAPA constructs that those assigned to the measurement-only control group; and (c) at the 12-month follow-up occasion, participants assigned to the motivational + volitional intervention group would report greater participatiin in influenza preventive behaviors and higher levels on the HAPA constructs than those assigned to the motivational intervention and the measurement-only control groups – we also expected particopants assigned to the the motivational intervention group to continue to report greater participation in the behaviors and higher levels on the constructs than paricipants assigned to the measurement-only control group.

Method

Participants

Participants in the current study comprised Chinese older adults in Hong Kong recruited from elderly centers across all districts of the territory. Participants were eligible to participate in the study if they were: (a) 65 years or older; (b) willing to be randomly assigned to intervention or control groups; (c) able to understand the study rationale; and (d) Chinese speaking. Using a screening questionnaire, participants were excluded if they reported: (a) having a cognitive impairment; (b) hearing loss; (c) they were too frail to move; (d) they had beenvaccinated for influenza in the year prior to the study and regularly adopted at least one of the following influenza preventive behaviors: washing hands after going out and before touching food, avoiding touching eyes, nose, or mouth with unwashed hands, and wearing facemasks. Initial contact was made with the superintendents of 210 government-funded elderly centers in Hong Kong via phone calls. Due to limited spatial and geographical resources, elderly centers in Hong Kong are non-profit government-funded club-type centers that older adults can join as members. Older adults can visit elderly centers during the daytime and participate in group activities,

but they do not live in the centers. This is one main reason why a telephone-delivered intervention was adopted as it provided a flexible means for older adults to participate. Twenty-five elderly centers from 13 districts in Hong Kong agreed to participate this study and assisted with the recruitment of older adult members of the centers via center monthly newsletters and open recruitment during their pre-scheduled group activities.

Sample size was estimated via an a priori statistical power analysis using the G*Power software. Power was based on a 3 (intervention group) x 4 (measurement occasion) mixed-model factorial ANOVA with repeated measures on the second factor. We aimed to recruit 195 participants at follow up based on a conservative small effect size (d = .20) based on interventions in a similar prevention context (Small et al., 2013). Statistical power for the analysis was set at .90 and we used a corrected alpha level set at .017 (i.e., .05/3 groups). Based on conservative estimate of 25% attrition across measurement occasions, we estimated that 261 participants should be recruited to the study.

Procedure

Screening and Randomization. Older adults expressing an interest in participating in the study (n = 538) were invited to attend an initial session where they were screened for eligibility and provided with full details of the study and an information and consent form pack. These volunteers also participated in a one-off group education session providing general information on types of influenza, peak influenza season, routes of influenza transmission, and influenza preventive behaviors. These one-off group education sessions were conducted in a separated space provided by the elderly centers during their opening hours, targeting the severity of seasonal influenza, the importance of influenza prevention, and key influenza preventive behaviors. Demonstrations of how to implement the influenza preventive behaviors were also provided. The duration of each education session lasted between 45 and 60 minutes. The size of the groups varied from approximately 10 to 35 older adults, depending on the space the elderly centers could provide and number of participants recruited. After screening, eligible older adults (n = 312) were presented with an informed consent form and prompted to assent their

participation in the study. The participants were subsequently randomly allocated to one of the three study groups: (a) the motivational intervention group (n = 104), (b) the motivational + volitional intervention group (n = 103), and (c) the measurement-only control group (n = 105). The randomization sequence was generated using the online research randomizer tool (https://www.randomizer.org/).

Blinding. Participants and research assistants were not aware of the purpose of intervention or group allocation, but they were aware of the content and requirements of their own group.

Intervention Design

Ethical approval to conduct the study was obtained from the Research Ethics Committee (REC) of Sun-Yat Sen? University. We started to contact elder centers and recruit participants in December 2017 with baseline data of the first cohort of participants collected in January 2018. Data collection was concluded in September 2019. During the first three months of the intervention, participants allocated to both intervention groups received telephone-delivered intervention sessions at weekly intervals. Each week, a trained part-time research assistant called each participant by telephone to deliver the intervention with calls lasting approximately 10 to 20 minutes. Research assistants were typically responsible for 12 to 25 participants depending on their time and availability. With permission from participants, calls were audio-recorded in order to conduct fidelity checks. Research assistants were trained by the research team. Participants allocated to the motivational and motivational + volitional intervention groups received weekly telephone calls for three months, a total of 12 calls, with the intervention content comprising techniques targeting the motivational phase of the HAPA. Thereafterm participants allocated to the motivational + volitional intervention group received a further set of weekly phone calls for three months, a further 12 calls, comprising techniques targeting the volitional phase of the HAPA, so they received a total of 24 phone calls. Participants allocated to the measurement-only control group did not receive either set of telephone calls across the intervention period. For a full description of study procedures, please refer to the CONSORT flowchart (Figure 1).

Motivational Intervention Group. Participants allocated to the motivational intervention group received weekly telephone calls in which a part-time research assistant guided them through messages on motivational strategies to promote influenza preventive behaviors. The intervention targeted four key constructs of the HAPA using different behavior change techniques (BCTs; Michie et al., 2013): (a) action self-efficacy using the BCTs of providing instruction on how to perform the behavior and verbal persuasion about capability; (b) risk perception using the BCT of providing information on health consequences of not performing influenza preventive behaviors; (c) outcome expectancies using the BCTs of highlighting the pros and cons of performing the behaviors and the salience of consequences; and (d) intentions using the BCTs of providing information about health consequences and information about others' approval. Each weekly call had a different focus with techniques targeting risk perceptions, outcome expectancies, action self-efficacy, or intentions (see Table A1 supplementary materials). In addition to the four main aspects, we encouraged older adults to seek social support to which was a technique aimed at promoting perceived social influence to perform the behaviors.

Motivational + Volitional Intervention Group. Participants allocated to the motivational + volitional intervention group received the same intervention as the motivational intervention group during the first three months. However, participants in this group continued to receive telephone-delivered intervention sessions t weekly intervals for a further three months. The sessions focused on self-regulatory strategies targeting constructs in the volitional stage of the HAPA (Ernsting et al., 2013). The intervention targeted change in four volitional phase constructs using different BCTs: (a) maintenance and recovery self-efficacy using the BCTs of focusing on past success and behavioral practice/rehearsal; (b) action planning using the BCT of planning of when, where, and in which situations the participant would adopt influenza preventive behaviors; (c) coping planning using the BCT of planning to deal with sporadic and indicdental events that might interfere with the action plans; and (d) action control using the BCT of self-monitoring of the influenza preventive behaviors. Each week had a different focus with techniques targeting maintenance and recovery self-efficacy, action

planning, coping planning, or self-monitoring of action control (see Table A1, supplementary materials).

Measurement-only Control Group. Participants allocated to the measurement-only control group did not receive either of the telephone-delivered intervention sessions. Instead, they received only general information on influenza prevention in the initial group-delivered education session, and did not have any contact with the research team other than prompts to complete study measures.

Measures

With the assistance of the part-time research assistants, participants completed measures of demographic caharcteristics (i.e., age, gender, education level, marital status, regions of residence, and number of children) at baseline, and psychological and behavioral measures at baseline, the 3-month (i.e., after the motivational intervention session for both intervention groups), the 6-month (i.e., after the volitional intervention for the motivational + volitional intervention group), and the 12-month follow-up occasions in in-person visits to the elderly centers. Participants were reminded of their follow-up assessments of psychological measures by telephone in advance and a time to complete the measures was scheduled. Participants' preventive behaviors were collected by telephone via three randomly-timed calls across nine days on the relevant data-collection occasion (baseline, and 3-, 5-, and 12-month follow-up occasions). To minimize attrition, participants were provided a HK$200 (approx. US$25) remunderation on completion of all assessments.

