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Factors associated with willingness to wear a mask to prevent the spread of COVID-19 in a Midwestern Community

Pamela S. Sinicrope [a,*,1], Laura A. Maciejko [b,1], Jean M. Fox [c], Michelle T. Steffens [d], Paul A. Decker [e], Philip Wheeler [f], Young J. Juhn [f], Chung-Il Wi [f], Mary Gorfine [g], Christi A. Patten [a,g]

[a] Behavioral Health Research Program, Department of Psychiatry and Psychology, Mayo Clinic, Rochester, MN, United States
[b] Mayo Clinic Alix School of Medicine, Rochester, MN, United States
[c] Department of Gastroenterology, Mayo Clinic, Rochester, MN, United States
[d] Department of Nursing, Mayo Clinic, Rochester, MN, United States
[e] Department of Health Sciences Research, Mayo Clinic, Rochester, MN, United States
[f] Community Pediatric & Adolescent Medicine, Mayo Clinic, Rochester, MN, United States
[g] Community Engagement Program, Center for Clinical and Translational Science, Mayo Clinic, Rochester, MN, United States

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ABSTRACT

Objective: To identify motivators and barriers to wearing a mask to prevent COVID-19.
Participants and methods: An anonymous, online survey of adults from Southeastern Minnesota conducted August 2020. We assessed willingness to wear a mask and its associations with socio-demographics, COVID-19-related factors and prevention behaviors using multivariable ordinal logistic regression.
Results: Of 7,786 respondents (78% women, 51% rural), 9% reported 'not at all willing', 27% 'willing', and 64% 'very willing' to wear a mask. Factors independently associated with willingness to wear a mask were: urban residence (OR = 1.23, 95% CI 1.05–1.44, p = 0.009); college degree or greater (OR 1.42, CI 1.05–1.93, p = 0.025); age (18–29 years OR 1.29, CI 01.02–1.64, p = 0.038; 30–39 OR = 1.37, CI 1.12–1.69, p = 0.003; 60–69 OR = 1.44, CI 1.09–1.91, p = 0.011; 70–89 OR 2.09, CI 1.32–3.37, p = 0.002; 40–49 reference group); and (all p < 0.001) democratic party affiliation (OR 1.79, CI 1.40–2.29), correct COVID-19 knowledge (OR 1.50, CI 1.28–1.75), 5 + COVID-19 prevention behaviors (OR 2.74, CI 1.98–3.81), positive perceived impacts for wearing a mask (OR 1.55, 1.52–1.59), perceived COVID-19 severity (OR 2.1, CI 1.44–3.1), and greater stress (OR 1.03, CI 1.02–1.04), and trust in the Centers for Disease Control (CDC) (OR 1.78, CI 1.45 –2.19).
Conclusion: Results from this sample of SEMN residents suggest interventions to enhance COVID-19 knowledge, positive expectations for mask wearing, and trust in the CDC are warranted. Research is needed to understand cultural and other barriers and facilitators among sub-populations, e.g., rural residents less willing to wear a mask.

1. Introduction

Community-wide face mask use has potential to stop the spread of COVID-19 and has been recommended as one of the key prevention behaviors by the Centers for Disease Control (CDC) (Centers for Disease Control, 2019; Gandhi and Rutherford, 2020; Lyu and Wehby, 2020; Peeples, 2020; Wang et al., 2020). The CDC recommends that individuals wear a 2-layer cloth or disposable mask that covers both nose and mouth when outdoors in public spaces where social distancing is not possible and at all times when indoors in public places (Centers for Disease Control, 2019). Studies suggest that face masks can reduce the chances of both transmitting and contracting the virus and that face masks may even reduce the severity of infection if the disease is contracted (Gandhi and Rutherford, 2020; Peeples, 2020). Research examining the impact of face mask use during the pandemic (Wong et al., 2020) found face mask use to be an independent factor for controlling disease spread early on in an the Hong Kong Special Administrative Region (HKSAR). In the U.S., Eikenberry et al. (2020) created a model to assess the impact of face mask use by the general public in NY and WA and found that if 80% of the public wore masks that were 50%

* Corresponding author at: Mayo Clinic Bio Business Building, 200 First Street SW, 5th Floor, Rochester, MN 55902, United States.
E-mail address: Sinicrope.Pamela@mayo.edu (P.S. Sinicrope).
[1] Pamela Sinicrope and Laura Maciejko are as co-first authors.

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effective, projected deaths could be reduced by 17–45% in NY and 24–64% in WA. A similar study conducted in China had similar findings (Chu et al., 2020). Furthermore, observational studies demonstrated that in countries with universal mask-wearing, per-capita COVID-19 mortality increased by 5.4% each week compared with 48% each week in other countries (Leffler et al., 2020). One study found that counties in Kansas that had a mask mandate experienced 7% fewer cases per 100 K people per day from March to October 2020 (Zambrana and Ginther, 2020). Finally, a systematic review and meta-analysis of 172 studies of behaviors to prevent COVID-19 also concluded that face masks could greatly reduce infection risk (Chu et al., 2020).

Despite the overwhelming evidence that supports wearing face masks, widespread adoption has been fraught with controversy and become a source of division, misinformation and confusion (Rozsa et al., 2020). Unlike other recommended prevention behaviors (e.g. hand washing, covering coughs and sneezes, disinfecting surfaces), wearing a mask when out in public is a novel behavior for Americans that requires community cooperation to be effective. Unfortunately, adoption of masking across the United States has been inconsistent. There has been no federal mandate. And while some states, counties, and cities have administered mandates—many others have not. A study by the CDC found that in May 2020, 75.1% of the U.S. population reported wearing face masks, and that those wearing face masks reported higher levels of behavioral intention to wear a mask, positive outcome expectations for wearing the mask, more social norms for wearing a mask, and higher levels of perceived susceptibility to COVID-19 (Fisher et al., 2020). However, wearing a face mask is a complex behavior requiring correct and consistent use by the wearer. While adoption of the face mask appears to be increasing, there are still those who resist wearing it or those who wear it incorrectly. Furthermore, there are still gaps in our understanding of individual and environmental factors that either promote or discourage effective mask wearing.

