**Preventative Health Behaviors, BMI, and COVID-19 among Religiously Diverse Adults in Israel**

**Abstract**

This study aimed to examine the relationships between perceived health risks, health behaviors, and obesity among religiously diverse adults in Israel during the COVID-19 pandemic. An online cross-sectional questionnaire based on the Health Belief Model was conducted among 636 adults in Israel, of whom 69.1% were Jewish, 26.5% were Muslim and 4.4%, were “other.” Jewish adults scored lower than Muslim and other adults on perceived personal risk (p<0.001), risk of infection spread (p<0.001), and engagement in preventative behaviors (p<0.005). Higher BMI predicted higher personal risk and subsequently predicted a higher likelihood of engaging in preventative behaviors (p<0.001). Healthcare providers of religiously diverse populations should consider the influence of religion on health practices and recommend lifestyle modification.

Key words: Preventive health behaviors, COVID-19, BMI, Religious Diversity

**Introduction**

The COVID-19 pandemic exacerbated health risks for adults around the world, especially for those with comorbidities. The severity of infection and COVID-19-related mortality have been positively correlated with excessive body weight (Rychter et al., 2020; Arbel et al., 2022). The World Health Organization (WHO) classifies obesity excessive body weight as a body mass index (BMI) of at least 30 kg/m2. The risks associated with COVID-19 are exacerbated by the increasing global prevalence of obesity, which almost tripled between 1975 and 2016, with current estimates suggesting that more than 2 billion people suffer from excessive body weight (Smith & Smith, 2016). Obesity is the fifth leading cause of death in the world and has been steadily increasing among people of all ages in developed and developing countries, increasing risks of morbidity and mortality as well as causing a heavy economic burden (Lubrano et al., 2013; Safaei et al., 2021; Smith et al., 2021). In Israel, half of the population is reported to be overweight (Central Bureau of Statistics, 2018).

Comorbidity illnesses are associated with higher-severity cases of COVID-19, with an identified link between coordinated immune system response to risk factors such as obesity and diabetes (Yu et al., 2021; Samuels, 2020; Petrakis et al., 2020). In a case series study in New York, researchers found a higher prevalence of obesity (41.7%) among 5,700 hospitalized patients with COVID‐19 (Richardson et al., 2020). Similarly, the rate of severe COVID-19 infections was significantly higher among obese adults compared with the general adult population in France (Caussy et al., 2020) and in China, consequently extending the duration of hospital stays (Gao et al., 2020).In Israel, researchers found multiple risk factors, including hypertension and obesity that increase the risk of complications (Yanover et al., 2020).

By January 2021, there were more than 8,000 new COVID-19 cases daily in Israel, with over 1,000 defined as severe infections and a total of 3,495 COVID-19-related deaths, with differences based on religious background (Ministry of Health Israel, 2021). The relative number of COVID-19 patients with serious infection in Israel has been highest among the Muslim population throughout the pandemic (Birenbaum-Carmeli & Chassida, 2021; Haklai et al., 2021). Correspondingly, COVID-19 mortality rates in Israel were higher among Muslim adults compared to Jewish adults (3.6 versus 2.6 per 100,000) (Avner & Schwartz, 2021). A systematic review found that being part of a religious community influenced the spread and containment of COVID-19, demonstrating that religion is a social determinant of health (Lee et al., 2021). As such, it is imperative to consider religion when addressing public health behaviors and outcomes.

In Israel, the overall composition according to self-reported religion is: Jewish 74%, Muslim 21%, and “other” (includes Christian, Druze, and no religion) 4.9% (Central Bureau of Statistics, 2020). Despite having access to universal health insurance and advanced healthcare services in Israel (Muhsen et al, 2017), Muslim adults experience limited accessibility to health information and supplementary health insurance (Chernichovsky et al., 2017). Compared to Jewish adults, Muslim adults have higher rates of chronic conditions including diabetes, hypertension (Daoud et al; 2018; Levin-Zamir et al., 2016 ; Sharkia et al., 2019), smoking, and obesity (Muhsen et al. 2017).

