Knowledge, Attitudes and Practices towards SARS-CoV-2 vaccination among morbid obese individuals: a pilot study

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Abstract. Background and aim. Vaccinations have dramatically impacted on the ongoing pandemic of COVID-19, the disease caused by severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2). As morbid obese (MO) individuals are at high risk for severe complications, their acceptance of SARS-CoV-2 vaccines is of certain public health interest. Methods. We investigated the knowledge, attitudes and eventual acceptance of SARS-CoV-2/COVID-19 vaccination among MO individuals either in waiting list, or recipients of bariatric surgery from a reference center (Parma University Hospital) shortly before the inception of the Italian mass vaccination campaign (March 2021). Data were collected through a web-based questionnaire. Association of individual factors with acceptance of SARS-CoV-2 vaccine was assessed by means of a logistic regression analysis with eventual calculation of adjusted Odds Ratios (aOR) and corresponding 95% Confidence Intervals (95%CI). Results. Adequate, general knowledge of SARS-CoV-2/COVID-19 was found in the majority of MO patients. High perception of SARS-CoV-2 risk was found in around 80% of participants (79.2% regarding its occurrence, 73.6% regarding its potential severity). Acceptance of SARS-CoV-2/COVID-19 vaccination was reported by 65.3% of participants, and was more likely endorsed by MO patients who were likely to accept some sort of payment/copayment (aOR 5.783; 1.426; 23.456), or who were more likely towards a vaccination mandate (aOR 7.920; 1.995; 31.444). Conclusions. Around one third of the MO individuals among potential recipient of bariatric surgery exhibited some significant hesitancy towards SARS-CoV-2 vaccine, and a rational approach may fail to capture and address specific barriers/motivators in this subset of individuals, stressing the importance for alternative interventions. (www.actabiomedica.it)

Key words: Italy, vaccines; SARS-CoV-2, Bariatric Surgery, knowledge, attitudes and practices, health belief model.

Introduction

Available evidence suggests that obesity represents an independent risk factor for COVID-19 (1), and that morbid obesity (MO; i.e. body mass index ≥ 40 kg / m²) increases morbidity and mortality in individuals developing COVID-19 after SARS-CoV-2 infection (2–4). The recent availability of vaccines against COVID-19 has dramatically reduced the risk of developing both COVID-19 disease, its severe complications and long-term sequelae also in patients with MO (5). To date (i.e. September 2021) several formulates have benefited from Emergency Use Authorization from Western European and North-American Health Authorities, including innovative mRNA-based formulates (i.e. Comirnaty from Pfizer/BioNTech and Spikevax from Moderna) (6,7), and adenovirus-based formulates (i.e. Ad26.COV2.S from Janssen/Johnson & Johnson, and
Vaxzevria from Astra-Zeneca, the latter being authorized only in European Union and United Kingdom (8,9). Alongside the aforementioned formulations, other vaccines, either based on heterologous adenoviral-vectors or inactivated SARS-CoV-2 have been extensively employed in Eastern Europe, Asia and South America (e.g. Sputnik V® from Gamaleya Institut, and Coronavirus from Sinovac) (10–12).

As the available evidences suggest that vaccine efficacy outcomes are not clinically different between individuals with and without obesity (5), the use of SARS-CoV-2 vaccines in persons with obesity has been strongly advocated for MO patients. The development of these vaccines within 1 year from the inception of the pandemic has been extremely fast, and somewhat unprecedented, eliciting doubts on their safety and real-world efficacy (10,13,14), and eventually sparking a largely unexpected wave of vaccine hesitancy (15). Vaccine hesitancy (VH), i.e. the delay in acceptance or refusal of vaccine despite its availability through vaccine services (16,17), is a well-known health threat. For instance, World Health Organization (WHO) has identified VH among the top 10 threats to global Health since the 2019, well before the inception of the SARS-CoV-2 pandemic (15–18). Moreover, because of the increasing occurrence of Variants of Concerns (VoC) such as the highly contagious “infamous” Delta-variant (i.e. sub-lineage B.1.617.2), VH may hamper the global effort to achieve the very high vaccination rates nowadays required to establish herd immunity (> 80% of the population) (14,19,20).

As previous studies have suggested that MO individuals may exhibit some significant VH towards seasonal influenza vaccine (21), we evaluated the acceptance of COVID-19 vaccination among MO subjects at the beginning of the SARS-CoV-2 vaccination campaign, including both individuals in waiting list for bariatric surgery, and patients having benefited from bariatric surgery since January 2020. We investigated the possible determinants of SARS-CoV-2 VH, the perceived barriers and facilitators, and socio-demographic data.