Psychological measures. Chinese versions of previously-validated self-report measures were used to measure the HAPA-related psychological variables in the motivational (risk perceptions, outcome expectancies, action self-efficacy, intention, social support) and volitional (action and coping planning, recovery and maintenance self-efficacy, self-monitoring, and habit) phases (e.g., Duan et al., 2018; Schwarzer et al., 2015; Zhang et al., 2019). Details of the measures are presented in Table A2 (supplementary materials).

Behavioral measure. Participants received three randomly-timed telephone calls within nine days (one per day) from the research assistants in which they were promoted to report whether or not they conducted the influenza preventive behaviors that day. The calls were typically administered in the late afternoon or early evening, consistent with participants' stated preferences. This was also the approximate time that the psychological measures were assessed, but they were collected via three additional teletphone calls across nine days.

We adopted multi-item measures to minimize acquiescence bias. For the measure of hand washing behavior, participants were asked whether they had washed their hands in two situations: (a) on returning to their home after going out and (b) before touching food. For the measure of avoid touching eyes, nose or mouth, participants were asked whether they had avoided touching their eyes, nose, or mouth before washing their hands. For the measure of facemask wearing, participants were asked whether they had worn facemasks when in direct contact with people, as well as in crowded places such as shopping malls and the metro railway. Participants were presented with an initial prompt ("Please recall today whether or not you have successfully…") followed by the behavior of interest and provided their responses on a binary scale (1 = "yes" and 0 = "no"). An index was formed by summing participants' scores for the prevention behaviors across the three randomly-selected days and then multiplying the score by the three time points resulting in a total behavior score ranging from 0 to 12. This is because (a) participants were asked to refer to all the influenza preventive behaviors rather than a specific behavior when assessing psychological variables, and (b) we considered a summed index of different influenza preventive behaviors across three time points more comprehensive and representative.

Data Analysis

Baseline randomization checks were conducted using one-way analyses of variance (ANOVA) and chi-square analyses on the baseline influenza preventive behaviors and psychological variables, and the baseline demographic variables, among participants randomly allocated into the

three intervention groups. In terms of the dropout analysis, independent samples *t*-tests and chi-square analyses were conducted to examine whether there were significant differences on the influenza preventive behavior measures and psychological variables as well as demographic variables between participants tgat dropped out of the study at any point across the follow-up data collection occasions and those that remained in the satudy at the 12-month follow-up occasion.

We applied an intention-to-treat (ITT) treatment of carried-forward data using the last observation carried forward method to provide a conservative estimate of the efficacy of the intervention in the current study (White et al., 2011). These analyses were not pre-registered. We evaluated the effects of intervention on influenza preventive behaviors and each of the HAPA-related psychological variables using separate 3 (intervention group: motivational intervention, motivational + volitional intervention, and measurement-only control) x 4 (measurement occasion: baseline, 3-, 6-, 12-month) mixed-model ANOVAS with repeated measures on the second factor using SPSS ver.?. In the event of the expected group by occasion interactions on the outcome variables, we followed these up examining effects within the relevant groups. Specifically, we planned to conduct follow-up analyses for the main effects of intervention on influenza preventive behaviors and psychological outcomes at the 3-month, 6-month, and 12-month follow-up occasions using independent samples one-way ANOVAs. Fisher's least significant difference test was used to test between-group comparisons. For each group, within-participants occasion effects on the outcome variables across the four follow-up measurement occasions were examined using one-way ANOVAs.

Results

Baseline Randomization Checks

At baseline, we found no significant group differences in participants' demographic characteristics, influenza preventive behaviors, and the HAPA psychological variables across the

motivational intervention, motivational + volitional intervention, and measurement-only control groups (see Table A3 supplementary materials).

Attrition Analysis

After accounting for attrition, the final sample comprised 225 older adults across the motivational intervention (n = 69), motivational + volitional intervention (n = 72), and measurement-only control (n = 84) groups. We found no significant between-group differences in baseline demographic characteristics between participants who dropped out of the study at any point and those who remained, except on region of residence (χ^2 (xx) = 23.82, p = .022, η^2 = y.yyy) and age, with older participants more likely to drop out than their younger counterparts (F (x, xxx) = 8.95, p = .003). Participants remaining in the study reported significantly higher frequency of participation in influenza preventive behaviors than participants who dropped out (F (x, xxx) = 4.03, p = .046, η^2 = y.yyy). There were also no significant between-group differences on the baseline psychological variables, with the exception of the habit construct indicating that participants remained in the study have higher levels of prevention habits (F (x, xxx) = 10.49, p = .001, η^2 = y.yyy) (see Table A4, supplementary materials).

Intervention Effects on Influenza Preventive Behaviors

Our ANOVAs revealed a statistically significant main effect of time (F (x, xxx) = 26.42, p < .001, η^2 = .079), and significant time × group interaction effect (F (x, xxx) = 2.75, p = .012, η^2 = .017) on influenza preventive behaviors. The overall between-group effect (F (x, xxx) = 0.46, p = .632, η^2 = .003) was non-significant, with between-group effect only significant at the 3-month follow-up (F (x, xxx) = 3.35, p = .036, η^2 = .021) (see Table A5, supplementary materials). Results of the paired between-group follow-up analyses on mean differences in influenza preventive behaviors at each of the 3-month, 6-month, and 12-month follow-up occasions are presented at the Table 1. Specifically, participation in influenza preventive behaviors were significantly higher among participants in the motivational + volitional intervention group (M = 8.97; SD = 2.20) compared to those in the measurement-only control group (M = 8.23; SD = 2.09) at the 3-month follow-up occasion (mean

difference = 0.743, p = .012). However, we found no significant between-group differences in the influenza preventive behaviors at the 6-month and 12-month follow-up occasions.

In terms of change in mean scores for nfluenza preventive participation among three intervention groups, analyses indicated maintenance but no change in both intervention groups between the 3- and 6-month follow-up occasions. However, behavior participation for both intervention groups declined so that they were no different to baseline levels at the 12-month follow-up occasion. By contrast, influenza preventive behavior participation among participants in the measurement-only control group increased between the 3- and 6-month, and between the 6- to 12-month, follow-up occasions. This resulted in non-significant between-group differences in behavioral participation between participants in the motivational intervention, motivational + volitional intervention, and measurement-only control groups at the 6- and 12-month follow-up occasions (see Table A6, supplementary materials). Supplementary analyses using an 'as-treated' approach, that is, with no carry-forward of scores for participant who dropped out, indicated that participation in influenza preventive behaviors significantly higher in both the motivational intervention and motivational + volitional intervention groups relative to those in the measurement-only control group at the 3-month follow-up occasion. However, between-group differences were non-significant at the 6- and 12-month follow-up occasions (see Table A7, supplementary materials).

Intervention Effects on Psychological Outcomes

ANOVAs revealed a statistically significant time x group interaction effect on intentions (F (x, xxx) = 2.19, p = .042, η^2 = .014), and significant within-group time effects on risk perception (F (x, xxx) = 3.43, p = .017, η^2 = .011), outcome expectancies (F (x, xxx) = 7.91, p < .001, η^2 = .025), action self-efficacy (F (x, xxx) = 9.35, p < .001, η^2 = .029), intention (F (x, xxx) = 13.01, p < .001, η^2 = .040), maintenance self-efficacy (F (x, xxx) = 12.49, p < .001, η^2 = .039), action planning (F (x, xxx) = 7.59, p < .001, η^2 = .024), and coping planning (F (x, xxx) = 15.74, p < .001, η^2 = .049). Regarding the between-group differences in these constructs at each follow-up occasion, we found statistically

significant intervention effects on social support at the 3-month (F (x, xxx) = 4.87, p = .008, η^2 = .031) and 6-month (F (x, xxx) = 3.67, p = .027, η^2 = .023) follow-up occasions, and on action planning at the 3-month (F (x, xxx) = 3.90, p = .021, η^2 = .025) and 12-month (F (x, xxx) = 3.78, p = .024, η^2 = .024) follow-up occasions (see Table A5, supplementary materials).