Given this gap (West et al., 2020), expressed in a Nature perspective, a need to develop interventions to apply methods and models of behavioral science, where the focus is on identifying the key determinants necessary to promote adoption of COVID-19 prevention behaviors such as masking. We sought to answer this call to address the surging COVID-19 cases in Southeastern Minnesota (SEMN). This region is a mix of rural and urban areas, which provides an opportunity to understand differences by geography. Such an analysis is particularly important in view of the data suggesting rural areas may be emerging COVID-19 hotspots (Paul et al., 2020; Zhang and Schwartz, 2020). Therefore, our objective is to identify key determinants of mask-wearing behavior to identify targets for education and awareness to achieve community-wide mask wearing adherence. Our study utilized constructs primarily consistent with Social Cognitive Theory (Social et al., 1977) and a community-engaged research approach (Baker et al., 1999).

2. Methods

2.1. Overview

This study was deemed exempt by the Mayo Clinic Institutional Review Board. The study team developed an online survey in RedCAP (Harris et al., 2019). Whenever possible, we utilized or adapted existing items from the literature, such as the NIH Phen-X toolkit (Hamilton et al., 2011). Mayo's Survey Research Center (SRC) provided feedback on the study design as did our Community Engagement in Research Advisory Board (CERAB). CERAB also helped with pilot-testing the survey and our community outreach plan. The survey was at a 6th grade reading level, contained 26–39 questions depending on branching logic, and took 15–20 min to complete, with questions organized into the following sections: 1) about wearing a mask, 2) about coronavirus, 3) about you, 4) intervention questions, and 5) final thoughts. The terms 'mask' and 'Coronavirus' were defined in the opening of the survey. No incentives were provided for survey completion.

2.2. Study design and study population

We worked closely with our community-engaged research advisory boards and the Mayo Clinic SRC to develop a survey and recruitment strategy that would be inclusive and encourage widespread participation. In particular, questions and study recruitment materials were phrased to be non-directive about wearing a mask. The survey was anonymous so those concerned about social-desirability or privacy, especially having their opinions linked to their medical record, could feel comfortable expressing views that might contradict CDC recommendations and/or the state mask mandate.

Thus, from August 4-September 4, 2020, we conducted an anonymous, cross-sectional, voluntary, community-based survey. All SEMN residents aged 18 years and older were eligible to participate. During this time, there was a state mask mandate requiring Minnesotans to wear a mask whenever in indoor public spaces with others and for workers to wear masks when outdoors if social distancing was not possible (Walz, 2020).

SEMN includes 11 counties and Rochester is its largest city. A significant proportion of the region's population interacts through commuter movements, agricultural markets, and commercial service areas (U.S. Census Bureau, xxxx). The 2019 estimated population of SEMN is 511,309, of whom 77% are over 18 years old (U.S. Census Bureau, 2014–2018; U.S. Census Bureau, 2010a). Based on the Census urban/rural classification as of 2010, 39.4% of the population lived in rural areas, 39.5% in urban clusters of between 5000 and 49,999 population, and 21.1% lived in the urbanized areas of Rochester and La Crescent (a central city of the La Crosse-La Crescent metropolitan statistical area [MSA]) (U.S. Census Bureau, 2010b). By rural–urban commuting area (RUCAcode classification of zip code areas, SEMN is 32% urban and 68% rural. The population is 89.8% white; Asian and Black/African American people make up the majority of the remainder; and 5.5% are Hispanic or Latino people (U.S. Census Bureau, 2014–2018).

2.3. Outreach

The survey outreach plan was multifaceted, involving direct and ongoing community partnerships with two community-engaged research advisory boards, social media announcements, and email communications. Social media advertising was provided via Mayo Clinic and shared on their Facebook and Twitter pages. To ensure participation outside of Olmsted County, extensive email outreach included more than 500 government organizations (city, county, and state level), chambers of commerce, libraries, local businesses, and various cultural, religious, LGBTQ+, and arts organizations. The study was also featured on local television, radio, and in several regional newspapers who provided information on how to participate in the survey.

2.4. Measures

2.4.1. Willingness to wear a mask

Our primary outcome was "When out in public, how willing or not willing are you to wear a mask to stop the spread of Coronavirus?" with a 4-point Likert response from "not at all willing" to "very willing." Willingness is defined as 'the quality or state of being prepared to do something; readiness (Oxford English Dictionary, 2020). We selected this word as it captures the state of flexibility in and capacity for performing a behavior which could be easier or harder to perform under different situations and which also has 'social reaction component' to it (Gibbons, 2020). Furthermore, by asking the question in Likert fashion, we allowed for respondents to express levels of willingness, rather than forcing them into a 'yes' or 'no' response.

2.4.2. Socio-Demographics

We assessed the following demographics: gender identity, age,

ethnicity/race, zip code, education level, political affiliation (Pew Research Center, 2020), and rural status defined by Rural-Urban Commuting Area (RUCA) classification (USDA Economic Research Service, 2020).

As community-masking is considered a collaborative behavior, we assessed perceived sense of community (Peterson et al., 2008) using an existing 5-item measure with a 4-point Likert response ('strongly disagree' to 'strongly agree'), with the final item being tailored to community masking norms (e.g. 'I expect that most people in my community will wear a mask to stop Coronavirus'). We assessed perceived trust in the Centers for Disease Control (CDC) (Hamilton et al., 2011) with a single item measure ('not at all' to 'completely').

2.4.3. COVID-19 prevention behaviors

We assessed frequency of wearing a mask as part of a larger measure of nine COVID-19 prevention behaviors (Hamilton et al., 2011) (e.g. physical distancing, wearing gloves, cleaning surfaces) with 4-point Likert response options ('not at all' to 'all of the time').