Overall, religious belief systems promote health behaviors that support life (Al-Jayyousi & Myers-Bowman, 2022; Milstein et al., 2020; Teman et al., 2016). During the COVID-19 pandemic, many religious communities were faced with a paradox, to rely on the guidance of religious leaders or to heed the recommendations of scientists and public health specialists (WHO, 2020). While there was often concordance between the religious leaders and scientists, there were also situations in which they differed. There was also lack of agreement between the different Muslim populations in the world, while some communities supported restrictions and preventive practices, while others disagreed with the recommendations (Piwko, 2021). Similarly, Jewish communities faced challenges regarding lack of consensus regarding COVID-19 precautions (Vanhamel et al., 2021) as did Christian communities (Corcoran et al., 2021; Osei-Tutu et al., 2021).

In light of the increased risk of severe COVID-19 infection among adults with comorbidities, the Health Belief Model (HBM) can serve as a health behavioral framework to explain the adoption of preventive measures among adults with obesity (Jones et al., 2016). The HBM posits that individuals who fear negative health outcomes such as COVID-19 infection will engage in optimal behavior changes. Research has shown that non-pharmaceutical interventions can help mitigate the spread of infection, including hand washing with antiseptic soap, use of alcohol-based hand sanitizer, wearing a face mask, physical distancing, isolation, and quarantine (Ayenigbara et al., 2020). Risk reduction measures require individual and community level participation and are instrumental in pandemic containment (Adhikari et al., 2020; Lao et al., 2021). The HBM has shown adequate utility in the prediction of health behaviors (Araban et al., 2017; Costa, 2020; Shitu et al., 2022), particularly regarding health promotion and risk reduction activities during the COVID-19 pandemic (Chertok, 2020). The recommendation to socially isolate to reduce the risk of COVID-19 infection is an external cue, prompting behavior modification (Wise et al., 2020).

According to the HBM, people are more likely to take preventive measures against COVID-19 if they perceive the threat of contracting the infection to be serious, feel they are personally susceptible to the infection, have the confidence to execute the recommended preventive actions, and perceive that there are fewer costs than benefits to engaging in preventive measures (Shitu et al., 2022). Therefore, identifying the factors influencing acceptance of or resistance to COVID-19 protective measures is important for understanding the effectiveness of public health policies and avoiding or reducing non-adherence to the proposed social controls. The purpose of this study was to examine the association between preventive health behaviors, sociodemographic factors, and obesity among religiously diverse adults in Israel during the COVID-19 pandemic.

**Methods**

A cross-sectional study was conducted using an anonymous online questionnaire. The questionnaire was developed based on the HBM and included 38 statements on perceptions of health behavior, obesity, and COVID-19. One section included questions about the degree of consent on a Likert-like response scale (with 1 = lowest and 10 = highest). The second part of the survey comprised statements regarding feelings and opinions associated with COVID-19 and obesity. A set of 11 questions was developed based on the model’s constructs concerning the perceived risk of COVID-19 infection, personal risk, risk of spreading the infection, and preventive behaviors, measured on a scale of 1 = lowest and 10 = highest (Table 1). Sociodemographic questions included a question about religious-cultural affiliation, defined as Jewish, Muslim, and “other” (which included Christian, Druze, and no religion). An overall Cronbach’s alpha was calculated for the tool (Rosenstock et al., 1988). Once fully formed, the online questionnaire was sent to 10 health profession colleagues (whose responses were excluded from the survey results) for feedback, following which minor adjustments were made. Institutional review board approval was granted by the author’s academic institution prior to initiation of the study. Participants had to confirm informed consent prior to answering the online survey.

**Sample**

The sample population was comprised of adult residents of Israel who were at least 18 years of age, fluent in Hebrew, and could participate in the online survey via smartphone or computer. Participants were recruited through snowball sampling and through the distribution of a link to the questionnaire that was circulated among social media networks of healthcare professionals around Israel via email, WhatsApp, and Facebook, with a request to forward the link to patients. The survey was conducted between December 2020 and January 2021, immediately prior to COVID-19 vaccinations being made available to the general adult population in Israel.

