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PSYCHOSOCIAL AND SUPPORTIVE CARE: RESEARCH ARTICLE

# SARS-CoV-2 vaccine acceptability among caregivers of childhood cancer survivors

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## Abstract

**Objective:** To explore willingness/hesitancy to vaccinate self and children against severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) among caregivers of childhood cancer survivors (CCS).

**Methods:** A 19-question survey was sent to caregivers of CCS and completed between February 25 and April 13, 2021. Logistic regression was used to investigate relationships between willingness/hesitancy to vaccinate (a) self and (b) CCS, and demographic variables, confidence in the government and medical community's responses to coronavirus disease 2019 (COVID-19), and factors specific to the CCS community (e.g., previous participation in an investigational therapeutic trial).

**Results:** Caregivers (6% male) from 130 unique families completed the survey. Mean CCS age at survey was 15 years (SD 6.4). Mean CCS age at diagnosis was 4.3 years (SD 4.3). Mean time from CCS diagnosis to survey completion was 10 years (SD 6.2). Twenty-one percent of caregivers expressed hesitancy to vaccinate themselves and 29% expressed hesitancy to vaccinate their CCS. Caregivers expressing confidence in the federal government's response to COVID-19 were six-fold likelier to express willingness to self-vaccinate ($p < .001$) and were three-fold likelier to express willingness to vaccinate their CCS ($p = .011$). Qualitative analysis of free-text responses revealed three general themes, including (a) confidence in science, medicine, and vaccination as a strategy for health promotion, (b) confidence in SARS-CoV-2 vaccination and belief that CCS are at greater risk of COVID-19 complications, and (c) concerns about the swiftness of COVID-19 vaccine development and insufficient safety/efficacy data in children and CCS.

**Conclusions:** Results underscore the need for COVID-19 vaccination education and outreach, even among families highly engaged with the medical community, and emphasize the importance of updating these families as relevant data emerge from vaccine trials and registries.

**Abbreviations:** ALSF, Alex's Lemonade Stand Foundation; CCS, childhood cancer survivors; COVID-19, coronavirus disease 2019; MCC, My Childhood Cancer; SARS-CoV-2, severe acute respiratory syndrome coronavirus 2

KEYWORDS
childhood cancer, COVID-19, SARS-CoV-2, vaccine acceptability, vaccine hesitancy

## 1 | INTRODUCTION

Broad acceptance of a severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) vaccine is considered an integral strategy for mitigating the coronavirus disease 2019 (COVID-19) pandemic. Several efficacious vaccines have been authorized by the United States Food and Drug Administration (FDA) for emergency use in adults,[1–3] and the Pfizer-BioNTech vaccine is authorized for use in anyone aged 12 and older.[4] Across the United States, vaccine uptake continues to steadily increase,[5] yet COVID-19 vaccination uptake remains lower among certain populations, including those with lower socioeconomic status, racial and ethnic minorities, and individuals reporting low trust in health care and government institutions.[6] Vaccine acceptability among caregivers of childhood cancer survivors (CCS) is poorly understood and may differ from the general population due to the prevalence of chronic, comorbid health conditions and compromised immune status in CCS.[7–13]

Immunosuppressed individuals and those with other chronic conditions, like cancer, may have uncertainties about COVID-19 vaccine efficacy, safety, and potential side effects due to limited vaccine trial data specific to this patient population. Studies in adults with cancer have reported overall positive attitudes toward COVID-19 vaccination and a general willingness to be vaccinated, though participants expressed concerns about the vaccine development process, its safety, and its efficacy.[14,15] Similar willingness has been reported in parents of young children, but these studies note that the final decision to vaccinate may be influenced by the recommendations of health professionals[16,17] and of governmental health organizations.[6]

We previously partnered with the Alex's Lemonade Stand Foundation (ALSF) to assess the impact of COVID-19 on US-based caregivers of CCS, identifying significant disruptions to daily life, continuity of medical care, and household finances that were associated with substantial emotional distress.[18] Many caregivers expressed hopefulness about the future—a sentiment that was associated with self-reported confidence in the government response to COVID-19 and the timeline for vaccine development. Although COVID-19 vaccine acceptability has been studied in the general population, in parents/guardians, and in adults with cancer, there remain no specific data on vaccine acceptability among caregivers of CCS.