Comparisons of between-group mean differences on the psychological outcomes at the 3-, 6-, and 12-month follow-up occasions are presented at Table 2. Specifically, wwe found significantly higher levels of action planning (mean difference = 0.361, p = .006) and coping planning (mean difference = 0.322, p = .022) among participants in the motivational + volitional intervention group compared to those in the measurement-only control group at the 3-month follow-up occasion. At the same occasion, also found significantly higher levels of social support among participants in the motivational + volitional control group compared to the measurement-only control group (mean difference = 0.301, p = .031). In addition, at the 6-month follow-up occasion, we found significantly higher levels of coping planning among participants in the the motivational + volitional intervention group relative to those in the measurement-only control group (mean difference = 0.327, p = .019). Furthermore, we found significantly higher levels of action planning in participants allocated to the motivational + volitional intervention group compared with those in the measurement-only control group (mean difference = 0.300, p = .023) at the 12-month follow-up occasion.

Comparing the two intervention groups, participants in the motivational + volitional intervention group reported significantly higher social support compared to those in the motivational intervention group at the 3-month follow-up occasion (mean difference = .419, p = .003). In addition, participants in the motivational + volitional intervention group indiated significantly higher levels of action planning relative to those in the motivational intervention group (mean difference = .324, p = .014) at the 12-month follow-up occasion. Descriptive statistics for the psychological variables are presented in Table A6 (supplementary materials).

Discussion

The current study aimed to examine the efficacy of a HAPA-based telephone-delivered intervention in promoting participation in influenza preventive behaviors (i.e., washing hands before going out and touching food; avoid touching eyes, nose, or mouth with unwashed hands; and wearing facemasks) among older adults in Hong Kong. Findings revealed that participants allocated to the motivational + volitional intervention group reported significantly higher levels of participation in preventive behaviors than those allocated to the measurement-only control group at the 3-month follow-up occasion, while there were no significant behavioral differences between the intervention and measurement-only control groups at the 6- and 12-month follow-up occasions. Participants in the motivational + volitional intervention group reorted higher levels of action and coping planning at the 3-month follow-up occasion, higher levels of social support and coping planning at the 6-month follow-up occasion, and a higher level of action planning at the 12-month follow-up occasion relative to the measurement-only control group. Paricipants in the motivational intervention group exhibited higher levels of social support than those in the measurement-only control group at the 3-month follow-up occasion. Overall, findings indicate that, our intervention only led to relaitively short-term improvements in older adults' influenza preventive behaviors, and we observed that behavior later reverted to pre-intervention levels and changes were not maintained as we had predicted.

The limited short-term changes in influenza preventive behaviors observed in the current intervention might be due to some increases in influenza preventive behaviors reported by participants in the measurement-only control group, which may be indicative of a potential question-behavior effect (Wilding et al., 2019). That is, older adults at the measurement-only control group completed the follow-up measures without accessing to the telephone-delivered intervention, but reported higher levels of influenza preventive behaviors simply because the questions they were asked during the course of the study also influenced their behavior. This effect may be due to cognitive dissonance reduction (Spangenberg et al., 2012) – older adults in the measurement-only control group had to justify the receipt of their incentive and therefore changed their behavior to reduce dissonance caused by the

value attached to the incentive and their lack of behavior. To control for placebo effects and increasing confidence in the causal efficacy of the HAPA-based intervention for influenza prevention, future research could consider using the active control group and matching expectations between treatment and control groups (Boot et al., 2013).

Another reason for the limited short-term effects of the intervention might be that the techniques used in the intervention targeting the motivational component of the HAPA were sufficient to help older adults form intentions and adopt influenza preventive behaviors, while the volitional component did not have sufficient strength or omnipresence to further improve influenza preventive behaviors after the first three months. Nonetheless, the influenza preventive behaviors among participants in the intervention groups quickly relapsed to baseline levels after the completion of the intervention. On the other hand, it is not uncommon that hand hygiene behavior change strategies are effective over a short period but fail to have long-term consequences (Gould et al., 2017). One key question that cannot be addressed in the current study is whether the sole use of volitional intervention through self-regulatory strategies (e.g., planning, self-monitoring) can also initiate and maintain the influenza preventive behaviors. Future research should therefore consider further examine the independent effects of motivational and volitional interventions on promoting influenza preventive behaviors using either a randomized crossover design (e.g., Lhakhang et al., 2015), or a factorial design examining the main and interactive effects of each set of techniques in separate groups (e.g., Hagger et al., 2020).

In line with HAPA predictions (Schwarzer, 2008), our findings confirmed that participants in the motivation + volitional intervention group reported increases in constructs from the volitional phase relative to the control group: action planning at the 3- and 12-month follow-up occasions, and coping planning at the 6- and 12-month follow-up occasions. The social support construct also increased at the 3- and 6-month follow-up occasions in this group relative to the control group. This highlighted the importance of helping older adults build social support networks, and make plans to act and cope with unexpected and sporadically-occurring contingencies that may prevent them from participating in the

influenza preventive behaviors and other health behaviors (e.g., Parschau et al., 2014). This is in line with previous studies using HAPA to promote influenza vaccine uptake (e.g., Payaprom et al., 2011). That we found improvements in psychological constructs that were not translated into the maintenance of preventive behavior presents problems for isolating the mechanism of action underpinning the techniques used givent hey were designed around the HAPA. One potential reason for the incongruence between theory measures and behavioral outcomes may be that the measures of the constructs may not be fit-for-purpose in detecting change evoked by the intervention (Hagger et al., 2020). Previous research has demonstrated change in measures of theory-related constructs as a conqeuence of interventions using techniques purported to change them, but very few measures of these constructs have been subject to the formal specificity and sensitivity analyses necessary to confirm that they are appropriate to detect such changes (Imai et al., 2010).

In terms of the mode of the intervention, the current study adopted a telephone-delivered approach. The telephone-delivered intervention format was adopted i due to its high accessibility and cost for an intervention targeting older adults (Chan et al., 2007). The telephone-delivered intervention is also beneficial to older adults as a way to receive the intervention from the comfort of their homes (Narasimha et al., 2018). However, telpehone-delivery my not be cost effective given the substantive demand for human resources, so options to automate delivery should be something that is explored as an alternative. Fo example, future interventions in this context and population could consider using the just-in-time adaptive interventions (JITAIs), an emerging technology-driven behavior-change method to deliver interventions using mobile sensing technology (e.g., smartphones) and software analytics to automatically detect behavior and deliver tailored treatment for behavior change (Nahum-Shani et al., 2015). For example, a certain type of influenza preventive behavior can be delivered to older adults with prompts of intervention contents via text messages when they were outside at a certain place based on the location data collected by sensors of the mobile phone.