**Analytic Strategy**

Data analysis was conducted using IBM SPSS Statistics Version 28. The alpha level was set at 0.05 for all statistical tests. First, differences in background variables by BMI (< 30 versus ≥ 30) were analyzed. An independent samples t-test was used for age and an χ2 test was used to measure independence for categorical variables. An exploratory factor analysis with principal component extraction and varimax rotation was conducted to determine the factor structure of the questionnaire. The number of factors was based on the criteria of an eigenvalue > 1, a scree plot and parallel analysis, and Velicer’s minimum average partial test (O’Connor, 2000). A reliability analysis was conducted using Cronbach’s alpha. Independent samples t-tests or one-way analysis of variance (ANOVA) were used to compare study variables by background variables, and zero-order correlations were performed to examine associations between study variables. Serial mediation was analyzed via the PROCESS macro for SPSS (Model 6; Hayes, 2022). This analysis included BMI as an independent variable, personal risk and risk of spreading infection as mediators (in serial), and preventive behaviors as the outcome, controlling for being a healthcare worker, gender, religion, and comorbidity. Based on 5,000 bootstrap samples of the data, percentile confidence intervals (CI) were estimated for the indirect effects.

**Results**

The sample was comprised of 635 adults in Israel, of whom 84.1% (*n* = 534) had a BMI of less than 30 and 15.9% (*n* = 101) had a BMI of 30 or greater. There were 484 women (71.2%) and 181 men (28.8%); 436 were Jewish (69.1%), 167 (26.5%) were Muslim, and 28 identified as “other” (Christian, Druze) (4.4%). Participants with a BMI of 30 or greater were older, more likely male, lacking an academic education, and with comorbidity compared to participants with a BMI lower than 30 (Table 1).

[Insert Table 1 here]

The overall Cronbach’s alpha for the tool was 0.74. The exploratory factor analysis of the 11 items resulted in 3 factors, which explained almost 70% of the variance. According to the content of the items, Factor 1 was described as preventive behaviors (α = 0.89), Factor 2 as the perceived risk of infection spread (α = 0.78), and Factor 3 as perceived personal risk of infection (α = 0.73), with satisfactory reliability results (Table 2).

[Insert Table 2 here]

Differences in the factors by gender demonstrated that compared to males, females scored higher for preventive behaviors (7.93 ± 1.86 versus 8.38 ± 1.82, *p* = 0.006). Participants with comorbidities scored higher for personal risk (5.98 ± 1.88 versus 4.83 ± 1.95, *p* < 0.001) and preventive behaviors (8.65 ± 1.33 versus 8.18 ± 1.88, *p* = 0.004). Healthcare workers scored higher than non-healthcare workers in terms of perceived risk of infection spread (7.27 ± 1.67 versus 6.88 ± 1.73, *p* = 0.004) and personal risk (5.23 ± 1.98 versus 4.74 ± 1.95, *p* = 0.002). BMI was positively correlated with perceived personal risk (*r*(633) = 0.17, *p* < 0.001) and preventive behaviors (*r*(633) = 0.09, *p* = 0.030). Personal risk was positively correlated with risk of infection spread (*r*(633) = 0.41, *p* < 0.001) and preventive behaviors (*r*(633) = 0.16, *p* < 0.001). Risk of infection spread was positively correlated with preventive behaviors (*r*(633) = 0.32, *p* < 0.001) (Table 3). Regarding religious affiliation, there were significant differences for all three factors. Post-hoc analysis using Tukey's HSD indicated that Jewish participants scored lower on all three factors compared to Muslims but did not differ from participants of other religious affiliation. Muslims also scored higher on risk of infection spread compared to participants of other religious affiliation (Table 4).

[Insert Table 3 here]

[Insert Table 4 here]

As presented in the mediation analysis model (Figure 1), the path from BMI to personal risk was positive and significant, as were the paths from personal risk to risk of infection spread and from risk of infection spread to preventive behaviors. The paths from BMI to risk of infection spread and to preventative behaviors and the path from personal risk to preventive behaviors was non-significant. Bootstrapping for the serial indirect effect revealed significant results (*B* = 0.01, *SE* = 0.003, bootstrapped 95% CI: 0.002, 0.012). As expected, a higher BMI predicted higher personal risk, which in turn predicted a greater risk of infection spread, which subsequently predicted greater preventive behaviors (Figure 1).

