A Cross-Cultural Analysis of Religious Fasting and Well-Being Using 15 Years of Internet Search Data

Jordan W. Moon [*1,2,3,4], Michael Barlev [4], Daniel L. Chen [3], & Steven L. Neuberg [4]

1. School of Psychology, University of Southampton, Southampton, United Kingdom
2. Centre for Culture and Evolution, Brunel University of London, Uxbridge, United Kingdom
3. Institute for Advanced Study in Toulouse, Toulouse School of Economics, and University of Toulouse Capitole, Toulouse, France
4. Department of Psychology, Arizona State University, Tempe, Arizona, USA

***Correspondence**: Jordan W. Moon, School of Psychology, University of Southampton, B44 University Road, Southampton, United Kingdom, SO17 1BJ.

Email: j.w.moon@soton.ac.uk

Ethics: This research received ethical approval from the University of Southampton (ERGO #109727).

Funding: This project was made possible through the support of the Templeton World Charity Foundation, Inc (funder DOI 501100011730) through grant 30290 (https://doi.org/10.54224/30290). The opinions expressed here are those of the authors and do not necessarily reflect the views of Templeton World Charity Foundation, Inc. JWM and DLC gratefully acknowledge support from the French Agence Nationale de la Recherche (under the Investissement d'Avenir program, ANR-17-EURE-0010).

Abstract

Voluntarily abstaining from food—fasting—is historically and cross-culturally widespread and prescribed by many world religions. Yet, its effects on psychological health and well-being remain poorly understood. We analyzed 15 years of internet search data to examine how religious fasts affect society-level well-being across three traditions: Islam (countries with ≥75% Muslim population), Judaism (Israel), and LDS (Utah, USA). We operationalized well-being using composite indices of Google searches indicative of poor psychological well-being and mental health. Our analysis reveals robust evidence that Ramadan improves well-being in Muslim-majority countries. In contrast, we did not find comparable effects for Jewish or LDS fasts (Yom Kippur and Fast Sundays, respectively), though these analyses were much more limited in scope. In all, these findings suggest that religious fasting can improve well-being. We discuss possible mechanisms and implications of these findings for understanding the cultural evolution of ritual practices.

Keywords: fasting, religious rituals, cultural evolution, hunger, flourishing

A Cross-Cultural Analysis of Religious Fasting and Well-Being Using 15 Years of Global Internet Search Data

Fasting—intentionally abstaining from food, partially or fully, for a period of time—is common across cultures and throughout history, especially in religious and spiritual traditions. Among religions listed in the Database of Religious History (Database of Religious History, 2024; Slingerland et al., 2024), about half prescribe fasting. Currently, much of the world observes religious fasts, with nearly a quarter observing the Islamic fast of Ramadan (Hackett et al., 2025).

What are the psychological effects of religious fasts? When hungry, people are less prosocial: they are more impulsive in their decision-making, more irritable and aggressive, and more punitive toward others (Aarøe & Petersen, 2013; Allen & Nettle, 2021; Edmunds et al., 2021; Fattorini et al., 2018; Petersen et al., 2014; Swami et al., 2022). Moreover, although the link between hunger and psychological health and well-being has not been explored as directly, some evidence suggests that hunger inhibits well-being and promotes negative emotions (Ackermans et al., 2022; MacCormack & Lindquist, 2019; Wojciak, 2014). Thus, one possibility is that religious fasts are associated with antisociality and lower psychological well-being.

In contrast to hunger, fasting in a religious context often seems to have the opposite effects. Muslims who fast during Ramadan are *more* generous (Haruvy et al., 2018), and Muslim judges may be *less* punitive during Ramadan (Mehmood et al., 2023). Moreover, whereas hunger increases impulsivity, Muslims who fast during Ramadan sometimes have greater self-control (Rad, 2023).

That said, the effects of fasting on psychological health and well-being are less clear. Preliminary evidence finds positive effects of fasting in Orthodox Christianity, Baha'i, and Islam

(Demmrich et al., 2023; Mousavi et al., 2015; Ring et al., 2022; Spanaki et al., 2021; Ugur, 2018), but other studies of the Ramadan fast find null or even negative effects (Al-Ozairi et al., 2015; Harder-Lauridsen et al., 2017; Kadri et al., 2000; Roky et al., 2000).