2.4.4. COVID-19-related factors

We included a 7-item COVID-19 knowledge measure (T/F) (Alsan et al., 2020) and asked respondents about their experience with COVID-19, including whether they themselves or anyone close to them had been confirmed with COVID-19 and the outcome of that infection (e.g. went to the hospital, recovered at home). Following that, we assessed perceived severity for getting COVID-19 modelled after an existing 4-point Likert measure (Hamilton et al., 2011). COVID-related stress was assessed via the Impact of Events-revised 6-item measure (Thoresen et al., 2010). Finally, we developed a 10-item measure of perceived impacts for wearing a mask that included attitudes (4-items) and outcome expectations (6-items) with 4-point Likert responses from 'strongly disagree' to 'strongly agree.'

Statistical analysis: Data were summarized using number, percent for categorical variables and mean (SD), and select percentiles for continuous variables. Comparisons across groups were made using chi-square tests (Fisher's exact) and two-sample t-tests/analysis of variance (Kruskal-Wallis) as appropriate. Multivariable ordinal logistic regression was used to assess the association of patient characteristics, attitudes, beliefs and perceptions with willingness to wear a mask across three categories: 'not at all willing,' 'willing' and 'very willing.' The willing category was collapsed to include those reporting being both 'somewhat willing' and 'willing.' P-values < 0.05 were considered statistically significant.

3. Results

3.1. Willingness to wear a mask in public

Among all, 674 (9%) reported 'not at all willing', 1137 (14%) 'somewhat willing', 1020 (13%), 'willing,' and 4955 (64%) 'very willing'. We collapsed responses to three categories of willingness, combining the 'somewhat' with the 'willing,' calling them 'willing' (2157, 27%).

3.2. Socio-demographics

Our sample included 7786 respondents, 6107 (78%) identifying as women, 1520 (20%) as men, and 159 (2%) as other genders. Of these respondents, 3955 (51%) are rural while 3813 (49%) are urban (Fig. 1). Respondents reported the following ages: 1106 (14%) 18–29, 1983 (25%) 30–39, 1799 (23%) 40–49, 1388 (18%) 50–59, 1060 (14%) 60–69, 402 (5%) 70–79, and 48 (1%) 80+. Table 1 provides an overview compared to 2010 Census data (U.S. Census Bureau, 2010a) which

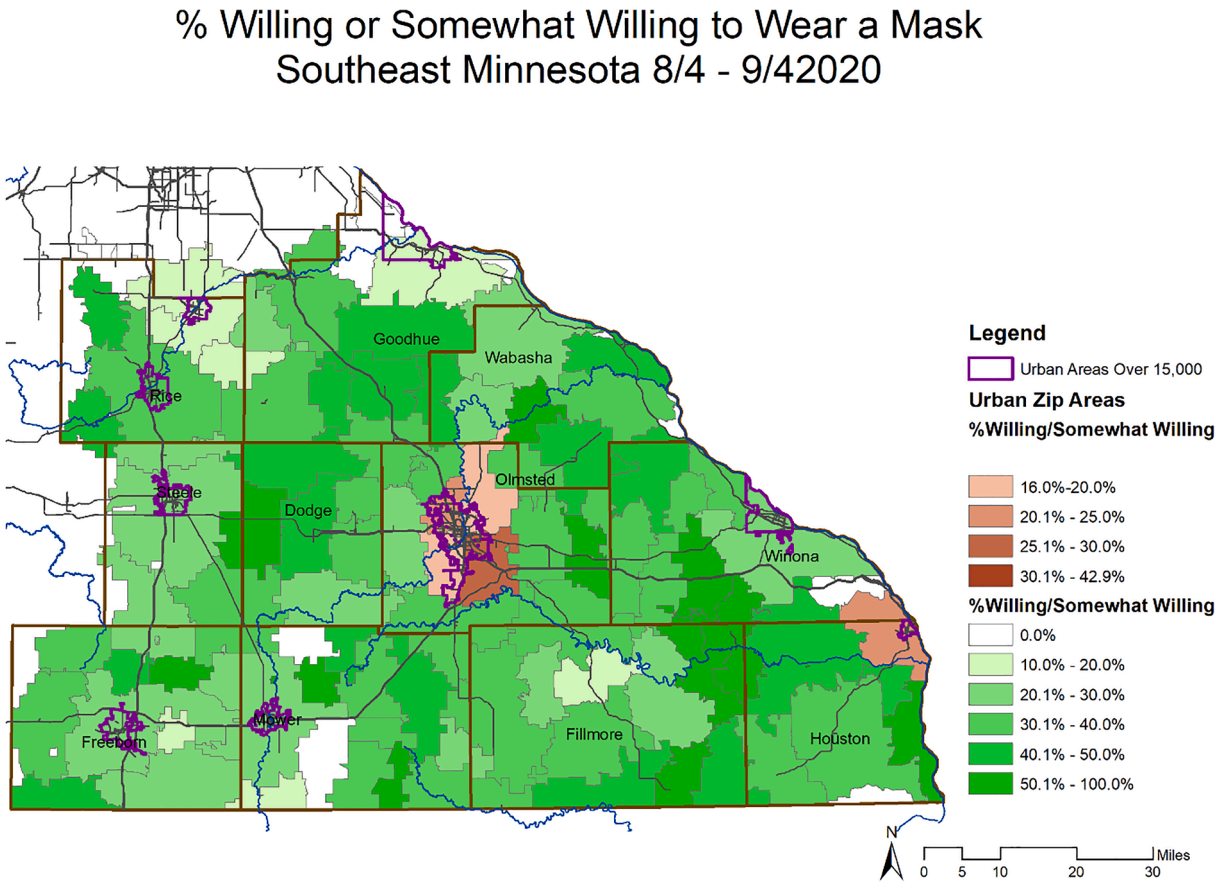

Fig. 1. Map of Response to Mask Survey in Southeastern Minnesota (SEMN) by Rural/Urban Geographic Location.