Materials and Methods

Study Design. A cross-sectional questionnaire-based study was performed between February 1st, 2021, and April 1st, 2021, involving MO patients followed by the Reference Center for Bariatric Surgery of the University of Parma, Department of Medicine and Surgery. Since January 2020 to March 31st, 2021, a total of 97 individuals were either included in waiting list or had undergone any bariatric procedure. During periodic telephonic follow-up, all potential participants were invited to fulfill a web-based questionnaire (Google Forms; Google LLC; Menlo Park, California, CA, USA) dealing with the acceptance of SARS-CoV-2 vaccine, whose link was provided by email to individuals proving their initial consent. The online survey was chosen due to the difficulty in doing a face-to-face study amid the ongoing COVID-19 outbreak. Two investigators (CP and LB) provided to the potential participants basic information about the aims of the study. The survey was anonymous, and no personal data, such as name, IP address, email address, or personal information unnecessary to the survey, was requested, saved, or tracked. No monetary or other compensation was offered to the participants.

Questionnaire. The test–retest reliability of the questionnaire was preventively assessed through a survey on 15 medical professionals completing the questionnaire at two different points in time. The beta-testing questionnaires were excluded from the analyses. All questions were self-reported, and not externally validated. According to the health belief model (22,23), we assumed that knowledge (i.e. the awareness of official recommendations), attitudes (i.e. propensity towards vaccinations), and practices (i.e. actual uptake of vaccination; collectively KAP), and eventual acceptance of SARS-CoV-2 vaccination depended on: a) availability i.e. the actual existence of an effective vaccine; b) access to the vaccine; c) perceived health risk, which depends on the trade-off between the vaccine (i.e. occurrence and severity of potential side effects) and COVID-19 (i.e. its prevalence and severity); d) information on benefits, risks and access pathways; e) previous experience with other vaccines (particularly seasonal influenza vaccine), and exposure to diseases, as this affects risk perception; and f) sociodemographic factors including age, education level, gender and more. Therefore, the final questionnaire included the following sections:
a. **Individual characteristics**: age (arbitrarily dichotomized as < 50-year-old vs. ≥ 50-year-old), sex, educational achievement (arbitrarily dichotomized as high-school or higher vs. less than high-school), whether they or any among their relatives had received a diagnosis of COVID-19 (yes vs. no), if they had a migration background or not, main information sources (i.e. conventional media such as TV and journals, governmental web sites, new media, friends and relatives, the general practitioner, professional courses).

b. **Knowledge Test.** Participants received a knowledge test containing a set of 15 true-false statements, elaborated through extensive literature review, covering typical misconceptions about COVID-19 and SARS-CoV-2 infections (e.g. “Main complications of COVID-19 is represented by a severe respiratory syndrome”; TRUE) that was originally validated in KAP studies on COVID-19 in Italian subjects (14,24). A General Knowledge Score (GKS) was then calculated as the sum of correctly and incorrectly marked recommendations: when the participants answered correctly, +1 was added to a sum score, whereas a wrong indication or a missing/”don’t know” answer added 0 to the sum score. GKS was then dichotomized by median value in higher vs. lower knowledge status.

c. **Risk perception.** Participants were initially asked whether they perceived healthcare settings at high risk or not for SARS-CoV-2 infection, and whether they felt themselves at increased risk for COVID-19 as when compared to the general population because of their morbid obesity. The items were presented as a 5-points Likert scale (i.e. from 1 “totally disagree”, to 5 “totally agree”) and eventually dichotomized as somewhat agreeing (i.e. agree to totally agree) vs. somewhat disagreeing (i.e. totally disagree to neutral).

Then, participants were asked to rate the perceived severity (CINF) and the perceived frequency (IINF) of SARS-CoV-2 infection in the general population by means of a fully labeled 5-points Likert scale. The available options ranged from “not significant” (i.e. “of no significant concern”, score 1) to “very significant” (i.e. “of very high concern”, score 5). As perceived risk has been defined as a function of the perceived probability of an event and its expected consequences, the correspondent Risk Perception Score (RPS) was calculated as follows:

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RPS = I \times C
\]

Eventual RPS for COVID-19 was then dichotomized by median value in high (i.e. > median) vs. low risk perception (i.e. ≤ median).

d. **Attitudes and Practices.** We inquired participants about their trust in vaccines as instrumental to prevent infectious diseases, both in general and then focusing on seasonal influenza vaccine, and COVID-19 vaccines (i.e. mRNA-based vaccines, adenovirus-based vaccines, any). Similarly, a series of perceived barriers (e.g. inappropriate vaccine safety, inappropriate vaccine efficacy, etc.) and facilitators (e.g. willingness to protect him-self/herself; willingness to protect friends, relatives, etc.) were presented to the participants. All aforementioned items were presented as a 5-points fully labeled Likert scale ranging from “totally disagree” to “totally agree”, that were dichotomized as somewhat agreeing (i.e. agree to totally agree) vs. somewhat disagreeing (i.e. totally disagree to neutral). Eventually, participants were asked about their willingness to pay for a SARS-CoV-2 vaccine (i.e. should be provided for free; participation to the expenditure; up to 10€/dose; between 10 to 49€/dose; between 50 to 99€/dose; between 100 to 199€/dose; 200€ or more/dose), and whether they thought that SARS-CoV-2 vaccine should be mandatory or not.