Compared to the general population, CCS families are more deeply integrated in the medical system due to medical complexities, and many CCS have participated in therapeutic clinical trials.[19,20] As a result, relationships between demographic/clinical factors and vaccine acceptability may be modified in this population due to differing levels of confidence in medical systems and more frequent interactions with providers. We have conducted a follow up to our prior COVID-19 survey,[18] this time focusing on acceptability of COVID-19 vaccination in CCS families. We assessed willingness/hesitancy to vaccinate self and children among caregivers of CCS and report relationships between demographic factors, confidence in the government and medical community's responses to COVID-19, and factors specific to the CCS community (e.g., previous participation in an experimental therapeutic trial) to provide insight into caregiver perceptions on vaccine acceptability and potential barriers to broad vaccine uptake in this at-risk population.

## 2 | METHODS

### 2.1 | Study population

To explore the physical and emotional consequences of a childhood cancer diagnosis and cancer therapy on the family unit, we have partnered with ALSF to conduct an ongoing series of longitudinal surveys of families affected by childhood cancer. Initiated in 2011, the web-based ALSF *My Childhood Cancer* (MCC) Survey Series explores families' experiences and attitudes from diagnosis, throughout treatment and follow-up care, and after bereavement. MCC targets parental respondents whose child was diagnosed with cancer before their 18th birthday. Participation in MCC is not limited by the child's current age, only their age at diagnosis. To date, 3150 unique families have participated in the MCC Survey Series.[18]

We previously reported results of a rapid survey on the impacts of COVID-19 among caregivers of CCS, completed between April 13 and May 17, 2020.[18] Here, we report on families that participated in Wave 2 of the MCC COVID-19 survey, containing additional questions focusing on vaccine acceptability and continued disruptions to life and medical care caused by the COVID-19 pandemic. Families were eligible to participate in Wave 2 if they had completed Wave 1 of the MCC COVID-19 survey and had a child diagnosed with cancer who was still living at the time of survey ($N = 360$). Additionally, the MCC Survey Series is delivered in English; therefore, participation is limited to English-speaking caregivers. Only one survey response was recorded per family. In the event that more than one caregiver from the same family completed the questionnaire, the first completed survey was retained. Analyses presented here are limited to US-based respondents whose child was not actively being treated for cancer. This study was approved by the Duke University Institutional Review Board (Pro00100771) and did not require informed consent.

### 2.2 | Survey development and distribution

Survey questions explored ways in which the COVID-19 outbreak continued to affect the child's medical care, steps respondents were still taking to reduce SARS-CoV-2 infection risks, primary sources of

information on COVID-19, and indicators of mental/somatic well-being, as previously described and published.[18] This portion of the survey included multiple-choice, Likert-type, and free-text questions adapted from a COVID-related update to the "Parenting Across Cultures" survey—a longitudinal study of mothers, fathers, and youth in nine countries.[21] Additional Likert-type and free-text questions related to COVID-19 vaccine acceptability were adapted from a published mixed methods investigation of parent/guardian perceptions of the acceptability of a COVID-19 vaccine.[6] The Wave 2 questionnaire contained 23 nonrandomized questions, which appeared on the screen one question at a time, with the option to return to prior questions (full Wave 2 questionnaire appears in Supporting Resource S1). The survey was independently tested for usability and functionality by two authors (Courtney E. Wimberly, Kyle M. Walsh) before launch. The closed survey was distributed via a unique emailed link to 360 MCC participants who completed the first wave of the COVID-19 survey. The link took participants to the survey on their MCC login page. The Wave 2 survey was sent on February 25 and closed on April 13, 2021 (48 days). Survey respondents were not remunerated for participation. No protected health information (e.g., names, dates of birth) was collected in this survey, and collected geographic locations were no smaller than state of residence.