Table 1
Demographic Characteristics: Southeastern MN Voluntary Survey Sample vs. SEMN Census Population (U.S. Census Bureau, 2014–2018) (REF).

Characteristics	Survey Respondents	SEMN Census Population
Gender/Sex		
Female	6107 (78)	253,245 (50)
Male	1520 (20)	251,086 (50)
Other	159 (2)	0 (0.0)
Age		
18-29	1106 (14)	78,543 (16)
30-39	1983 (25)	63,561 (13)
40-49	1799 (23)	58,118 (11)
50-59	1388 (18)	70,709 (14)
60-69	1060 (14)	58,007 (11)
70-79	402 (5)	34,393 (7)
80+	48 (1)	23,847 (5)
Ethnicity		
Non-Hispanic	7562 (98)	476,322 (94)
Hispanic	184 (2)	28,009 (6)
Race		
White	7465 (96)	452,889 (90)
Black or African American	56 (0.7)	17,192 (3)
American Indian or Alaska Native	58 (0.7)	1877 (0.4)
Asian	151 (1.9)	14,933 (3.)
Native Hawaiian or Pacific Islander	10 (0.1)	362 (0.1)
Other	138 (1.8)	17,078 (3)
Geographic Location		
Rural	3955 (51)	335,754 (67.6)
Urban	3813 (49)	160,957 (32.4)
College Degree	4928 (64)	110,176 (33)

Values are N (%).

shows our sample trends similarly but with more representation from women (78 vs. 50%), middle-aged groups (e.g. 30–39 year olds: 25 vs 13%) and lacks representation from Black/African American people (0.7 vs. 3%). Furthermore, Fig. 1 shows that participation occurred all throughout SEMN.

3.3. Univariable analysis

In the univariable analysis (Table 2), with the exception of race and experience with COVID-19, all factors were significantly associated with increasing levels of willingness to wear a mask. Some associated socio-demographic factors included: identifying as a woman, being in older age groups (60+), living in an urban part of SEMN, having a college education and Democratic Party affiliation. Performing more COVID-19 prevention behaviors and with increasing frequency, including wearing a mask, were also related. Some of the significant COVID-19-related factors included: more correct answers on knowledge questions about COVID-19 transmission (any or all), high levels of perceived severity and perceived stress related to COVID-19 (mean 12.842, SD 7.850), more positive expectation that wearing a mask would help businesses stay open, and high levels of trust in the CDC (Table 2).

4. Multivariate analysis

Factors independently associated with willingness included: performing 5+ COVID-19 prevention behaviors (OR 2.74, CI 1.98 – 3.81, $p < 0.001$), Democratic Party affiliation (OR 1.79, CI 1.40–2.29, $p < 0.001$), having a college degree (OR 1.42, CI 1.05 – 1.93, $p = 0.025$), living in an urban location (OR = 1.23, CI 1.05 – 1.44, $p = 0.009$), age (18–29 years OR 1.29, CI 01.02–1.64, $p = 0.038$; 30–39 years OR = 1.37, CI 1.12 – 1.69, $p = 0.003$; 60–69 years OR = 1.44, CI 1.09 – 1.91, $p = 0.011$; 70–89 years OR 2.09, CI 1.32 – 3.37, $p = 0.002$; age 40–49 reference group), correct Covid-19 knowledge (OR 1.50, CI 1.28–1.75, $p < 0.001$), higher outcome expectations (OR 1.55, 1.52 – 1.59, $p < 0.001$), higher levels of perceived COVID-19 severity (OR 2.1, CI

Table 2
Demographic, COVID-19 specific, behavioral and psychosocial factors by willingness to wear a mask to stop the spread of Coronavirus.

Characteristic	Willingness to wear a mask			P*
	Not at all Willing N = 674	Willing N = 2157	Very Willing N = 4955	
Demographics				
Gender				<0.001
Female	419 (7%)	1624 (27%)	4064 (66%)	
Male	220 (14%)	497 (33%)	803 (53%)	
Other	35 (22%)	36 (23%)	88 (55%)	
Age				<0.001
18-29	74 (7%)	388 (35%)	644 (58%)	
30-39	199 (10%)	593 (30%)	1191 (60%)	
40-49	189 (10%)	549 (31%)	1061 (59%)	
50-59	127 (9%)	370 (27%)	891 (64%)	
60-69	71 (7%)	192 (18%)	797 (75%)	
70-79	13 (3%)	61 (15%)	328 (82%)	
80+	1 (2%)	4 (8%)	43 (90%)	
Ethnicity				<0.001
Non-Hispanic	663 (9%)	2100 (28%)	4799 (63%)	
Hispanic	5 (3%)	39 (21%)	140 (76%)	
Race				
White	621 (8%)	2082 (28%)	4762 (64%)	<0.001
Black or African American	7 (12%)	13 (23%)	36 (64%)	0.51
American Indian or Alaska Native	9 (15%)	15 (26%)	34 (59%)	0.18
Asian	2 (1%)	25 (17%)	124 (82%)	<0.001
Other	44 (30%)	41 (28%)	63 (42%)	<0.001
Geographic Area				<0.001
Rural	472 (12%)	1333 (34%)	2150 (54%)	
Urban	198 (5%)	819 (22%)	2796 (73%)	
Education				<0.001
High school degree or less	76 (18%)	174 (40%)	185 (42%)	
Some college, trade, or associates Degree	307 (13%)	835 (36%)	1202 (51%)	
College or higher	285 (6%)	1131 (23%)	3512 (71%)	
Political Affiliation				<0.001
Prefer not to share	167 (13%)	482 (39%)	600 (48%)	
Democrat	16 (1%)	276 (9%)	2788 (90%)	
Republican	312 (20%)	809 (51%)	463 (29%)	
Independent	115 (9%)	414 (30%)	838 (61%)	
Something Else	55 (12%)	164 (35%)	251 (53%)	
# Comorbidities for COVID-19				<0.001
0	381 (10%)	1113 (30%)	2246 (60%)	
1-2	256 (7%)	922 (26%)	2372 (67%)	
3-6	37 (7%)	122 (25%)	337 (68%)	
Number of comorbidities, mean (SD)	0.67 (0.92)	0.73 (0.93)	0.84 (0.97)	<0.001

