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Switching the default: a formative evaluation of pre-booked appointments on COVID-19 vaccination uptake and effects on intended uptake

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ABSTRACT

Background: In autumn 2023, COVID-19 vaccination invitations in the Netherlands shifted from self-scheduling to pre-booked appointments for selected groups. While defaulting to pre-booked slots may increase uptake, potential rebound effects remain unclear. We examine preferences between appointment types, their effect on vaccination intentions, and whether effects are different for individuals hesitant about this vaccination round.
Methods: A mixed-methods approach was used to assess vaccination intentions for three groups (<60 with influenza vaccination indication, 60–69 and 70+ years) eligible for pre-booked appointments. In a two-phase formative evaluation study, we examined attitudes around pre-booked appointments in 15 interviews (phase 1) and experimentally tested (phase 2) perceived burden of pre-booked appointments vs self-scheduled appointments and their effect on vaccination intentions in a representative online panel ($n = 1.886$) and those who experience hesitancy about this vaccination.
Findings: Interviews (phase 1) showed that pre-booked appointments are seen as presumptuous or inconvenient by some, but also as a useful aid in support of vaccination uptake, sometimes by the same people. Participants in the experiment (phase 2) indicated to perceive self-scheduling as less burdensome (Coefficient = −0.23) but this perception did not translate to differences in vaccination intentions (Adjusted OR = 1.11) Similar results were observed in the hesitant subgroup (Coefficient = −0.25; Adjusted OR = 0.88).
Discussion: In our study pre-booked appointments do not change COVID-19 vaccination intentions. As pre-booked appointments evoked negative and positive sentiments and self-scheduling was found easier and more pleasant, we conservatively recommend its implementation for older adults who received their COVID-19 vaccination the previous year.

1. Introduction

Achieving optimal vaccination coverage is a cornerstone of public health [1]. This goal is increasingly urgent as vaccination rates decline [2,3]. Various approaches could support vaccination uptake [4–6], many of which focus on behavioural strategies which support those who have the intention to get vaccinated by reducing structural and convenience barriers [7,8]. Examples include text-based reminders [9,10], local vaccination offering [11] or compensation financial costs [12–14].

The most promising of these behavioural strategies is thought to be switching from self-scheduling to pre-booked appointments [4,6]. This is a so-called default intervention [9,15–17], which aligns policy settings with desired policy outcomes, thereby reducing the mental capacity required to translate vaccination intentions to action [16,17]. Informed by the Health Belief Model [8], which posits that health behaviour is shaped amongst others by perceived benefits, barriers, and cues to

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action, default interventions can be understood as a structural cue to action that reduces perceived barriers (e.g. the cognitive and emotional burden associated with active decision-making). Default interventions have been effective in various contexts, from organ donation to cancer screenings, retirement savings, and energy use [17]. The current paper describes behavioural research assessing citizens' preferences, acceptance and intentions of pre-booked vaccination letters and appointments, leading up to national level implementation of pre-booked appointments for COVID-19 vaccinations in The Netherlands amongst older adults, which subsequently showed to be effective in increasing vaccination uptake [18].

Previous studies have shown that default interventions, and pre-booked appointments in particular, can be effective in increasing vaccination uptake. Although no systematic review has focused only on the effects of pre-booked appointments [4,6], several experimental and quasi-experimental studies have evaluated the effectiveness of pre-booked appointments in the context of influenza vaccination (amongst university staff and faculty in the US [19] and in the Netherlands amongst healthcare workers [20]) and in the context of COVID-19 (amongst teenagers [21] and older adults [22] in Sweden and amongst those aged 50–59 in Italy [23]. All studies found positive effect on vaccination uptake. Our study leads up an evaluation of switching to pre-booked appointments which increased uptake by 3.3% at age 71.7 and 4.7% at age 90.0 relative to self-scheduling appointment system [18].

In the context of the national switch of pre-booked appointments for COVID-19 vaccination amongst older adults, we focus on the acceptability of this switch. Less is known about how pre-booked appointments align with people's preferences. Especially when *switching* defaults – from asking people to book their own appointments to sending invitations with pre-booked appointments, as was our current case - it is important to consider people's attitudes. Evidently, organisations implementing pre-booked appointments want to prevent unintended negative consequences. In particular, there is some concern that pre-booked appointments may trigger negative reactions for some. Perceived loss of autonomy can evoke psychological reactance [24], which could lower intentions and backfire on the intervention. One large experiment found that imagining pre-booked appointments reduced vaccination intentions and policy support [25].

The possibility of a decrease in vaccination intention is of particular concern for people who display hesitancy. Vaccine hesitancy is defined as a "state of indecisiveness regarding vaccination" [26,27] despite vaccine availability. Hesitancy exists on a continuum and is influenced by factors such as trust, perceived necessity, and accessibility [27,28]. While intention reflects motivational readiness, hesitancy captures doubts that may inhibit action even when vaccines are accessible. If pre-booking is perceived as government interference, one may expect that this could cast additional doubt for those who already have doubts about the vaccination, tipping them toward non-vaccination.