[Insert Figure 1 here]

**Discussion**

Findings from this study indicate that BMI was correlated with perception of personal risk and preventive behaviors. This is consistent with previous population-based findings in Israel has found an increased risk of serious COVID-19 infection and complications among adults with obesity (Muhsen et al. 2017). Adults with obesity had a high likelihood of perceiving a risk of being infected with COVID-19, influencing their increased concern about preventive behaviors. This relationship was found to be significant even after controlling the data for sex, religion, profession, and comorbidities, highlighting the influence of obesity on concern about COVID-19. Similar to previous findings, the results of the current study showed a link between preventive behaviors and COVID-19 infection, as well as a link between BMI and a serious illness (Samuels, 2020; Petrakis et al., 2020), but the effect of being overweight on the perception of the risk of COVID-19 infection and preventive behaviors was not investigated in the earlier studies. Similarly, adults with other comorbidities including cardiac, blood vessel, and respiratory diseases perceived they had a higher risk of infection and were more attentive to preventive behaviors.

Regarding religion, Jewish participants attributed less importance to preventive behaviors than Muslim participants. Differences were also found in the perception of risk, as Muslims were more concerned with the risk of infection, which may have influenced their engagement in preventive behaviors. Concern regarding COVID-19 may be related to the higher mortality rate among Muslim adults compared to Jewish adults in Israel (Avner & Schwartz, 2021). Researchers found disparities in adherence to COVID-19 guidelines between Muslim and Jewish adults, which appear to be related to a lack of trust in the government and Ministry of Health guidelines (Shibli et al., 2022). Moreover, an online survey among Muslim adults in Israel showed that mistrust in the government and a lack of perceived risk about the severity of COVID-19 increased the likelihood of Muslim adults not complying with recommendations (Ali-Saleh & Obeid, 2022). These findings point to the importance of examining levels of trust among minority populations.

Differences according to gender demonstrated that compared with males, female participants had a higher likelihood of perceiving the importance of engaging in preventive behaviors. Our findings are consistent with previous studies showing that compared to males, females were more likely to engage in preventative behaviors including hand hygiene, wearing a face mask, physical distancing, isolation, and quarantine (Chang, 2020; Dev et al., 2022). In contrast, researchers in India found that women were less cautious and showed less awareness than men regarding the consequences of COVID-19, due to a lack of education (Pinchoff et al., 2020). Understanding differences in health behavior based on sex is important, as men tend to suffer from more severe COVID-19 infections and exhibit higher mortality than women (Global Health 5050, 2020; Xie et al., 2020; Connor et al., 2020).

Healthcare workers’ perceived risk of infection spread and personal risk were significantly greater compared with these perceptions among non-healthcare workers. Healthcare workers also understood the risks of transmitting infection and engaged in more health behaviors compared with non-healthcare workers, similarly noted in previous research (Houghton et al., 2020; Gesser-Edelsburg et al., 2020). Healthcare workers were active members of the health system preparation and management of the pandemic. These preparations included expanding physical and human resources to enhance the potential for providing high-level and more intense care. Healthcare workers were also educated in the importance of preventing the transmission of infection, which was apparent from their greater knowledge scores compared with those of non-healthcare workers.

This study was conducted prior to the COVID-19 vaccinations being made available to the public, when fear of COVID-19 was high and prevention was limited to non-pharmaceutical interventions. The questionnaire was distributed at a time of global uncertainty, isolation, restrictions, and evolving health recommendations. As in many countries, Israel established expert teams, promoted public health messages, and supplied information to the public. However, perspectives about the virus, its prevention, and its treatment were debated, posing a challenge to public health professionals. Furthermore, as rates of obesity in Israel are increasing and more than half of the population now considered overweight (Zhongming & Wei, 2019), the risk of COVID-19 morbidity is elevated, highlighting the importance of adherence to preventive behaviors.

**Limitations**

Limitations of this research include the online and snowball sampling recruitment methods which may increase the risk of sampling bias that might not represent the wider target population and the self-reporting nature of the survey which may increase the risk of response bias. The survey inquired into perceived importance of health behaviors without verification of engagement in the behaviors. Recommendations for future research include repeating the survey using purposive sampling and other means of recruitment to ensure representation of a religiously diverse population and conducting a longitudinal study to examine changes over time.

