**Perceived Health Risks, Health Behaviors, and BMI among Religiously Diverse Adults in Israel**

**Abstract**

**Introduction:** Overweight adults have an increased risk of COVID-19-related mortality. The interplay of culture and religion in this context has been minimally examined. This study examined the relationships between perceived health risks, health behaviors, and obesity among diverse adults in Israel during the COVID-19 pandemic.

**Methods:** An online cross-sectional study was distributed among diverse adults in Israel during the pandemic.

**Results**: Participants included 636 adults: 69.1% Jewish, 26.5% Muslim, and 4.4% “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).

**Discussion**: Healthcare providers for diverse populations should consider the influence of religion and culture on health practices and recommend relevant lifestyle modification to reduce risks associated with COVID-19, particularly among obese adults.

Key words: Preventive health behaviors, COVID-19, BMI, cultural diversity, religion

**Background**

The COVID-19 pandemic has 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 > 30 kg/m2. The risks associated with COVID-19 are exacerbated by the increasing global prevalence of obesity. The World Obesity Federation predicts that one billion people globally, including 1 in 5 women and 1 in 7 men, will be living with obesity by 2030 (World Obesity Federation, 2022). 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 of 5,700 hospitalized patients with COVID‐19 in New York, researchers found a higher prevalence of obesity (41.7%) (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). Also 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 (Ministry of Health Israel, 2021). The Muslim population in Israel had disproportionately higher rates of morbidity. The relative number of COVID-19 patients with serious infection in Israel has been highest among the Arab population throughout the pandemic (Birenbaum-Carmeli & Chassida, 2021; Haklai et al., 2021). COVID-19 mortality rates in Israel differ between Muslim adults, at 3.6 per 100,000, and Jewish adults at 2.6 per 100,000 (Avner and Schwartz, 2021).

There are over 9.5 million people in Israel with an overall religious distribution among the state’s citizens of 74% Jewish, 21% Muslim, and 4.9% Other (including Christian, Druze, and no religion) (Central Bureau of Statistics, 2020). Each religious group is also comprised of a range of religious levels that also influence the beliefs and practices of each respective subpopulation. For example, among the Jewish population, 45.3% are secular, 33.1% are traditional, 10.7% orthodox, and 10.5% are ultra-orthodox (Vital Statistics, 2023). Among the Muslim fully 68% of Israeli Muslims say religion holds a very important place in their lives. As religion is a strong aspect of identity in Israel, researchers found that 55% of Jews, 29% of Muslims, 34% of Christians, and 34% of Druze consider their religious identity a formidable aspect of their culture (Pew Research Center, 2016).

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 difficult choice, whether 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 a lack of agreement between the various Muslim communities globally, with some communities supporting restrictions and preventive practices, whereas others disagreed with the recommendations (Piwko, 2021). Similarly, Jewish communities faced challenges with respect to a 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 an appropriate health behavioral framework to explain the adoption of preventive measures among adults with obesity (Jones et al., 2016). The HBM postulates that people will take action to prevent, screen for, or control illness if they perceive susceptibility to the condition, perceive potentially serious consequences of the condition, perceive benefits of a given course of action to reduce susceptibility or severity, and perceive that the benefits of taking action outweigh the barriers. The readiness to take action can be influenced by triggers (cues) to initiate the action (Rosenstock et al., 1988). Applying the HBM to COVID-19 recommendations, we posit that individuals who fear negative health outcomes such as COVID-19 infection were more likely to 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 recommendations to socially isolate to reduce the risk of COVID-19 infection are external cues, prompting behavior modification (Wise et al., 2020). A systematic review regarding religious communities during the early stages of the COVID-19 pandemic demonstrated that being part of a religious community played a significant role in both the spread and containment of COVID-19. It also is indicated that religion is a social determinant of health, and thus, it is imperative to consider religion when addressing public health issues (Lee et al., 2021).

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, using the HBM. The study objective was to examine the perceived health risks, health behaviors, and BMI among religiously diverse adults during the COVID-19 pandemic in Israel.

**Methods**

***Design & Measures***

A cross-sectional study was conducted using an anonymous online questionnaire, with a set of 11 questions developed based on the HBM’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). The remaining 27 questions inquired into sociodemographic characteristics including a question about cultural-religious affiliation, defined as Jewish, Muslim, and “other” and into health status and behaviors before and during the pandemic including self-reported BMI. The questionnaire was sent to ten colleagues and health professionals for content validity: a physician specializing in infectious diseases, an epidemiology nurse, a dietician, a researcher specializing in obesity, and a social worker (whose responses were excluded from the survey results). Following feedback and minor adjustments to the tool based on the expert review, the tool was finalized for distribution. The overall Cronbach’s alpha for the tool based on the full sample (excluding the pilot data alpha-0.82) was calculated. 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). Next, a reliability analysis was conducted using Cronbach’s alpha. Institutional review board approval was granted by the author’s academic institution prior to the initiation of the study.

