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Original article

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 / m^2) 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 formulates, 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 Coronavac 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 sparkling 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 then 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 (C^{INF}) and the perceived frequency (I^{INF}) 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 concer*n", 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:

$$RPS = I \times C \quad (1)$$

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 though 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

continuous variables were compared through Spearman's rank test. On the other hand, variables passing the normality check (D'Agostino & Pearson p value ≥ 0.10) were compared using the Student's t test or ANOVA, and through Peasons's correlation test where appropriate. Categorical variables were reported as per cent values, and their distribution in respect of the outcome variable of being somewhat favorable towards a SARS-CoV-2 vaccine was initially analyzed through chi-squared test. All categorical variables that at univariate analysis were associated with a positive attitude towards being recipient for any SARS-CoV-2 vaccine with a p value < 0.2) were included in a stepwise binary logistic regression analysis model in order to calculate adjusted odds ratios (aOR) and their respective 95% confidence intervals (95%CI). All statistical analyses were performed by means of IBM SPSS Statistics 24.0 for Macintosh (IBM Corp. Armonk, NY).

Ethical Considerations. Before giving their consent to the survey, participants were briefed that all information would be gathered anonymously and handled confidentially. Participation was voluntary, and the questionnaire was collected only from subjects who had expressed consent for study participation. Identification of individual participants by means of the presented material is impaired by the lack of personal data such as the community of residence, the precise occupational setting, etc. Because of the anonymous, observational design, the lack of clinical data about patients, as the study did not configure itself as a clinical trial, a preliminary evaluation by an Ethical Committee was not required, ac-cording to the Italian law (Gazzetta Ufficiale no. 76, dated 31/3/2008).

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; 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 = 0.006; Figure 1a), 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 formulates, followed by inactivated formulates (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,

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		
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%	

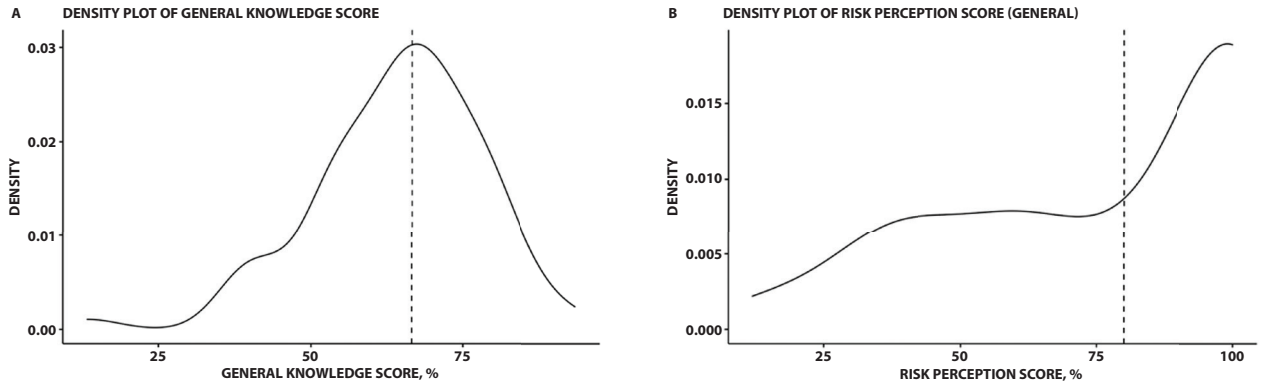

Figure 1. Density plots for General Knowledge Score (%) and Risk Perception Score (%). Dotted lines represent the median value for the cumulative score.

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	39, 54.2%
Any formulates	47, 65.3%
Inactivated formulates	44, 61.1%
Live attenuated formulates	42, 58.3%
mRNA-based formulates	46, 63.9%
Adenovirus-based formualtes	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)

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%

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.