**Data analysis.** Continuous variables were initially tested for normal distribution (D’Agostino & Pearson omnibus normality test): where the corresponding p value was < 0.10, “normal” distribution was assumed as rejected and variables were compared through Mann-Whitney or Kruskal-Wallis test for multiple independent samples, while bivariate correlations between
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around one third of all participants reported an educational achievement equals to high-school or higher (29.2%).

The most commonly reported information source on SARS-CoV-2/COVID-19 were conventional media such as journals and TV (56.9%), web sites from international and governmental agencies (54.2%), followed by new media (36.1%), the general practitioner (31.9%), friends/relatives (11.1%), and professional courses (9.7%). Of them, only 6 (8.3%) were previously diagnosed with SARS-CoV-2 infection, while 13 (33.3%) reported a diagnosis of COVID-19 among friends or relatives.

Assessment of Knowledge about SARS-CoV-2. Internal consistency coefficient amounted to Cronbach's alpha = 0.774. The overall understanding of COVID-19 among participants was particularly skewed (D'Agostino-Pearson p value ≥ 0.10) as mean GKS was generally high (after normalization: 64.35% ± 13.71; median 66.7%).

The detail on the knowledge test is provided as Annex 1.

Assessment of attitudes and practices. As shown in Table 2, the majority of respondents (83.3%) reported high or very high trust in vaccines as instrumental to prevent infectious diseases, but only 37.5% reported having been vaccinated against seasonal influenza vaccine during at least 4 of the 5 winter seasons. Focusing on COVID-19 vaccines, 65.3% of respondents acknowledged a high or even very high acceptance, that peaked to 64.9% for mRNA-based formulations, followed by inactivated formulations (61.1%), compared to 58.3% for adenovirus-based vaccines and live-attenuated ones.

Interestingly, only half of participants indicated they would pay for the vaccine, as 47.2% of respondents was unwilling to pay for vaccination, recommending that vaccine had to be provided for free. Even among individuals favorable to pay for the vaccine, in most cases it occurred as a copayment (34.7%).

The majority of respondents (52.7%) was then favorable for a mandatory status of SARS-CoV-2 vaccine, either with (8.3%) and without (44.4%) fines for hesitant, while around a third (33.3%) recommended a voluntary basis, and 9.7% were favorable to its official recommendation in high-risk subjects and/or workers.

Results

Descriptive analysis. As shown in Table 1, a total of 72 morbid obese patients (74.2% of the potentially eligible population) participated to the inquiry, 39 of them being recipient of a previous surgical procedure for bariatric surgery (54.2%). Around 1/3 of all respondents were aged 50 years or more (37.5%; mean age 45.5 ± 10.19); 72.2% were females, and 27.8% males; 12.5% of them were foreign-born individuals;
including HCWs. On the contrary, only 2 participants (2.8%) were formally against the SARS-CoV-2 vaccine, because of its allegedly unsafe profile.

**Assessment of the risk perception.** A total of 53 out of 72 respondents (73.6%) acknowledged COVID-19 as a severe disease, with a similar share of participants reporting the infection as commonly reported (79.2%), with an eventual RPS of 75.61% ± 27.98, median value 80.00% (**Figure 1b**). On the contrary, only one third of them (33.3%) reported

### Table 1. Characteristics of the 72 individuals participating into the study (39 recipients of Bariatric Surgery, 33 in waiting list).

| Variable | Total (No./72, %) | Average ± S.D. |
|----------|-------------------|----------------|
| **Demographics** | | |
| Age (years) | 45.5 ± 10.19 | |
| Age ≥ 50 years | 27, 37.5% | |
| Male sex | 20, 27.8% | |
| Educational achievement - high school or higher | 21, 29.2% | |
| Migration background | 9, 12.5% | |
| **Recipient of Bariatric Surgery** | 39, 54.2% | |
| Previous diagnosis of COVID-19? | 6, 8.3% | |
| Previous diagnosis of COVID-19 among friends/relatives? | 13, 18.1% | |
| **Information sources** | 41, 56.9% | 64.35 ± 13.71 |
| Conventional media (Journals, TV) | 41, 56.9% | |
| Governmental / Institutional web sites | 39, 54.2% | |
| New Media (blog, social media, etc.) | 26, 36.1% | |
| General practitioner | 23, 31.9% | |
| Friends, relatives | 8, 11.1% | |
| Professional courses | 7, 9.7% | |
| Knowledge Score (%) | 64.35 ± 13.71 | |
| Knowledge Score > median (66.7%) | 25, 34.7% | |

**Figure 1.** Density plots for General Knowledge Score (%) and Risk Perception Score (%). Dotted lines represent the median value for the cumulative score.
Table 2. Perceived Risk Factors, Barriers, and Facilitators towards SARS-CoV-2 vaccination among 72 individuals participating into the survey (39 recipients of Bariatric Surgery, 33 in waiting list).