**Conclusions**

This study identified factors associated with the adherence to COVID-19 preventive behaviors among religiously diverse populations of adults in Israel with particular attention being paid to BMI status. The results suggest that with increasing obesity, the risk of serious COVID-19 infection and the associated complications appear to motivate overweight adults to engage in numerous ways of preventing infection. In light of the complex relationship between religion, perceptions, and adherence to preventive practices in COVID-19, it is imperative that healthcare providers understand their patients’ diverse religious backgrounds and identify the patient’s religious beliefs. Ultimately, healthcare providers who employ this form of foresight offer an increased potential to maximize the effectiveness and success of treating patients with various interventions. Here, it has been shown that HBM can be advantageous in predicting optimal health behavior changes and examining the associations between preventive health behaviors and obesity among religiously diverse adults in Israel.

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**Table 1.** Sample characteristics according to BMI status (N = 635)

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|   |   |   | **Body Mass Index (kg/m2)** |   |   |
|  | **Total sample** | **< 30** | **≥ 30** |  |  |
| **Variable** | **(*N* = 635)** | **(*n =* 534)** | **(*n =* 101)** |  |  |
| **A. Continuous** | ***M*** | ***SD*** | ***M*** | ***SD*** | ***M*** | ***SD*** | ***p*** | ***d*** |
| Age (Years) | 37.94 | 14.07 | 37.17 | 13.97 | 41.94 | 14.00 | 0.002 | -0.34 |
| **B. Categorical** | ***n*** | **%** | ***n*** | **%** | ***n*** | **%** | ***p*** |  |
| Gender |  |  |  |  |  |  | .009 |  |
|  Male | 181 | 28.8% | 142 | 26.7% | 39 | 39.8% |  |  |
|  Female | 448 | 71.2% | 389 | 73.3% | 59 | 60.2% |  |  |
| Family status |  |  |  |  |  | .198 |  |
|  Married/Living with partner | 403 | 63.7% | 333 | 62.6% | 70 | 69.3% |  |  |
|  Other | 230 | 36.3% | 199 | 37.4% | 31 | 30.7% |  |  |
| Education |  |  |  |  |  |  | .026 |  |
|  Academic | 486 | 76.9% | 417 | 78.5% | 69 | 68.3% |  |  |
|  Other | 146 | 23.1% | 114 | 21.5% | 32 | 31.7% |  |  |
| Religion |  |  |  |  |  |  | .754 |  |
|  Jewish | 436 | 69.1% | 366 | 68.9% | 70 | 70.0% |  |  |
|  Muslims | 167 | 26.5% | 140 | 26.4% | 27 | 27.0% |  |  |
|  Other | 25 | 4.4% | 25 | 3.0% | 3 | 3.0% |  |  |
| Healthcare worker |  |  |  |  |  | .795 |  |
|  No | 303 | 47.7% | 256 | 47.9% | 47 | 46.5% |  |  |
|  Yes | 332 | 52.3% | 278 | 52.1% | 54 | 53.5% |  |  |
| Comorbidity a |  |  |  |  |  | < .001 |  |
|  No | 532 | 84.4% | 462 | 87.2% | 70 | 70.0% |  |  |
|  Yes | 98 | 15.6% | 68 | 12.8% | 30 | 30.0% |  |  |
| Region in Israel |  |  |  |  |  | .501 |  |
|  North | 142 | 25.3% | 120 | 25.5% | 22 | 23.9% |  |  |
|  Sharon | 154 | 27.4% | 129 | 27.4% | 25 | 27.2% |  |  |
|  Center | 134 | 23.8% | 108 | 23.0% | 26 | 28.3% |  |  |
|  Jerusalem | 92 | 16.4% | 76 | 16.2% | 16 | 17.4% |  |  |
|  South | 40 | 7.1% | 37 | 7.9% | 3 | 3.3% |   |   |
| *Note.* Data were missing for 4 cases for age:a Blood pressure, heart disease, respiratory disease and/or asthma. |