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Table 2 (*continued*)

Characteristic	Willingness to wear a mask			
	Not at all Willing N = 674	Willing N = 2157	Very Willing N = 4955	P*
Knowledge about COVID-19 transmission (percent that marked true)				
Through respiratory droplets	543 (7%)	2062 (28%)	4901 (65%)	<0.001
Through close contact	383 (6%)	1830 (26%)	4771 (68%)	<0.001
Through a contaminated surface	406 (6%)	1833 (26%)	4768 (68%)	<0.001
Spread without showing symptoms	541 (7%)	2074 (28%)	4925 (65%)	< 0.001
Through unprotected sex	54 (6%)	203 (21%)	721 (74%)	<0.001
The virus is a hoax	130 (57%)	93 (41%)	4 (2%)	<0.001
All knowledge questions correct	163 (3%)	1091 (22%)	3685 (75%)	<0.001
COVID-19 prevention behaviors				<0.001
<5 prevention behaviors	215 (64%)	115 (34%)	5 (2%)	
5 or more prevention behaviors	445 (6%)	2000 (28%)	4812 (66%)	
Wearing a mask when out in public				<0.001
None of the time	217 (85%)	27 (11%)	11 (4%)	
Some of the time	293 (40%)	422 (58%)	17 (2%)	
Most of the time	96 (7%)	789 (57%)	504 (36%)	
All of the time	60 (1%)	909 (17%)	4396 (82%)	
Staying six feet away from others				<0.001
None of the time	189 (61%)	107 (35%)	12 (4%)	
Some of the time	296 (18%)	847 (52%)	492 (30%)	
Most of the time	143 (4%)	943 (23%)	2933 (73%)	
All of the time	44 (2%)	250 (14%)	1503 (84%)	
Hand washing or sanitizing				<0.001
None of the time	41 (63%)	20 (31%)	4 (6%)	
Some of the time	121 (33%)	176 (49%)	64 (18%)	
Most of the time	175 (10%)	688 (41%)	826 (49%)	
All of the time	335 (6%)	1264 (22%)	4032 (72%)	
Covering coughs and sneezes				<0.001
None of the time	22 (34%)	25 (38%)	18 (28%)	
Some of the time	30 (24%)	64 (52%)	30 (24%)	
Most of the time	90 (11%)	304 (38%)	405 (51%)	
All of the time	527 (8%)	1750 (26%)	4453 (66%)	
Not touching my face				<0.001
None of the time	163 (37%)	192 (44%)	85 (19%)	
Some of the time	221 (10%)	883 (39%)	1153 (51%)	
Most of the time	183 (5%)	844 (23%)	2677 (72%)	
All of the time	102 (8%)	225 (17%)	998 (75%)	
Praying for coronavirus to go away				<0.001
None of the time	282 (9%)	740 (24%)	2119 (67%)	
Some of the time	145 (8%)	508 (29%)	1116 (63%)	
Most of the time	57 (7%)	287 (32%)	544 (61%)	
All of the time	181 (10%)	601 (31%)	1137 (59%)	
Not touching surfaces in public places				<0.001
None of the time	311 (40%)	360 (46%)	113 (14%)	
Some of the time	188 (7%)	872 (33%)	1569 (60%)	
Most of the time	120 (4%)	707 (23%)	2275 (73%)	
All of the time	53 (4%)	210 (17%)	983 (79%)	
Staying at home				<0.001
None of the time	376 (34%)	563 (51%)	162 (15%)	
Some of the time	226 (8%)	970 (35%)	1608 (57%)	
Most of the time	59 (2%)	557 (16%)	2770 (82%)	
All of the time	10 (2%)	59 (13%)	398 (85%)	
Impact of Events (stress about coronavirus)				<0.001
Mean (SD)	9.0 (8.5)	11.1 (8.1)	14.1 (7.3)	
I thought about Coronavirus when I didn't mean to				<0.001
Not at all	318 (22%)	587 (41%)	520 (37%)	
Rarely	125 (8%)	506 (33%)	907 (59%)	
Sometimes	116 (4%)	669 (24%)	2040 (72%)	
Often	109 (5%)	386 (20%)	1463 (75%)	
I felt watchful or on guard				<0.001
Not at all	369 (23%)	669 (42%)	563 (35%)	
Rarely	131 (9%)	543 (37%)	790 (54%)	
Sometimes	91 (3%)	651 (24%)	2009 (73%)	
Often	76 (4%)	281 (15%)	1559 (81%)	
Other things kept making me think about Coronavirus				<0.001
Not at all	263 (19%)	570 (41%)	553 (40%)	
Rarely	94 (6%)	433 (30%)	944 (64%)	
Sometimes	142 (5%)	658 (23%)	2059 (72%)	
Often	165 (8%)	477 (24%)	1356 (68%)	
I was aware that I still had feelings about Coronavirus, but I didn't deal with them				<0.001
Not at all	407 (14%)	979 (35%)	1427 (51%)	
Rarely	134 (5%)	579 (24%)	1742 (71%)	
Sometimes	69 (4%)	430 (23%)	1322 (73%)	
Often	53 (9%)	145 (23%)	429 (68%)	
I tried not to think about Coronavirus				<0.001
Not at all				

(*continued on next page*)

Table 2 (*continued*)

