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## Original Research

## Willingness to pay for SARS-CoV-2 rapid antigen tests during the COVID-19 pandemic: evidence from the general adult population

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## ABSTRACT

**Objective:** Our aim was to examine the willingness to pay (WTP) for SARS-CoV-2 rapid antigen tests and its correlates during the COVID-19 pandemic in Germany.

**Study design/Methods:** A representative online survey was conducted in late summer 2021 (with  $n = 3075$ ; the average age was 44.5 years; 14.8 years ranging from 18 to 70 years) in Germany. Two-part models were conducted. Various correlates (such as empathy or altruism) were included in the regression analysis.

**Results:** The average WTP for SARS-CoV-2 rapid antigen tests (in euros) was 6.6 (standard deviation 8.4) in the general adult population. It markedly differed between subgroups (e.g. the average WTP was 2.9 among individuals not vaccinated against COVID-19 and 7.5 among individuals vaccinated against COVID-19; it was 5.4 among the lowest income decile, whereas it was 8.6 among the highest income decile). Regressions showed that a higher WTP for SARS-CoV-2 rapid antigen tests was associated with being male, being in the highest income group, being vaccinated against COVID-19, and having higher levels of empathy.

**Conclusions:** As the very first study in this area, our study described WTP for SARS-CoV-2 rapid antigen tests and some interesting differences between population subgroups. In particular, individuals not vaccinated against COVID-19 reported a low WTP for SARS-CoV-2 rapid antigen tests. Approximately one-fourth of the sample reported a WTP for SARS-CoV-2 rapid antigen tests of €0 among individuals vaccinated against COVID-19, whereas approximately two-thirds of those not vaccinated against COVID-19 reported such a WTP. Knowledge about the WTP for COVID-19 rapid antigen tests is important for policy makers (e.g. for testing strategies) during this pandemic. It may also give a rough estimation of the acceptance of such rapid tests.

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## Introduction

Since March 2020, individuals in Germany have been contending with the consequences of the ongoing COVID-19 pandemic. A few months after the start of the pandemic, tests (e.g. polymerase chain reaction tests) were used to quickly identify infected persons and put in place appropriate measures (e.g. isolation and tracing of contact persons).<sup>1,2</sup> Later in 2020, SARS-CoV-2 rapid antigen tests (and also self-tests) became available in Germany. Many corona

rapid testing centers opened in Germany in spring 2021, with many testing options being relatively quick, widespread, and relatively inexpensive. Such testing services are perceived as having great potential in the global fight against the pandemic.<sup>3,4</sup>

There are some studies on readiness for a COVID-19 vaccine in Germany (e.g. <sup>7</sup>). These studies also showed a high readiness for rapid testing (from December 2020 to March 2021).<sup>5</sup> For example, the likelihood of using such a test was positively associated with low price and ease of use.<sup>5</sup> Moreover, although various studies in different countries and subgroups examined the willingness to pay (WTP) for a (hypothetical) COVID-19 vaccine,<sup>5–11</sup> there are not currently any studies regarding the WTP for SARS-CoV-2 rapid antigen tests (in Germany and also globally). Generally, a WTP refers to a maximum amount of money an individual is willing to spend for a certain product or service.<sup>12</sup>

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Such knowledge is important for policy makers (e.g. for testing strategies) during the COVID-19 pandemic. Moreover, knowledge about the WTP for SARS-CoV-2 rapid antigen tests may give a rough estimation of the acceptance of such rapid tests in the general adult population and in certain subgroups (such as individuals not vaccinated against COVID-19). Thus, our aim was to examine the WTP for SARS-CoV-2 rapid antigen tests and its correlates in Germany in late summer 2021.

It is worth noting that during the time of data collection (late August to early September 2021), such rapid tests were free of charge in Germany. However, during that time, the German government had already announced that such rapid tests would no longer be free of charge from October 2021.

## Methods

### Sample

The data came from a representative online survey of 3075 adults in Germany aged 18–70 years. Only people aged <18 or >70 years, as well as those who did not live in Germany, were excluded. It should be noted that the questionnaire was only available in German. Fieldwork took place from late August to early September 2021. The individuals were recruited by a well-known market research institute using its own online access panel.