### 2.3 | Construction of dependent and independent variables

Both dependent and independent variables were derived from survey questions. Dependent variables included measures of caregiver willingness to vaccinate themselves and their CCS during the COVID-19 pandemic, as well as a binary indicator of COVID-19 vaccination status at the time of survey. To measure vaccine acceptability, we asked, "When the COVID-19 vaccine becomes available to you, will you accept the vaccine for yourself?" and "When the COVID-19 vaccine becomes available to [your CCS], will your child receive the vaccine?" Four response options were included for both questions: "yes definitely," "unsure but leaning toward yes," "unsure but leaning toward no," "definitely no." We included a fifth response option ("already vaccinated") for participants and CCS who had already received a COVID-19 vaccination at the time of survey completion. For analysis, answers to self and CCS vaccine willingness were dichotomized into binary variables for "yes, will vaccinate" and "no, will not vaccinate" and used as dependent variables. Caregivers and CCS who had already been vaccinated were included in the "yes, will vaccinate" group. An additional binary indicator of caregivers that had already been vaccinated at the time of survey completion was constructed and used as an additional dependent variable.

Independent variables included the child's treatment status ("surveillance/follow-up care" vs. "treatment/surveillance completed"), child's cancer type, the caregiver-respondent's sex, child's age at survey completion, annual household income at MCC registration, whether the child had ever received treatment as part of a clinical trial, caregiver confidence in the federal government's response to COVID-19, caregiver confidence in their state/local governments' responses to COVID-19, caregiver confidence in hospitals' and physicians' responses to COVID-19, and several sources of COVID-19 information including governmental organizations, social media, cancer care professionals, and academic centers. Household income was collapsed to three levels (<$50,000, $50,000–$100,000, >$100,000) for analysis.

Additional data collected in the survey but not included in regression models either did not show substantial variability across respondents or were collected for purposes outside the scope of this analysis of COVID-19 vaccine acceptability (e.g., an ALSF COVID-19 needs assessment, longitudinal changes in psychosocial impacts).

### 2.4 | Statistical analysis

Descriptive statistics were calculated for each independent and dependent variable. Univariate analyses were used to assess whether participants who responded to Wave 1 *only* differed from those who responded to both Wave 1 and Wave 2. Logistic regression was used to assess the relationship between our primary outcomes of interest (willingness to vaccinate self and to vaccinate the CCS), demographic variables including income, and confidence in entity response variables. Confidence in state/local and federal government responses were highly correlated and presented modeling issues due to collinearity. We therefore used these predictors in separate models for each outcome of interest. For all statistical tests, $\alpha = .05$ was used to determine nominal statistical significance. Stata (16.1, StataCorp LLC, College Station, TX, USA) was used for statistical analyses.

Free-text responses were analyzed by two investigators (Courtney E. Wimberly, Kyle M. Walsh) to identify common themes. The two investigators met interactively to refine themes and develop a codebook for qualitative analysis.[22] Free-text responses were coded in parallel and differences were resolved through discussion.[23] Interrater reliability was calculated as the percent agreement (total number of ratings divided by the total number in agreement) between the investigators coding free-text responses (Courtney E. Wimberly, Kyle M. Walsh). Final themes were reviewed and supportive responses de-identified for publication.