Characteristic	Willingness to wear a mask			
	Not at all Willing N = 674	Willing N = 2157	Very Willing N = 4955	P*
	252 (15%)	575 (33%)	896 (52%)	
Rarely	84 (5%)	381 (23%)	1207 (72%)	
Sometimes	115 (4%)	635 (22%)	2124 (74%)	
Often	214 (15%)	546 (37%)	699 (48%)	
I had trouble concentrating				<0.001
Not at all	392 (13%)	953 (32%)	1661 (55%)	
Rarely	113 (5%)	523 (25%)	1494 (70%)	
Sometimes	88 (5%)	449 (25%)	1262 (70%)	
Often	72 (9%)	210 (27%)	508 (64%)	
Reports Experience with COVID-19 (through testing, having it, or someone close having it)				0.96
Yes	332 (9%)	1054 (28%)	2432 (64%)	
No	339 (9%)	1098 (28%)	2499 (63%)	
Perceived Severity of getting Coronavirus				<0.001
Not at all serious	502 (24%)	998 (47%)	608 (29%)	
Somewhat serious	134 (4%)	866 (25%)	2490 (71%)	
Serious	18 (2%)	176 (13%)	1129 (85%)	
Very serious	4 (1%)	88 (11%)	692 (88%)	
Masking Impact Scale (wearing a mask…)				<0.001
Mean (SD)	11.4(3.3)	16.9 (4.5)	26.2(2.9)	
will help businesses stay open				<0.001
Strongly Disagree	344 (59%)	214 (36%)	30 (5%)	
Disagree	231 (29%)	540 (68%)	22 (3%)	
Agree	65 (4%)	997 (53%)	808 (43%)	
Strongly Agree	10 (0.2%)	374 (8.4%)	4060 (91.4%)	
should be my choice				<0.001
Strongly Disagree	10 (0.4%)	88 (3.8%)	2209 (95.8%)	
Disagree	3 (0.1%)	379 (16.7%)	1893 (83.2%)	
Agree	32 (2%)	751 (60%)	472 (38%)	
Strongly Agree	627 (35%)	914 (52%)	237 (13%)	
Should be required				<0.001
Strongly Disagree	636 (47%)	680 (50%)	47 (3%)	
Disagree	28 (3%)	739 (87%)	81 (10%)	
Agree	2 (0.1%)	531 (38.2%)	858 (61.7%)	
Strongly Agree	3 (0.1%)	168 (4.1%)	3944 (95.8%)	
isn't needed				<0.001
Strongly Disagree	62 (1%)	386 (8%)	4401 (91%)	
Disagree	67 (5%)	945 (70%)	346 (25%)	
Agree	202 (24%)	623 (74%)	17 (2%)	
Strongly Agree	334 (65%)	147 (29%)	31 (6%)	
shows respect for others				<0.001
Strongly Disagree	405 (60%)	248 (36%)	28 (4%)	
Disagree	211 (31%)	450 (67%)	15 (2%)	
Agree	42 (3%)	1036 (69%)	427 (28%)	
Strongly Agree	6 (0.1%)	392 (8.1%)	4440 (91.8%)	
when others aren't makes me feel embarrassed				<0.001
Strongly Disagree	533 (17%)	709 (23%)	1817 (60%)	
Disagree	92 (3%)	927 (36%)	1584 (61%)	
Agree	24 (2%)	418 (28%)	1030 (70%)	
Strongly Agree	19 (4%)	70 (14%)	399 (82%)	
when others aren't makes me feel disrespected				<0.001
Strongly Disagree	585 (33%)	843 (47%)	366 (20%)	
Disagree	74 (5%)	878 (56%)	611 (39%)	
Agree	2 (0.1%)	344 (15.2%)	1924 (84.8%)	
Strongly Agree	8 (0.4%)	68 (3.3%)	1992 (96.3%)	
makes me look weak				<0.001
Strongly Disagree	367 (7%)	884 (16%)	4177 (77%)	
Disagree	158 (9%)	1090 (59%)	590 (32%)	
Agree	57 (24%)	128 (54%)	53 (22%)	
Strongly Agree	82 (64%)	26 (20%)	21 (16%)	
makes me look threatening				<0.001
Strongly Disagree	332 (7%)	842 (16%)	3951 (77%)	
Disagree	148 (8%)	1017 (52%)	780 (40%)	
Agree	96 (25%)	209 (54%)	80 (21%)	
Strongly Agree	90 (51%)	57 (32%)	29 (17%)	
Makes me a target for security/ police				<0.001
Strongly Disagree	348 (7%)	960 (18%)	3909 (75%)	
Disagree	179 (9%)	986 (50%)	824 (41%)	
Agree	67 (25%)	139 (53%)	57 (22%)	
Strongly Agree	69 (47%)	43 (29%)	35 (24%)	
Sense of community				<0.001
Mean (SD)	8.6 (2.7)	9.5 (2.3)	10.8 (2.6)	
I can get what I need in my community				<0.001
Strongly Disagree	44 (28%)	53 (33%)	61 (39%)	
Disagree	87 (16%)	181 (33%)	277 (51%)	
Agree	337 (9%)	1355 (35%)	2167 (56%)	
Strongly Agree	201 (6%)	554 (18%)	2423 (76%)	

(*continued on next page*)

Table 2 (*continued*)

Characteristic	Willingness to wear a mask			
	Not at all Willing N = 674	Willing N = 2157	Very Willing N = 4955	P*
I feel like I am a member of my community				<0.001
Strongly Disagree	50 (32%)	42 (26%)	67 (42%)	
Disagree	70 (11%)	242 (40%)	295 (49%)	
Agree	369 (9%)	1373 (33%)	2374 (58%)	
Strongly Agree	179 (6%)	489 (17%)	2190 (77%)	
People in my community are good at influencing each other				<0.001
Strongly Disagree	65 (29%)	81 (36%)	80 (35%)	
Disagree	161 (11%)	501 (33%)	850 (56%)	
Agree	334 (7%)	1324 (29%)	2970 (64%)	
Strongly Agree	99 (7%)	224 (17%)	1011 (76%)	
I have a good bond with others in my community				<0.001
Strongly Disagree	40 (21%)	58 (31%)	91 (48%)	
Disagree	79 (7%)	338 (31%)	669 (62%)	
Agree	382 (8%)	1419 (30%)	2883 (62%)	
Strongly Agree	164 (9%)	310 (18%)	1258 (73%)	
I expect that most people in my community will wear a mask to stop Coronavirus				<0.001
Strongly Disagree	279 (38%)	218 (30%)	230 (32%)	
Disagree	245 (13%)	677 (35%)	982 (52%)	
Agree	117 (3%)	1122 (29%)	2647 (68%)	
Strongly Agree	20 (2%)	121 (10%)	1071 (88%)	
Trust in information sources Centers for Disease Control (CDC)				<0.001
Not at all	324 (54%)	244 (41%)	28 (5%)	
Somewhat	269 (21%)	689 (53%)	331 (26%)	
Mostly	72 (2%)	919 (30%)	2079 (68%)	
Completely	8 (0.3%)	291 (10%)	2502 (89%)	

Values are N (%) unless indicated by mean (SD).
* Chi-square test or analysis of variance.