In all, although some evidence suggests benefits of religious fasting, it is not clear whether well-being consistently increases during religious fasting periods[1], how long the effects last, how these effects fluctuate throughout fasting periods, and how robust these effects are across cultures and religious traditions.

We present a large-scale, cross-cultural test of the effects of religious fasting using 15 years of internet search data. The geographic and temporal scope of these data allows us to assess the effects of religious fasting on well-being in three religious traditions. We focus on Ramadan, a month-long fast practiced by Muslims, Yom Kippur, a 25-hour fast and the holiest day in Judaism, and monthly "Fast Sundays" among Latter-day Saints (commonly known as "Mormons"). See Method for more details on the three fasting traditions. These three religions are ideal for exploring the effects of religious fasting because they each practice fasting collectively and in unison (i.e., all adherents are encouraged to fast at the same time), and there are regions where they make up a majority of the population.

Google search data—aggregated using a free tool called Google Trends (Moon & Barlev, in press)—are especially well-suited for investigating the effects of fasting on mental health and subjective well-being. First, they can provide indices of well-being that can be used across cultures (Foa et al., 2022; Greyling & Rossouw, 2025). Second, unlike survey data, internet

[1] One particularly influential cross-cultural study on fasting and well-being did not compare fasting vs. non-fasting periods, but tested whether longer Ramadan fasts are associated with greater well-being in the subsequent calendar year (Campante & Yanagizawa-Drott, 2015). This result would imply that Ramadan fasting has large, long-lasting effects, such that additional hours of fasting increases well-being at detectible levels throughout full calendar years.

search data are substantially less susceptible to self-report biases (Stephens-Davidowitz, 2017). Third, the temporal granularity of these data allows us to examine trends in well-being across time—before, during, and after fasting periods (although with important caveats for our day-long fasts—Yom Kippur and Fast Sundays). Finally, the ability to capture 15 years of data makes it less likely that findings are driven by short-term anomalies.

We investigated three research questions: First, we asked whether well-being increases during religious fasting periods. Second, we explored the duration of these effects—whether they last beyond fasting periods and whether they start *before* fasting periods (e.g., in anticipation). Third, because there is natural variation in length of the Ramadan fast between countries depending on season and latitude, we explored the possibility of "dosage" effects—that Ramadan fasting might have greater effects on well-being in countries and years where the lengths of the fast were longer.

To anticipate, we found robust evidence that well-being—as indexed by a lower proportion of total search volume relating to poor psychological well-being and mental health — increases during Ramadan in Muslim-majority countries. We did not find compelling evidence that the effects of Ramadan are amplified by dosage (i.e., longer vs shorter fasting periods). We did not find consistent evidence for similar effects for Yom Kippur or Fast Sundays, although we hold these conclusions as only tentative, given the short duration of these fasts relative to our temporal granularity and the sizes of the populations available for those analyses. We consider potential mechanisms for the Ramadan findings and interpret results through a cultural evolutionary lens.

Method

Preregistration

The study was pre-registered (https://osf.io/a8zjw). Although the analyses reported in the main text deviate from the pre-registration, most deviations make the analyses more conservative (i.e., less likely to yield false positives). We explain these deviations and present the analyses as pre-registered in the Supplemental Materials.

All analyses used publicly available data from Google Trends. All analysis code is available on the Open Science Framework (https://osf.io/2g35k/). Data for the pre-registered analyses (from the Google Trends explorer) are also available. Because the analyses presented in the main text use data downloaded from the Google Trends API, terms of use prohibit us from sharing these raw data.

Data Source

We operationalized society-level well-being using Google searches (Cebrián & Domenech, 2023; Moon & Barlev, in press). We accessed Google search data using the Google Trends API. Users must apply for access and agree to terms of use (see: https://support.google.com/trends/contact/trends_api).

Google Trends API does not return raw numbers of Google searches, but rather scores proportional to total searches within the selected geographical region and time range—multiplied by 10^7 for interpretability. This means that scores are of relative popularity and are not confounded by the fluctuating total number of searches across time.