The autumn 2023 COVID-19 vaccination campaign in the Netherlands provided a unique test-case to study the effects of changing the default vaccination invitation from self-scheduling to pre-booked appointments being implemented and subsequently evaluated. Unlike previous campaigns where eligible individuals (under 60 with an influenza vaccination indication and over 60 years of age) had to schedule their own COVID-19 vaccination appointment, it was decided that during the autumn 2023 campaign a select cohort for whom this was deemed suitable would receive an invitation letter to attend a pre-booked appointment [18]. This research comprised a two-phase formative evaluation study with qualitative interviews examining attitudes and potential sources of hesitancy to determine whether pre-booked appointments could be a viable option in this context and population (phase 1), and a large experimental evaluation to test how pre-booked appointments vs. self-scheduling of appointments affected preferences and vaccination intentions prior to roll-out of the intervention (phase 2) to support the selection of a suitable cohort for roll-out and develop the invitation letters. The experiment focused on the eligible population, people hesitant about this COVID-19 vaccination round and people who received a COVID-19 vaccine in the previous year (and are therefore more likely to get vaccinated [28,29]) specifically.

2. Phase 1: formative qualitative evaluation

As part of a larger qualitative study (see Supplementary Material 1) exploring attitudes and potential sources of hesitancy toward pre-booked appointment letter materials, we asked participants from the eligible groups for the autumn '23 vaccination, those over 60 and under 60 with an influenza vaccination indication, how they felt about pre-booking. Here we asked the research question: how do people perceive pre-booked vs self-scheduling of vaccination appointments?

2.1. Methods

Participants. Fifteen participants from the eligible population (5 adults 70 years or older, 5 adults 60 to 69 years old, 5 adults were younger than 60 with an influenza vaccination indication[1]) were recruited by a research agency through their existing research panel. Participants were approached to represent diversity in gender, educational level region, and levels of trust in the government (see Supplementary Table 1 for details). We sampled across 70+, 60–69 and under 60 with an influenza vaccination indication each (as opposed merely under and over 60) because vaccination uptake shows distinct patterns between these three populations, with lesser vaccination uptake and greater vaccine hesitancy as the group gets younger [28,30] to be able to make assertions representative across the eligible population. Additionally, we selected individuals who had at least received one prior vaccination, because previous vaccination uptake is one of the strongest predictors of future uptake [28] which allowed us to focus on i) individuals who would realistically receive and consider such invitations in practice and ii) have experience of the system at status quo and how a change in system may affect their choices. Simultaneously we ensured that we would capture variation in attitudes and levels of hesitancy within this group [28,30].

Materials. We developed 1) an interview guide (Supplementary Material 1) based on the Health Belief Model (which includes constructs such as perceptions of risk, barriers and drivers, cues to action and of efficacy of preventative actions) [8], commonly used to study vaccine hesitancy [31–33], 2) a draft version of the invitation letter containing the pre-booked appointment (Supplementary Fig. 1), 3) and a visual storyboard (Supplementary Fig. 2), based on a mapping of decision points (Fig. 1). The latter was presented to help participants mentally place themselves in the situation of receiving a COVID-19 vaccination invitation in autumn, particularly important as interviews were held in summer.

Procedure. One-on-one interviews were completed in person between 19 and 25 June 2023, conducted by experienced interviewers, Participants travelled to one of two research locations (Amsterdam or Amersfoort). Following a semi-structured interview guide, participants were first asked about their COVID-19 vaccination experiences prior to and during the coronavirus pandemic (step 1). Next, participants were shown the storyboard and invitation letter and were encouraged to share their thoughts and feelings at each decision point (step 2). Interviews lasted approximately 35–40 min. Participants received payment for participation and informed consent was provided by all participants.

Analysis. Interviews were recorded and transcribed. The Directed Content Analysis approach [34–36] was used to analyse the transcripts.

[1] 5 healthcare workers and 5 pregnant persons were also interviewed given they were also part of the eligible group for the COVID-19 vaccination, but as they were not eligible for pre-booked appointments, we do not include the results here.