## 3 | RESULTS

### 3.1 | Study population

A total of 150 eligible caregivers completed the survey (42% response rate). After excluding non-US respondents ($N = 8$) and caregivers with children in active treatment ($N = 12$), 130 responses remained for analysis (Table 1). Participants who responded to Wave 1 *only* did not differ significantly from those responding to both iterations of the survey (**Table** S1; Supporting Resource S2). Slightly less than half of respondents' children were currently in surveillance or follow-up care with their oncology team (45%), while 55% had completed all treatment and posttreatment surveillance and were no longer receiving

**TABLE 1** Respondent characteristics of caregivers and their childhood cancer survivors (CCS)

| | Number of respondents ($n = 130$) | Percentage of study population (%) |
|---|---|---|
| *CCS treatment status* | | |
| Surveillance/follow-up care only | 72 | 45 |
| All treatment/surveillance completed | 58 | 55 |
| *Respondent sex* | | |
| Female | 122 | 94 |
| Male | 8 | 6 |
| *Respondent non-Hispanic White* | 120 | 92 |
| *CCS received treatment as part of clinical trial*[a] | | |
| Yes | 55 | 42 |
| No | 61 | 47 |
| Not sure | 14 | 11 |
| *Annual household income*[b] | | |
| <$20,000 | 2 | 2 |
| $20,000–$49,999 | 18 | 14 |
| $50,000–$74,999 | 31 | 24 |
| $75,000–$99,999 | 25 | 19 |
| $100,000–$149,999 | 25 | 19 |
| $150,000+ | 21 | 16 |
| Prefer not to say | 7 | 5 |
| *CCS cancer type* | | |
| Hematologic | 69 | 53 |
| Other solid tumor | 42 | 32 |
| CNS | 19 | 15 |
| *Other children in household* | 97 | 75 |
| *Mean (SD) CCS age at diagnosis* | 4.3 (4.3) | – |
| *Mean (SD) CCS age at survey completion* | 15 (6.4) | – |
| *Mean (SD) years diagnosis to survey* | 10 (6.2) | – |

[a]Respondents answering "not sure" were excluded from analysis.
[b]Respondents answering "prefer not to say" were excluded from analysis.

cancer center-based care (but could still be attending late effects clinics). Respondents were majority female (94%), and household incomes were broadly distributed, with 16% of families earning <$50,000 annually and 35% earning >$100,000 annually. The greatest proportion of primary cancer diagnoses were hematologic malignancies (53%). Forty-two percent of CCS had previously received treatment as part of a clinical trial. The majority of respondents had other children living in the household (75%). CCS were an average of 4.3 years old at diagnosis and 15 years old at time of survey completion. De-identified, individual-level data are available from the authors upon request.

## 3.2 | COVID-19 vaccine acceptability

Nearly 80% of caregiver-respondents expressed willingness to receive the COVID-19 vaccine for themselves, including 26% who had already been vaccinated, 45% who indicated that they would definitely receive the vaccine when it became available to them, and 8% who were unsure but "leaning toward yes" (Table 2). Slightly more than 20% of caregivers endorsed low willingness to vaccinate themselves, including 13% that were "leaning toward no," and 8% that would "definitely not" receive the vaccine.

Slightly more than half of respondents reported their CCS would definitely receive the COVID-19 vaccine when it became available to them (51%), and five CCS had already been vaccinated (4%). An additional 18% of caregivers felt unsure if their CCS would receive the vaccine but were "leaning toward yes." Eighteen percent of caregivers were unsure about vaccinating their CCS and "leaning toward no," while 11% reported that their CCS would "definitely not" receive the vaccine, both of which were higher levels of vaccine hesitancy than caregivers reported for vaccinating themselves. Among 97 caregiver-respondents with other children living in the household, 12% indicated that their vaccination plan for these children differed from that for their CCS.