Regions

We retrieved data for the societies most homogeneous for Islam, Judaism, and the LDS Church. For Islam, we accessed data for 41 countries in which Muslims comprise at least 75% of the populations (https://www.thearda.com/world-religion/world-maps?var=ADH_495). We

selected this threshold because it allows us to be relatively certain that most people within the sample observe Ramadan.

For Jews, we accessed data from Israel, which is approximately 71% Jewish (https://www.thearda.com/world-religion/national-profiles?u=113c#IRFDEMOG).

Finally, LDS data come from the state of Utah in the United States, which is approximately 69% LDS (https://www.thearda.com/world-religion/world-maps?var=ADH_495), although we note that current LDS rates might be substantially lower (Cragun et al., 2023).

Temporal Granularity and Timespan of the Data

Not all Google Trends queries yield high quality data. When search volume for a queried term or terms within a given geographical region and time window falls below an undisclosed privacy threshold, Google Trends returns a score of zero. One consequence of this is that queries of less popular terms, or queries using finer geographical or temporal granularities, return more zeros and are consequently less reliable (Moon & Barlev, in press).

Although daily data would have been ideal for testing our hypotheses—especially for the day-long Yom Kippur fast and Fast Sundays—queries at this temporal granularity returned mostly zeros. We therefore use the most reliable granular data available to us: weekly data.

Additionally, although Google Trends provides data beginning in 2004, data from its earlier years are sparse (in part due to fewer Google users) and often less reliable (Moon & Barlev, in press; Raubenheimer, 2024). To avoid these lower quality data, and to avoid complexities due to a major update to the Google Trends algorithm—where some have observed large changes in the data (Algan et al., 2019)—our analyses begin with data starting in 2011.

Measuring Well-Being

We created a measure of psychological well-being using Google Trends topics. Topics in Google Trends represent aggregates of terms that comprise a construct of interest. For example, whereas a query for the keyword *weather* would include only searches for the English word *weather*, the topic *Weather* also includes searches for terms related to weather, such as synonyms or words in different languages. See Moon and Barlev (in press) for more details about topics versus keywords.

Previous research investigated whether emotion topics (e.g., *Happiness*, *Sadness*) track fluctuations in self-reported emotions on a national "Mood Tracker Poll" in Great Britain (Foa et al., 2022). Most negative—but not positive—emotions were valid proxies, each predicting about 50% of the variance in self-reported emotions. We selected three emotion topics from this research relevant to our conceptual model: *Sadness*, *Stress*, and *Apathy*. We also included two topics related to mental health: *Depression* and *Antidepressant*.

To create a robust measure of subjective well-being and mental health, we first standardized all five topics, such that the mean for each was zero *within each year* (and also within each country). We then conducted a Bayesian factor analysis using data for the five topics, restricting it to load on a single factor. We used the default priors of the MCMCpack package (Martin et al., 2011) in R with 10,000 MCMC iterations following a 5,000-iteration burn-in period.

We calculated well-being scores for each time point within each country as follows: First, raw emotion scores were standardized using country-specific means and standard deviations. Then, we computed factor scores by applying the posterior mean factor loadings as weights to the standardized scores. When one or more emotion topics had missing data for a given time point, scores were calculated using only the available topics, with weights normalized by the sum

of their loadings. Scores were reversed such that higher values indicate greater subjective well-being and mental health (meaning our well-being measure is negatively correlated with all five topics). This approach allowed us to estimate well-being using at least one topic for every time point and every country in our main analysis.

Fasting Traditions and Event Period Definitions

Below, we describe the three fasts—Ramadan, Yom Kippur, Fast Sunday—and how we defined the "event period" for each, meaning the weeks of interest, which includes the fast itself along with pre- and post-fast temporal windows.

Islam: Ramadan

During Ramadan, the ninth month of the Islamic lunar calendar, Muslim adults who are able fast from dawn until sunset, avoiding both eating and drinking. During this time there is a heightened emphasis on charitable giving and compassion for the poor: adherents give voluntarily to charity and pay an obligatory donation that is distributed to the poor at the end of the month.

Although not required, many adherents consume large meals before the daily fast begins (*Suhoor*) and after sunset at the conclusion of the fast (*Iftar*). The evening meal is often shared with family, friends, and co-religionists.

