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## Original Article

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## COVID-19 booster vaccine willingness

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## ABSTRACT

**INTRODUCTION.** As the protection from the COVID-19 vaccines diminishes over time, health authorities are currently considering how to maintain immunity by means of vaccine booster doses. In a recent survey, we investigated COVID-19 booster vaccine willingness among Danes, a population with a high acceptance of the initial round of COVID-19 vaccination.

**METHODS.** The data were derived from the sixth wave of the longitudinal COVID-19 Consequences Denmark Panel Survey 2020, which included questions on booster vaccine willingness. The data from the respondents were primarily analysed using descriptive statistics. The association between age, gender, level of education, region, type of received vaccine and booster vaccine willingness was analysed using multivariate logistic regression.

**RESULTS.** Among those reporting to be vaccinated against COVID-19 or that their vaccination was scheduled, a weighted total of 90% indicated that they were willing to receive the booster vaccine, if/once offered. The only characteristic associated with booster vaccine willingness at the set level of statistical significance (0.05) was age (increased willingness with age; adjusted odds ratio per year: 1.04, 95% confidence interval: 1.02-1.06).

**CONCLUSIONS.** The willingness to receive a booster dose of a COVID-19 vaccine is high among Danes. If health authorities decide to offer COVID-19 booster vaccines to the young, they may consider providing specific information targeted at this population to increase uptake.

**FUNDING.** The Novo Nordisk Foundation.

**TRIAL REGISTRATION.** not relevant.

Vaccination against COVID-19 is currently the top priority from a global health perspective, and at the time of writing the total number of COVID-19 vaccines administered worldwide is rapidly approaching 7.5 billion doses [1]. Since the protection from the vaccines against COVID-19 diminishes with time [2, 3], global and national health authorities are currently considering how to maintain immunity by means of vaccine booster (typically third) doses. Studies strongly suggest that vaccine booster doses provide strong immunity and protection against COVID-19 [4, 5], and booster doses are already being administered to the elderly and frail in some countries [1]. However, as for the initial COVID-19 vaccine programmes, the success of COVID-19 booster vaccine programmes relies entirely on the willingness of individuals to accept the booster dose. Therefore, we investigated COVID-19 booster vaccine willingness among Danes, a population with a high acceptance of the initial round of COVID-19 vaccination [1]. Specifically, the following two research questions were addressed: i) How large a proportion of those vaccinated against COVID-19 will accept the booster vaccine? and ii) Which characteristics are associated with willingness to receive the booster vaccine?

## METHODS

The data from this study were derived from the sixth wave of the longitudinal COVID-19 Consequences Denmark Panel Survey 2020. The results of the prior rounds of the survey are reported elsewhere [6-11]. For the sixth wave, we again commissioned the survey agency Epinion to conduct a survey among the 2,457 original respondents in the survey. This sixth wave survey was fielded from 30 August to 15 September 2021 and included the following questions on vaccine willingness: “Have you been vaccinated against coronavirus or is your vaccination scheduled?” Those confirming were asked: “Which vaccine did you receive (check more boxes if you received different vaccines)?” followed by: “The health authorities expect that all Danes will be offered a so-called ‘booster-vaccine’ to increase the efficacy of the vaccine against coronavirus. Will you accept the booster vaccine, if/when offered?”

Participation in the survey was based on consent. Under Danish law, ethical review board approval is not required for survey studies. The data were stored and handled in accordance with the General Data Protection Regulation. The responses to all questions in the survey were weighted using inverse propensity weighting [12] by gender, age, level of education, region and political party choice at the latest general election (5 June 2019) to render respondents representative of the adult population of Denmark on these variables. The data were primarily analysed using descriptive statistics. The association between age, gender, level of education, region, type of received vaccine and booster vaccine willingness was analysed using bivariate and multivariate logistic regression with the threshold of statistical significance set to 0.05. All statistical analyses were conducted using Stata version 17.0 (StataCorp LLC, College Station, Texas, US).

*Trial registration:* not relevant.

## RESULTS

**Table 1** shows the characteristics (unweighted and weighted) of the 1,555 individuals who participated in the survey (retention rate of 63% compared with the initial wave of the survey).

