RELIGION, SPIRITUALITY, AND MENTAL HEALTH AMONG SCIENTISTS DURING THE PANDEMIC: A FOUR-COUNTRY STUDY

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Abstract. A vast body of research shows largely positive associations between religiosity/spirituality (R/S) and positive well-being outcomes. Such research has examined religious communities and general populations, but little is known about the relationship between R/S and well-being among scientists, who typically tend to be less religious than the general public. Drawing on nationally representative survey data on physicists and biologists in India, Italy, the United Kingdom, and the United States (N = 3442), this study examines whether the relationship between R/S and mental health holds for scientists, particularly during the COVID-19 pandemic. We find that net of statistical controls, higher levels of religious and spiritual commitment are associated with significantly higher levels of well-being and lower levels of psychological distress. Overall, the results indicate that a positive relationship between R/S and mental health holds even for scientists. The study's findings have implications for future analysis of the relationship between R/S and the well-being of people working in other professions.

Keywords: academic science; cross-national study; health; religion

Introduction

Considerable research shows that religion and spirituality provide meaning, identity, self-esteem, and social support for many people (Antonovsky 1987; Krause 2003), especially during times of stress (Schieman, Bierman, and Ellison 2013). During the COVID-19 pandemic, many people turned to religion to support their psychological well-being (Dein et al. 2020; Achour et al. 2021; Schnabel and Schieman 2022). Among those who ex-

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perienced considerable stress during COVID-19 were academic scientists (Abbott 2020). The causes of such stress were many: a delayed publication process, lack of job security, institutional restrictions, lost or threatened funding, and competing demands at home (Holleman, Cofta-Woerpel, and Gritz 2015; Perumalswami et al. 2020; Wadman 2021), not to mention the experience of illness itself. Even so, research has neglected to examine whether and how religiosity and spirituality (R/S) relate to the well-being of scientists, which would be especially important to know during the pandemic.

The scarcity of studies on this topic may be attributable in part to social tensions between religion and science. Sociologists have argued that the perceived tension between science and religion is more institutional than epistemological (Evans and Evans 2008). For instance, scientists in most countries are less religious than the general population (Ecklund et al. 2016). Being constrained by the scientific workplace's secular norms, religious scientists often selectively incorporate their faith into the workplace by restricting conversations about their faith (Di and Ecklund 2017), claiming to be spiritual rather than religious (Ecklund and Long 2011; Di et al. 2021), or tempering the centrality of religious rituals in their lives (Thomas 2021). Furthermore, the evidence suggests that social and cultural dynamics associated with religion in academic science often differ from those in society as a whole (Yancey 2011; Scheitle and Ecklund 2018).

Because there is little crossover between studies on religion and health and those on religion and science, we know little about how they interact. We do not know, for instance, how R/S relate to well-being in academic science—a context that has unique social and cultural dynamics associated with religion. As an initial step to address this lacuna in the literature, this study relies on nationally representative survey data collected from physicists and biologists working in four countries—India, Italy, the United States, and the United Kingdom (N = 3442)—and examines how R/S relate to their mental health during the COVID-19 pandemic. The study's findings indicate that despite the contested intersection between religion and science, R/S are positively related to the physical and psychological well-being of scientists.

Religion and Health

Although extensive research indicates that R/S are positively related to physical and mental well-being (Hackney and Sanders 2003; Schieman, Bierman, and Ellison 2013; Jung 2020; Bonhag and Upenieks 2021), it is important to seek a nuanced understanding of this relationship. For example, the literature prompted us to explore: (1) whether religiosity is *always* beneficial to people's well-being (Bradshaw, Ellison, and Flannelly

2008; Kaushal et al. 2022); (2) which measurement of religiosity is associated with the scientists' well-being (Strawbridge et al. 2001; Bartkowski, Acevedo, and Van Loggerenberg 2017; Jung 2020; Speed and Lamont 2021; Kaushal et al. 2022); and (3) should scholars treat R/S as similar or separate concepts in their analysis of R/S and well-being (Emmons 2005; Park 2005; Koenig 2009; Lake 2012)?

Although the relationship between R/S and well-being is known to be usually positive (Ivtzan et al. 2013; Galek et al. 2015; Bonhag and Upenieks 2021; Schnabel and Schieman 2022), this need not always be the case. For instance, religious attendance (a public form of religious practice) is positively related to life satisfaction (Maselko and Kubzansky 2006) and negatively related to anxiety (Ellison, Burdette and Hill 2009) and depression (Hayward et al. 2012). However, one recent study, using data from U.K.-based participants, found no evidence of a positive relationship between religious attendance and concurrent or later mental health status (Kaushal et al. 2022). Indeed, individuals with poor mental health outcomes are more likely to engage in religious attendance later in life (Kaushal et al. 2022).