Findings of the current study has some implications for public health practice. Given the well-known intention-behavior 'gap', future theory-based interventions should consider adopting strategies that increase intention to initiate influenza preventive behaviors, but also those that prompt use of volitional components that assist in implementing intentions and promote behavioral maintenance in this populaton (Ernsting et al., 2013; Keshavarz et al., 2022). It is also important to note that the current intervention was implemented and completed before the occurrence of the COVID-19 pandemic. In contrast to seasonal influenza infections, there has been a generalized shift in attention among the general population to COVID-19 as a higher priority health threat, particularly in the older populations, largely attributable to intensive media coverage and government messaging and restriction polices (Hartley & Perencevich, 2020). Individuals' knowledge of, and attention to, infection preventive behaviors has, therefore, substantially changed. Due to this context change, and the difference in the prevalence and broad immunity of the infections, findings of this study cannot be directly generalized to managing COVID-19 infections, even though the preventive behaviors are largely similar. Older adults, are likely to have become more proactive in their regular adoption of preventive behaviors due to high perceived severity of, and vulnerability to, COVID-19 infection (Chen et al., 2020). In addition, the transmissibility of seasonale influenza may have been reduced due to high rates of compliance with preventive behaviors during the COVID-19 pandemic, but as these efforts cease rates of influenza transmission are likely to increase and immunity levels are likely to be lower. For example, Ali and colleagues (2022) estimated that the observed decreases in influenza inflection rates during the COVID-19 pandemic peak years will subsequently lead to an 60% increase in population susceptibility to influenza. Therefore, intervention endeavors should be continuously implemented to promote older adults maintain participation in influenza preventive behaviors.

Strengths, Limitations, and Future Directions

The current study had three key strengths. First, it has a strong basis in theory building on a leading approach, the HAPA, that specifies the constructs that represent the motivational and volitional

phases of behavior change and the mechanisms involved (Schwarzer, 2008). Second, it adopted a randomized controlled trial (RCT) design with multiple preventive behaviors, which provides a rigorous basis to infer effects on key behaviors that have clinical relevance. Finlly, by focusing on older adults, out intervention targeted a priority population with high vulnerablity to influenza infection.

However, the limitations of the current study should be also acknowledged. First, we relied on older adults to self-report their influenza preventive behaviors. Although three out of nine days were randomly selected for asking older adults to report their preventive behaviors that day, there is still a possibility of recall accuracy and bias. There might also be a tendency toward providing socially desirabile responses. The older adults may have wanted tend to present themselves in a generally favorable light as those who are highly compliant with preventive behaviors (Fastame & Penna, 2012). Future studies should consider nnon-self-report means to measure older adults' influenza preventive behaviors participation. For example, automated, wearable cameras could be used to record behaviors (e.g., situations and frequency of facemask use), although ethical issues would need to be considered (Kelly et al., 2013). Second, we adopted the last observation carried forward method in our intention-to-treat analysis to obtain conservative estimates of the efficacy of the intervention (White et al., 2011). However, this method is likely to overestimate the treatment differences and multiple imputation methods (e.g., Bayesian least squares) are recommended (Barnes et al., 2006). Nonetheless, the best approach is to ensure robust, rigorous design and implementation methods are adopted to maximize retention and minimize dropout (McKnight et al., 2007). Third, we observed substantive dropout from the intervention. Future interventions should consider intensive and highly pro-active methods to contact and encourage participation using multiple means (e.g., email, text messaging, telephone calls). Fourth, the current study does not provide information on dose-response for the intervention, that is, how much change in the preventive behaivors is actually needed to reduce the likelihood of influenza infection. This is important as the rates of infection should be the most important outcome variable.

Therefore, interventions should target improvement of influenza preventive behaviors alongside changes in influenza infection rates.

Conclusion

The current study indicated that the HAPA-based, telephone-delivered intervention lead to limited improvements in influenza preventive behaviors among a sample of Hong Kong older adults, but provided little evidence of behavioral maintenance. The intervention did not have pervasive effects on all targeted HAPA constructs, but did lead to changes in older adults' perceived action and coping planning and social support. Researchers interested in developing interventions to promote influenza preventive behaviors in this population should consider adopting factorial designs to test the main and interactive effcts of HAPA-based intervention techniques on behavioral uptake and maintenance, examime the senstivity of measures of HAPA constructs, and adopt non-self-report measures of behavior.

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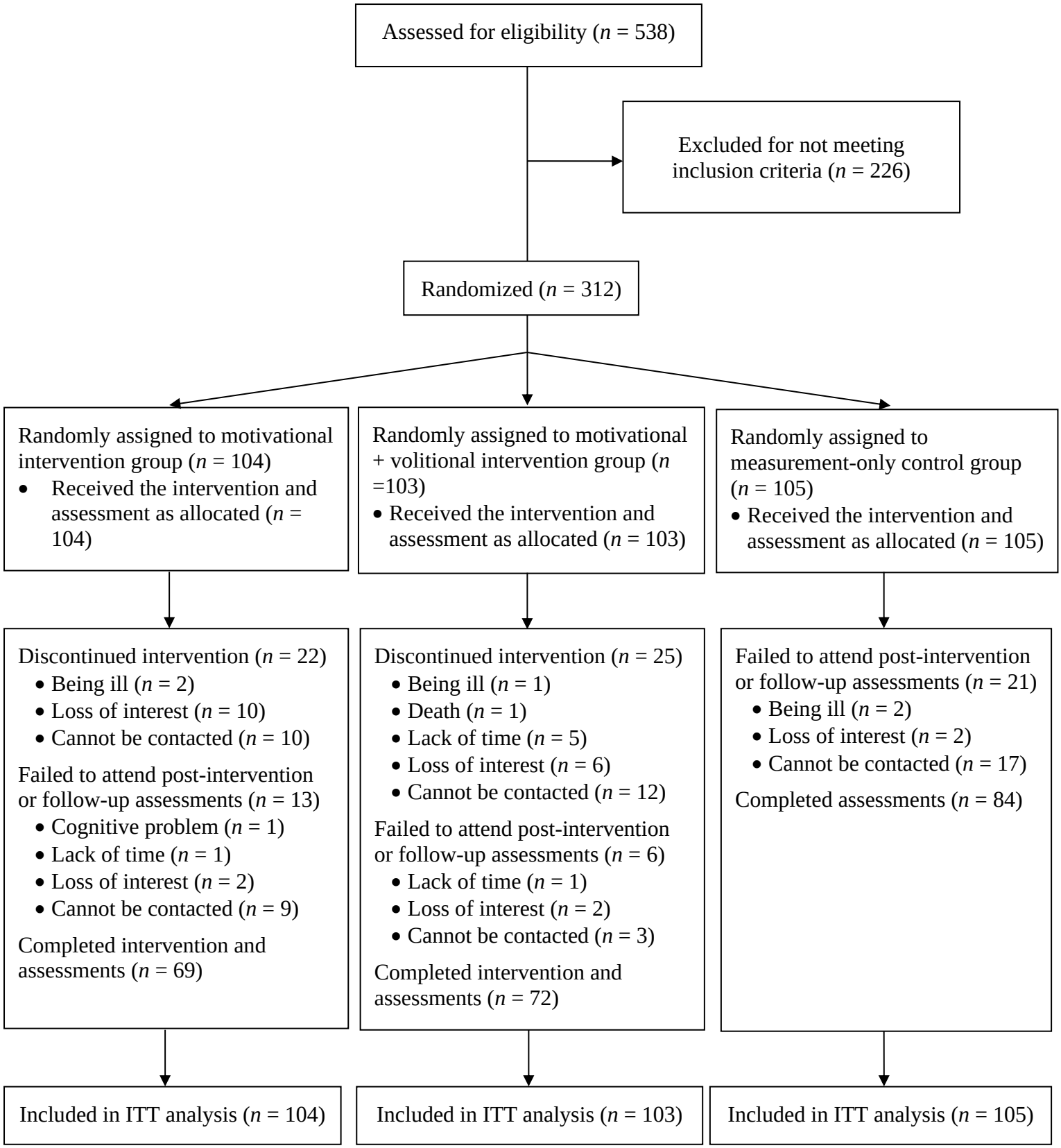

Figure 1. The CONSORT flowchart of the Health Action Process Approach (HAPA) based influenza prevention intervention for older adults

Table 1

Between-group comparisons on the influenza preventive behaviors across intervention and control groups at the 3-month, 6-month, and 12-month follow-up occasions (n = 312)

	Motivational intervention vs. Measurement-only control			Motivational + volitional intervention vs. Measurement-only control			Motivational + volitional intervention vs. Motivational intervention		
	Mean difference	*SE*	*p*	Mean difference	*SE*	*p*	Mean difference	*SE*	*p*
3-month	0.519	.295	.080	0.743*	.294	.012	0.224	.296	.450
6-month	-0.024	.293	.934	0.238	.292	.416	0.262	.293	.372
12-month	-0.236	.258	.361	0.013	.259	.959	-0.236	.258	.361

Note. Fisher's Least significant difference was used for comparison. *SE* = standard error.