Individuals were drawn from this online sample in such a way that they reflected the distribution of gender, age bracket, and federal state in the German adult population.<sup>13</sup> Quotas were derived from Best for Planning 2020. An invitation to participate was sent to approximately 14,000 individuals. As this was an online survey, potential differences between respondents and non-respondents could not be examined.

With regard to the representativeness, for example, in the German Socio-Economic Panel (GSOEP), the median household net income was similar compared with our study (GSOEP: about 2200 euros in the year 2018 [continuously assessed] vs in our study: 2500–3000 Euro [income category; late Summer 2021]).<sup>13</sup> Moreover, the proportion of unemployed individuals was 5.7% according to the German Federal Employment Agency in the year 2021, and this proportion equaled 5.6% in our present study. However, while about 11.4% of the individuals had a migration background in our study, 26.7% of the individuals had a migration background according to the microcensus.<sup>14</sup>

All participants in the study provided written informed consent. The Local Psychological Ethics Committee of the Center for Psychosocial Medicine of the University Medical Center Hamburg-Eppendorf approved the study (number: LPEK-0356).

### Outcomes

Individuals self-reported the WTP for SARS-CoV-2 rapid antigen tests (in euros). It was introduced as follows: “Currently, the costs for rapid tests are covered by the state. From October, the rapid tests for the unvaccinated will no longer be free of charge. What is the maximum amount you would be willing to pay for such a rapid test?” (options: €0; €5; €10; €15; €20; €25; €30; €35; €40; more than €40). Values of “more than €40” were transformed to €45 to calculate an average WTP.

It should be noted that two concepts exist to calculating WTP: revealed preferences and stated preferences. Revealed preferences can be quantified by using, for example, natural field experiments or laboratory experiments. In contrast, stated preferences can be quantified using indirect surveys (e.g. conjoint analysis) or direct survey approaches. In our study, the stated preference concept via a direct survey approach was applied.

### Independent variables

In regression analysis, we included the following factors as correlates: sex (women, men, and diverse), age, presence of at least one child in own household (no or yes), marital status (married, not living together with spouse; divorced; widowed; and single), education (upper secondary school, qualification for applied upper secondary school, polytechnic secondary school, intermediate secondary school, lower secondary school, currently in school training/education, and without school-leaving qualification), having a migration background (no or yes), employment situation (full-time employed, retired, and other), household net income in Euro (trichotomized into lowest income decile, second to ninth income decile, and highest income decile), being vaccinated against COVID-19 (no or yes), and long-term illnesses (absence of chronic diseases and presence of at least one chronic disease).

Moreover, we included empathy (ability to imagine what life is like for another individual<sup>15</sup>) and altruism (referring to disinterestedness and selflessness<sup>16</sup>). Based on the short scale of the Interpersonal Reactivity Index<sup>15</sup> (German version: Saarbrücken personality questionnaire, SPF<sup>17</sup> – short version: SPF-K), empathy was assessed. This tool consists of four items.<sup>18</sup> A sum score was calculated (which ranges from 4 to 20, higher values correspond to higher levels of empathy). Cronbach's alpha was 0.81 in our study. The subscale “altruism” of the International Personality Item Pool (IPIP–5F30F-R1<sup>19</sup>) was used, which consists of six items. All items were recoded. Thereafter, the score was generated by averaging all items (ranging from 1 to 5, with higher values reflecting higher altruism). Cronbach's alpha was 0.87 in our study.

### Statistical analysis

Initially, the average WTP for SARS-CoV-2 rapid antigen tests in Euro was displayed (total sample and by some subgroups). Thereafter, two-part models<sup>20</sup> were conducted to analyze the correlates of WTP for SARS-CoV-2 rapid antigen tests (first part: logit model; second part: generalized linear model with gamma distribution and log link function; taking into account the skewed distribution of positive values<sup>21</sup>). Such models are frequently used when the proportion of zero values is large (i.e. absence of WTP for SARS-CoV-2 rapid antigen tests in our study). The “twopm” command in Stata was used to conduct the two-part models.<sup>20</sup> We calculated average marginal effects due to ease of interpretation. They indicate the change in WTP for SARS-CoV-2 rapid antigen tests (in euros) associated with a one unit change in the correlates (or the difference to the reference category, in the case of categorical variables).

Statistical significance was defined as *P* value of 0.05 or smaller. Stata 16.1 (Stata Corp., College Station, TX) was used to conduct statistical analyses.