A weighted total of 95% confirmed that they had either received the vaccine against coronavirus or that their vaccination was scheduled. Among those, 77% reported having received the Pfizer/BioNTech vaccine, 16% Moderna, 1% Johnson & Johnson and 4% AstraZeneca, either both doses or one dose in combination with either the Pfizer/BioNTech or the Moderna vaccine. Among those reporting to be vaccinated or that vaccination was scheduled, 90% indicated that they were willing to receive the booster vaccine if/once offered, whereas 7% indicated that they were unwilling to receive the booster and 3% preferred not to answer.

**TABLE 1** Characteristics of the 1,555 respondents.

	Unweighted	Weighted
<i>Vaccinated, n (%)</i>		
Yes or planned	1,482 (95.3)	(94.6)
No/prefer not to answer <sup>a</sup>	73 (4.7)	(5.4)
<i>Initial vaccines, n (%)<sup>b</sup></i>		
Pfizer/BioNTech	1,184 (79.9)	(77.4)
Moderna	208 (14.0)	(16.2)
Johnson & Johnson	17 (1.2)	(1.4)
AstraZeneca alone or in combination with Pfizer/ BioNTech or Moderna	65 (4.4)	(4.4)
Prefer not to say/other combination	8 (0.5)	(0.5)
<i>Booster willingness, n (%)<sup>b</sup></i>		
Yes	1,352 (91.2)	(89.8)
No	90 (6.1)	(7.0)
Prefer not to answer	40 (2.7)	(3.3)
<i>Sex, n (%)</i>		
Male	787 (50.6)	(49.1)
Female	768 (49.4)	(50.9)
<i>Age, mean (± SD), yrs</i>		
	53.0 (± 17.0)	49.7 (± 17.5)
<i>Level of education, n (%)</i>		
Primary and lower secondary school	220 (14.2)	(15.4)
Upper secondary education	107 (6.9)	(7.7)
Vocational education	645 (41.5)	(43.7)
Short-cycle higher education	116 (7.5)	(6.4)
Medium-cycle higher education incl. bachelor	318 (20.5)	(17.8)
Long-cycle higher education	149 (9.6)	(10.0)
<i>Region, n (%)</i>		
North Denmark Region	159 (10.2)	(10.5)
Central Denmark Region	374 (24.1)	(22.5)
Region of Southern Denmark	316 (20.3)	(21.4)
Region Zealand	189 (12.2)	(14.6)
Capital Region of Denmark	517 (33.3)	(31.0)

SD = standard deviation.

a) < 6 responded: "Prefer not to answer".

b) Among the vaccinated: yes or planned (N = 1,482).

**Table 2** lists the results of the logistic regression analysis showing that the only characteristic associated with booster vaccine willingness (among those willing to answer) at the set level of statistical significance was age (willingness increased with age; adjusted odds ratio per year: 1.04, 95% confidence interval: 1.02-1.06). This analysis was based on the 1,442 respondents who reported to be vaccinated/scheduled for vaccination against COVID-19 in the initial vaccine programme and who did not refuse to answer the booster vaccine willingness question (see Table 1).

**TABLE 2** Associations between booster vaccine willingness and individual characteristics assessed via bi- and multivariate logistic regression (N = 1,442<sup>a</sup>).

	Booster vaccine willingness	
	bivariate, OR (95% CI)	multivariate, AOR (95% CI)
<i>Initial vaccine type</i>		
Pfizer/BioNTech	1.64 (0.70-3.82)	1.16 (0.45-2.95)
Moderna	0.85 (0.33-2.18)	0.85 (0.30-2.42)
Johnson & Johnson	1.75 (0.20-15.53)	1.67 (0.16-17.04)
Prefer not to say/other combination	0.32 (0.03-3.26)	0.31 (0.04-2.66)
AstraZeneca alone or in combination with Pfizer/BioNTech or Moderna	1.00 (ref.)	1.00 (ref.)
<i>Sex</i>		
Male	1.21 (0.77-1.91)	1.21 (0.75-1.97)
Female	1.00 (ref.)	1.00 (ref.)
Age, per year	1.03 (1.02-1.05)*	1.04 (1.02-1.05)*
<i>Education</i>		
Primary and lower secondary school	1.50 (0.58-3.89)	1.70 (0.62-4.68)
Upper secondary education	0.70 (0.26-1.89)	1.10 (0.40-3.03)
Vocational education	0.86 (0.40-1.84)	0.67 (0.30-1.50)
Short-cycle higher education	2.07 (0.50-8.60)	1.56 (0.41-6.66)
Medium-cycle higher education incl. bachelor	1.16 (0.49-2.75)	1.00 (0.41-2.45)
Long-cycle higher education	1.00 (ref.)	1.00 (ref.)
<i>Region</i>		
North Denmark Region	0.95 (0.44-2.06)	1.00 (0.44-2.29)
Central Denmark Region	1.32 (0.74-2.36)	1.40 (0.77-2.57)
Region of Southern Denmark	1.90 (0.92-3.92)	2.01 (0.97-4.28)
Region Zealand	0.93 (0.46-1.88)	0.87 (0.43-1.78)
Capital Region of Denmark	1.00 (ref.)	1.00 (ref.)