***Sample***

The sample population was comprised of 635 adult residents of Israel who were at least 18 years of age, fluent in Hebrew, and were able to participate in the online survey via smartphone or computer. Since religion is considered to be strongly associated with cultural identity in Israel (Pew Research Center, 2016), religion was used a proxy for culture in this study. The distribution of religious identification was similar to the national distribution in Israel with 68.5% Jewish (n=441), 26.6% Muslim (n=171), and 4.9% (n=23) Christian and “other.” 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 and social media 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.

***Data Analysis***

Data analysis was conducted using IBM SPSS Statistics Version 28. The alpha level was set at 0.05 for all statistical tests. Bivariate analyses using x2 or t-tests was first conducted to examine differences in participant characteristics. Factors associated with religious affiliation were examined using one-way analysis of variance (ANOVA) and zero-order correlations were performed to examine associations between study variables. Lastly, serial mediation was analyzed via the PROCESS macro for SPSS (Model 6; Hayes, 2022). In the multivariable model, BMI was used as an independent variable to examine personal risk and risk of spreading infection as mediators, 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**

Among the 635 adult participants, 84.1% (*n* = 534) reported a BMI less than 30 and 15.9% (*n* = 101) reported a BMI of 30 or greater. A majority of the participants were female 71.3% (n=453), marital status 63.8% (n=405), academic education, 76.9% (n=488). Participants with a BMI of 30 or greater were more likely to be older, male, lacking an academic education, and with comorbidities compared to participants with a BMI lower than 30 (Table 1).

[Insert Table 1 here]

The overall Cronbach’s alpha for the tool was acceptable at 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]

*Mediation analysis*

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 (Figure 1). 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.

[Insert Figure 1 here]

**Discussion**

This study identified factors associated with the adherence to COVID-19 preventive behaviors among culturally-religiously diverse populations of adults in Israel with particular attention being paid to BMI status. BMI was correlated with perception of personal risk and preventive behaviors. 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 in the multivariable model even after controlling 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.

Differences according to gender (Galasso at al., 2020) 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).

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). Despite having access to universal health insurance and advanced healthcare services in Israel (Muhsen et al, 2017), Muslim adults experience limited access to health information and supplementary health insurance (Chernichovsky et al., 2017). Compared to Jewish adults, Muslim adults also 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). Specific to COVID-19, researchers found disparities in adherence to COVID-19 guidelines between Muslim and Jewish adults, which may 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.

Despite Muslim Israeli citizens constituting approximately one-fifth of Israel’s population, 95% of them live in localities ranked among Israel’s lowest socioeconomic clusters. Furthermore, while they have access to universal health insurance and advanced healthcare services (Muhsen et al, 2017), they experience limited accessibility to health information and supplementary health insurance (Chernichovsky et al., 2017). Compared to Jewish adults in Israel, 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). Particular to obesity, population-based research in Israel has found an increased risk of serious COVID-19 infection and complications (Muhsen et al. 2017).

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 the infection and engaged in more health behaviors compared with non-healthcare workers. This finding is consistent with those of previous research (Houghton et al., 2020; Gesser-Edelsburg et al., 2020). Healthcare workers were part of the medical preparation for 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.

**Research Limitations**

Some limitations of this research include the cross-sectional nature of the questionnaire survey design and the snowball sampling method, which could potentially lead to a biased sample that might not represent the wider target population over the extended pandemic period. The survey was developed specifically for this study which may limit further relevance of the survey to other public health studies in different populations. 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 to ensure representation of a culturally-religiously diverse population and conducting a longitudinal study to examine changes over time.

**Conclusions**

While rates of obesity are increasing, the risk of serious COVID-19 infection and the associated complications have motivated overweight adults to engage in preventing infection. Religion also influences health behaviors, which should be considered alongside obesity, to better understand the motivating factors and perceptions impacting health behaviors and outcomes.\*\*\*

In light of the complex relationships between religion, health risk perceptions, and adherence to preventive practices in COVID-19, it is imperative that nurses be able to identify the different perceptions of diverse cultural-religious backgrounds. Ultimately, nurses 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 culturally-religiously diverse adults in Israel.

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