## Results

### Sample characteristics

In our total sample, the average age was 44.5 years (standard deviation [SD] 14.8 years). It consisted of 51.1% female individuals. In [Supplementary Table S1](#), we provide a comparison of our sample and the target cohort (sex, age group, and state). The average WTP for SARS-CoV-2 rapid antigen tests (in euros) is presented in [Table 1](#) (total sample and stratified by subgroups). In the total sample, the average WTP for SARS-CoV-2 rapid antigen tests (in euros) was 6.6 (SD 8.4). In the subgroups, the average WTP for SARS-CoV-2 rapid antigen tests (in euros) ranged between 2.9 (among individuals not vaccinated against COVID-19) and 7.5 (among individuals vaccinated against COVID-19). Further details are given in [Table 1](#). In

**Table 1**  
Average WTP for SARS-CoV-2 rapid antigen tests (in euros) stratified by various subgroups.

Independent variables	N	Average WTP for SARS-CoV-2 rapid antigen tests (in euros)	P value
Total sample	3075	6.6 (8.4)	
Gender			<0.01
Male	1502	7.2 (9.3)	
Female	1570	6.1 (7.3)	
Diverse	3	6.7 (7.6)	
Age group			<0.01
18–29 years	628	5.7 (6.8)	
30–39 years	597	6.5 (8.7)	
40–49 years	597	6.4 (8.2)	
50–59 years	659	7.3 (8.5)	
60 years and older	594	7.1 (9.4)	
Children in own household			0.70
No	2206	6.6 (8.3)	
Yes	869	6.7 (8.5)	
Marital status			<0.01
Single/divorced/widowed/married, not living together with spouse	1313	6.1 (8.0)	
Married, living together with spouse	1762	7.0 (8.6)	
Education			0.73
Upper secondary school	1326	6.9 (8.1)	
Qualification for applied upper secondary school	328	6.6 (9.6)	
Polytechnic secondary school	168	6.5 (9.5)	
Intermediate secondary school	888	6.3 (7.9)	
Lower secondary school	347	6.4 (8.5)	
Currently in school training/education	9	5.0 (5.6)	
Without school-leaving qualification	9	5.6 (9.8)	
Migration background			0.79
No	2724	6.6 (8.3)	
Yes	351	6.7 (8.5)	
Employment status			<0.05
Full-time employed	1458	6.9 (8.6)	
Retired	499	7.0 (9.4)	
Other	1118	6.0 (7.5)	
Vaccinated against COVID-19			<0.001
No	593	2.9 (5.4)	
Yes	2482	7.5 (8.7)	
Chronic diseases			0.93
Absence of at least one chronic disease	1765	6.6 (8.3)	
Presence of at least one chronic disease	1310	6.6 (8.5)	
Household net income			<0.001
Lowest income decile	328	5.4 (8.8)	
Second to ninth income decile	2006	6.4 (7.8)	
Highest income decile	427	8.6 (9.8)	

Notes: One-way analyses of variance or independent *t*-tests were conducted, as appropriate (*P* values). WTP, willingness to pay.

addition, it may be worth noting that 34.5% of the individuals reported a WTP for SARS-CoV-2 rapid antigen tests of €0. This proportion markedly differed according to income (individuals in the lowest income decile: 43.3%; individuals in the highest income decile: 25.5%) and particularly according to vaccination status (individuals not vaccinated against COVID-19: 63.9%; individuals vaccinated against COVID-19: 27.5%).

Significant differences in the average WTP for SARS-CoV-2 rapid antigen tests between the subgroups were identified according to gender, age group, marital status, employment status, and vaccination status.

With regard to effect sizes, although most differences in average WTP for SARS-CoV-2 rapid antigen tests between the subgroups were quite small, particularly the difference in average WTP for SARS-CoV-2 rapid antigen tests between individuals vaccinated against COVID-19 and individuals not vaccinated against COVID-19 was notable (Cohen's *d* = 0.57). Furthermore, there were some differences in average WTP between individuals in the lowest income decile and individuals in the highest income decile (Cohen's *d* = 0.34).

### Regression analysis

To check for multicollinearity, we calculated the variance inflation factors (VIF). The highest VIF was 2.7 (highest income group), with an average VIF of 1.4, indicating that multicollinearity is not a threat.