Similar interpretations are found in the relationship between prayer (a private form of religious practice) and physical and mental health outcomes (Bradshaw, Ellison, and Flannelly 2008; Baesler and Ladd 2009; Jeppsen et al. 2015). For example, the frequency of prayer in U.S. adults is negatively related to psychological distress and positively related to mental health but has no significant relationship with physical health (Meisenhelder and Chandler 2000; Baesler and Ladd 2009). Further analysis shows that even the positive association between the frequency of prayer and mental health may be moderated by specific religious beliefs, such as whether God is a remote or loving figure (Bradshaw, Ellison, and Flannelly 2008).

In the analysis of the relationship between R/S and well-being, religiosity is commonly measured through religious practices such as church attendance (Strawbridge et al. 2001; Speed and Lamont 2021; Kaushal et al. 2022), prayer (Meisenhelder and Chandler 2000; Bartkowski, Acevedo, and Van Loggerenberg 2017), and belief, such as whether an individual believes in God (Magin et al. 2021) or the supernatural (Jung 2020). These measurements, however, may not apply to those who are affiliated with non-Christian religions (Müller 2020) or whose religiosity is "fuzzy" (Voas 2009). Across the globe, an increasing number of people maintain a casual loyalty to their faith traditions (Voas 2009; Brauer 2018; Müller 2020), and those who embody fuzzy religiosity may not necessarily engage in religious practices regularly or at all, even though religion plays a role in their lives (Voas 2009). Furthermore, for those affiliated with non-Christian religions, an understanding of God, gods, or the supernatural may differ from those affiliated with Christian religions (Müller 2020).

Hence, to understand the relationship between religiosity and well-being among academic scientists in various national contexts, we used a more comparable measurement—the importance of religion—to capture their religious commitment (Voas and Doebler 2011).

While differences occur in the interpretations of the relationship between religion and well-being (Chatters 2000; Schieman, Bierman, and Ellison 2013), given that most studies document a positive relationship between them, especially with mental health, we expected the following hypotheses to hold:

H1a: The importance of religion is positively related to general well-being.

H1b: The importance of religion is negatively related to psychological distress.

Besides the question of how to measure religiosity, scholars also debate whether R/S are interchangeable (Emmons 2005; Park 2005; Koenig 2009; Lake 2012). Early researchers conceptualized R/S as much the same thing, influencing mental health by providing adherents with identity, access to social support, a sense of meaning, and a meaning-making framework to cope with stress (Emmons 2005; Park 2005; Koenig 2009; Lake 2012). However, the emergence of the spiritual but not religious (SBNR) challenged this conceptualization (Fuller 2001; Bender 2010). Instead of accepting a view of the sacred by religious authorities, SBNRs construct their understanding of the sacred outside of religion (Bender 2010). Furthermore, one study found that SBNRs show better psychological well-being than their nonspiritual counterparts (Ivtzan et al. 2013). This suggests that spirituality is positively related to mental well-being, even though a sense of transcendence and sacredness falls outside any particular belief system (Ivtzan et al. 2013). Spirituality may also benefit physical health through practices such as meditation or yoga (Hasselle-Newcombe 2005; Wachholtz and Pargament 2008), helping to reduce blood pressure, lower heart rate, change brain waves, and contribute to overall better health outcomes (Jones 2004).

With the emergence of SBNRs, Simmons (2021) proposed another emerging category: those who are religious but not spiritual (RBNS). In contrast with those who are SBNR, the RBNS keep their religious affiliation as a social marker but do not focus on the transformation of selfhood (Simmons 2021). Although RBNSs do not focus on cultivating spirituality through their religious affiliation, they may have access to the health benefits through the communal facets of their religiosity (Holt-Lunstad 2021). Thus, we hypothesized that:[1]

H2a: Compared with people who are neither religious nor spiritual, those who are SBNR, RBNS, and those who are spiritual and religious will report higher overall scores on well-being.

H2b: Compared with people who are neither religious nor spiritual, those who are SBNR, RBNS, and those who are spiritual and religious will report lower scores of psychological distress.

Religion and Health during COVID-19

The connections between religiosity and well-being may have become even closer during COVID-19, which introduced new stressors that negatively influenced overall well-being (Seryczyńska et al. 2021; Varghese et al. 2021; van Bakel et al. 2022). Concerns about the pandemic were intensified by stay-at-home orders and lifestyle changes that negatively impacted general health (Loades et al. 2020; McElroy et al. 2020). Many academics experienced anxiety due to delays in publication, funding uncertainty, and restrictions on collaborating with colleagues (Chan, Oey, and Tan 2020; Palayew et al. 2020).