Table 3
Multivariable Analysis of Factors Independently Associated With Willingness to Wear a Mask.

	OR (95% CI)	P
Variable		
Gender		
Male	ref	
Female	1.05 (0.87–1.26)	0.64
Other	0.78 (0.45–1.37)	0.38
Age		
18-29	1.29 (1.02–1.65)	0.036
30-39	1.37 (1.12–1.69)	0.003
40-49	ref	
50-59	1.09 (0.86–1.37)	0.48
60-69	1.44 (1.09–1.91)	0.011
70-89	2.09 (1.32–3.38)	0.002
Ethnicity		
Non-Hispanic	ref	
Hispanic	1.54 (0.91–2.68	0.11
Race		
White	0.55 (0.29–1.03)	0.06
Black or African American	1.07 (0.42–2.94)	0.89
American Indian or Alaska Native	0.74 (0.34–1.71)	0.47
Asian	1.10 (0.53–2.350)	0.81
Other	0.50 (0.25–1.0)	0.047
Geographic Area		
Rural	ref	
Urban	1.23 (1.05–1.44)	0.009
Education		
High school degree or less	ref	
Some college, trade, or Associates Degree	1.28 (0.93–1.74)	0.13
College or higher	1.43 (1.05–1.94)	0.023
Political Affiliation		
Prefer not to share	ref	
Democrat	1.79 (1.41–2.29)	<0.001
Republican	1.01 (0.81–1.25)	0.96
Independent	1.10 (0.87–1.40)	0.42
Something Else	1.29 (0.94–1.77)	0.12
Coronavirus Knowledge about spread		
Not answering all knowledge questions correctly	ref	
All knowledge correct	1.50 (1.28–1.75)	<0.001
Experience with COVID		
None	1.11 (0.96–1.29)	0.17
Yes	ref	
Number of comorbidities		
0	Ref	
1-2	0.89 (0.76–1.05)	0.17
3-6	0.86 (0.61–1.22)	0.39
Impact of events	1.03 (1.02–1.04)	<0.001
COVID prevention behaviors		
<5	ref	
≥5	2.74 (1.98–3.81)	<0.001
Sense of community	1.03 (0.99–1.06)	0.07
Masking Impact Scale	1.55 (1.52–1.59)	<0.001
Trust CDC	1.78 (1.45–2.19)	<0.001
Perceived severity of COVID		
Not at all serious	ref	
Somewhat serious	1.46 (1.21–1.76)	<0.001
Serious	1.71 (1.29–2.29)	<0.001
Very serious	2.10 (1.44–3.1)	<0.001

1.44–3.1, $p < 0.001$), stress (OR 1.03, CI 1.02 – 1.04, $p < 0.001$), and trust in the CDC (OR 1.78, CI 1.45 – 2.19, $p < 0.001$) (Table 3).

5. Discussion

This community-engaged study adds information on key determinants of willingness to wear a mask to prevent the spread of COVID-19. First, with 73% of respondents reporting wearing a mask in public 'all the time,' and 2% 'none of the time,' adoption of the behavior appears promising yet suboptimal. We found there were three distinct levels of willingness to wear a mask with only 9% reporting they were 'not at all' willing, a group likely more difficult to change due to deep-seated beliefs and attitudes.

Those in the 'willing' group would be a logical choice to begin intervention efforts given they are receptive to wearing a mask but may have reservations or barriers. Many of them don't report wearing a mask 'all the time' (58%), disagree that masking 'will help businesses stay open' (35%), and disagree that 'masks should be required' (67%). These data suggest current public health messaging are neither reaching nor resonating with some, likely due, in part, to a lack of trust in the CDC, which is borne out in the data, with only 14% of the 'willing' expressing they trust the CDC completely as compared to 51% of the 'very willing 'and 1% of the 'not at all willing'(Table 2).

Our multivariable analysis provided data on which determinants are independently associated with willingness and suggest we target those in the 18–59 age groups, living in rural locations, with less than a college degree, and who do not have Democratic Party affiliation. Age as a significant factor suggests those in the 60+ age groups have an

understanding of their increased risk for a more severe course of COVID-19 compared to those in the younger age groups. Education as a significant determinant further suggests the need for focusing on developing prevention messaging for lower literacy levels using the clear, simple approach as outlined by the NIH (NIH Office of Communications, 2018), which recommends utilizing materials that are interactive, with familiar language, and that present concepts one-at-a-time accompanied with simple visual designs that incorporate cultural contexts. Extra attention must be paid to best practices for relaying information that is uncertain so as not to erode trust.

Our community is unique in that we have a significant mix of rural and urban areas with almost equal representation from both on our survey. Because studies show that populations in rural areas in the US have increasing cases as well as greater COVID-related physical and mental health consequences, additional work is necessary to understand the cultural and social normative factors that might explain how and why rural geographic location are associated with less inclination toward COVID-19 prevention strategies. Because our sample was primarily non-Hispanic White, further work will be needed to gain a more in-depth and purposeful understanding of willingness of other racial/ethnic groups, perhaps via qualitative methods.