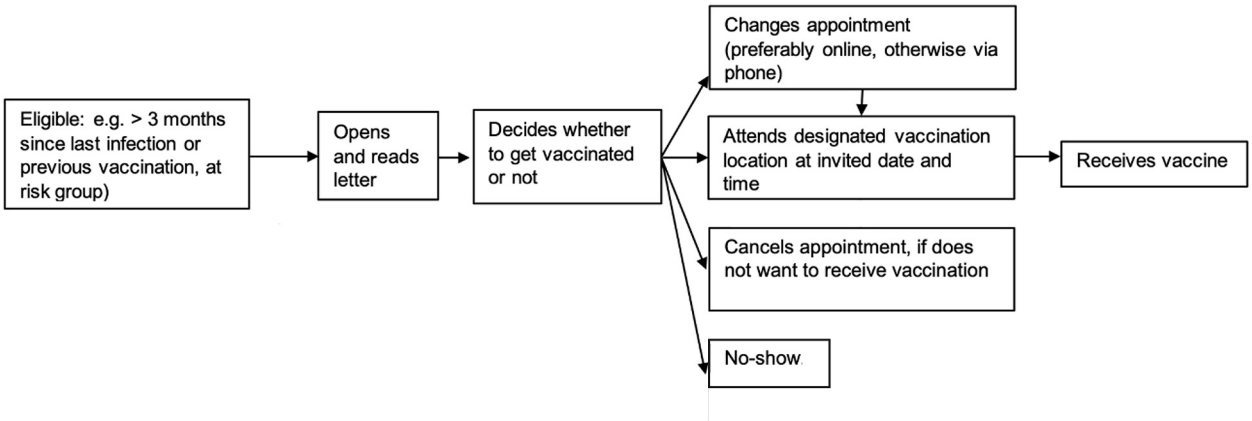

Fig. 1. Mapping of decision points from the moment of receiving the letter until the moment the invitee receives the vaccine.

Two independent reviewers coded 3 interviews to calibrate the interpretation of key constructs, supervised by SM. Next, all 15 interviews were coded by one of the independent reviewers. 8 were coded independently by the other. Differences were resolved by discussion or in consultation with SM.

For the purposes of this paper, we focus on the subset of questions specifically related to participants' perceptions of pre-booked versus self-scheduled appointments (see Supplementary Material 1 for topic guide highlighting this section in blue, and Step 2–5 of the storyboard of Supplementary Fig. 2).

2.2. Results and discussion

The phase 1 evaluation aimed to investigate how people perceive pre-booked vs self-scheduling of vaccination appointments, in terms of attitudes and preferences.

We found that pre-booked appointments received mixed responses. Some welcomed it, for instance:

> "*Well, that feels like a relief, of course. Because then you don't have to do anything. It's there, you put it in your calendar, and that's that.*"

Others indicated a preference for self-scheduling, considering pre-booked appointments to be presumptuous or inconvenient:

> *"I'd rather make the appointments myself. That way I can see when I have time. You grab your little laptop and just fiddle around a bit. They don't need to make an appointment for me. […] I prefer to check when I'm available and pick another date."*

Several participants indicated feeling that the pre-booked appointment could be effective in promoting follow-through (either for themselves or for others). This was noted even by some participants who simultaneously indicated to find pre-booked appointment inconvenient:

> *"The fact that the appointment is already scheduled feels a bit inconvenient, because it often doesn't suit me. […] Still, I think that without an appointment I might put it off more easily… I'm dreading it anyway."*

> *"Doesn't really matter to me, to be honest. I'll go anyway. But I think maybe for a lot of people this is easier. Because then it suddenly says, like, you have to get that flu shot – or in this case the COVID jab – on that day. I think maybe it's easier for a lot of people."*

Some participants mentioned that the pre-booked appointment would lead them to check their agenda for availability more quickly, helping them to follow through on the ask in the invitation letter. One respondent also felt that the appointment time slot triggers a sense of moral responsibility:

> *"I'm being invited, so I'm going to do it. It gives me the feeling that someone's looking out for you. The fact that the appointment is already set does encourage you to go. They're saving a spot for you."*

Crucially, none of the participants gave any indication of potential reduced intentions to vaccinate under a system of pre-booked appointments, while – as evident from the quotes above – some participants do suggest that it may overall increase uptake.

Taken together, phase 1 showed that participants held a variety of both positive and negative opinions and attitudes about pre-booked appointments, spanning from perceiving it as presumptuous or inconvenient to considering it a useful aid in support of their intentions to get the vaccine. We did not find indications for reduced vaccination intentions; no participants expressed strong negative emotions or referred to withholding their vaccination intention if receiving a pre-booked appointment. It should be noted that the sample in this study consisted of people who had received at least one previous COVID-19 vaccination, indicating at least some level of vaccination willingness. This means that results cannot be generalised to those who are vaccine hesitant.

3. Phase 2: formative experimental evaluation

Having found no indications of strong negative emotions or increased vaccination hesitancy,[2] we subsequently set out to experimentally investigate how self-scheduled versus pre-booked appointments affect perceived burden and intentions. The research question in Study 2 was: What are eligible groups' perceived burden between pre-booked vaccination appointments vs self-scheduling of appointments? And do these two appointment systems have different effects on their vaccination intentions? To answer this question, we employed an experimental design in a representative sample to compare the effects of self-scheduled versus pre-booked appointments on preferences and vaccination intentions. Although eligibility is usually separated only by under and over 60 years, yet vaccination intentions and uptake are lower and hesitancy is usually higher amongst the younger of these two