In addition to the daily fasts, Ramadan includes what is for Muslims the most sacred night of the year—*Laylat al-Qadr*, or *Night of Power*, which commemorates the beginning of Quranic revelation. Beginning right after Ramadan ends—at the very start of the next lunar month—is *Eid al-Fitr*, a celebration that, depending on the country, lasts from one to three days or longer.

Event Period Coding. We defined Ramadan periods using historical Islamic calendar dates for 2011-2025. We coded a week as Ramadan if it included at least four days of Ramadan (i.e., if the majority of the week was during Ramadan). Because Ramadan spans approximately 29-30 days and our data were weekly, some years contained five weeks with a majority of Ramadan days (≥4 days) while others contained only four such weeks. Two of the 15 years (2011-2025) had five weeks coded as Ramadan, whereas the rest had four weeks.

We analyzed the effects of Ramadan in two ways: (1) as a single combined period, and (2) separately examining individual weeks to investigate temporal dynamics within the fasting period. We labeled weeks as Week 1, Week 2, Middle Week (for years that have five weeks), Second-Last Week, and Last Week. This ensured that the last two weeks always represented the last two weeks of Ramadan (rather than, when Ramadan is coded with five weeks, the fourth week being second-last).

Around each Ramadan period, we defined four pre-Ramadan periods (4, 3, 2, and 1 weeks before), and four post-Ramadan periods (1, 2, 3, and 4 weeks after). All remaining weeks of the year served as the baseline comparison period.

One important limitation of using weekly data is that the weeks coded as preceding and following Ramadan often included one to three days of Ramadan. Moreover, Eid al-Fitr—the celebration that immediately follows the end of Ramadan—was often coded in the last week of Ramadan. Thus, our differentiation of Ramadan from the one week preceding and following it should be interpreted cautiously.

Judaism: Yom Kippur

Yom Kippur, the Day of Atonement, is the holiest day in Judaism. Yom Kippur is observed through a 25-hour fast, from sunset to nightfall the following day. During this fast,

Jews abstain from food, water, and bodily pleasures such as sex and bathing. In many Jewish communities, observance also includes abstaining from electronic devices and internet use.

Yom Kippur is centered on repentance and reconciliation, with both God and people. The day is devoted almost entirely to communal prayer and is typically spent in synagogue in the presence of co-religionists. The fast begins and ends with large family meals, while the intervening period is marked by withdrawal from ordinary daily activities.

Of particular note, the period preceding Yom Kippur is itself set apart as special. The ten days beginning with Rosh Hashanah (the Jewish new year) and ending with Yom Kippur—collectively, the Ten Days of Repentance—are characterized by heightened moral reflection, efforts to repair interpersonal relationships, and increased charitable giving (tzedakah).

Judaism includes several other more minor fast days—most notably Tisha B'Av and minor fasts commemorating historical tragedies—which are primarily mournful, marking collective loss. Unlike Yom Kippur, these fasts are not centered on repentance and typically involve fewer behavioral restrictions and less intensive communal worship. We do not examine the effects of those fasts here, as they are not as widely observed.

Event Period Coding. We coded fasting periods as the week containing Yom Kippur. We defined four pre–Yom Kippur periods (4, 3, 2, and 1 weeks before) and four post–Yom Kippur periods (1, 2, 3, and 4 weeks after). All remaining weeks of the year served as the baseline comparison period.

This means that the week coded as Yom Kippur included days preceding and/or following the fast. We cannot, therefore, conceptually isolate the effects of the fast itself. Additionally, Jews are not supposed to use the internet on Yom Kippur, meaning that Google search data for the week coded as Yom Kippur reflects traffic on the days immediately preceding

and/or following the fast. Finally, because the days preceding Yom Kippur are themselves set apart as special (the Ten Days of Repentance), they might have effects on mental health independent of the fast.

LDS: Fast Sunday

The LDS Church prescribes fasting on one Sunday per month. On these fast days, adherents are encouraged to abstain from food and water for approximately 24 hours by foregoing two meals—this typically results in a fast beginning after the evening meal on Saturday and ending with dinner on Sunday. Fast Sundays differ from regular Sundays in two main ways: First, local congregations collect charitable donations, or "fast offerings," in which members are encouraged to donate at least the amount of money saved by the meals skipped. Second, in lieu of typical Sunday services, in which talks by members of the congregation are assigned beforehand, the main meeting on fast Sundays is a "fast and testimony meeting," in which individuals in attendance spontaneously offer brief statements of faith. Fast Sundays typically end with a communal meal, often with family and other co-religionists.