For their part, members of faith communities, even before the pandemic, could call on religion to cope with stressors, such as unemployment (Pargament et al. 1998; Probst and Strand 2010) and trauma (Proffitt et al. 2007), through pathways to forgiveness, spiritual support, and benevolent religious reappraisals, all of which significantly benefit mental well-being (Pargament et al. 1998). However, although less common, seeing stress as a divine punishment or a demonic intervention is significantly and negatively related to well-being (Pargament et al. 1998). It is, therefore, understandable that religious coping, whatever its form, was common during COVID-19 (Filho et al. 2021; Counted et al. 2022; Mishra et al. 2023). For example, studies of the effects of the pandemic indicate that undergraduate students in India (Mishra et al. 2023); academics in primarily Muslim societies (Achour et al. 2021); adults in Columbia, South Africa and the United States (Counted et al. 2022; Schnabel and Schieman 2022); and academic students and staff worldwide (Filho et al. 2021) all engage in religious activities, receive advice from religious groups, perform prayer and meditation, find meaning in their lives from faith, and consequently report significantly better psychological and overall well-being. A positive relationship between religion and well-being was also noticed when people were socially isolated during the pandemic (Chan, Michalak, and Ybarra 2019; Filho et al. 2021).

Although the positive relationship between R/S and well-being may have been more salient during the pandemic, we wonder whether this applies to academic scientists due to the perceived tension between science and religion (Evans and Evans 2008) and the relatively lower levels of religiosity among scientists compared to the general public in many countries

(Ecklund et al. 2019). Hence, to assess this relationship, we need to understand the role that religion plays in academic science as a unique social institution (tables 1, 2).

Religion and Spirituality in Academic Science

The workplace often demands a significant investment of time, energy, and commitment (Sullivan 2014; Pagis 2021), and many scientists are encouraged to view their job as a passion and source of self-fulfillment, which can manifest as a physical and emotional attachment to their field (Wright et al. 2004). This expectation is supported by Ronald Vale, an academic biologist, who believes that "reinventing oneself through one's career" is a motivating factor for academics to invest in their work in academia (Vale 2010, 12).

Because scientists are part of a demanding profession, the integration of religion and spirituality in the workplace may be influenced by institutional norms, such as secularism (Beit-Hallahmi 2015; Di and Ecklund 2017). One U.S. study in the 1960s found that graduate students with scientific training are less likely to be religious (Stark 1963)—a similar pattern repeated in more recent studies in the United States and elsewhere (Ecklund 2010; Ecklund et al. 2016). While scientists in fields considered "pure" or "inquiry-focused," such as physics and biology, might be less religious or nonreligious than scientists working in applied fields, such as computer science, a norm of secularism pervades all science (Beit-Hallahmi 2015; Evans 2022).

Of course, academic scientists are not entirely irreligious, and there are instances where R/S are present in the academic scientific workplace (Ecklund et al. 2019). However, the secular norm may affect the relationship between religion/spirituality and the scientists' mental health differently than in other fields like healthcare (Héliot et al. 2020). And studies have found that religious scientists often navigate and reconcile their beliefs with the secular institutional norms of academic science (Di and Ecklund 2017; Scheitle and Dabbs 2021). For example, scientists in several countries report not incorporating their faith into their scientific work (Ecklund et al. 2019; Sorrell and Ecklund 2019), and others identify as SBNR to ease tensions between religion and science (Di et al. 2021). In India, where the line between science and religion blurs, scientists often combine participation in religious rituals with a scientific, logical, and rational approach, unlike people who are not scientists (Thomas 2021).

Despite efforts to reconcile their beliefs with the norm of secularism in academic science, many religious scientists still report experiencing discrimination (Scheitle and Dabbs 2021). In one U.S. study, some non-Christian scientists report considering scientists who believe in Christianity to be less competent than nonreligious scientists (Rios et al. 2015).

Other studies find that religious scientists, including graduate students and scientists who follow Protestant or Muslim religions, are more prone to discrimination due to their faith compared to their nonreligious colleagues (Scheitle and Ecklund 2018; Scheitle, Remsburg, and Platt 2021).

Although much of the research on religiosity, spirituality, and well-being focuses on the general population (see Chatters 2000; Schieman, Bierman, and Ellison 2013 for reviews), most studies assume that the relationship between R/S and well-being operates similarly for different professions. However, the extent of time and energy people put into their work prompts the question of whether this relationship operates differently for different workers. It is for this reason that we investigate if hypotheses on the connection between R/S and well-being derived from research on the general population apply to academic scientists whose work has strong secular norms and tensions with religion and spirituality (Di and Ecklund 2017; Ecklund et al. 2019).

Data and Methods

Data for this study came from an international survey of scientists in the physics and biology departments at PhD granting institutions and research institutes in Italy, India, the United Kingdom, and the United States. The four countries were selected in part due to differences in the level of development of their science infrastructure as well as cultural differences in the connection between science and religion. Specifically, the United States and the United Kingdom were selected as the two societies where the social tensions between science and religion are most salient (Johnson et al. 2018; Noy and O'Brien 2016). In the United States, the so-called divide between science and religion intersects with the divides in political belief, morality, and even lifestyle (Evans 2013; Noy and O'Brien 2016). Meanwhile, in the United Kingdom, celebrity scientists, such as Richard Dawkins, preach the idea of there being inherent conflict between science and religion (Johnson et al. 2018). Italy and India were selected as two societies where the tensions between science and religion are often more implicit (Ecklund et al. 2019; Thomas 2021). In both India and Italy, religion is often lived and diffused, being incorporated into values and lifestyles and not *necessarily* expressed through church attendance (Cipriani 2003; Thomas 2021). The lived nature of religion in the two societies may provide scientists in those nations with room to navigate the boundaries between science and religion (Ecklund et al. 2019; Thomas 2021).