[2] The two evaluation studies were completed in the space of 6 weeks, ahead of the national autumn '23 COVID-19 vaccination campaign. Data was collected for the qualitative study (phase 1) from June 19–25, 2023, followed by the experimental study (phase 2) from June 29–July 10, 2023. Phase 2 was informed by phase 1 based on preliminary results only and a team of researchers dedicating full time capacity. A Dutch report on the integrated findings was delivered to the Ministry of Health on the 28th of July 2023 [39] informing the letters and launch strategy of the national campaign which started October 2, 2023 and lasted until December 31, 2023. The effectiveness of switching to pre-booked appointments was evaluated by Haverkate et al. [18] in 2025.

groups [15,23]. Thus, to allow us to offer age-based recommendations for the selection of a suitable cohort for roll-out, we oversampled participants aged 60–69 and 70+ years separately, in addition to under 60 with an influenza vaccination indication. Next to looking at effects across the representative sample of the population eligible for COVID-19 vaccination, we also hone in on effects for people who are more and less likely to get vaccinated: those who have previously been vaccinated [28] and people hesitant about this round of vaccination.

3.1. Methods

Participants 1826 participants were recruited through a research panel online via a University of Leiden affiliated research agency (Populytics, led by co-author NM) with experience in psychological and behavioural research. We recruited participants across the same three age categories as in phase 1: over 70 years, 60–69 years, and under 60 years with a flu vaccination indication.[3] The sample was largely representative of the Dutch population for gender and education level, with a slight skew toward females and higher levels of education (see Table 1 for characteristics).

Design We ran a between-subject factorial design, where participants were shown either a self-scheduled or a pre-booked vaccination invitations letter (Independent Variable, IV). To determine differences between the letters, we assessed clarity of the letters (manipulation check), perceived burden (ease and pleasantness) of appointment systems (Dependent Variable, DV1), and vaccination intention (DV2).

Procedure and measures Data was collected between 29 June and 10 July 2023. Participants were shown one of two vaccination invitation letters assigned by the research agency using even split random number generator: either they saw one with a pre-booked appointment, or one with an invitation to self-schedule an appointment[4]; see Supplementary Materials 2). Having read the letter, participants were asked "How clear did you find the letter?" and "How clear was it what you had to do to get a vaccination?" (both answered on five-point Likert scales ranging from (not at all) to 5 (very much). These two questions together constituted the manipulation check.

Subsequently, participants received two questions about their opinions on the letter they saw. Their attention was first drawn to the pre-booked or self-scheduling aspect of the appointment the text: "In the invitation letter you could read that [you had to make an appointment / an appointment had already been scheduled for you]." Below we asked the question: "What do you think about this matter? [of booking an appointment / an appointment already being made for you?]" and reported on two Likert scales, one ranging from 1 (very difficult) to 5 (very easy), the other ranging from 1 (very unpleasant) to 5 (very pleasant; DV1a and b). Next participants reported on their vaccination intention: "You just saw an invitation for getting a corona vaccine in the autumn. If you would receive this invitation, would you plan to take the corona vaccination?" (DV2) with the response options definitely no, probably no, I don't know, probably yes, definitely yes. Finally, participants reported on age, gender, and whether they had received a COVID-19 booster shot the previous year before being debriefed. The experiment took approximately 15 min to complete. Participants received payment for participation, and all participants provided informed consent.

Statistical methods An average perceived burden score was computed from the ease and pleasantness ratings (which were strongly correlated, $r = 0.76$; $p < .001$). Given our interest in estimating the impact of the self-scheduled versus pre-booked invitation letters on intention to get vaccinated as a binary choice, we re-coded the intention variable in two ways. First, we grouped those who were likely (including answering options probably yes and definitely yes) relative to those who were less likely (including answering options I don't know yet, probably not and definitely not) to get vaccinated; and second, we grouped those who were displaying hesitancy about this round of vaccination (answering option I don't know yet) relative to those who answered with more certainty (answering options probably and definitely no /yes); as per Kroese et al. [28].

First, we ran a linear regression for clarity of invitation letters, constituting a manipulation check. This analysis showed that across both types of letters, 98% of participants found the letter (very) clear and 97% found it (very) clear what to do to get vaccinated. Second, to answer our research questions, we ran linear regressions on perceived burden (Model 1: ease and pleasantness; DV1), and a logistic regression for vaccination intention (Model 2: DV2; 'I don't know yet' vs definitely or probably yes and definitely or probably no) as a factor of scheduling system (Self-scheduling vs Pre-booked appointments; IV1), risk group (under 60 with flu shot indication vs 60–69 vs 70+; IV2), and their interaction, controlling for gender and education. To check whether the effect of the scheduling system differed for those who did or did not have a booster the previous year, we then ran additional analyses on perceived burden and intention adding an interaction between the type of invitation letter participants saw (self-scheduled versus pre-booked) and Booster (yes vs no; Model 1b and 2b). To zoom in specifically on the hesitant group, we recoded the intention variable to distinguish participants who responded "I don't know yet" from those who expressed a more definite intention (i.e., "probably" or "definitely" yes or no). For the outcome of perceived burden (DV1), we added this hesitancy variable into the model as a moderator (Model 1c). For the outcome of intention (DV2) we adjusted the outcome to 'I don't know vs yes/no grouping' (Model 2c). All models were preceded by assumption checks, and no violations of linear or logistic regression assumptions were detected. Analyses were completed using statistical packages R version 4.3.2 and Jamovi version 2.6.45.