## 3.3 | Factors associated with COVID-19 vaccine willingness

In multivariable logistic regression models, older CCS age at survey completion was significantly associated with the caregiver's willingness to give the vaccine to their CCS ($p = .028$) but not to receive the vaccine themselves ($p = .073$) (Table 3). Additionally, the odds of caregiver willingness to self-vaccinate against COVID-19 increased by approximately 5.8% (95% CI = 1.92–17.72, $p = 1.9 \times 10^{-3}$) with each one-unit increase (e.g., moving from "strongly disagree" to "somewhat disagree") in confidence in the federal government's response to the pandemic. Odds of caregiver willingness to vaccinate their CSS increased by approximately 2.6% (95% CI = 1.21–5.74, $p = .014$) for each one-unit increase in confidence in this variable. When confidence in the federal response to COVID-19 was replaced in the model by confidence in the state/local government's response, it too was associated with increased odds of willingness to self-vaccinate (OR = 10.30, 95% CI = 2.70–39.24, $p = 6.3 \times 10^{-4}$) and a more modest increase in the odds of willingness to vaccinate the CCS (OR = 1.94, 95% CI = 1.00–3.74, $p = .048$). Confidence in federal versus state/local government were highly correlated, and a model containing both variables showed that the associations with willingness to self-vaccinate and to vaccinate the CCS attenuated both for confidence in the federal response to COVID-19 (OR = 2.22, 95% CI = 0.89–5.53, $p = .080$), and for confidence in the state/local response (OR = 1.32, 95% CI = 0.60–2.90, $p = .49$). Finally, caregivers reporting that they obtained information on COVID-19 from cancer care professionals were significantly more likely to indicate that they would self-vaccinate (OR = 26.77, 95% CI = 2.79–257.03, $p = 4.4 \times 10^{-4}$) and that they would vaccinate their

**TABLE 2** Distributions of caregiver respondents' answers for vaccine willingness,[a] confidence in COVID-19 response, and information source items

| | Number of respondents ($n = 130$) | Percentage of study population (%) |
|---|---|---|
| *Will respondent receive vaccine when available?* | | |
| Definitely yes | 59 | 45 |
| Unsure, leaning toward yes | 10 | 8 |
| Unsure, leaning toward no | 17 | 13 |
| Definitely no | 10 | 8 |
| Already vaccinated | 34 | 26 |
| *Will CCS receive vaccine when available?* | | |
| Definitely yes | 66 | 51 |
| Unsure, leaning toward yes | 23 | 18 |
| Unsure, leaning toward no | 22 | 18 |
| Definitely no | 14 | 11 |
| Already vaccinated | 5 | 4 |
| *Does vaccination plan for other children differ from that of CCS?*[c] | | |
| Yes | 12 | 12 |
| No | 85 | 88 |
| *Confident in federal government response* | | |
| Strongly disagree | 20 | 15 |
| Somewhat disagree | 33 | 25 |
| Somewhat agree | 66 | 51 |
| Strongly agree | 11 | 8 |
| *Confident in state/local government response* | | |
| Strongly disagree | 30 | 23 |
| Somewhat disagree | 33 | 25 |
| Somewhat agree | 51 | 39 |
| Strongly agree | 16 | 12 |
| *Confident in hospital/doctor's office response* | | |
| Strongly disagree | 4 | 3 |
| Somewhat disagree | 10 | 8 |
| Somewhat agree | 51 | 39 |
| Strongly agree | 65 | 50 |
| *COVID-19 information sources*[c] | | |
| Governmental organizations | 118 | 91 |
| Social media | 49 | 38 |
| Cancer care professionals | 48 | 37 |
| Academic centers | 26 | 20 |

[a]Vaccine willingness items adapted from Bell et al., 2020.[6]
[b]This question was asked only to those 97 caregivers reporting other children in the household. Therefore, percentages reported for this question are out of 97, not 130.
[c]Respondents could select multiple sources of information on COVID-19. Thus, percentages here will not total to 100.

CCS (OR = 7.88, 95% CI = 1.96–31.57, $p = 3.6 \times 10^{-3}$). No other variables were significantly associated with caregiver willingness to vaccinate themselves or their CCS in any models, including previous participation in clinical trials and age of CCS at survey completion.