Using the percentage of Gross Domestic Product (GDP) spent on research and development (R&D expenditure) as a measurement of the development of scientific infrastructure, we found that, as of 2020, the United States and India represent two vastly different cases, as the former spends 3.45% of its GDP on R&D, whereas the latter spends 0.66% of its

GDP on R&D (The World Bank 2020). Italy and the United Kingdom represent somewhat similar cases in terms of the percentage of GDP spent on R&D development (1.53% in Italy and 1.71% in the United Kingdom; The World Bank 2020). By collecting data from academic scientists from four distinct and similar academic contexts, we can gain a relatively comprehensive understanding of the relationship between R/S and health in academic science.

This study focuses on physicists and biologists specifically because the two fields have a significant tension with religion (Ecklund et al. 2019). Most famously, they have faced controversies such as creationism versus evolution and the Big Bang versus Steady State theories (Colburn and Henriques 2006; Bagdonas and Silva 2015). Still, by examining the views of scientists working in biology and physics, we aim to understand whether the relationship between R/S and well-being observed in the general population is present among academic scientists, particularly in fields where the tension between science and religion is salient.

Respondents were selected in a two-stage process: first by identifying eligible research institutions with the relevant departments and then by identifying individual researchers nested within those institutions. In total, 22,840 eligible respondents were identified in 233 institutions in these countries. The web-based survey was conducted between May and September 2021. Surveys were distributed in English, although Italian respondents could complete the survey in Italian. A total of 3442 respondents completed the survey, yielding a final AAPOR (American Associate for Public Opinion Research) response rate of 15%. Survey weights were applied to the analysis to ensure representativeness to the populations from which scientists were sampled.

The study used OLS (Ordinary Least Squares) regression techniques to model associations between religiosity and two outcome variables: (1) overall well-being was measured using a reduced (seven-item, on a scale from 1 to 10 for each item) version of the Harvard Flourishing index (VanderWeele 2017; hereinafter referred to as HF), which provides a composite measure of life satisfaction, physical health, mental health, meaning and purpose, character and virtue, close social relationships, and financial security with questions such as "how would you rate your overall mental health?"; (2) psychological distress was measured using the Kessler K6 scale (Kessler, Mickelson, and Williams 1999), a validated six-item measure (on a scale from one to five for each item) of psychological distress intended to assess risk for serious mental illness in the general population with questions such as "during the past 30 days, how often do you feel nervous?" We selected the HF index and Kessler K6 scale as our dependent variables because they are widely used and provide comprehensive measurements of well-being and psychological distress, respectively (Kessler, Mickelson, and Williams 1999; VanderWeele 2017). Both are composite measure-

ments that allow us to engage with other scholarly research that relies on these measurements and provide a relatively comprehensive understanding of our respondents' well-being. Admittedly, such composite measurements can lack nuance, a limitation that we will discuss further below.

We measured religiosity in terms of (1) religious affiliation, (2) indicators of whether respondents consider themselves religious, spiritual, both, or neither, and (3) how important respondents consider religion or spirituality in their lives (inverted here to make it more intuitive, so 5 = very important, 4 = moderately important, 3 = neutral, 2 = low importance, 1 = not at all important). Item #3 was only asked of those who indicated in #2 that they had either some religion or spirituality, so we imputed the lowest value of the importance of religion to those who indicated that they were neither religious nor spiritual.

Because the survey was not focused on religion, the questionnaire included only these three items about religion, which is another limitation of the study. Statistical models control for the country, academic discipline, gender, professional position, whether the respondent experienced a stressful event in the past 12 months, and the impact of COVID-19 (i.e., whether the respondent or someone close to the respondent was infected with COVID-19).

Results

The international nature of this sample allowed more religious diversity than would otherwise have been possible in a single-nation survey. For example, as illustrated in table 1, approximately 10% of respondents are Hindu and 12% are Catholic. However, by and large, most physicists and biologists in the countries we studied are neither religious nor spiritual, with 55% selecting that answer, and 56% indicating no religious affiliation. Even so, there is a substantial minority of scientists in our population who are indeed religiously affiliated, and about 45% of scientists identified themselves as either religious or spiritual, although only 25% said that religion is moderately or very important. In terms of field, physicists make up a majority of the scientists (52%). Women comprise 40% of our sample and 32% of the population of interest. Most of our sample respondents were from India, though the majority of scientists in this population are from the United States. In terms of COVID, when this survey was administered, 6% of respondents reported having been infected, but 21% reported that somebody close to them had become very ill during the pandemic. In our analyses, the application of survey weights helped correct for sample biases with respect to country, discipline, gender, and position, and allowed generalization to the target population of physicists and biologists at PhD-granting institutions in the four countries.