Power In our a priori power analyses, we evaluated the required sample sizes for several planned statistical tests (*t*-tests, one-way ANOVA, multi-way ANOVA, and multiple regression; see https://osf.io/gcq59 for details. For analyses comparing appointment conditions using a linear regression, a sample of 252 participants per group was required for a medium effect ($f = 0.25$) to achieve 95% power at $\alpha = 0.05$. More complex models, such as multi-factor regression models, required 400 participants per age group, to detect a medium effect ($f^2 = 0.15$). We oversampled 1826 respondents, exceeding the minimum requirements for detecting medium-sized effects. In line with our preregistered power analyses, statistical significance is reported using a conventional $\alpha < 0.05$ threshold.

Missing data There was no missing data.

Pre-registration and ethics The analysis plan was pre-registered (https://osf.io/gcq59) to ensure methodological transparency and The Medical Review Ethics Committee of the National Institute of Public Health and the Environment (RIVM) of the Netherlands provided a declaration indicating the trial was exempt from medical ethical review [GZB-634].

Data availability The data that support the findings of this study are not publicly available due to the ethical considerations as participants of

[3] To identify the under 60s with a flu vaccination indication, we had to sample under 60s across the population. Those who did not self-report to be eligible for a flu vaccination and were under 60 were removed from further analysis given they were not eligible for the COVID-19 vaccination in Autumn '23. We opted for this approach, because when the experiment started we did not know who the eligible population would be. Also, there was no possibility to sample participants based on their flu indication, without affecting representativeness of the sample. We excluded under 60 without a flu indication from the analysis because they are not in the eligible population, thus their experiences and perceptions of the letters are not relevant for this paper.

[4] In the actual vaccination invitations, the appointment location is tailored to each individual's place of residence, such that the selected site is the closest available vaccination location. In the quantitative study, the letter therefore included a placeholder ("<location within 10 min' travel from your home>") rather than a personalised location, as participants' exact addresses were not available. Participants were geographically diverse and not drawn from a single location.

Table 1
Relevant demographic characteristics of participants. Note. Percentages are row percentages within participant group. Education = highest attained education level. Pleasantness and ease categories are collapsed response categories.

		Over 70	60–69	Under 60 with flu vaccination indication	Total
Total	**n**	505 (40)	506 (41)	236 (19)	1247
Gender	**Female n (%)**	264 (52)	248 (52)	138 (59)	650 (53)
	Male n (%)	244 (48)	241 (48)	96 (41)	581 (47)
Education	**Low n (%)**	150 (30)	93 (18)	31 (13)	274 (17)
	Medium n (%)	169 (34)	206 (41)	104 (44)	479 (38)
	High n (%)	180 (36)	204 (41)	100 (43)	484 (44)
Perceived burden (pleasantness)	**Unpleasant n (%)**	46 (12)	66 (18)	149 (37)	261 (23)
	Neutral n (%)	96 (26)	104 (29)	119 (29)	319 (28)
	Pleasant n (%)	233 (62)	191 (53)	140 (34)	564 (49)
Perceived burden (ease)	**Hard n (%)**	56 (14)	94 (23)	143 (32)	293 (23)
	Neutral n (%)	64 (16)	66 (16)	94 (21)	224 (18)
	Easy n (%)	275 (70)	247 (61)	211 (47)	733 (59)
Vaccination intentions	**Definitely no n (%)**	66 (13)	119 (25)	68 (31)	253 (21)
	I don't know n (%)	36 (7)	52 (11)	36 (17)	124 (10)
	Definitely yes n (%)	403 (80)	309 (64)	113 (52)	825 (69)

this study did not give written consent for their data to be shared publicly. Aggregated data are available from the corresponding author JGS, upon reasonable request.

3.2. Results and discussion

In Table 2 we show an overview of the regression models used to assess the effects of the invitation system on perceived burden (1) and vaccination intention (2).