AOR = adjusted odds ratio; CI = confidence interval; OR = odds ratio.

\*) p < 0.05.

a) These respondents reported to be vaccinated/scheduled for vaccination against COVID-19 in the initial vaccine programme and did not refuse to answer the booster vaccine willingness question (see Table 1).

**Data availability statement**

Due to risk of identification of individual participants, the data cannot be shared.

**DISCUSSION**

That an estimated 90% of the COVID-19-vaccinated Danes are willing to receive a booster dose is in line with numbers on COVID-19 booster vaccine willingness from similar surveys conducted in the United States [13], the United Kingdom [14] and Israel [15], and this bodes well for the success of the booster vaccine programmes.

With regard to the characteristics associated with vaccine willingness, we found that higher age was positively associated with booster vaccine willingness. Vaccine hesitancy is most pronounced among young people; a consistent finding across studies of the initial COVID-19 vaccine programmes [7, 16-19]. Consequently, if health authorities decide to offer booster vaccination to the young, they may consider providing targeted information to this population to increase (booster) COVID-19 vaccine uptake.

Our findings should be interpreted in the context of their limitations.

First, the data for this study stem from a questionnaire-based survey. Whereas surveys are widely used to study vaccine willingness, data on actual vaccine uptake are preferable since they are not prone to social desirability bias (e.g., when people report vaccine willingness, but do not subsequently accept the vaccine). Therefore, studies based on uptake of the COVID-19 booster vaccine are warranted once such data become available.

Second, although the reported results are weighted by key sociodemographic variables, the fact that our respondents were sampled from a web panel and were asked to participate in five previous rounds of the survey likely render them self-selected on, e.g., a higher sense of duty, which may potentially overestimate the booster vaccine willingness in the general population.

Third, as the COVID-19 booster vaccine was recommended only for a highly selected fraction of the Danish population (the elderly and frail) at the time the survey was fielded, the question on booster vaccine willingness may have seemed somewhat hypothetical to the majority of respondents. Relatedly, at the time of the survey, the European Medicines Agency had not yet authorised the use of the mRNA COVID-19 vaccines for the booster dose. For these reasons, we deliberately phrased the question on COVID-19 booster vaccine willingness in a hypothetical and conditional manner: “The health authorities expect that all Danes will be offered a so-called ‘booster-vaccine’ to increase the efficacy of the vaccine against coronavirus. Will you accept the booster vaccine, if/when offered?” Nevertheless, the hypothetical nature of this question and the lacking authorisation from the European Medicines Agency may have contributed to underestimation of booster vaccine willingness. It will therefore be important to replicate the findings of the present study when/if the booster vaccine programme is rolled out further.

Fourth, it is worth keeping in mind that the reported COVID-19 vaccine willingness and actual COVID-19 vaccine uptake in Denmark are among the highest in the world [1, 8]. Both booster willingness and uptake may therefore plausibly be lower in countries with lower support of the initial COVID-19 vaccine programme.

## CONCLUSIONS

According to this survey, the willingness to receive a booster dose of a COVID-19 vaccine is high among Danes – and increases with age. If health authorities decide to offer booster vaccination to the young, they may consider providing specific information targeting this population to increase uptake. It is, however, important to take into account that this survey was conducted before COVID-19 booster vaccination was recommended to/authorised for use in the majority of the Danish population.