Two-part models are displayed in Table 2. It is worth repeating that the first part refers to a logit model, and the second part refers to a generalized linear model with gamma distribution and log link function. The likelihood of reporting a WTP for SARS-CoV-2 rapid antigen tests higher than zero (first part: logit model) was positively associated with a high educational level, being in the highest income decile, being vaccinated against COVID-19 and having a higher empathy level. The extent of WTP (conditional on a WTP for SARS-CoV-2 rapid antigen tests higher than zero; second part) was positively associated with being male and being vaccinated against COVID-19. In addition, average marginal effects (last column in Table 2) showed that higher WTP for SARS-CoV-2 rapid antigen tests was significantly associated with being male, being in the highest income decile, being vaccinated against COVID-19 and higher levels of empathy.

**Table 2**  
Two-part models with WTP for SARS-CoV-2 rapid antigen tests (in euros) as outcome measure (1. Logit 2. GLM<sup>a</sup>).

Independent variables	Logit OR (SE)	GLM b (SE)	Predict. margin
Sex			
Women (Ref.: men)	1.09 (0.10)	−0.17*** (0.04)	−0.92** (0.33)
Diverse	1.49 (3.04)	0.04 (0.33)	1.10 (4.80)
Age	1.00 (0.00)	0.00 (0.00)	0.01 (0.01)
Marital status: married, living together with spouse (Ref.: single/divorced/widowed/married, not living together with spouse)	1.03 (0.10)	−0.02 (0.04)	−0.07 (0.33)
Highest educational degree			
Qualification for applied upper secondary school (Ref.: upper secondary school)	0.61*** (0.09)	0.09 (0.07)	−0.48 (0.55)
Polytechnic secondary school	0.85 (0.16)	0.12 (0.10)	0.47 (0.86)
Intermediate secondary school	0.93 (0.10)	−0.00 (0.05)	−0.16 (0.37)
Lower secondary school	0.87 (0.13)	0.04 (0.07)	0.01 (0.53)
Currently in school training/education	0.37 (0.32)	−0.16 (0.15)	−2.75 (1.74)
Without school-leaving qualification	0.44 (0.37)	0.18 (0.30)	−0.74 (2.84)
Children in own household: Yes (Ref.: No)	0.88 (0.09)	0.07 (0.04)	0.23 (0.36)
Migration: Migration background (Ref.: no migration background)	0.94 (0.13)	0.03 (0.06)	0.08 (0.47)
Employment status			
Retired (Ref.: Full-time employed)	0.80 (0.11)	0.06 (0.07)	−0.10 (0.53)
Other	0.94 (0.10)	−0.00 (0.04)	−0.15 (0.36)
Income			
Second to ninth income decile (Ref.: lowest income decile)	1.23 (0.18)	−0.00 (0.08)	0.40 (0.58)
Highest income decile	1.75** (0.35)	0.14 (0.10)	2.14** (0.76)
Chronic diseases: presence of at least one chronic disease (Ref.: absence of chronic diseases)	0.90 (0.08)	0.00 (0.04)	−0.19 (0.32)
Vaccinated against COVID-19: Yes (Ref.: No)	4.50*** (0.48)	0.23*** (0.06)	4.49*** (0.43)
Empathy	1.09*** (0.02)	0.01 (0.01)	0.21*** (0.06)
Altruism	1.13+ (0.08)	−0.01 (0.03)	0.20 (0.27)
Constant	0.13*** (0.04)	1.96*** (0.17)	
Observations	2761	2761	2761

Two-part models with WTP for SARS-CoV-2 rapid antigen tests (in euros) as outcome measure<sup>a</sup>; Generalized linear model (GLM) with log link and gamma distribution; OR = odds ratio; robust standard errors (SE) in parentheses; \*\*\* $P < 0.001$ ; \*\* $P < 0.01$ ; \* $P < 0.05$ ; + $P < 0.10$ .

## Discussion

Using data from the general adult population in Germany, this is the very first study quantifying the WTP for SARS-CoV-2 rapid antigen tests and its correlates during the COVID-19 pandemic – and consequently forms a basis for future research. It should be emphasized that rapid test centers charged around 15€ for SARS-CoV-2 rapid antigen tests in Germany in October 2021. However, due to the increase in the number of cases, these SARS-CoV-2 rapid antigen tests are already free of charge again (mostly since November 2021).