Invitation system perceived burden. Participants find an invitation to self-scheduling an appointment (opt-in) easier (94% (very) easy or not difficult nor easy) and more pleasant (90% (very) pleasant or not unpleasant nor pleasant) than a pre-booked appointment (75% and 68% respectively, see Supplementary Fig. 3 and 4 for the distribution of responses). A regression model indeed confirms a perceived burden for self-scheduling over pre-booked appointments [Coefficient = −0.23, 95% CI = −0.442 – −0.017, $p = .034$], with a greater leaning toward self-scheduling amongst the under 60s [Coefficient = −0.43, 95% CI = −0.84 – −0.03, $p = .035$; see Fig. 2a]. When adding whether people had previously received a booster or not into the model as a moderator [Model 1b], we note a small perceived burden for pre-booked appointments amongst those who received the booster [Interaction: Coefficient = 0.448, 95% CI = 0.13–0.76, $p = .005$]. Including the moderator of hesitancy ('I don't know yet') vs. those who are not (yes/no; Model 1c) shows no interaction with appointment system on perceived burden. In sum, self-scheduling is preferred over pre-booked appointments overall and this effect is stronger for younger age groups. In addition, those who received a booster perceived pre-booked appointments as more burdensome relative to self-scheduling appointments, more than those who did not receive a previous booster, and perceived burden of those who are hesitant about getting vaccinated this round are no different from those who are not hesitant.

Vaccination intention Participants' vaccination intention was highly comparable across the two types of appointment systems (see Fig. 2b), with 66% of respondents indicating a positive intention across both conditions (see Supplementary Fig. 5 for the distribution). The logistic regressions [Model 2a] showed that there were no significant differences [Adj OR = 1.11, SE = 0.27, 95% CI = 0.68–1.80, $p = .665$] in vaccination intention between participants based on the type of appointment system employed in the letters. Neither incorporating having received the booster, nor changing the outcome variable to reflect those uncertain about this vaccination ('I don't know yet') vs those who are not (yes/no), changed the results [Model 2b and c]. In other words, our results suggest that compared to self-scheduled appointments, pre-booked appointments did not change vaccination intention.

4. Discussion

This paper investigates the effects pre-booked appointments as compared to self-schedule appointment on perceived burden and vaccination intentions. We focused on a representative sample of the eligible population and two subgroups: people vaccinated in the previous year (more likely to vaccinate again [28]), and people who were hesitant about this COVID-19 vaccination round. Our primary aim was to assess the acceptability of pre-booked appointments, and their effects on vaccination intentions.

In a qualitative study participants described positive and negative sentiments toward pre-booked appointments. While some participants found them overly directive or inconvenient, participants also acknowledged the practicality of pre-booked appointments and their potential to support follow-through. Our experiment showed that pre-booked appointments were seen as less pleasant or convenient self-scheduling, but that perceived burden did not affect vaccination intentions. Taken together these results align with the evidence base where perceived barriers (e.g. inconvenience or loss of autonomy) and perceived benefits (e.g. easing follow-through) jointly shape health behaviour [8,37,38].

Perceived burden varied by participant subgroup. Those under 60 with an influenza vaccination indication held stronger perceived burden for self-scheduling, possibly due to workweek constraints. Participants who had vaccinated in the previous year on average held showed the opposite: they perceived less burden from pre-booked appointments than from self-scheduling. This may be as they would benefit from the reduction in practical steps required more so, for an action they are more motivated to take. Participants who are hesitant about this vaccination, were not found to have different perceived burden from those who are not. These results are supported by the theoretical notion that individuals with higher baseline motivation (greater perceived benefits than perceived barriers) are more responsive to interventions that reduce friction [5,8,38]. Together, these findings suggest that older age groups and those who received a vaccine may be most receptive to pre-booked appointments.

Importantly, no differences in vaccination intentions were found between pre-booked and self-scheduling appointment conditions, also not for participants who were hesitant about this vaccination round. This is in keeping with the few previous studies who show null effects of default changes on COVID-19 vaccination intentions [4,6] and suggests pre-booking may increase uptake without deterring individuals hesitant about the choice.

These results hold several implications for policy and implementation. If taking a conservative approach, self-scheduling may be best suited to eligible populations under 60 (those with a flu vaccination indication), whereas those who previously received a booster may be

Table 2

Regression results on the effects of the invitation system by risk group on perceived burden (1) and vaccination intention (2). All models control for gender and education. Adj OR = Adjusted Odds Ratios in case of logistic regression, 95 CI = 95% confidence intervals, Coeffi = Linear regression coefficient. $^{*}p < .05$. ^interaction between booster and appointment system are shown for these models as opposed to the interaction between appointment system and risk group as these are of lower interest for these models. The latter were not significant. See Supplementary Table 2 for full results.