Although LDS practitioners are encouraged to fast, some sources suggest that fast Sundays may nowadays only be observed by a minority. One medical study found that approximately 38% of a sample of LDS individuals regularly fasted (Horne et al., 2008). A separate study found that most LDS people (69%) donate via fast offerings (Curtis et al., 2015). Thus, some aspects of fast Sunday may be more commonly practiced than others.

Event Period Coding. Fast Sundays take place the first Sunday of each month, with two main exceptions: In April and October, the LDS Church holds a church-wide conference in lieu of normal services. Because of this, fasts are moved at the discretion of local congregations, typically to the week before or the week after. Because there is variation in which congregations

fast on each of these days, we did not code either of these as a fasting period. Otherwise, the week beginning with the first Sunday of each month was coded as a fasting period. Note that this means that the timepoint coded as "Fast Sunday" includes the fast day plus the six days following it.

In contrast to the Ramadan and Yom Kippur analyses, we coded only one pre-fast and one post-fast week, as additional weeks would have created overlapping event periods.

Ramadan Intensity

If fasting has positive effects on subjective well-being and psychological health, then a more intense fast might lead to stronger effects. Ramadan allows us to test this prediction. Because Ramadan follows the Islamic calendar, it does not always occur during the same season. One implication of this is that the amount of daylight—and therefore the amount of time spent fasting—differs as a function of both year and country. Countries farther from the equator have greater seasonal variance in daylength, and therefore the length of the Ramadan fast, with longer fasts when Ramadan occurs during the summer, and shorter fasts when Ramadan occurs in the winter.

Previous research has leveraged this natural experiment to test the effects of Ramadan (Aksoy & Gambetta, 2022; Campante & Yanagizawa-Drott, 2015; Mehmood et al., 2023). To test whether fasting duration (or "Ramadan intensity") moderates the effects of Ramadan on well-being, we obtained weekly daylight hours data for the capital cities of each of the Muslim countries in our study. We did this by obtaining coordinates for each of the capital cities, following Campante and Yanagizawa-Drott (2015), and the sunrise and sunset times in those capital cities for every day from 2011 to 2025 (from the Astronomical Applications Department

of the U.S. Naval Observatory). We used these times to compute the average number of hours of daylight in each country and week.

If the effects of Ramadan depend on the duration of the daily fasts, then there should be a significant Ramadan × Daylight interaction, such that the effects of Ramadan are amplified when average hours of daylight are higher.

Main Event Study Model

We fitted the following fixed-effects regression models predicting well-being:

$$Wellbeing\_it = \beta_0 + \beta_1 Period\_it + \beta_2 Year\_t + \beta_3 Country\_i + \beta_4 Month\_i + \varepsilon\_it$$

In this model, *i* indexes countries, *t* indexes weeks, and *Period* uses dummy coded indicators to capture the event windows—the periods coded as fasting weeks as well as the pre- and post-fasting periods.

For all Ramadan analyses, we estimated separate models for (1) the entire Ramadan period (four or five weeks combined) and (2) each Ramadan week separately (Week 1, Week 2, Middle Week, Second-Last Week, Last Week) to examine temporal dynamics within the fasting period. All models include a fixed effect for year, and a fixed effect of month to control for seasonal patterns.

All models include a fixed effect for year and a fixed effect for month to control for yearly fluctuations in well-being and seasonal patterns. Only the Ramadan analyses—which involve multiple countries—include the country fixed effect.

Ramadan Intensity Interaction Model

To test whether Ramadan intensity moderates the effects of Ramadan, we estimated the following interaction models:

$$Wellbeing\_it = \beta_0 + \beta_1 Period\_it + \beta_2 Daylight\_it + \beta_3 (Period \times Daylight)\_it + \beta_4 Year\_t + \beta_5 Country\_i + \beta_4 Month\_i + \varepsilon\_it$$

Daylight was standardized within each model, such that the mean daylight was zero (*SD* = 1). The interaction term β_3 tests whether the effect of Ramadan on well-being is larger when fasting hours are longer.