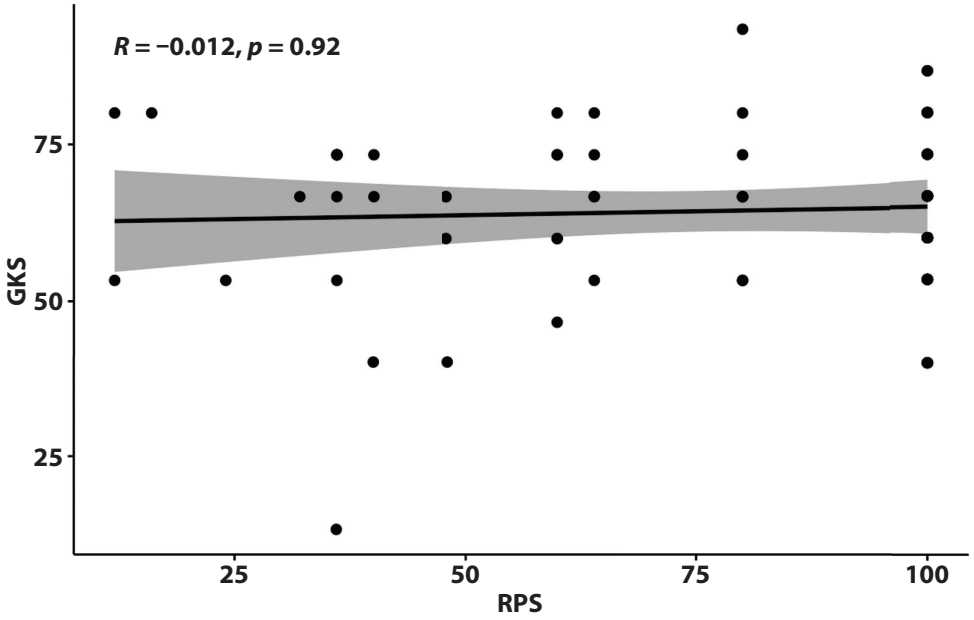

Figure 2. Scatterplot representing the correlation between Risk Perception Score (RPS) and General Knowledge Score (GKS). No significant correlation was eventually identified in Spearman Rank correlation test (R = -0.012; p = 0.92).

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 schoool 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) (high / very high)	39, 83.0%	18, 72.0%	0.431
Perceived severity of COVID-19 (in general) (severe / very severe)	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./47, %)	Somewhat disagree (No./25, %)	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

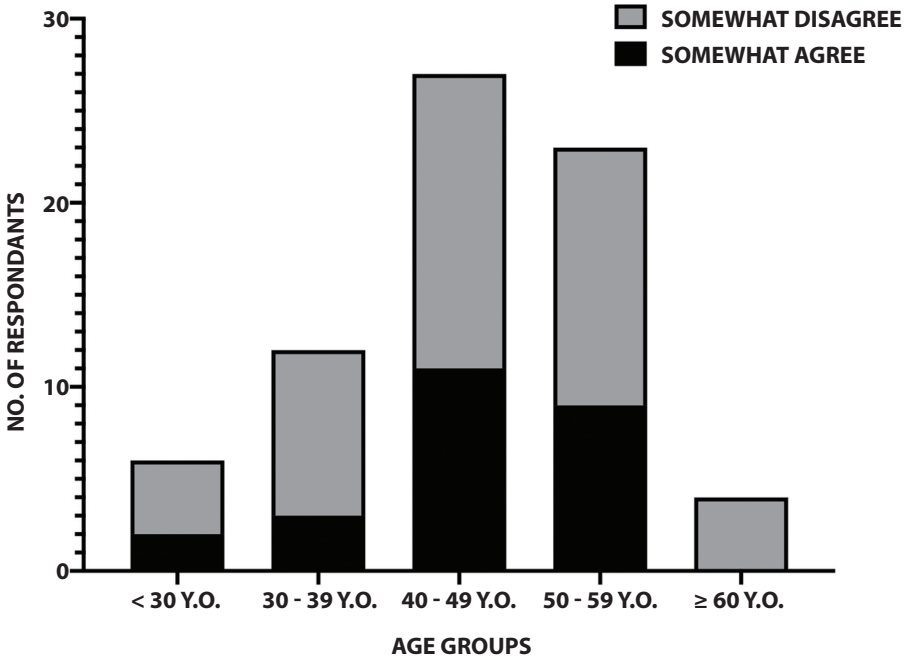

Figure 3. Attitude towards SARS-CoV-2 (i.e. agreement vs. disagreement) by age group. No significant difference was identified, even though all (n = 4) participants aged 60 years or more at the time of the survey were not favorable towards SARS-CoV-2 vaccine.

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

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

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.

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-pharmaceutic 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%)