Compared with other groups, particularly individuals not being vaccinated against COVID-19 reported a rather low WTP for SARS-CoV-2 rapid antigen tests. In addition, regressions showed that a higher WTP for SARS-CoV-2 rapid antigen tests was associated with being male, being in the highest income decile, being vaccinated against COVID-19 and higher levels of empathy.

It appears to be plausible for us that not being vaccinated against COVID-19 was associated with much lower levels of WTP for SARS-CoV-2 rapid antigen tests in our study. The findings from the European COvid Survey (September 2021) showed that different reasons for not getting vaccinated against COVID-19 exist in Germany such as that the respondents did not want to support the profit-striving of global vaccine producers or they did not think that COVID-19 vaccines are safe enough.<sup>22</sup> These reasons may also reflect that such individuals also do not want to support manufacturers of rapid tests and do not have much trust in the accuracy of such rapid tests. This could be a politically important outcome: The fact that they have to pay for such tests is probably a deterrent to testing, particularly for the individuals not being vaccinated against COVID-19, for whom the tests are likely most important.

Those who refuse vaccination probably see less danger in infection. However, future research is required to elucidate the underlying mechanisms.

Moreover, individuals in the highest income decile reported a higher WTP for SARS-CoV-2 rapid antigen tests in our study compared with individuals in the lowest income decile. Such income discrepancies may particularly reflect differences in financial opportunities. Moreover, such individuals in the highest income decile may have a higher trust in the accuracy of such rapid tests compared with individuals in the lowest income decile and may thus report a higher WTP for SARS-CoV-2 rapid antigen tests.

Our study also showed an association between higher empathy and a higher WTP for SARS-CoV-2 rapid antigen tests. Such a link appears quite plausible because empathy is also positively associated with prosocial behavior, such as donating blood<sup>23</sup> and also wearing face masks during the pandemic.<sup>24</sup> Individuals scoring high in empathy may therefore appreciate rapid tests because of their potential in the fight against COVID-19. Surprisingly, altruism was only marginally significantly associated with a higher likelihood of reporting a WTP for SARS-CoV-2 rapid antigen tests higher than zero. Future research is required to clarify this association in further detail.

Some strengths and limitations of our present study are worth acknowledging. This is the very first study quantifying the WTP for SARS-CoV-2 rapid antigen tests during the pandemic. Data were taken from a large, representative study. However, the questionnaire was only available in the German language. Thus, it is very likely that individuals with a migration background are underrepresented. Moreover, the general possibility of an online bias cannot be dismissed. Established tools were used to quantify the

correlates. A single item was used to assess WTP (preference concept via a direct survey approach was applied). Advantages of such an assessment include its high face validity, as well as its simple and efficient assessment of WTP. However, further research with more sophisticated tools to measure WTP is desirable because such direct survey approaches may lead to the fact that the true WTP is not being identified. For example, indirect survey methods such as conjoint analyses or discrete choice analyses could be used. Moreover, further research is required using data from the oldest old because our study only included individuals aged 18–70 years. In addition, longitudinal studies are required to confirm our findings.

In conclusion, our study revealed the WTP for SARS-CoV-2 rapid antigen tests and also revealed some interesting differences between subgroups. Particularly, individuals not being vaccinated against COVID-19 reported a low WTP for SARS-CoV-2 rapid antigen tests. Approximately one-fourth reported a WTP for SARS-CoV-2 rapid antigen tests of €0 among individuals being vaccinated against COVID-19, whereas approximately two-thirds reported such a WTP among individuals not being vaccinated against COVID-19. Knowledge about the WTP is important for policy makers (e.g. for testing strategies) during this pandemic. It may also give a rough estimation of the acceptance of such rapid tests.

### Author statements

#### Ethical approval

Approval for the study was provided by the Local Psychological Ethics Committee of the Center for Psychosocial Medicine of the University Medical Center Hamburg-Eppendorf (number: LPEK-0356). Our study is in accordance with the ethical standards laid down in the 1964 Declaration of Helsinki and its later amendments.

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#### Competing interests

None.

#### Consent to participate

All participants included in this study provided informed consent.

#### Consent to publish

Not applicable.

### Appendix A. Supplementary data

Supplementary data to this article can be found online at <https://doi.org/10.1016/j.puhe.2022.03.016>.

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