### 3.4 | Factors associated with caregiver COVID-19 vaccination status

All else held constant, the odds caregivers were already vaccinated against COVID-19 at time of survey increased by approximately 2% (95% CI = 0.94–4.44, $p = .015$) for each one-unit increase in confidence in the federal government's response to COVID-19, and by approximately 2.5% (95% CI = 0.92–6.75, $p = .073$) for each one-unit increase in confidence in the hospitals' and doctors' offices responses to the pandemic. However, these associations did not reach significance. Caregiver sex, caregiver race/ethnicity, household income, prior CCS participation in a therapeutic clinical trial, and CCS cancer type, current age, and treatment status were not associated with caregiver vaccination status at time of survey completion ($p > .05$). Too few CCS (5/130, 4%) had themselves been vaccinated to perform regression modeling for this outcome.

### 3.5 | Free-text themes

Interrater reliability for free-text response coding was extremely high, at 97% overall. Three primary themes emerged from qualitative analysis of free-text responses regarding vaccine acceptance for CCS: (a) generalized expressions of confidence in science, in medicine, and in vaccination as a strategy for CCS health promotion; (b) confidence in the efficacy of SARS-CoV-2 vaccines and belief that CCS are at greater risk of COVID-19 complications than the general population; and (c) concerns about the accelerated timeline of COVID-19 vaccine development and insufficient safety/efficacy data in children and CCS

**TABLE 3** Relationships between covariates and COVID-19 vaccine willingness among caregivers of childhood cancer survivors (CCS) from multivariable regression models (OR, 95% CI)

| | Willing to vaccinate self | Willing to vaccinate CCS |
|---|---|---|
| *Respondent sex (ref: female)* | | |
| Male | 0.14 (0.01–1.73) | 0.63 (0.08–5.16) |
| *CCS cancer type (ref: hematologic)* | | |
| CNS | 0.37 (0.05–2.92) | 0.71 (0.16–3.23) |
| Other solid tumor | 0.87 (0.17–4.53) | 1.08 (0.31–3.90) |
| *CCS treatment status (ref: all complete)* | | |
| Surveillance/follow-up | 0.68 (0.14–3.26) | 0.65 (0.20–2.11) |
| *CCS age at survey completion*[a] | 1.17 (0.99–1.38) | **1.15 (1.02–1.30)** |
| *Clinical trial participation (ref: no)* | | |
| Yes | 2.18 (0.47–10.17) | 1.73 (0.56–5.30) |
| *Income*[b] | 3.21 (0.99–10.39) | 2.18 (0.96–4.98) |
| *Confidence in response*[c] | | |
| Federal government | **5.83 (1.92–17.72)** | **2.64 (1.21–5.74)** |
| State government | **10.30 (2.70–39.24)** | **1.94 (1.00–3.74)** |
| Hospital/doctor's offices | 1.80 (0.71–4.59) | 1.17 (0.54–2.49) |
| *Information sources (ref: no)* | | |
| Governmental organizations | 2.95 (0.23–38.58) | 2.11 (0.30–14.96) |
| Social media | 0.32 (0.07–1.55) | 0.44 (0.14–1.40) |
| Cancer care professionals[d] | **26.77 (2.79–257.03)** | **7.88 (1.96–31.57)** |
| Academic centers | 6.06 (0.42–88.04) | 5.33 (0.94–30.24) |

*Note*: Bold values indicate significance at $p = .05$.

[a]Modeled as a continuous variable.

[b]Income was modeled as a three-level, ordinal variable. The reported odds ratio (OR) corresponds to each one-unit increase in the variable.

[c]Confidences in response variables were modeled as four-level, ordinal variables. All associations presented are for a model including only the federal government confidence variable, with the exception of associations with the state government confidence variable, which were calculated without the federal government variable in the model due to collinearity.

[d]Includes "child's oncologist," "child life specialist," "hospital's resource center," and "case worker/social worker/counselor."