| Variable                                                                 | Total (No./72, %) |
|--------------------------------------------------------------------------|-------------------|
| **Attitudes**                                                            |                   |
| Trust in vaccinations (high / very high)                                  | 60, 83.3%         |
| Regularly vaccinated with SIV (Every year / Almost every year)            | 27, 37.5%         |
| **Agreement towards vaccination**                                        |                   |
| Any formulations                                                         | 47, 65.3%         |
| Inactivated formulations                                                 | 44, 61.1%         |
| Live attenuated formulations                                              | 42, 58.3%         |
| mRNA-based formulations                                                  | 46, 63.9%         |
| Adenovirus-based formulations                                            | 42, 58.3%         |
| Would you pay for COVID-19 vaccine?                                       |                   |
| Absolutely no                                                            | 34, 47.2%         |
| Copayment                                                                | 25, 34.7%         |
| Up to 10€                                                                | 3, 4.2%           |
| 10 to 50€                                                                | 1, 1.4%           |
| 50 to 100€                                                               | 1, 1.4%           |
| 100 to 200€                                                              | 2, 2.8%           |
| > 200€                                                                   | 4, 5.6%           |
| N/A                                                                      | 2, 2.8%           |
| COVID-19 vaccine(s) should receive mandatory status?                     |                   |
| Absolutely no, against its delivery                                      | 2, 2.8%           |
| Absolutely no, free choice                                               | 24, 33.3%         |
| No, it should be reserved to high-risk subjects, including HCWs          | 1, 1.4%           |
| No, it should be reserved to high-risk subjects and people at occupational risk (not only HCWs) | 6, 8.3% |
| Yes, it should be made mandatory                                         | 32, 44.4%         |
| Yes, it should be made mandatory with fines for not compliant            | 6, 8.3%           |
| Perceived risk for COVID-19 compared to the general population           |                   |
| (high / very high)                                                       | 24, 33.3%         |
| Perceived incidence of COVID-19 (in general)                             |                   |
| (high / very high)                                                       | 57, 79.2%         |
| Perceived severity of COVID-19 (in general)                              |                   |
| (severe / very severe)                                                   | 53, 73.6%         |
| **Perceived Risk Factors**                                               |                   |
| Inappropriate use of PPE (i.e. gloves, face masks...)                    | 59, 81.9%         |
| Inappropriate use of sanitizing solutions                                 | 48, 66.7%         |
| Difficulties in obtaining appropriate PPE                                 | 14, 19.4%         |
| Difficulties in wearing PPE during the working shift                     | 46, 63.9%         |
| Inappropriate risk perception in the general population                   | 54, 75.0%         |
| Inappropriate physical distancing at workplaces                           | 41, 56.9%         |
| Collective preventive measures are inadequate                             | 24, 33.3%         |

(Continued)
a perceived higher risk for COVID-19 infection among MO individuals than among the general population. Focusing on the perceived risk factors for getting SARS-CoV-2 infection, the majority of respondents identified the inappropriate use of personal protective equipment (PPE, 81.9%), followed by the improper risk perception in the general population (75.0%), the inappropriate use of sanitizing solutions (66.7%), difficulties in wearing PPE during the whole of the working shift (63.9%). Factors such as the managing of mass transit (63.9%), the physical distancing (56.9%), and the safety of canteen, restaurants and bar (43.7%). Also the proper tracing (52.8%) and testing (48.6%) of incident cases in the general population were extensively taken in account. On the contrary, claims regarding the collective preventive measures (33.3%), environmental factors (i.e., air temperature, humidity, weather, etc.) (38.9%), the managing of workplaces’ safety (29.2%) and the availability of PPE (19.4%) were only marginally reported.

**Perceived facilitators and barriers.** Focusing on the reported facilitators towards SARS-CoV-2 vaccination (Table 3), the majority of respondents acknowledged the willingness to protect themselves (70.8%), friends/relatives (66.3%), followed by the aim of avoiding COVID-19 infection (29.2%), the desire of avoiding complication of COVID-19 (15.3%), while only 9.7% reported the perception of higher risk compared to the general population, and 2.8% the lack of confidence in alternative treatments.

Regarding the possible barriers, most of respondents identified doubts in vaccine safety (69.4%), followed by doubts on vaccine efficacy (36.1%), and lack of confidence in pharmaceutical industry (27.8%). Residual options reported were the lack of trust in vaccine disposal (2.8%), the lack of trust in national health service and its personnel, and the confidence in alternative therapies, i.e. hyperimmune plasma and hydroxychloroquine (in all cases, 1.4%). Interestingly, only 2 individuals (2.8%) dismissed the interest in SARS-CoV-2 vaccine through the denial of a higher risk associated with the morbid obesity.