Table 2

Between-group comparisons on psychological variables across intervention and control groups at the 3-month, 6-month, and 12-month follow-up occasions (n = 312)

	Motivational intervention vs. Measurement-only control			Motivational + volitional intervention vs. Measurement-only control			Motivational + volitional intervention vs. Motivational intervention		
	Mean difference	*SE*	*p*	Mean difference	*SE*	*p*	Mean difference	*SE*	*p*
Risk perception									
3-month	0.087	.182	.633	0.257	.181	.157	0.170	.182	.351
6-month	-0.165	.184	.372	0.098	.184	.595	0.262	.185	.156
12-month	0.139	.177	.432	-0.001	.177	.995	0.138	.176	.432
Outcome expectancies									
3-month	-0.046	.075	.538	0.044	.075	.559	-0.002	.075	.976
6-month	-0.009	.076	.906	-0.065	.076	.391	-0.074	.076	.327
12-month	-0.047	.073	.523	-0.065	.073	.379	-0.018	.074	.812
Social support									
3-month	0.301*	.139	.031	0.118	.139	.397	0.419**	.139	.003
6-month	0.194	.139	.157	0.377**	.139	.007	0.180	.140	.199
12-month	0.174	.153	.257	0.201	.153	.189	0.027	.154	.861
Action self-efficacy									
3-month	0.039	.098	.694	0.012	.098	.905	-0.027	.099	.785
6-month	0.093	.100	.351	0.095	.100	.341	0.002	.100	.987
12-month	0.063	.106	.551	0.038	.106	.715	-0.025	.106	.715
Intention									
3-month	0.231	.123	.061	0.232	.123	.059	0.001	.123	.992
6-month	0.065	.116	.575	0.086	.116	.460	0.021	.117	.860
12-month	-0.057	.101	.570	-0.048	.101	.636	0.010	.101	.924
Maintenance self-efficacy									

3-month	-0.108	.091	.236	0.008	.090	.932	0.115	.908	.205
6-month	-0.056	.089	.527	0.036	.089	.682	0.093	.089	.299
12-month	-0.070	.086	.415	-0.065	.085	.445	0.005	.086	.957
Recovery self-efficacy									
3-month	-0.012	.092	.894	0.038	.092	.677	0.051	.093	.584
6-month	-0.030	.091	.741	-0.002	.091	.986	0.028	.091	.755
12-month	-0.058	.095	.547	-0.125	.095	.191	-0.067	.096	.482
Action planning									
3-month	0.124	.132	.345	0.361**	.131	.006	0.237	.132	.074
6-month	0.062	.122	.611	0.199	.122	.103	0.137	.122	.264
12-month	-0.025	.131	.851	0.300*	.131	.023	0.324*	.132	.014
Coping planning									
3-month	0.075	.140	.596	0.322*	.140	.022	0.247	.141	.080
6-month	0.192	.139	.169	0.327*	.139	.019	0.135	.140	.334
12-month	-0.028	.135	.867	0.173	.135	.199	0.201	.135	.137
Self-monitoring									
3-month	0.124	.127	.331	0.220	.127	.083	0.096	.127	.450
6-month	-0.032	.132	.806	0.119	.132	.368	0.151	.132	.254
12-month	-0.055	.129	.670	0.103	.129	.424	0.158	.129	.223
Habit									
3-month	-0.024	.074	.748	0.008	.074	.910	0.032	.074	.665
6-month	-0.033	.080	.680	0.063	.080	.432	0.095	.080	.233
12-month	-0.012	.072	.863	-0.064	.072	.372	-0.052	.072	.474

Note. Fisher's Least significant difference was used for comparison. *SE* = standard error.

Online Supplementary Materials

Table A1

Key targets, contents, and schedule of the HAPA-based influenza prevention intervention for older adults

Key targets	Contents	Schedule
Motivational phase of the intervention (Month 1 – Month 3)		
1. Risk perception	The risk of getting infected without adopting influenza preventive behaviors.	Week 1 of Month 1 – Month 3
2. Outcome expectancies	The benefits of adopting influenza preventive behaviors and consequences of failing to adopt the preventive behaviors.	Week 2 of Month 1 – Month 3
3. Action self-efficacy	The confidence in implementing the influenza preventive behaviors.	Week 3 of Month 1 – Month 3
4. Intentions	The ways of establishing intentions to perform the influenza preventive behaviors.	Week 4 of Month 1 – Month 3
Volitional phase of the intervention (Month 4 – Month 6)		
5. Maintenance and recovery self-efficacy	How to maintain the influenza preventive behaviors facing barriers; and how to continue the preventive behaviors when relapsed and participants cannot continue them for a while.	Week 1 of Month 4 – Month 6
6. Action planning	When, where, and in which situations to implement the influenza preventive behaviors.	Week 2 of Month 4 – Month 6
7. Coping planning	Making plans to deal with the sporadic and accidental events that might interfere with action plans of influenza preventive behaviors.	Week 3 of Month 4 – Month 6
8. Self-monitoring	Building up measures to monitor their own influenza preventive behaviors.	Week 4 of Month 4 – Month 6

Note. The influenza preventive behaviors include: wearing facemasks, washing hands, and avoiding touching eyes, nose, or mouth without washing hands. In addition to the key targets, older adults were also encouraged to establish social support networks and building habits for the preventive behaviors.

Table A2

Sample Items and Responses of the HAPA Measures

Variables	Number of items	Sample items	Responses	α
Risk perceptions	9	During the influenza pandemic, my risk of being infected will increase.	1 = *strongly disagree* to 7 = *strongly agree*	.858
Outcome expectancies	4	Effectively adopt influenza preventive behaviors will help me maintain healthy.	1 = *totally disagree* to 4 = *totally agree*	.777
Action self-efficacy	3	If you have not adopted the influenza preventive behaviors recommended by the Department of Health of Hong Kong, do you have the confidence starting to implement the preventive behaviors, even if it needs a lot of energy from you to do so.	1 = *totally disagree* to 4 = *totally agree*	.884
Social support	6	Regarding the support from your family and friends during the past month, my friends encourage me to adopt the influenza preventive behaviors.	1 = *totally disagree* to 4 = *totally agree*	.850
Intentions	3	In the coming month, adopting influenza preventive behaviors recommended by the Department of Health Hong Kong is something I intended to do.	1 = *strongly disagree* to 7 = *strongly agree*	.853
Maintenance self-efficacy	5	Having you already adopted the influenza preventive behaviors recommended by the Department of Health Hong Kong, do you have the confidence to maintain the preventive behaviors even if you cannot immediately experience the benefits.	1 = *totally disagree* to 4 = *totally agree*	.895
Recovery self-efficacy	4	If you have already adopted the influenza preventive behaviors recommended by the Department of Health Hong Kong, do you have the confidence to readopt the preventive behaviors, even if you have not implemented these preventive behaviors for weeks.	1 = *totally disagree* to 4 = *totally agree*	.883
Action planning	4	In the coming month, I have made a detailed and specific plan about how to adopt the influenza preventive behaviors.	1 = *totally disagree* to 4 = *totally agree*	.840
Coping planning	3	In the coming month, I have made a detailed and specific plan about the time when I cannot adopt the influenza preventive behaviors due to the uncontrollable environmental factors.	1 = *totally disagree* to 4 = *totally agree*	.895
Self-monitoring	3	Regarding the influenza preventive behaviors during the last month, I always monitored myself when, where, and in what situations to adopt the behaviors.	1 = *totally disagree* to 4 = *totally agree*	.863
Habit	12	Conducting the influenza preventive behaviors during the last month is something I do frequently.	1 = *totally disagree* to 4 = *totally agree*	.921

Note. Baseline data were used to calculate the internal consistency coefficients (α) of the psychological measures.