(Table 4). General confidence in the fields of science, medicine, and vaccine development was a recurrent theme in free-text responses and was frequently stated as the reason caregivers would accept the COVID-19 vaccine for their CCS once available ($N = 18$); for example, "Because I trust his doctors and I believe in science. I'm more afraid of COVID than I am of the vaccine." Numerous caregivers expressed confidence in the SARS-CoV-2 vaccines specifically and believed that their CCS was at greater risk of COVID-19 complications than the general population ($N = 54$); for example, "Her lungs have been compromised by chemotherapy so I'd like her to avoid any illness that affects them" and "She will get the vaccine because she has comorbidities that put her at high risk – loss of a kidney, adrenal insufficiency, poor pituitary function, etc." Free-text responses also indicated that some caregivers were hesitant to accept the COVID-19 vaccine for their CCS due to accelerated vaccine development and a lack of safety/efficacy data for children and CCS in particular ($N = 37$); for example, "[my CCS] has enough possible side effects from all the chemo she has received that I would rather wait until we can see more data on kids and the vaccine."

## 4 | DISCUSSION

We assessed acceptability of SARS-CoV-2 self-vaccination and vaccination of CCS among a US-based cohort of caregivers via a rapid survey conducted between February 25 and April 13, 2021. Factors associated with vaccine willingness and hesitancy in our study population were largely aligned with results from other studies of the general population, identifying both income and trust in governmental institutions as key factors in perceived risks and benefits. Our study is unique among recent studies of vaccine acceptability in that we specifically measured respondents' confidence in the federal response to the COVID-19 pandemic. Additionally, our study reinforces emerging reports that a subset of parents has concerns about long-term effects of COVID-19 vaccination on developing children, but that such concerns may be modified when risk–benefit assessments are made in the context of comorbid chronic conditions, such as those experienced by CCS.[14–16]

Caregivers who expressed higher confidence in the federal and state governments' responses to COVID-19, and those who reported

**TABLE 4** Free-text themes with sample corresponding quotes

| THEMES AND QUOTES |
|---|
| **Confidence in science, in medicine, and in vaccination as a strategy for CCS health-promotion (N = 17)** |
| I believe in science. |
| Because I trust his doctors and I believe in science. I'm more afraid of COVID than I am of the vaccine. |
| I trust if medical professionals (and in particular her pediatrician) say it's safe for her, then we will do it. |
| We will defer to the recommendations of her oncologist and endocrinologist, but we hope she is able to get the vaccine to help protect her and the people with whom she comes in contact. |
| We believe vaccines work. |
| I strongly believe in the importance of vaccines. The more we are all vaccinated, the sooner we can get back to normal. |
| **Confidence in efficacy of SARS-CoV-2 vaccination and that a CCS is at greater risk of COVID-19 complications (*N* = 45)** |
| I believe in the science behind the vaccine. |
| It is the best protection against the virus. |
| She tends to get sicker than most people when getting virus or bacterial infections, and we worry how her body will be able to fight off the virus if she got it. |
| She has many life-threatening conditions. We are fearful of her ability to fight COVID and want to protect her as best we can. |
| **Concerns about accelerated SARS-CoV-2 vaccine development and lack of safety/efficacy data in children and CCS (*N* = 34)** |
| This vaccine was rushed through the approval process and there have been too many adverse effects. The one I am most concerned about is one that affects the blood itself and causes an autoimmune disease. This concerns me because she had a blood cancer and she already has a number of chronic conditions stemming from her cancer and chemo. |
| Just worried it may be too rushed for children. |
| I don't want to mess with her immune system. It hasn't been studied long-term in children and especially not kids with cancer. |
| More information on how it affects children will need to be available before I decide. |