**Univariate analysis.** In fact, GKS was not correlated with RPS for SARS-CoV-2 infection (R = -0.012, p = 0.92). In other words, a better knowledge status (i.e., less misconceptions and/or less personal attitudes guiding the vaccine decisions) was not associated with a greater risk perception for SARS-CoV-2 infection (Figure 2). Neither GKS and RPS were also correlated with the age of participants at the time of the survey (R = 0.76, p = 0.525 and R = 0.011, p = 0.925, respectively).

As shown in Table 4, in univariate analysis factors such as having being recipients of bariatric surgery, gender, education achievement, migration background, but also the knowledge status unrelated with a positive attitude towards SARS-CoV-2 vaccines (for all variables, p > 0.05). Information sources and personal interactions with COVID-19 did not similarly exhibit any significant association with vaccine propensity.

Interestingly, as shown in Figure 3, the share of individuals reporting a favorable attitude towards SARS-CoV-2 not only was not significantly different by the cut-off of being 50-year-old at the time of the survey (i.e. 38.3% vs. 36.0% for individuals aged 50 years or more, p = 1.000), but also remained quite consistent across the various age groups. However, all individuals ages 60 years or more exhibited a formal disagreement towards the vaccine.

| Variable                                                        | Total (No./72, %) |
|-----------------------------------------------------------------|-------------------|
| Positive patients are not properly tracked/traced/monitored      | 38, 52.8%        |
| Positive patients are not properly inquired among general population| 35, 48.6%        |
| Environmental factors                                           | 28, 38.9%        |
| Inappropriate managing of mass transits                         | 46, 63.9%        |
| Inappropriate managing of workplaces                            | 21, 29.2%        |
| Inappropriate managing of schools                               | 27, 37.5%        |
| Inappropriate managing of bar, restaurants and other food business| 31, 43.7%        |
Figure 2. Scatterplot representing the correlation between Risk Perception Score (RPS) and General Knowledge Score (GKS). No significant correlation was eventually identified in Spearman Rank correlation test ($R = -0.012; p = 0.92$).

Table 3. Perceived barriers and facilitators towards SARS-CoV-2 vaccination among 72 morbid obese individuals participating into the survey (February - April 2021).

| Variable                                           | Total (No./72, %) |
|----------------------------------------------------|-------------------|
| **Perceived Facilitators**                         |                   |
| I want to protect myself                           | 51, 70.8%         |
| I want to protect my friends/relatives              | 48, 66.7%         |
| Avoiding complications of COVID-19                 | 11, 15.3%         |
| Avoid developing COVID-19                          | 21, 29.2%         |
| I’m among high-risk groups                         | 7, 9.7%           |
| I’m not confident in alternative treatments        | 2, 2.8%           |
| **Perceived barriers**                             |                   |
| Lack of trust in vaccine safety                    | 50, 69.4%         |
| Lack of trust in vaccine efficacy                  | 26, 36.1%         |
| Lack of trust in vaccine disposal                  | 2, 2.8%           |
| Lack of trust in NHS                               | 1, 1.4%           |
| Lack of trust in Health personnel                  | 1, 1.4%           |
| I don’t belong to any at risk groups               | 2, 2.8%           |
| I’m more confident in alternative therapies, e.g. hyperimmune plasma | 1, 1.4% |
| I’m more confident in alternative therapies, e.g. Hydroxychloroquine | 1, 1.4% |
| I think that economic interests have prevailed over sanitary ones | 20, 27.8% |
Table 4. Comparison of individual factors between by attitude towards the vaccine. The comparisons were performed by means of chi squared test (with Yates’ correction because of the reduced number of individuals).