Table A3

Baseline sociodemographic characteristics, psychological variables, and influenza preventive behaviors among older adults (n = 312)

Variable	Motivational intervention	Motivational + volitional intervention	Measurement-only control	χ^2 / *F*	*p*
Age, Mean (*SD*)	76.29 (7.45)	75.66 (7.28)	75.71 (6.78)	0.26	.77
Gender, *n* (%)				1.16	.56
Male	14 (13.6%)	18 (17.3%)	20 (19%)		
Female	89 (86.4%)	86 (82.7%)	85 (81%)		
Regions of residence, *n* (%)				15.12	.92
Eastern District	20 (19.4%)	19 (18.3%)	16 (15.2%)		
Southern District	4 (3.8%)	4 (3.8%)	4 (3.8%)		
Wan Chai	1 (1.0%)	0 (0.0%)	3 (2.9%)		
North District	7 (6.8%)	6 (5.8%)	5 (4.8%)		
Kwun Tong	29 (28.2%)	33 (31.7%)	31 (29.5%)		
Sham Shui Po	18 (17.5%)	15 (14.4%)	21 (20.0%)		
Wong Tai Sin	3 (2.9%)	1 (1.0%)	1 (1.0%)		
Kwai Tsing	5 (4.9%)	6 (5.8%)	7 (6.7%)		
Yuen Long	8 (7.8%)	13 (12.5%)	6 (5.7%)		
Tsuen Wan	4 (3.8%)	3 (2.9%)	4 (3.8%)		
Tuen Mun	5 (4.8%)	3 (2.9%)	5 (4.8%)		
Sai Kung	0 (0.0%)	0 (0.0%)	1 (1.0%)		
Tai Po	0 (0.0%)	0 (0.0%)	1 (1.0%)		
Marital status, *n* (%)				9.17	.52
Single and living alone	14 (13.6%)	15 (14.4%)	13 (12.5%)		

Close relationship but not living together	2 (1.9%)	3 (2.9%)	1 (1.0%)		
Close relationship and living together	5 (4.9%)	14 (13.5%)	12 (11.5%)		
Marital relationship	34 (33.0%)	35 (33.7%)	30 (28.8%)		
Divorced	5 (4.9%)	6 (5.8%)	9 (8.7%)		
Widowed	43 (41.7%)	31 (29.8%)	39 (37.5%)		
Highest education, *n* (%)				14.23	.29
No school education	24 (23.3%)	20 (19.2%)	26 (25.0%)		
Primary school	43 (41.7%)	43 (41.3%)	37 (35.6%)		
Junior high school	27 (26.2%)	22 (21.2%)	24 (23.1%)		
Senior high school	4 (3.9%)	14 (13.5%)	11 (10.6%)		
College graduation	4 (3.8%)	3 (2.9%)	2 (1.9%)		
University graduate and above	0 (0.0%)	1 (1.0%)	4 (3.8%)		
Others	1 (1.0%)	1 (1.0%)	0 (0.0%)		
Number of children, *n* (%)				14.70	.68
n = 0	11 (10.8%)	13 (12.5%)	14 (13.5%)		
n = 1	9 (8.8%)	19 (18.3%)	14 (13.5%)		
n = 2	32 (31.4%)	30 (28.8%)	21 (20.2%)		
n = 3	21 (20.6%)	16 (15.4%)	25 (24.0%)		
n = 4	17 (16.7%)	16 (15.4%)	17 (16.3%)		
n = 5	9 (8.8%)	7 (6.7%)	6 (5.8%)		
n = 6	3 (2.9%)	2 (1.9%)	4 (3.8%)		
n = 7	0 (0.0%)	1 (1.0%)	1 (1.0%)		
n = 8	0 (0.0%)	0 (0.0%)	1 (1.0%)		
n = 9	0 (0.0%)	0 (0.0%)	1 (1.0%)		

Influenza preventive behaviors (0-12), Mean (*SD*)	7.91 (2.16)	8.05 (2.20)	7.93 (1.89)	0.13	.881
Risk perception (1-7), Mean (*SD*)	3.93 (1.22)	3.98 (1.40)	3.81 (1.38)	0.42	.66
Outcome expectancies (1-4), Mean (*SD*)	4.16 (0.51)	4.25 (0.54)	4.24 (0.65)	0.66	.52
Action self-efficacy (1-4), Mean (*SD*)	3.99 (0.84)	3.84 (1.04)	4.03 (0.87)	1.19	.31
Social support (1-4), Mean (*SD*)	3.43 (0.97)	3.57 (0.89)	3.39 (1.05)	1.57	.21
Intentions (1-7), Mean (*SD*)	5.87 (1.14)	6.17 (0.80)	6.00 (1.33)	1.89	.15
Maintenance self-efficacy (1-4), Mean (*SD*)	3.96 (0.74)	4.00 (0.84)	4.11 (0.86)	0.93	.40
Recovery self-efficacy (1-4), Mean (*SD*)	4.04 (0.81)	4.12 (0.74)	4.21 (0.75)	1.22	.30
Action planning (1-4), Mean (*SD*)	3.55 (0.94)	3.58 (0.95)	3.53 (1.12)	0.06	.94
Coping planning (1-4), Mean (*SD*)	3.29 (1.12)	3.42 (1.15)	3.51 (1.17)	0.96	.38
Self-monitoring (1-4), Mean (*SD*)	3.76 (1.02)	3.83 (0.95)	3.82 (1.20)	0.14	.87
Habit (1-5), Mean (*SD*)	4.33 (0.48)	4.36 (0.53)	4.35 (0.59)	0.10	.90

Note. *SD* = Standard deviation. χ^2 = Chi-square. Range of the scores for influenza preventive behaviors and psychological variables is listed in the bracket next to the name of the variable.

Table A4

Comparison of baseline sociodemographic characteristics, psychological variables, and influenza preventive behaviors between the dropouts and non-dropouts (n = 312)