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**Conflicts of interest** Potential conflicts of interest have been declared. Disclosure forms provided by the authors are available with the article at [ugeskriftet.dk/dmj](https://ugeskriftet.dk/dmj)

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## REFERENCES

1. Mathieu E, Ritchie H, Ortiz-Ospina E et al. A global database of COVID-19 vaccinations. *Nat Hum Behav* 2021;5:947-53.
2. Baraniuk C. How long does covid-19 immunity last? *BMJ* 2021;373:n1605.
3. Shrotri M, Navaratnam AMD, Nguyen V et al. Spike-antibody waning after second dose of BNT162b2 or ChAdOx1. *Lancet* 2021;398:385-7.
4. Bar-On YM, Goldberg Y, Mandel M et al. Protection of BNT162b2 Vaccine Booster against Covid-19 in Israel. *N Engl J Med* 2021;385:1393-400.
5. Flaxman A, Marchevsky NG, Jenkin D et al. Reactogenicity and immunogenicity after a late second dose or a third dose of ChAdOx1 nCoV-19 in the UK: a substudy of two randomised controlled trials (COV001 and COV002). *Lancet* 2021;398:981-90.
6. Vistisen HT, Sønderskov KM, Dinesen PT et al. Psychological well-being and symptoms of depression and anxiety across age groups during the second wave of the COVID-19 pandemic in Denmark. *Acta Neuropsychiatr* 2021;33:331-4.
7. Jepsen OH, Kølbaek P, Gil Y et al. COVID-19 vaccine willingness amongst patients with mental illness compared with the general population. *Acta Neuropsychiatr* 2021;33:273-6.
8. Sønderskov KM, Dinesen PT, Østergaard SD. Sustained COVID-19 vaccine willingness after safety concerns over the Oxford-AstraZeneca vaccine. *Dan Med J* 2021;68(5):A03210292.
9. Sønderskov KM, Dinesen PT, Vistisen HT et al. Variation in psychological well-being and symptoms of anxiety and depression during the COVID-19 pandemic: results from a three-wave panel survey. *Acta Neuropsychiatr* 2021;33:156-9.
10. Sønderskov KM, Dinesen PT, Santini ZI et al. Increased psychological well-being after the apex of the COVID-19 pandemic. *Acta Neuropsychiatr* 2020;32:277-9.
11. Sønderskov KM, Dinesen PT, Santini ZI et al. The depressive state of Denmark during the COVID-19 pandemic. *Acta Neuropsychiatr* 2020;32:226-8.
12. Cole SR, Hernán MA. Constructing inverse probability weights for marginal structural models. *Am J Epidemiol* 2008;168:656-64.
13. Ipsos. Axios/Ipsos poll - wave 50. 2021. <https://www.ipsos.com/sites/default/files/ct/news/documents/2021-08/topline-axios-coronavirus-index-wave-50.pdf> (17 Sep 2021).
14. Office for National Statistics. Coronavirus and the social impact on Great Britain. <https://www.ons.gov.uk/peoplepopulationandcommunity/healthandsocialcare/healthandwellbeing/datasets/coronavirusandthesocialimpactsongreatbritainattitudestothecoronaviruscovid19vaccineboosterandwinterflujabsreferringtotheperiod28julyto1august> (27 Aug 2021).
15. Heller O, Shlomo Y, Chun Y et al. The game is not yet over, and vaccines still matter: lessons from a study on Israel's COVID-19 vaccination. <https://www.brookings.edu/blog/up-front/2021/09/13/the-game-is-not-yet-over-and-vaccines-still-matter-lessons-from-a-study-on-israels-covid-19-vaccination/> (20 Sep 2021).
16. Daly M, Robinson E. Willingness to vaccinate against COVID-19 in the U.S.: representative longitudinal evidence from April to October 2020. *Am J Prev Med* 2021;60:766-73.
17. Murphy J, Vallières F, Bentall RP et al. Psychological characteristics associated with COVID-19 vaccine hesitancy and resistance in Ireland and the United Kingdom. *Nat Commun* 2021;12:29.
18. Robertson E, Reeve KS, Niedzwiedz CL et al. Predictors of COVID-19 vaccine hesitancy in the UK household longitudinal study. *Brain Behav Immun* 2021;94:41-50.
19. Schwarzingler M, Watson V, Arwidson P et al. COVID-19 vaccine hesitancy in a representative working-age population in France: a survey experiment based on vaccine characteristics. *Lancet Public Heal* 2021;6:e210-e221.