Political affiliation was strikingly different across the three groups of willingness, with 90% of Democrats reporting being 'very willing' compared to 29% of Republicans. These findings suggest that masks have indeed been highly politicized, likely due to the influence of messaging about masks from politicians that has at times been contrary to CDC recommendations.

When behavioral-prevention variables were examined, performing five or more prevention behaviors was found to be independently associated with willingness to wear a mask, suggesting that people already engaged in mitigation and prevention behaviors may be inclined to do even more to stop the spread of COVID-19 infection. As the behaviors are considered more effective when performed collectively, our findings suggest that efforts to increase consistent and correct mask use should also include or reinforce all COVID-19 prevention behaviors.

There were important differences found in COVID-19-related variables, whereby willingness was positively correlated with increasing levels of COVID-19 knowledge, perceived stress and severity, and mask wearing outcome expectancies. At the same time, there needs to be substantial effort to bolster public trust in CDC messaging. Interventions targeting these groups should seek to utilize credible role models such as testimonials from rural residents about masking to enhance knowledge, positive outcome expectancies and trust in public health messaging.

The study has many strengths. First, we utilized a large voluntary community-based sample, using an extensive outreach effort; and as a result, we received a large response across our entire community (Fig. 1). The survey was anonymous and not linked to personal health information, which may have enhanced response. We used a community-engaged approach with input and involvement from community members on the study design, survey development and outreach efforts. Moreover, our survey was based on a solid theoretical framework.

The study has limitations. The representativeness of our sample is not perfectly aligned with the SEMN census data, although the large response across our geographic location did increase the precision of our estimate. Despite extensive community outreach efforts to gain responses from more vulnerable populations by race/ethnicity, the response from Black/African American and Hispanic community members was relatively low, and further efforts and novel approaches are needed to garner participation from these important members of our community, so that their specific needs can also be incorporated into a public health strategy to promote adoption of COVID-19 risk reduction measures. Part of this challenge might be due to our inability to use in-person outreach and communication to recruit participants because of social distancing measures in place due to COVID-19. And while extensive efforts were made to allow all to respond with their true beliefs about masking, it is possible that those who were less willing to wear a mask might have also been less interested in participating and inclusion bias could be a limitation of our findings. This means that willingness to wear a mask could be lower than what we found in this survey; and due to this fact, conclusions related to the actual percentage of those willing to wear a mask in SEMN community should be interpreted with caution. We attempted to minimize inclusion bias by using the following approaches: 1) we developed the survey using a community engaged approach which provided feedback on how to word questions so as not to introduce judgement or bias as far as beliefs about wearing a mask; 2) we promoted the survey using a wide array of community contacts across all of southeastern MN to ensure access to the survey and demonstrated significant response across the area; 3) we opted to make the survey anonymous to ensure that those who might be concerned about their opinions being linked back to them or their medical record could feel comfortable participating. Finally, we had a significant response of almost 8000 people which includes 28% who were willing (not very willing) and 9% who were not all willing, which provided adequate numbers to make meaningful comparisons across the three levels of willingness. Nonetheless, we acknowledge the potential for selection bias. Though many of our measures were utilized from the Phen-X database, we had to create several new measures and there was little time to develop them. However, we modeled our new measures after existing ones, utilized consistent Likert-style response patterns and relied on our theoretical framework for guidance.

6. Public health implications/next steps

Our study provides novel insights on motivators and barriers to wearing a mask to help Southeastern Minnesotans protect against surging COVID-19 cases, hospitalizations and deaths. We highlight evidence of gaps in willingness to wear a mask among SEMN residents across different sociodemographic, behavioral and COVID-19-related factors. Targeted efforts to address individual and environmental barriers and that capitalize on motivators for wearing a mask are needed and underway with involvement from a local community advisory board. Our findings suggest social marketing campaigns or other interventions to enhance COVID-19 knowledge, positive attitudes and expectations for mask wearing, as well as trust in the CDC are warranted and a logical first step. However, such campaigns may not be enough to alter behavior and focus on underlying cognitive factors such as self-efficacy and outcome expectations are warranted. Further research is needed to understand cultural and other barriers and facilitators among sub-populations, e.g., rural residents less willing to wear a mask who do not have Democratic party affiliation; younger age groups who perceive less risk; and it is essential to identify credible role models to carry the message about COVID-19 to enhance receptivity and reach, especially salient as we move toward adding recommendations related to vaccines and residents must make decisions about whether and when to get vaccinated and vaccination relates to the need for community masking. Also, of interest is the complexity of mask-wearing behavior while the community undergoes vaccine and to reinforce the use of masking while also social distancing as some may be less likely to distance when masked (Cartaud et al., 2020). Developing strategies with involvement from the community and that specify a multi-level theoretical framework, such as social cognitive theory will have the greatest likelihood for success.

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CRediT authorship contribution statement

Pamela S. Sinicrope: Conceptualization, Methodology, Investigation, Data curation, Writing–original draft, Writing - review & editing, Visualization, Project administration, Supervision, Funding acquisition. **Laura A. Maciejko:** Conceptualization, Methodology, Investigation, Data curation, Writing–original draft, Writing - review & editing, Visualization, Project administration, Software, Validation. **Jean M. Fox:** Conceptualization, Methodology, Investigation, Data curation, Writing - review & editing, Project administration, Supervision. **Michelle T. Steffens:** Conceptualization, Methodology, Investigation, Data curation, Writing - review & editing, Project administration. **Paul A. Decker:** Methodology, Formal analysis, Investigation, Writing - review & editing. **Philip Wheeler:** Methodology, Formal analysis, Investigation, Writing–original draft, Writing - review & editing. **Young J. Juhn:** Methodology, Formal analysis, Investigation, Writing - review & editing. **Chung-Il Wi:** Methodology, Formal analysis, Investigation, Writing - review & editing. **Mary Gorfine:** Conceptualization, Methodology, Resources. **Christi A. Patten:** Conceptualization, Methodology, Investigation, Writing - review & editing, Visualization, Supervision, Funding acquisition.

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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