	Non-dropouts	Dropouts	χ^2 / *F*	*p*
Age, Mean (*SD*)	75.08 (6.95)	77.78 (7.66)	8.95**	.003
Gender, *n* (%)			0.029	.865
Male	37 (16.4%)	15 (17.2%)		
Female	188 (83.6%)	72 (82.8%)		
Regions of residence, *n* (%)			23.82*	.022
Eastern District	40 (17.8%)	15 (17.2%)		
Southern District	12 (5.3%)	0 (0.0%)		
Wan Chai	4 (1.8%)	0 (0.0%)		
North District	14 (6.2%)	4 (4.6%)		
Kwun Tong	70 (31.3%)	23 (26.4%)		
Sham Shui Po	35 (15.6%)	19 (21.8%)		
Wong Tai Sin	4 (1.8%)	1 (1.1%)		
Kwai Tsing	6 (2.7%)	12 (13.8%)		
Yuen Long	19 (8.4%)	8 (9.2%)		
Tsuen Wan	8 (3.6%)	3 (3.4%)		
Tuen Mun	11 (4.9%)	2 (2.3%)		
Sai Kung	1 (0.4%)	0 (0.0%)		
Tai Po	1 (0.4%)	0 (0.0%)		
Marital status, *n* (%)			4.45	.487
Single and living alone	28 (12.4%)	14 (16.3%)		
Close relationship but not living together	4 (1.8%)	2 (2.3%)		
Close relationship and living together	26 (11.6%)	5 (5.8%)		
Marital relationship	67 (29.8%)	32 (37.2%)		
Divorced	15 (6.7%)	5 (5.8%)		
Widowed	85 (37.8%)	28 (32.6%)		
Highest education, *n* (%)			9.03	.172
No school education	49 (21.8%)	21 (24.4%)		
Primary school	84 (37.3%)	39 (45.3%)		
Junior high school	56 (24.9%)	17 (19.8%)		
Senior high school	25 (11.1%)	4 (4.7%)		
College graduation	8 (3.6%)	1 (1.2%)		
University graduate and above	2 (0.9%)	3 (3.5%)		
Others	1 (0.4%)	1 (1.2%)		
Number of children, *n* (%)			7.02	.635
n = 0	31 (13.8%)	7 (8.2%)		
n = 1	34 (15.1%)	8 (9.4%)		
n = 2	58 (25.8%)	25 (29.4%)		
n = 3	44 (19.6%)	18 (21.2%)		
n = 4	33 (14.7%)	17 (20.0%)		
n = 5	14 (6.2%)	8 (9.4%)		
n = 6	7 (3.1%)	2 (2.4%)		
n = 7	2 (0.4%)	0 (0.0%)		
n = 8	1 (0.4%)	0 (0.0%)		
n = 9	1 (0.4%)	0 (0.0%)		
Influenza prevention behaviors, Mean (*SD*)	8.11 (1.99)	7.59 (2.26)	4.03*	.046

Risk perception (1-7), Mean (*SD*)	3.96 (1.34)	3.78 (1.32)	1.115	.292
Outcome expectancies (1-4), Mean (*SD*)	4.25 (0.57)	4.12 (0.56)	3.373	.067
Action self-efficacy (1-4), Mean (*SD*)	3.94 (0.94)	3.97 (0.88)	0.055	.815
Social support (1-4), Mean (*SD*)	3.44 (0.96)	3.42 (1.01)	0.036	.849
Intentions (1-7), Mean (*SD*)	6.04 (1.11)	5.95 (1.13)	0.370	.543
Maintenance self-efficacy (1-4), Mean (*SD*)	4.05 (0.82)	3.98 (0.82)	0.594	.442
Recovery self-efficacy (1-4), Mean (*SD*)	4.13 (0.78)	4.12 (0.76)	0.002	.963
Action planning (1-4), Mean (*SD*)	3.54 (0.99)	3.60 (1.04)	0.235	.628
Coping planning (1-4), Mean (*SD*)	3.35 (1.18)	3.57 (1.03)	2.335	.128
Self-monitoring (1-4), Mean (*SD*)	3.83 (1.03)	3.73 (1.14)	0.575	.449
Habit (1-5), Mean (*SD*)	4.41 (0.49)	4.19 (0.53)	10.493**	.001

Note. *SD* = Standard deviation. χ^2 = Chi-square. Range of the scores for influenza preventive behaviors and psychological variables is listed in the bracket next to the name of the variable.

Table A5

Results of the 3 × 4 repeated measure ANOVAs on influenza preventive behaviors and *psychological variables across time and group (n = 312)*

Variables	Sum of squares	*df*	Mean Square	*F*	*p*
Influenza Preventive Behaviors					
Within-participant effects					
Time * Group	28.88	6	4.81	2.75*	.012
Time	138.77	3	46.26	26.42***	<.001
Between-group effects					
3-month	30.35	2	15.18	3.35*	.036
6-month	4.36	2	2.18	0.49	.613
12-month	3.67	2	1.83	0.53	.589
Risk perception					
Within-participant effects					
Time * Group	4.06	6	0.68	0.80	.569
Time	8.69	3	2.90	3.43*	.017
Between-group effects					
3-month	3.58	2	1.79	1.04	.355
6-month	3.64	2	1.82	1.03	.358
12-month	1.33	2	0.67	0.41	.663
Outcome expectancies					
Within-participant effects					
Time * Group	.70	6	0.12	0.69	.658
Time	4.03	3	1.34	7.91***	<.001
Between-group effects					
3-month	.14	2	0.07	0.24	.786
6-month	.34	2	0.17	0.57	.565
12-month	.23	2	0.12	0.42	.660
Social support					
Within-participant effects					
Time * Group	4.52	6	0.75	1.48	.181
Time	2.00	3	0.67	1.31	.269
Between-group effects					
3-month	9.77	2	4.89	4.87**	.008
6-month	7.35	2	3.68	3.67*	.027
12-month	2.49	2	1.24	1.02	.362
Action self-efficacy					
Within-participant effects					
Time * Group	2.36	6	0.39	1.12	.351
Time	9.91	3	3.30	9.35***	<.001
Between-group effects					
3-month	.08	2	0.04	0.08	.922
6-month	.62	2	0.31	0.60	.552
12-month	.21	2	0.11	0.18	.834
Intention					
Within-participant effects					
Time * Group	6.31	6	1.05	2.19*	.042
Time	18.78	3	6.26	13.01***	<.001
Between-group effects					
3-month	3.75	2	1.87	2.39	.094

6-month	.42	2	0.21	0.30	.742
12-month	.20	2	0.10	0.19	.831
Maintenance self-efficacy					
Within-participant effects					
Time * Group	.91	6	0.15	0.62	.714
Time	9.18	3	3.06	12.49***	<.001
Between-group effects					
3-month	.86	2	0.43	1.01	.366
6-month	.45	2	0.23	0.55	.578
12-month	.32	2	0.16	0.42	.658
Recovery self-efficacy					
Within-participant effects					
Time * Group	1.52	6	0.25	0.87	.504
Time	1.54	3	0.52	1.81	.144
Between-group effects					
3-month	.15	2	0.07	0.16	.849
6-month	.06	2	0.03	0.07	.933
12-month	.82	2	0.41	0.86	.424
Action planning					
Within-participant effects					
Time * Group	4.10	6	0.68	1.27	.270
Time	12.28	3	4.09	7.59***	<.001
Between-group effects					
3-month	7.02	2	3.51	3.90*	.021
6-month	2.16	2	1.08	1.40	.248
12-month	6.78	2	3.39	3.78*	.024
Coping planning					
Within-participant effects					
Time * Group	7.60	6	1.27	1.83	.090
Time	32.70	3	10.90	15.74***	<.001
Between-group effects					
3-month	5.92	2	2.96	2.89	.057
6-month	5.66	2	2.83	2.80	.062
12-month	2.47	2	1.23	1.31	.272
Self-monitoring					
Within-participant effects					
Time * Group	1.71	6	0.29	0.62	.713
Time	11.44	3	3.81	8.32	<.001
Between-group effects					
3-month	2.54	2	1.27	1.52	.221
6-month	1.32	2	0.66	0.73	.485
12-month	1.33	2	0.66	0.77	.464
Habit					
Within-participant effects					
Time * Group	.67	6	0.11	1.00	.427
Time	.75	3	0.25	2.26	.080
Between-group effects					
3-month	.06	2	0.03	0.10	.904
6-month	.49	2	0.24	0.74	.479
12-month	.24	2	0.12	0.45	.639

Table A6

Means and standard deviations (SD) of the influenza preventive behaviors and psychological variables for the three groups at the 3-month, 6-month, and 12-month follow-up occasions (n = 312)