| Variable                                                  | Somewhat agree (No./47, %) | Somewhat disagree (No./25, %) | P value |
|-----------------------------------------------------------|----------------------------|-------------------------------|---------|
| Being recipient of Bariatric Surgery                      | 24, 51.1%                  | 15, 60.0%                     | 0.634   |
| Age ≥ 50 years                                            | 18, 38.3%                  | 9, 36.0%                      | 1.000   |
| Male sex                                                  | 14, 29.8%                  | 6, 24.0%                      | 0.806   |
| Educational achievement - high school or higher           | 5, 12.8%                   | 4, 12.1%                      | 1.000   |
| Migration background                                      | 14, 29.8%                  | 7, 27.0%                      | 1.000   |
| Knowledge Score > median (66.7%)                          | 17, 36.2%                  | 8, 32.0%                      | 0.925   |
| Previous diagnosis of COVID-19                            | 3, 6.4%                    | 3, 12.0%                      | 0.709   |
| Previous diagnosis of COVID-19 among friends/relatives    | 9, 19.1%                   | 4, 16.0%                      | 0.993   |
| Higher Risk Perception Score                              | 25, 52.2%                  | 10, 40.0%                     | 0.413   |
| Perceived risk for COVID-19 compared to the general population (high / very high) | 18, 38.3%                  | 6, 24.0%                      | 0.336   |
| Perceived incidence of COVID-19 (in general)              | 39, 83.0%                  | 18, 72.0%                     | 0.431   |
| Perceived severity of COVID-19 (in general)               | 39, 83.0%                  | 14, 56.0%                     | 0.028   |
| Trust in vaccinations                                     | 42, 89.4%                  | 18, 72.0%                     | 0.121   |
| Regularly vaccinated with SIV                             | 20, 42.6%                  | 7, 28.0%                      | 0.338   |
| Journal, TV                                               | 27, 57.4%                  | 14, 56.0%                     | 1.000   |
| Governmental web sites                                    | 24, 51.1%                  | 15, 60.0%                     | 0.634   |
| New Media                                                 | 17, 36.2%                  | 9, 36.0%                      | 1.000   |
| Friends, relatives                                        | 6, 12.8%                   | 2, 8.0%                       | 0.827   |
| General practitioner                                      | 16, 34.0%                  | 7, 28.0%                      | 0.796   |
| Professional courses                                      | 5, 10.6%                   | 2, 8.0%                       | 1.000   |
| Favorable attitude towards any economic contribution to be vaccinated | 32, 68.1%                  | 4, 16.0%                      | < 0.001 |
| Favorable attitude towards vaccination mandate            | 33, 70.2%                  | 5, 20.0%                      | < 0.001 |
| Being Recipient of Bariatric Surgery                      | 24, 51.1%                  | 15, 60.0%                     | 0.634   |
| Lack of trust in vaccine safety                           | 33, 70.2%                  | 17, 68.0%                     | 1.000   |
| Lack of trust in vaccine efficacy                         | 14, 29.8%                  | 12, 48.0%                     | 0.203   |
| Lack of trust in vaccine disposal                         | 2, 4.3%                    | 0, -                          | 0.770   |
| Lack of trust in NHS                                      | 1, 2.1%                    | 0, -                          | 1.000   |
| Lack of trust in Health personnel                         | 1, 2.1%                    | 0, -                          | 1.000   |
| I don't belong to any at risk groups                     | 1, 2.1%                    | 1, 4.0%                       | 1.000   |
| I'm more confident in alternative therapies, e.g. hyperimmune plasma | 1, 2.1%                    | 0, -                          | 1.000   |
| I'm more confident in alternative therapies, e.g. Hydroxychloroquine | 1, 2.1%                    | 0, -                          | 1.000   |
| I think that economic interests have prevailed over sanitary ones | 17, 36.2%                  | 3, 12.0%                      | 0.057   |
| I want to protect myself                                  | 32, 68.1%                  | 19, 76.0%                     | 0.666   |
| I want to protect my relatives                            | 32, 68.1%                  | 16, 64.0%                     | 0.930   |
| Avoiding complications of COVID-19                        | 6, 12.8%                   | 5, 20.0%                      | 0.640   |

Table 4 (Continued)
| Variable                                      | Somewhat agree (No./ %) | Somewhat disagree (No./ %) | P value |
|----------------------------------------------|-------------------------|---------------------------|---------|
| Avoid developing COVID-19                   | 13, 27.7%               | 8, 32.0%                  | 0.910   |
| I’m among high-risk groups                   | 6, 12.8%                | 1, 4.0%                   | 0.437   |
| I’m not confident in alternative treatments  | 2, 4.3%                 | 0, -                      | 0.770   |

Figure 3. Attitude towards SARS-CoV-2 (i.e. agreement vs. disagreement) by age group. No significant difference was identified, even though all (n = 4) participants aged 60 years or more at the time of the survey were not favorable towards SARS-CoV-2 vaccine.

Even though individuals reporting higher vaccine propensity more frequently acknowledged COVID-19 as a severe / highly severe disease (83.0% vs. 56.0%, p = 0.028), also cumulative scores (i.e. GKS and RPS) were not significantly associated with the agreement towards receiving SARS-CoV-2 vaccine.

On the contrary, the acceptance of SARS-CoV-2 vaccine was strongly associated with a favorable attitude for providing an economic contribution for the vaccine (68.1% vs. 16.0%), and promoting vaccination mandate (70.2% vs. 20.0%; p < 0.001 for both statements).

**Multivariate analysis.** As reporting any trust in vaccination, and the belief that economic interests have prevailed over sanitary ones in promoting vaccination campaigns were associated with a favorable attitude towards vaccination with a p value < 0.2 (i.e. p = 0.121 and p = 0.057), Multivariate Analysis eventually (Table 5) included the following explanatory variables: reporting any trust in vaccinations, perceiving COVID-19 as a severe / very severe disease, being favorable towards contributing to the expenses (either totally or partially) for the vaccine, being favorable towards a vaccination mandate, and believing on economic interest as prevalent over sanitary ones.

In fact, multivariate analysis identified as strong predictors for a favorable attitude towards SARS-CoV-2 vaccines reporting a favorable attitude
both towards any economic contribution to be vaccinated (aOR 5.873, 95%CI 1.426 to 23.456) and towards a vaccination mandate (aOR 7.902, 95%CI 1.996 to 31.444).