Model no. (type)	Outcome	Predictors	Effect of invitation system (opt-in baseline)			Interaction between risk group (70+ baseline) and invitation system (opt-in baseline)			
			Adj OR / Coeffi	95 CI	p	Interaction	Adj OR / Coeffi	95% CI	p
1a (linear)	Perceived burden (pleasantness and ease combined)	Appointment system, risk group	−0.230	−0.442–0.017	0.034*	Pre-booking X <60 with flu indication	−0.435	−0.839 – −0.030	0.035*
						Pre-booking X 60–69 years	−0.123	−0.426–0.180	0.425
1b (linear)	Perceived burden (pleasantness and ease combined)	Appointment system, risk group, booster (yes vs no)	−0.567	−0.896 – −0.238	0.001*	Pre-booking X Booster (yes vs no)^	0.448	0.135–0.762	0.005*
1c (linear)	Perceived burden (pleasantness and ease combined)	Appointment system, risk group, hesitant (in doubt vs yes/no)	−0.245	−0.46 – −0.031	0.025*	Pre-booking X Hesitant (in doubt vs yes/no)	0.161	−0.286–0.607	0.710
2a (logistic)	Intentions (yes vs in doubt/no)	Appointment system, risk group	1.113	0.686–1.800	0.665	Pre-booking X <60 with flu indication	0.549	0.241–1.251	0.153
						Pre-booking X 60–69 years	1.09	0.573–2.08	0.787
2b (logistic)	Intentions (yes vs in doubt/no)	Appointment system, risk group, booster (yes vs no)	1.500	0.688–3.287	0.307	Pre-booking X Booster (yes vs no)^	0.518	0.243–1.100	0.087
2c (logistic)	Hesitant (in doubt vs yes/no)	Appointment system, risk group	0.888	0.425–1.856	0.752	Pre-booking X <60 with flu indication	2.355	0.712–7.793	0.161
						Pre-booking X 60–69 years	0.554	0.203–1.515	0.250

more suited to pre-booked appointments. However, our results also indicate that offering pre-booked appointments across the eligible population, even to more hesitant people, despite somewhat greater perceived burden of pre-booked appointments, could still benefit vaccination uptake, as we did not observe lowered vaccination intentions in this group. In other words, pre-booking seems to be sufficiently acceptable across the eligible populations, serving primarily as a cue to action facilitating follow through amongst those already inclined to vaccinate rather than changing underlying motivation [8,38].

Our study informed the national vaccination campaign of autumn 2023, which was rolled out on October 2, 2023, and ran until December 31, 2023. Following this study, pre-booked appointments, (using the invitation letters developed by our study (see Supplementary Material 3 for national template used) were implemented in the Dutch autumn 2023 campaign for individuals aged 71.7–90 and who had previously vaccinated. Using a regression discontinuity design, Haverkate et al. [18] found that pre-booked appointments increased uptake by 3.3% at age 71.7 and 4.7% at age 90.0 relative to self-scheduling appointment system. Results were similar for the subgroup of people who had received a vaccination in the previous year. Given the combined findings of these two papers, we conclude that while people mostly perceived greater burden from self-scheduling, pre-booking may effectively increase vaccination uptake without undermining vaccination intentions.

This contrasts with prior studies warning of backlash from default interventions [24,25]. One difference may be that our pre-booked appointments were described as voluntary in the letter invitations (see Supplementary Materials 2), unlike more directive approaches in earlier studies [24,25]. Also, our intervention was set within a campaign-like context rather than more hypothetical or decontextualised settings [24,25], enhancing external validity.

A strength of this study is the use of a mixed methods approach. We combined a 2-phase evaluation: qualitative insights on preferences, attitudes and opinions paired with experimental evidence assessing the causal effects of pre-booked appointments on perceived burden and vaccination intention. Another strength is that the study was carried out in the context of an actual vaccination campaign, making the research feel real and valid to participants and allowing for direct inference of implications for practice. In fact, the letters trialed in the experiment were rolled out during the autumn 2023 campaign and pre-booked appointments were rolled out to the receptive group (those who had previously been vaccinated and in an older age group), as per the advice of this study.

Limitations include the lack of inclusion of hard-to-reach groups and a focus on individuals who had received at least one previous COVID-19 vaccination. Negative effects of pre-booked appointments may be more pronounced amongst those groups. We also avoided broader measures of reactance and hesitancy to prevent priming participants, which may limit our findings on negative response. And the measures that were used were tailored to the purposes of this study and thus unvalidated in previous research. Finally, we do not account for the effects of no-shows and cancellations in this study. Future research could investigate if, when and how pre-booked appointments evoke reactance and expand to no-show and cancellation effects.

To conclude, although self-scheduling was broadly perceived as less burdensome, no negative effects of pre-booked appointments on intentions were observed amongst the eligible group. This held true even for those hesitant about this round of COVID-19 vaccination. Whilst one possibility is to apply roll-out to those who are most receptive (older adults or those who have previously been vaccinated) we argue that a broader roll-out is appropriate. Given that we observed no adverse effects, applying pre-booked appointments across the eligible population may help improve uptake without increasing health inequalities. Nonetheless, as pre-booked appointments evoked both negative and positive sentiments and self-scheduling was found easier and more pleasant, it is important to further examine potential rebound effects of switching the default, particularly amongst subgroups in the population