	Motivational intervention		Motivational + volitional intervention		Measurement-only control	
	Mean	*SD*	Mean	*SD*	Mean	*SD*
3-month follow up						
Influenza Preventive Behaviors (0-12)	8.75	2.09	8.97	2.20	8.23	2.09
Risk perception (1-7)	3.89	1.23	4.06	1.36	3.80	1.34
Outcome expectancies (1-4)	4.16	.51	4.20	.52	4.20	.60
Action self-efficacy (1-4)	4.14	.60	4.11	.81	4.10	.71
Social support (1-4)	3.48	.96	3.60	.93	3.18	1.10
Intentions (1-7)	6.20	.69	6.21	.59	5.97	1.24
Maintenance self-efficacy (1-4)	4.05	.57	4.17	.70	4.16	.68
Recovery self-efficacy (1-4)	4.10	.60	4.16	.74	4.12	.64
Action planning (1-4)	3.67	1.03	3.91	.82	3.55	.98
Coping planning (1-4)	3.58	.99	3.83	.96	3.50	1.08
Self-monitoring (1-4)	3.99	.93	4.08	.85	3.86	.96
Habit (1-5)	4.33	.48	4.36	.53	4.35	.59
6-month follow up						
Influenza Preventive Behaviors (0-12)	8.72	2.15	8.98	2.19	8.74	1.99
Risk perception (1-7)	3.81	1.34	4.08	1.32	3.98	1.33
Outcome expectancies (1-4)	4.29	.52	4.23	.58	4.30	.54
Action self-efficacy (1-4)	4.16	.66	4.16	.65	4.07	.84
Social support (1-4)	3.35	1.05	3.53	.85	3.15	1.09
Intentions (1-7)	6.18	.66	6.21	.68	6.12	1.10
Maintenance self-efficacy (1-4)	4.14	.58	4.24	.64	4.20	.71
Recovery self-efficacy (1-4)	4.17	.60	4.20	.64	4.20	.72
Action planning (1-4)	3.75	.87	3.88	.74	3.69	1.01
Coping planning (1-4)	3.76	.95	3.90	.89	3.57	1.16
Self-monitoring (1-4)	3.96	1.03	4.11	.80	3.99	1.01
Habit (1-5)	4.32	.60	4.41	.51	4.35	.62
12-month follow up						
Influenza Preventive Behaviors (0-12)	8.62	1.87	8.63	1.90	8.86	1.81
Risk perception (1-7)	3.79	1.28	3.78	1.34	3.65	1.18
Outcome expectancies (1-4)	4.33	.53	4.31	.49	4.37	.56
Action self-efficacy (1-4)	4.22	.68	4.20	.76	4.16	.84
Social support (1-4)	3.40	1.11	3.43	1.02	3.23	1.18
Intentions (1-7)	6.33	.57	6.34	.71	6.39	.87
Maintenance self-efficacy (1-4)	4.23	.56	4.24	.66	4.30	.63
Recovery self-efficacy (1-4)	4.20	.64	4.14	.72	4.26	.70
Action planning (1-4)	3.70	1.03	4.02	.75	3.72	1.03
Coping planning (1-4)	3.77	1.00	3.97	.87	3.80	1.04
Self-monitoring (1-4)	3.97	1.00	4.13	.82	4.03	.96
Habit (1-5)	4.42	.44	4.39	.45	4.43	.63

Table A7

Between-group comparisons on the influenza preventive behaviors across intervention and control groups at the 3-month, 6-month, and 12-month follow-up occasions using the as-treated approach (n = 225)

	Motivational intervention vs. Measurement-only control			Motivational + volitional intervention vs. Measurement-only control			Motivational + volitional intervention vs. Motivational intervention		
	Mean difference	*SE*	*p*	Mean difference	*SE*	*p*	Mean difference	*SE*	*p*
3-month	0.699*	.319	.029	0.756*	.314	.017	0.057	.329	.864
6-month	0.210	.307	.494	0.210	.302	.487	0.000	.316	.999
12-month	-0.089	.247	.719	-0.215	.243	.378	-0.126	.254	.622

Note. Fisher's Least significant difference was used for comparison. *SE* = standard error.

CONSORT 2010 checklist of information to include when reporting a randomised trial*

Section/Topic	Item No	Checklist item	Reported on page No
Title and abstract			
	1a	Identification as a randomised trial in the title	1
	1b	Structured summary of trial design, methods, results, and conclusions (for specific guidance see CONSORT for abstracts)	2
Introduction			
Background and objectives	2a	Scientific background and explanation of rationale	3-5
	2b	Specific objectives or hypotheses	6-7
Methods			
Trial design	3a	Description of trial design (such as parallel, factorial) including allocation ratio	8-9
	3b	Important changes to methods after trial commencement (such as eligibility criteria), with reasons	N/A
Participants	4a	Eligibility criteria for participants	7
	4b	Settings and locations where the data were collected	7
Interventions	5	The interventions for each group with sufficient details to allow replication, including how and when they were actually administered	9-10
Outcomes	6a	Completely defined pre-specified primary and secondary outcome measures, including how and when they were assessed	10-12
	6b	Any changes to trial outcomes after the trial commenced, with reasons	N/A
Sample size	7a	How sample size was determined	7-8
	7b	When applicable, explanation of any interim analyses and stopping guidelines	N/A
Randomisation:			
Sequence generation	8a	Method used to generate the random allocation sequence	8
	8b	Type of randomisation; details of any restriction (such as blocking and block size)	8
Allocation concealment mechanism	9	Mechanism used to implement the random allocation sequence (such as sequentially numbered containers), describing any steps taken to conceal the sequence until interventions were assigned	8
Implementation	10	Who generated the random allocation sequence, who enrolled participants, and who assigned participants to interventions	8
Blinding	11a	If done, who was blinded after assignment to interventions (for example, participants, care providers, those assessing outcomes) and how	8
	11b	If relevant, description of the similarity of interventions	9-10
Statistical methods	12a	Statistical methods used to compare groups for primary and secondary outcomes	12-13

	12b	Methods for additional analyses, such as subgroup analyses and adjusted analyses	12-13
Results			
Participant flow (a diagram is strongly recommended)	13a	For each group, the numbers of participants who were randomly assigned, received intended treatment, and were analysed for the primary outcome	27
	13b	For each group, losses and exclusions after randomisation, together with reasons	27
Recruitment	14a	Dates defining the periods of recruitment and follow-up	8-9
	14b	Why the trial ended or was stopped	N/A
Baseline data	15	A table showing baseline demographic and clinical characteristics for each group	33
Numbers analysed	16	For each group, number of participants (denominator) included in each analysis and whether the analysis was by original assigned groups	27
Outcomes and estimation	17a	For each primary and secondary outcome, results for each group, and the estimated effect size and its precision (such as 95% confidence interval)	13-15
	17b	For binary outcomes, presentation of both absolute and relative effect sizes is recommended	N/A
Ancillary analyses	18	Results of any other analyses performed, including subgroup analyses and adjusted analyses, distinguishing pre-specified from exploratory	13-15
Harms	19	All important harms or unintended effects in each group (for specific guidance see CONSORT for harms)	N/A
Discussion			
Limitations	20	Trial limitations, addressing sources of potential bias, imprecision, and, if relevant, multiplicity of analyses	19-20
Generalisability	21	Generalisability (external validity, applicability) of the trial findings	18-19
Interpretation	22	Interpretation consistent with results, balancing benefits and harms, and considering other relevant evidence	16-19
Other information			
Registration	23	Registration number and name of trial registry	Title page
Protocol	24	Where the full trial protocol can be accessed, if available	Title page
Funding	25	Sources of funding and other support (such as supply of drugs), role of funders	Title page

*We strongly recommend reading this statement in conjunction with the CONSORT 2010 Explanation and Elaboration for important clarifications on all the items. If relevant, we also recommend reading CONSORT extensions for cluster randomised trials, non-inferiority and equivalence trials, non-pharmacological treatments, herbal interventions, and pragmatic trials. Additional extensions are forthcoming: for those and for up to date references relevant to this checklist, see www.consort-statement.org.