Table 1. Weighted means by variable

	%	Mean (Weighted)	Mean (Unweighted)	SD (Weighted)	Max	Min	N	Cases	HF score (Weighted)	Kessler score (Weighted)
HF		50.82	49.68	9.49	70	5	3430			
KESSLER		13.06	14.11	4.98	30	6	3430			
Religion or spirituality is very or moderately important	25	0.25	0.26	0.43	1	0	3382	879	53	13
I was infected with COVID-19	6	0.06	0.09	0.24	1	0	3442	302	49	14
Someone close to me passed away or became seriously ill during the pandemic	21	0.21	0.25	0.40	1	0	3442	851	50	14
Female	32	0.32	0.40	0.47	1	0	3419	1357	50	14
Country: India	10	0.10	0.39	0.29	1	0	3442	1345	48	15
Country: Italy	10	0.10	0.19	0.30	1	0	3442	637	53	13
Country: UK	26	0.26	0.27	0.44	1	0	3442	925	49	14
Country: USA	54	0.54	0.16	0.50	1	0	3442	535	52	12
Postgraduate student	27	0.27	0.40	0.44	1	0	3442	1370	47	15
Postdoc	14	0.14	0.14	0.35	1	0	3442	465	49	14
Research scientist	5	0.05	0.08	0.21	1	0	3442	282	49	14
Junior faculty (e.g., assistant professor)	11	0.11	0.09	0.31	1	0	3442	309	50	13
Mid-level faculty (e.g., associate professor)	11	0.11	0.10	0.32	1	0	3442	359	53	12
Senior faculty (e.g., full professor)	24	0.24	0.12	0.43	1	0	3442	424	54	10

(*Continued*)

Table 1. (Continued)

	%	Mean (Weighted)	Mean (Unweighted)	SD (Weighted)	Max	Min	N	Cases	HF score (Weighted)	Kessler score (Weighted)
Position: Other (e.g., adjunct professor)	7	0.07	0.07	0.26	1	0	3442	233	54	12
Religion: Did not answer	2	0.02	0.02	0.14	1	0	3442	54	54	11
Field: Biology	38	0.38	0.40	0.49	1	0	3442	1381	51	13
Field: Other	10	0.10	0.07	0.31	1	0	3442	224	51	13
Field: Physics	52	0.52	0.53	0.50	1	0	3442	1837	51	13
Religion: Buddhist	1	0.01	0.01	0.09	1	0	3388	23	51	14
Religion: Catholic	12	0.12	0.12	0.32	1	0	3388	419	54	12
Religion: Hindu	10	0.10	0.26	0.30	1	0	3388	883	52	13
Religion: Jewish	3	0.03	0.02	0.18	1	0	3388	54	54	11
Religion: Muslim	2	0.02	0.03	0.13	1	0	3388	105	48	15
Religion: Orthodox	1	0.01	0.01	0.10	1	0	3388	45	47	14
Religion: Other	3	0.03	0.02	0.18	1	0	3388	78	48	14
Religion: Protestant	12	0.12	0.06	0.32	1	0	3388	190	52	13
Religion: Sikh	0	0.00	0.00	0.04	1	0	3388	12	53	15
Religion: Unaffiliated	56	0.56	0.47	0.50	1	0	3388	1579	50	13
Did not answer the religious/spiritual question	2	0.02	0.02	0.14	1	0	3442	55	55	10
Not religious, but spiritual	16	0.16	0.16	0.37	1	0	3387	543	51	14
Not religious, not spiritual	55	0.55	0.49	0.50	1	0	3387	1649	50	13
Religious and spiritual	17	0.17	0.17	0.37	1	0	3387	583	52	13
Religious, not spiritual	13	0.13	0.18	0.33	1	0	3387	612	52	13

In models 1 and 2 (table 2), we utilized the importance of religion as a measurement of religiosity to understand how religiosity is related to overall well-being and psychological distress for academic physicists and biologists. Model 1 supports H1a, which hypothesizes that the importance of religion is positively related to general well-being. Specifically, the coefficient for the importance of religion is significant to the $p < 0.001$ level, with a movement of one on the five-point scale for importance of religion leading to an increase of slightly less than one point on the HF index that runs from 5 to 70. Model 2 shows an insignificant relationship with the Kessler scale and therefore does not support H1b.