Discussion

Our cross-sectional study on a small sample of MO individuals identified a mixed attitude towards SARS-CoV-2 vaccines, as around 35% of the total respondents exhibited either VH of vaccine resistance (i.e. substantial refusal of the vaccination, despite formal recommendations or even requirements). Even though no specific effectors were eventually identified among individual characteristics, participants with a proactive attitude towards SARS-CoV-2 vaccine were not only favorable to contribute to the expenses for the vaccination (aOR 5.873, 95%CI 1.426 to 23.456), but also more likely to promote vaccination mandate (aOR 7.902, 95%CI 1.996 to 31.444).

VH is a complex phenomenon. According to the 5C model, it depends on the confidence in vaccine safety and efficacy, complacency (i.e. inappropriate perception of personal risk and disease severity), convenience (i.e. easy access to vaccines and vaccination centers), appropriate communication that avoids misinformation and disbeliefs, and eventually context (including ethnicity, religion, occupation, and socioeconomic status of the recipients) (25–27). As for its determinants, it is also a dynamic process, particularly when dealing with SARS-CoV-2 vaccines (16,17,27–30): any variation in the perceived safety/efficacy profile, in the availability of appropriate information on vaccine, and on the various variables affecting vaccine availability (e.g. costs, characteristics of vaccination centers, etc.) in turns affects the individual acceptance of vaccines. As the ongoing pandemic is characterized by sudden and unforeseeable events (e.g. the emergence of more infectious VoC, the claims for vaccine-related side effects, etc.), also estimates for VH have been quite variables since the inception of mass vaccination campaign, with striking heterogeneities among various population groups (14,18,24,25,31–34). As a consequence, our results – despite their potential significance, should be cautiously assessed.

Table 5. Multivariate analysis of factors associated with the outcome variable of being somewhat favorable towards COVID-19 vaccination. The association is reported as adjusted odds ratios (aOR) with the correspondent 95% confidence intervals (95%CI) whose calculation was performed by means of binary logistic regression analysis of all factors that in univariate analysis were associated with the outcome variable with a p < 0.2.

| Variables                                             | Being somewhat favorable towards COVID-19 vaccine |
|-------------------------------------------------------|--------------------------------------------------|
| Trust in vaccinations                                  | aOR 1.082 95%CI 0.211; 5.539                      |
| Perceived severity of COVID-19 (severe / very severe) | aOR 2.874 95%CI 0.703; 11.749                      |
| Favorable attitude towards any economic contribution to be vaccinated | aOR 5.783 95%CI 1.426; 23.456                      |
| Favorable attitude towards vaccination mandate        | aOR 7.920 95%CI 1.995; 31.444                      |
| I think that economic interests have prevailed over sanitary ones | aOR 0.233 95%CI 0.042; 1.278                      |

Our survey was performed at the beginning of the mass vaccination campaign, before the availability of real-world data on healthcare workers had shown the substantial efficacy of the authorized vaccines in averting SARS-CoV-2 infections and, mostly, its severe outcomes. According to the health belief model, a person’s willingness to change their health behaviors (i.e. accepting the SARS-CoV-2 vaccine) is primarily due to their health perceptions (22,35), and a subsequent lack of confidence on vaccine efficacy may have therefore affected the study participants. For the same reason, the relatively large approval of the vaccine among the respondents should be inferred as an emotive reaction to the constraints of the pandemic, and on its destructive impact on the daily life (36,37). In a previous survey, it was suggested that MO individuals, being aware of the higher risk profile towards the dismal consequences of SARS-CoV-2 infection, did extensively rely on physical
distancing and associated non-pharmaceutical interventions (1). Therefore, the vaccine may have benefited from an irrational acceptance, as a way to quickly have back the “old normality”. Not coincidentally, neither risk perception nor knowledge status were associated with a better acceptance of SARS-CoV-2 vaccines, suggesting the prevalence of other factors.

For instance, when the participants were inquired about the main facilitator towards SARS-CoV-2 vaccine, the majority of respondents focused on the willingness to achieve a “protection” against the pathogen, and to similarly protect friends and relatives. On the contrary, a more rational factor, such as avoiding a disease that was otherwise perceived as somewhat severe was not acknowledged among the main drivers for vaccine acceptance. Collectively, such results further stress the importance of emotive drivers, that may be quite difficult to be ascertained through the health belief model, that provided the blueprint for our study.

Eventually, the strong association between vaccination acceptance and vaccination mandate on the one hand, acceptance of some expense to be provided with the vaccine on the other hand, suggests that the acceptance of vaccine should be rather interpreted as the acceptance of vaccination campaign as a whole. Likewise, vaccine hesitant individuals are often involved in the spreading of misbeliefs and false fears on vaccines, individuals with a positive attitude towards vaccine may be in turn involved in interventions aimed to improve vaccination rates, particularly in selected population such as among morbid obese individuals (17,28,38,39). The contribution of patients having a similar backstory, sharing a somewhat consistent personal background, has the potential to intervene on the very same emotive drivers that our research has identified as possibly prevalent in promoting vaccine acceptance.