obtaining COVID-19 information from cancer care professionals, were likelier to report that they would accept the SARS-CoV-2 vaccine for themselves and their CCS. Trust in governments has been identified as a positive predictor of vaccine willingness in the general population for both the SARS-CoV-2 vaccine[6] and other vaccines.[24,25] Government and public health officials may consider focusing efforts toward bolstering public confidence in the favorable risk–benefit profile of SARS-CoV-2 vaccination in hesitant groups. However, as vaccine acceptance is tied to confidence in government, it will be critical to find nongovernmental agents to promote vaccination to hesitant populations. Pediatric oncology teams are well suited for this role, particularly for CCS still receiving ongoing oncology care, and should ensure that they are asking about vaccination hesitancy, are equipped to discuss concerns about vaccination, and, potentially, have vaccines available to increase vaccine uptake among CCS. Understanding CCS and caregiver concerns about COVID-19 vaccination may help care teams better counsel them around vaccine hesitancy. Having vaccination resources where individuals typically receive care expands access and may increase uptake among those still considering or resistant to vaccination.[26]

Qualitative analysis revealed more explicit concerns related to CCS vaccination, including an appreciation of the more fragile health statuses of CCS and their potential increased risk of experiencing severe COVID-19 complications. These concerns were balanced against the understandable concern that a CCS could potentially also be at greater risk of vaccine-related complications and a desire for more long-term information on vaccine efficacy and safety in the CCS population. Forty-two percent of CCS in our sample had previously participated in an oncology clinical trial, compared with 25%–54% in nationally representative surveys of childhood cancer patients.[19] Given these families' past experiences with novel treatments and their participation in ongoing cancer surveillance and late effects clinical evaluations, our results underscore the need for outreach and communication, even among families that are highly engaged with the medical community.

Although our study provides valuablet data on a unique and at-risk patient population, it nonetheless has several limitations. The ALSF MCC cohort is relatively diverse in terms of income distribution; however, its respondents are largely White and non-Hispanic and are entirely English-speaking. Given lower vaccination rates amongst US minority populations[6,25] and as the proportion of Americans being vaccinated begins to plateau, it will be important to understand how factors associated with COVID-19 vaccine acceptability differ among caregivers of different racial/ethnic backgrounds. Additionally, offering the MCC Survey Series in languages other than English would expand inclusion criteria to include participation by more racially and ethnically diverse populations. Participants in our survey are those who voluntarily enrolled in MCC. Our findings may be impacted by any differences in participants motivated to participate versus those who chose not to participate in the larger MCC series. MCC's web-based platform may also exclude some potential participants; for example, those who are uncomfortable with electronic surveys or those without electronic access. These further limit the generalizability of our results to the larger CCS population. While discordant perspectives on

COVID-19 vaccine acceptability may exist within two-parent households, we were not able to assess this in our dataset; further, the majority of the respondents were female, and additional data are needed to evaluate potential differences related to caregiver sex. Finally, the questions in our survey evaluating vaccine willingness were adapted from a published mixed methods study that had been internally validated,[6] but these questions have not been specifically validated in caregivers of children with chronic illnesses or of CCS.

Associations between vaccine acceptability, income, and confidence in governmental responses to COVID-19 pandemic have clear relevance as the COVID-19 vaccine rollout continues. Nearly a third of our study sample expressed hesitancy about vaccinating their CCS against COVID-19, and this hesitancy was associated with lower confidence in the government response to the pandemic. Educational programs and interventions may be required to reach optimal levels of vaccine uptake in this hesitant population, and such targeted outreach could be more effective when delivered by nongovernmental organizations. Our findings emphasize the importance of pediatric oncology care teams discussing the potential risks and benefits of COVID-19 vaccination with caregivers of CCS, and updating these families as new relevant data emerge from vaccine trials and registries.

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## DATA AVAILABILITY STATEMENT

De-identified, individual-level data are available from the authors upon reasonable request.

## CONFLICT OF INTEREST

The authors declare no potential conflicts of interest.

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## SUPPORTING INFORMATION

Additional supporting information may be found in the online version of the article at the publisher's website.

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