**Table 2.** Results of exploratory factor analysis based on the COVID-19 risk perception questionnaire (N = 623)

|  |  |  |  |
| --- | --- | --- | --- |
| **Item** | **Preventive behaviors** | **Risk of infection spread** | **Personal risk** |
| How much do you think that you are personally at risk of getting infected? |  |  | .81 |
| How much do you think that you are personally at risk of severe infection? |  |  | .83 |
| How much do you think that members of your home are at risk of getting infected? |  |  | .68 |
| How serious is the overall risk in your community of the spread of infection? |  | .74 |  |
| How serious is the overall risk in your country of the spread of infection? |  | .86 |  |
| How easily does coronavirus spread? |  | .81 |  |
| How important is it for you to avoid crowds or groups of people? | .88 |  |  |
| How important is it for you to avoid public places? | .88 |  |  |
| How important is it for you to keep a distance from other people? | .87 |  |  |
| How important is it for you to wear a mask in public? | .77 |  |  |
| How important is it for you to maintain hand hygiene? | .68 |  |  |
| Eigenvalue | 3.48 | 2.22 | 1.94 |
| Percentage of variance explained | 31.6% | 20.2% | 17.8% |
| Cronbach’s α | 0.89 | 0.78 | 0.73 |
| *Note:* Factor loadings above .45 are shown.  |

**Table 3.** Means, standard deviations, and independent samples t-test statistics for study variables

|  |  |  |  |
| --- | --- | --- | --- |
|   | **Gender** |  |   |
|  | **Male (*n* = 181)** | **Female (*n* = 448)** |  |  |
| **Variable** | ***M*** | ***SD*** | ***M*** | ***SD*** | ***t*** | **Cohen's *d*** |
| Risk of infection spread | 6.98 | 1.77 | 7.12 | 1.69 | -0.99 | -0.09 |
| Personal risk | 5.14 | 2.00 | 4.96 | 1.97 | 1.03 | 0.09 |
| Preventative behaviors | 7.93 | 1.86 | 8.38 | 1.82 | -2.78\*\* | -0.24 |
|  | **Healthcare worker** |  |  |
|  | **No (*n* = 303)** | **Yes (*n* = 332)** |  |  |
| **Variable** | ***M*** | ***SD*** | ***M*** | ***SD*** | ***t*** | **Cohen's *d*** |
| Risk of infection spread | 6.88 | 1.73 | 7.27 | 1.67 | -2.90\*\* | -0.23 |
| Personal risk | 4.74 | 1.95 | 5.23 | 1.98 | -3.16\*\* | -0.25 |
| Preventative behaviors | 8.15 | 1.80 | 8.34 | 1.86 | -1.36 | -0.11 |
|  | **Comorbidity** |  |  |
|  | **No (*n* = 532)** | **Yes (*n* = 98)** |  |  |
| **Variable** | ***M*** | ***SD*** | ***M*** | ***SD*** | ***t*** | **Cohen's *d*** |
| Risk of infection spread | 7.07 | 1.73 | 7.11 | 1.59 | -0.19 | -0.02 |
| Personal risk | 4.83 | 1.95 | 5.98 | 1.88 | -5.38\*\*\* | -0.59 |
| Preventative behaviors | 8.18 | 1.88 | 8.65 | 1.33 | -2.34\* | -0.26 |
| \**p* < .05. \*\**p* < .01. \*\*\**p* < .001. |

**Table 4.** Means, standard deviations, and one-way ANOVA statistics for study variables

|  |  |  |  |
| --- | --- | --- | --- |
|   | **Religion** |  |   |
|  | **Jewish (*n* = 436)** | **Muslims (*n* = 167)** | **Other (*n* = 28)** |  |  |
| **Variable** | ***M*** | ***SD*** | ***M*** | ***SD*** | ***M*** | ***SD*** | ***F*** | **η2** |
| Risk of infection spread | 6.76a | 1.58 | 7.94b | 1.71 | 7.07a | 1.94 | 31.80\*\*\* | 0.14 |
| Personal risk | 4.82a | 1.88 | 5.54b | 2.16 | 4.37a,b | 2.01 | 8.52\*\*\* | 0.05 |
| Preventative behaviors | 8.12a | 1.84 | 8.55b | 1.80 | 8.48a,b | 1.78 | 3.58\* | 0.03 |
| *Note*. Means with different subscript letters differ significantly from each other at the .05 level. |
| \**p* < .05. \*\*\**p* < .001. |

**Figure 1.** Model depicting the serial indirect effects of body mass index on preventive behaviors via personal risk and risk of infection spread *(N* = 617)

 

*Note:* Values are unstandardized regression coefficients (standard errors), controlling for age, being a healthcare worker, gender, religion, and comorbidity. Solid lines indicate significant paths, and dashed lines indicate non-significant paths.

\*\**p* < 0.01. \*\*\**p* < 0.001.