Table 2. Religiosity and well-being

	Dependent variable:			
	HF (1)	KESSLER (2)	HF (3)	KESSLER (4)
Importance of religion or spirituality	0.87***	–0.09		
	(0.13)	(0.07)		
Not religious but spiritual			2.13***	0.17
			(0.45)	(0.23)
Religious but not spiritual			2.67***	–0.36
			(0.59)	(0.30)
Religious and spiritual			2.91***	–0.63*
			(0.58)	(0.29)
Catholic	1.89***	–0.81**	1.78**	–0.65*
	(0.55)	(0.28)	(0.59)	(0.30)
Protestant	–0.60	0.03	–0.68	0.30
	(0.56)	(0.28)	(0.62)	(0.31)
Orthodox	–2.25	0.03	–3.00	0.19
	(1.58)	(0.80)	(1.60)	(0.81)
Jewish	0.28	–0.34	–0.68	–0.15
	(0.86)	(0.44)	(0.93)	(0.47)
Muslim	0.07	–0.55	–0.05	–0.31
	(1.28)	(0.65)	(1.31)	(0.66)
Hindu	2.18***	–1.65***	1.96**	–1.54***
	(0.64)	(0.33)	(0.68)	(0.34)
Buddhist	–3.19	1.88*	–2.86	2.12*
	(1.68)	(0.85)	(1.70)	(0.86)
Sikh	5.66	–0.37	4.94	–0.36
	(4.27)	(2.26)	(3.98)	(2.09)
Other religion	–3.05***	0.74	–2.97***	0.79
	(0.85)	(0.43)	(0.85)	(0.43)

(*Continued*)

Table 2. (Continued)

	Dependent variable:			
	HF (1)	KESSLER (2)	HF (3)	KESSLER (4)
Other than pandemic, experienced stressful life event in past year	–3.88***	2.17***	–3.89***	2.13***
	(0.34)	(0.17)	(0.34)	(0.17)
Italy	3.68***	–1.23**	3.57***	–1.30**
	(0.82)	(0.42)	(0.82)	(0.42)
UK	1.79**	–1.74***	1.73*	–1.78***
	(0.68)	(0.35)	(0.68)	(0.35)
USA	3.58***	–1.99***	3.61***	–2.05***
	(0.65)	(0.33)	(0.65)	(0.33)
Male	1.07**	–0.88***	1.08**	–0.83***
	(0.34)	(0.17)	(0.34)	(0.17)
Position: Postdoc	1.86***	–1.09***	1.90***	–1.10***
	(0.50)	(0.25)	(0.50)	(0.25)
Position: Research scientist	1.74*	–0.83*	1.79*	–0.84*
	(0.80)	(0.40)	(0.80)	(0.40)
Position: Junior faculty	2.20***	–1.61***	2.22***	–1.55***
	(0.59)	(0.30)	(0.59)	(0.30)
Position: Mid-level faulty	4.21***	–2.58***	4.26***	–2.59***
	(0.65)	(0.33)	(0.66)	(0.33)
Position: Senior faculty	4.43***	–2.61***	4.44***	–2.62***
	(0.71)	(0.36)	(0.71)	(0.36)
Position: Other	3.71***	–1.37***	3.73***	–1.35**
	(0.81)	(0.41)	(0.81)	(0.41)
Discipline: Other	–1.25*	0.25	–1.29*	0.22
	(0.54)	(0.27)	(0.54)	(0.27)
Discipline: Physics	0.74*	–0.56**	0.79*	–0.55**
	(0.34)	(0.17)	(0.34)	(0.17)
Contracted COVID	–0.92	0.15	–1.04	0.17
	(0.63)	(0.32)	(0.63)	(0.32)
Someone close contracted COVID	–0.68	0.65**	–0.66	0.70***
	(0.40)	(0.20)	(0.40)	(0.20)
Age	0.07***	–0.06***	0.07***	–0.06***
	(0.02)	(0.01)	(0.02)	(0.01)
Constant	41.01***	19.29***	41.59***	19.17***
	(0.83)	(0.42)	(0.82)	(0.41)
Observations	3276	3276	3280	3280
R^2	0.20	0.26	0.19	0.26
Adjusted R^2	0.19	0.25	0.19	0.25
Residual SE	33.99 (df = 3249)	17.18 (df = 3249)	34.01 (df = 3251)	17.16 (df = 3251)
F-statistic	30.45*** (df = 26; 3249)	43.19*** (df = 26; 3249)	28.11*** (df = 28; 3251)	40.37*** (df = 28; 3251)

*$p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

Moving to our hypotheses on the relationship between religiosity, spirituality, and well-being, we found that H2a is supported by model 3, which demonstrates that any alternative to "not spiritual, not religious" scored higher by 2–3 points. Similarly, H2b is also supported by model 4 in the case of religious and spiritual, which scored about 0.6 points lower on the Kessler scale.

Each model included measures of religious affiliation, generally finding that Catholic and Hindu affiliation (relative to nonaffiliated individuals) are positively associated with the HF index and negatively associated with the Kessler scale. For nonreligious variables, having someone close to them become severely ill with COVID was significantly related to distress (but not well-being), but having actually contracted COVID themselves was not related to either distress or well-being.