Model Estimation

All models used cluster-robust standard errors to account for correlation in residuals. For Ramadan analyses, we used two-way clustering by year and country to account for within-country correlation over time and within-year correlation across countries. For Yom Kippur and LDS Fast Sunday analyses (which included single regions), we clustered only by year.

Analyses were conducted in R version 4.5.0 using the sandwich package (Zeileis et al., 2020) for robust standard errors and lmtest (Hothorn et al., 2025) for coefficient testing.

Results

Ramadan

Our full Ramadan dataset included 41 Muslim-majority countries. However, many of these countries' datasets were mostly zeros, which indicate missing data due to low search volume. To ensure data quality, our main analysis included only countries that had at least one trend with no missing data across the entire span. As *Sadness* was the topic with the least missingness, all of these countries at least have a score for *Sadness* for each week. This allowed us to estimate well-being for all time points using at least one indicator.

After exclusions, this analysis included data from 16 countries: Algeria, Bangladesh, Egypt, Indonesia, Iran, Iraq, Jordan, Kuwait, Morocco, Oman, Pakistan, Qatar, Saudi Arabia, Tunisa, Turkey, and UAE. The well-being factor (calculated using a Bayesian factor analysis on

the five topics) had the following loadings: Sadness (0.28), Depression (0.72), Antidepressant (0.34), Apathy (0.33), and Stress (0.39). Higher scores indicate greater well-being (decreased negative emotion search volume).

Compared to baseline periods, Ramadan was associated with increased well-being, $b = 0.28$, $SE = 0.08$, $t = 3.36$, $p < .001$. See Figure 1. The two weeks preceding Ramadan and the week following Ramadan also had significantly higher well-being scores (Pre-2: $b = 0.17$, $SE = 0.07$, $t = 2.43$, $p = .015$; Pre-1: $b = 0.27$, $SE = 0.09$, $t = 3.02$, $p = .003$; Post-1: $b = 0.31$, $SE = 0.11$, $t = 2.92$, $p = .003$).

When examining each Ramadan week separately, we found that well-being was higher than baseline in all except Week 2 of Ramadan:

- **Week 1**: $b = 0.38$, $SE = 0.10$, $t = 3.74$, $p < .001$
- **Week 2**: $b = 0.13$, $SE = 0.14$, $t = 0.95$, $p = .341$
- **Middle Week**: $b = 0.54$, $SE = 0.09$, $t = 6.29$, $p < .001$
- **Second-Last Week**: $b = 0.23$, $SE = 0.08$, $t = 2.76$, $p = .006$
- **Last Week**: $b = 0.36$, $SE = 0.08$, $t = 4.68$, $p < .001$