**Limits of this study.** Despite the potential interest, our study was affected by several limitations. Firstly, we were able to recruit a very small study population, whose representativity and subsequent generalizability of our results must be questioned. Second, participants filled the questionnaire as a web-based survey. Even though two of the researchers were preventively made available to assist the participants to fulfill the questionnaire, such approach has potentially caused a further self-selection of the respondents, with an over-representation of individuals having a better literacy and familiarity with new media (14,40–42). Third, as for much of the COVID-19 international literature, our study captured a very limited timeframe in a quickly evolving landscape. As suggested by several studies on VH, the share of vaccine hesitant individuals in the general population is continuously and rapidly fluctuating (18,31–34,36,43–45), with the obvious consequences on the studies attempting their assessment.

**Conclusions**

In conclusion, our study suggests that around one third of the MO individuals among potential recipient of bariatric surgery may exhibit some significant VH. As individuals affected by morbid obesity are at high risk to develops severe consequences of SARS-CoV-2 infection, such data confirm the importance of appropriate and properly tailored interventions. In this regard, our study suggests that a rational approach may fail to capture and address VH in this specific subset of individuals. On the other hand, the involvement of MO patients highly favorable to SARS-CoV-2 vaccine may more properly address the emotive factors underlying the vaccine acceptance in these individuals.

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Annex 1. Knowledge test: response distribution of presented items proposed to the 72 morbid obese individuals participating in the survey and contributing to the assessment of General Knowledge Score (GKS) (Cronbach's Alpha = 0.774).

| Statement                                                                 | CORRECT ANSWER | No., %         |
|----------------------------------------------------------------------------|----------------|----------------|
| 1. More severe cases of COVID-19 occur in subjects ≥ 65 y.o. subjects and/or affected by comorbidities | TRUE           | 53 (73.6%)     |
| 2. Main complication of COVID-19 is represented by respiratory distress syndrome | TRUE           | 58 (80.6%)     |
| 3. Present-day case-fatality-ratio of COVID-19 in Italy …                  |                |                |
| … is greater than 1 out of 10 affected cases (> 10%)                      | FALSE          | 2 (2.8%)       |
| … accounts to 1 out of 10 affected cases (~10%)                           | FALSE          | 19 (26.4%)     |
| … accounts to 1 out of 100 affected cases (~1%)                           | TRUE           | 28 (38.9%)     |
| … accounts to 1 out of 1000 affected cases (~0.1%)                        | FALSE          | 6 (8.3%)       |
| … still remains unknown                                                   | FALSE          | 6 (8.3%)       |
| 4. At the end of December 2020, the number of COVID-19 cases diagnosed in Italy accounted to… |                |                |
| … less than 1,000                                                        | FALSE          | 1 (1.4%)       |
| … between 10,000 and 100,000 individuals                                  | FALSE          | 9 (12.5%)      |
| … between 100,000 and 500,000 individuals                                | FALSE          | 16 (22.2%)     |
| … between 500,000 and 1,000,000 individuals                              | TRUE           | 21 (29.2%)     |
| … over 1,000,000 individuals                                              | FALSE          | 8 (11.1%)      |
| 5. The virus causing COVID-19 is a pathogen quite similar to              |                |                |
| … HIV                                                                     | FALSE          | 1 (1.4%)       |
| … measles virus                                                          | FALSE          | 1 (1.4%)       |
| … influenza virus                                                         | FALSE          | 17 (23.6%)     |
| … SARS virus                                                             | TRUE           | 42 (58.3%)     |
| 6. The pathogen causing COVID-19 is transmitted through running water    | FALSE          | 50 (69.4%)     |
| 7. All cases infected by the pathogen develop COVID-19 symptoms           | FALSE          | 62 (86.1%)     |
| 8. SARS-CoV-2 is efficiently transmitted by cough                        | TRUE           | 67 (93.1%)     |
| 9. SARS-CoV-2 is mainly transmitted by contaminated blood                 | FALSE          | 31 (43.1%)     |
| 10. An efficient vaccine against COVID-19 has been made available in Italy | TRUE           | 46 (63.9%)     |
| 11. Infections by the new Coronavirus cannot be asymptomatic             | FALSE          | 62 (86.1%)     |
| 12. An efficient and etiologic treatment for COVID-19 has been made available | FALSE          | 43 (59.7%)     |
| 13. Latency of COVID-19 may reach 14 days                                 | TRUE           | 57 (79.2%)     |
| 14. Gold standard for diagnosis of COVID-19 is represented by Real-Time quantitative Polymerase Chain reaction on nasal swabs | TRUE           | 67 (93.1%)     |
| 15. Hand washing reduces the risk for developing COVID-19                 | TRUE           | 67 (93.1%)     |