Discussion

While revealing some ambivalence, previous research documents an overall positive relationship between R/S and well-being (Koenig 2009; Ivtzan et al. 2013; Galek et al. 2015), especially during stressful periods (Park 2005), such as the COVID-19 pandemic (Schnabel and Schieman 2022). Because few studies have examined the relationship between R/S and well-being in academic science—a social institution with unique dynamics associated with religion and spirituality (Evans and Evans 2008; Scheitle and Ecklund 2018)—we surveyed academic physicists and biologists in Italy, India, the United States, and the United Kingdom. The findings suggest that religious or spiritual academic scientists have better overall well-being and mental health outcomes compared to their nonreligious colleagues.

Specifically, using the importance of religion as a measurement of religiosity, the findings from the study's survey indicate that religion is positively related to scientists' overall well-being during COVID-19—the time point when we collected our data. However, there is no statistically significant relationship between the importance of religion and scientists' experiences of psychological distress. This finding affirms the conclusion made in previous studies regarding the positive relationship between religiosity and overall well-being among the general population (Hackney and Sanders 2003) but does not support the conclusion regarding the negative relationship between religiosity and the experiences of psychological distress (Magin et al. 2021).

Confined by the cross-sectional nature of our survey data, we cannot make conclusive arguments to explain the similarities and differences between scientists and the general public when it comes to the relationship between religiosity and well-being. Nonetheless, we offer some speculative conclusions. First, the HF index is a composite measurement of general well-being that includes information on respondents' financial and social

well-being. For academic scientists, a connection with their faith communities and experiencing certainties through their identification with religion may enhance the "meaning and purpose" dimension of the HF index, but may not have a statistically significant relationship with their psychological distress. During the COVID-19 pandemic, scientists' experiences of psychological distress may have been more closely related to their experiences of stress related to publishing, funding delays, or whether someone close had contracted COVID. This working conclusion is somewhat affirmed by our findings, because scientists who experienced a stressful life event in the past year and scientists with someone close having contracted COVID were more likely to experience psychological distress even after controlling their religiosity.

This conclusion also supports recent research suggesting that positive and negative mental health (i.e., flourishing and psychological distress) are not opposite ends of the same continuum but rather reflect distinct continua; predictors that are positively associated with one may not necessarily be negatively associated with the other (Iasiello, van Agteren, and Cochrane 2020; Jacobi 2022). In other words, our findings indicate the importance of the dual-continua model in analyses of the relationship between religiosity and mental health in science (Iasiello, van Agteren, and Cochrane 2020; Jacobi 2022). Specifically, echoing previous scholars (Iasiello, van Agteren, and Cochrane 2020; Jacobi 2022), we argue that mental illness and mental wellness are not two opposite ends of the same continuum; rather, there are two separate continua that measure positive and negative mental health (Jacobi 2022). The first continuum describes individuals' positive mental health, with high positive mental health and low positive mental health as the two opposite ends (Iasiello, van Agteren, and Cochrane 2020). On the second continuum, which conceptualizes people's negative mental health, mental illness and no mental illness are the two opposite ends (Iasiello, van Agteren, and Cochrane 2020). This is particularly pertinent to our study finding that although the importance of religion is not related to scientists' experiences on the negative mental health continuum, it is related to academic scientists' experiences on the positive mental health continuum. We invite future scholars to continue adopting the dual continua model in future analyses on religion and mental health in science.

Second, the lack of statistical significance in the relationship between the importance of religion or spirituality and scientists' experiences of psychological distress may also be related to the unique institutional norms in academic science. Due to the perceived tensions between science and religion (Di and Ecklund 2017), more religious people might feel the need to conceal their religiosity or their reliance on religion at work, which may lead to more stress. Another possible explanation for the lack of a significant relationship between the importance of religion or spirituality and

psychological distress could be the differences in country-level perceptions of the tensions between religion and science. This variation could result in nonuniform relationships between R/S and scientists' experiences of spiritual distress across different national contexts. Due to data constraints, we are unable to provide conclusive explanations for the lack of statistical significance in the relationship between R/S and scientists' experiences of psychological distress. We encourage future scholars to expand on our research, possibly by incorporating more direct measures of scientists' perceptions of tensions between science and religion.

In addition to this measurement of the importance of religion, we further examined how R/S—two related but conceptually different constructs—are associated with the well-being of academic scientists. Like previous studies (Ivtzan et al. 2013), we found that religious and spiritual scientists report significantly better well-being outcomes overall compared to nonreligious and nonspiritual scientists. Still, while scientists who are either religious or spiritual have significantly better overall well-being outcomes compared to their nonreligious or nonspiritual colleagues, the difference is most salient between those who are both religious and spiritual and those who are neither. With a focus on the relationship between scientists' R/S and the likelihood for them to experience psychological distress, we also found that compared to their nonreligious and nonspiritual counterparts, only scientists who are both religious and spiritual report significantly lower experiences of psychological distress.