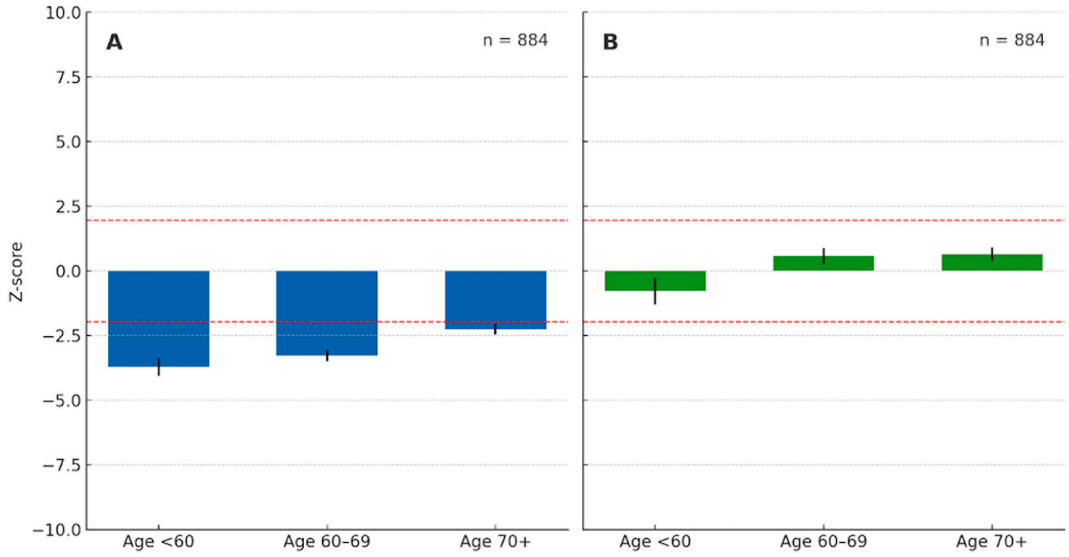

Fig. 2. Effect of pre-booked appointments (opt-out) vs. self-scheduling (opt-in, baseline) on A) perceived burden (ease and pleasantness) B) vaccination intention across the three eligible groups: under 60 with flu vaccination indication, between 60 and 69 and 70+ (Study 2). Y-axis displays z-scoring for comparison. Positive values indicate support for pre-booked appointments; negative values indicate support self-scheduling. Error bars present 95% confidence intervals. Red dotted line presents significance <0.05. (For interpretation of the references to colour in this figure legend, the reader is referred to the web version of this article.)

with lower vaccination intentions.

Use of artificial intelligence tools

None declared.

Pre-print

This work was published as a preprint article on PsyArXiv: https://osf.io/preprints/psyarxiv/9m37t_v1

Authors' contribution

JGS, FK, ML, SM and MdB designed the studies in the paper. SM led the conduct, transcription and analysis of interviews in Study 1. RD and AG completed the analyses. JGS, FK, NM, AM were responsible for design and data collection of Study 2. AM and JGS carried out the analysis for Study 2. JGS, MH, HdM, SH, SvdH, MdB and ML were responsible for aligning findings with Haverkate et al. [18]. JGS, FK, MS and SM wrote the first draft of the manuscript. All authors critically reviewed and signed off on the final version of the manuscript.

CRediT authorship contribution statement

Jet G. Sanders: Writing – review & editing, Writing – original draft, Visualization, Validation, Supervision, Software, Project administration, Methodology, Investigation, Formal analysis, Conceptualization. **Floor Kroese:** Writing – review & editing, Writing – original draft, Supervision, Project administration, Methodology, Investigation, Conceptualization. **Sumit Mehra:** Writing – original draft, Visualization, Project administration, Methodology, Investigation, Formal analysis, Conceptualization. **Marijn Stok:** Writing – review & editing, Writing – original draft. **Aylin Munyasya:** Writing – review & editing, Writing – original draft, Validation, Software, Methodology, Investigation, Formal analysis, Data curation. **Manon R. Haverkate:** Writing – review & editing, Writing – original draft, Methodology. **Niek Mouter:** Writing – review & editing, Supervision, Project administration, Methodology, Investigation, Data curation. **Susan J.M. Hahné:** Writing – review & editing, Conceptualization. **Susan van den Hof:** Writing – review & editing, Supervision, Conceptualization. **Marijn de Bruin:** Writing – review & editing, Supervision, Project administration, Methodology, Investigation, Funding acquisition, Conceptualization. **Mattijs S. Lambooij:** Writing – review & editing, Writing – original draft, Validation, Supervision, Methodology, Investigation, Conceptualization.

Ethical statement

This study received medical ethical clearance by the Centre for Human Centered Research (HCR) at the RIVM. The HCR is of the opinion that the research does not fulfil the conditions as stated in article one of the Dutch law for Medical Research Involving Human Subjects (WMO, GZB-634) nor in the EU Clinical Trial Directive.

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Declaration of competing interest

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

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Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.vaccine.2026.128967.

Data availability

De-identified individual participant data included in this study are available from the corresponding author upon reasonable request.

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