These findings provide us with some information on how R/S are related to academic scientists' overall well-being and different experiences of psychological distress. As we found that the differences in the positive relationship between R/S are the most salient between the religious and spiritual and the neither religious nor spiritual, we wonder if R/S can be differently associated with the individual's well-being. Indeed, both religion and spirituality may provide practitioners with identity, a sense of meaning, and meaning-making frameworks (Emmons 2005; Park 2005; Koenig 2009; Lake 2012). However, nuanced differences in how religion and spirituality are related to their practitioners' overall well-being and psychological distress might also occur.

Specifically, religion might provide an additional layer of support; namely, a sense of community (Lim and Putnam 2010). Religious scientists might obtain moral, social, financial, and spiritual support from their faith communities, especially if isolated (Holt-Lunstad 2021). Belonging to a community may also serve as an alternative meaningful identity, which may help respondents withstand the pandemic's challenges to their scientific work. And spirituality may provide respondents a sense of transcendence, with or without religious affiliation (Bender 2010; Ammerman 2013). Experiencing transcendence both within and outside religion can provide practitioners, the spiritual scientists in this case, with

inspiration and positivity, especially during a global pandemic (Walsh 2020). Our findings therefore highlight the necessity of separating R/S as distinct constructs in the analysis of R/S and well-being.

While religious affiliation was incorporated as a control variable in our study, several patterns emerged. For example, across all models, scientists who are Catholics and Hindus reported significantly higher well-being and experienced significantly lower psychological distress. We wonder to what extent these findings are related to the relative compatibility between these two religions and science (Salazar et al. 2019; Thomas 2021) and should be attributed to the majority status of Catholicism and Hinduism in two of the national contexts (Italy and India) included in this study. We invite future scholars to adopt a different methodology or a new set of data to further investigate why the patterns emerged among Catholic and Hindu scientists.

Our study contributes to social scientific studies of science and religion. Most existing studies on the relationship between religiosity and well-being focus on the general population (Schieman, Bierman, and Ellison 2013). Existing social scientific studies on science and religion, however, indicate that the secular institutional norms in academic science may influence whether scientists disclose their religious identity and whether and how they integrate religion and spirituality in their workplace (Scheitle and Ecklund 2018; Scheitle and Dabbs 2021). Indeed, our study reveals some differences in the relationship between R/S among academic scientists when compared to previous findings formulated from an analysis of this relationship among the general population (Schieman, Bierman, and Ellison 2013). Based on our findings, we argue that institutional norms may also influence how the faithful in academic science rely on religion and spirituality to cope with stressors. Hence, the overall positive relationship between R/S and well-being should be further examined in academia and perhaps in other professional workplaces with similarly contested relationships.

The central focus of our research was to examine the association between R/S and the well-being of scientists during the pandemic. There were, however, some supplemental findings that have implications for future analyses and policies intended to promote the well-being of academic scientists. First, men generally had significantly better overall well-being and experience significantly less psychological distress than women. Second, junior, mid-level, and senior faculty members reported overall better well-being outcomes compared to graduate students. Third, scientists who contracted COVID did not report significantly worse well-being outcomes when compared to their counterparts who did not contract COVID. However, knowing someone close who had COVID related significantly to greater psychological distress. These supplemental findings indicate that in academic science, women, graduate students, and

those knowing someone close with COVID may need additional support for their overall psychological well-being.

This study has several limitations. First, it considers the relationship between R/S and the well-being of scientists in only two disciplines and four national contexts. Hence, its findings may not be generalizable to other sciences or countries. In addition, given the constraints of our sample size, we could not compare the study's four contexts in more nuanced ways; instead, we controlled for national context to identify general relationships between R/S and the scientists' well-being. Third, we measured well-being using a reduced version of the HF index and the Kessler K6 scale. Although both are widely used to measure well-being (Kessler, Mickelson, and Williams 1999; VanderWeele, McNeely, and Koh 2019), composite measurements are inherently limited, offering few nuanced descriptions of which dimension of well-being relates to R/S. Fourth, because the focus of the survey was not religion or spirituality, we were limited to three survey questions about R/S; future research would benefit from including a variety of religion items to examine relationships between well-being and, say, religious attendance or community participation among scientists. It is also noteworthy that our results might have been influenced due to an increased reliance on religion and spirituality for managing anxiety and stress during COVID-19. It is important, therefore, to keep in mind that these findings may not accurately reflect the scientists' experiences outside the context of the pandemic.

Despite these limitations, this research contributes to the literature by investigating the relationship between R/S and well-being in academic science. The study illustrates how norms in specific social institutions, such as secularism in science, may shape and reshape the association between R/S and mental health, particularly during times of stress. Although our study was limited to academic biology and physics, the conceptual framework on the relationship between R/S and well-being as influenced by institutional norms may apply to other social institutions that have contested relationships with religion, such as technology and engineering.

Note

1. When testing our hypotheses, we compare overall well-being and psychological distress of nonspiritual academic scientists with their counterparts who are spiritual, regardless of whether they experience spirituality through religion.

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