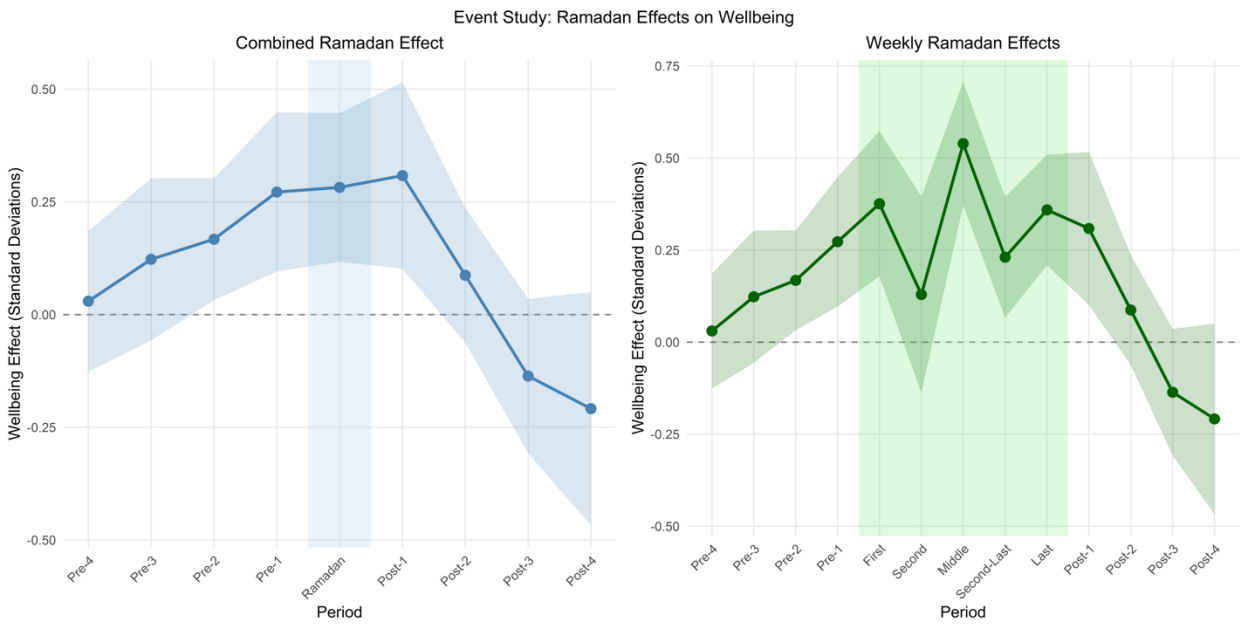

Fig. 1. Event study showing composite psychological well-being scores for weeks before, during, and after Ramadan, across 16 Muslim-majority countries using data from 2011-2025. The left panel shows the results with Ramadan as a single period. The right panel shows results with Ramadan weeks disaggregated. Ribbons represent 95% confidence intervals; shaded time periods represent Ramadan.

Robustness Analyses

The analysis reported above results from several analytic decisions, such as how much missingness to allow and which topics to include in the well-being composite. To test whether our results are robust to different analytic decisions, we conducted three robustness analyses. It is possible that more lenient criteria (i.e., including countries with at least some missing data) or different operationalizations of well-being (i.e., using different sets of emotions) would yield different results.

In this section, we test whether results remain comparable (a) when allowing different amounts of missing data and (b) when using different combinations of topics to operationalize well-being. (c) Lastly, we conduct a permutation test, which runs our model 1000 times with different weeks coded as Ramadan. If the true Ramadan weeks indeed have higher well-being, then few, if any, sets of random weeks should show stronger effects.

First, as shown in Table 1, we conducted our main analysis with varying thresholds of missingness. For the 2011-2025 data (that is, the same range reported above), we ran the analysis allowing 5%, 15%, 30%, and 50% missing data, recalculating the factor loadings using the same Bayesian factor analysis as above.

Table 1. Effect of Ramadan period on well-being under different missingness thresholds.

Missingness Threshold	Number of Countries	Effect of Ramadan (*SE*)	*t*	*p*
Data				
0%	16	0.28 (0.08)	3.36	< .001
5%	20	0.25 (0.07)	3.41	< .001
15%	23	0.24 (0.07)	3.38	< .001
30%	25	0.24 (0.07)	3.39	< .001
50%	28	0.22 (0.07)	3.04	.003

Second, we conducted the analysis using every possible combination of three and four of the five topics (a total of 16 combinations). To create these well-being composites, we re-ran the Bayesian factor analysis using the same process as the main analysis. In each of the 16 combinations, the effect of Ramadan was statistically significant. Coefficients ranged from b = 0.22 (p = .031; Sadness + Antidepressant + Apathy) to 0.35 (p < .001; Antidepressant + Apathy + Stress).

Finally, if weeks coded as Ramadan truly have higher levels of well-being than other weeks, then the specific weeks coded as Ramadan should show stronger effects than sets of weeks chosen at random. To test this, we conducted an inference robustness analysis, or permutation test. In this analysis, the timing of the pre-Ramadan (4 weeks), Ramadan (4 or 5 weeks, depending on the year), and post-Ramadan (4 weeks) blocks were randomly assigned within each year, and this was repeated 1000 times. Note that this random assignment meant that some Ramadan/pre-Ramadan/post-Ramadan blocks overlapped with their actual periods.

Out of the 1000 alternative assignments, the average observed effect was –0.01 (SD = 0.10), and ranged between –0.36 and 0.26. No random set of dates had a coefficient as high as the model with true Ramadan dates (b = 0.28—see Table 1).

Individual Emotions

Finally, we tested each emotion separately, using only countries that had complete data (i.e., no zeros) for that emotion. This left 16 countries for Sadness, eight for Depression, and only one (Turkey) for Antidepressant.

We fitted the same models as above, standardizing scores within country and year, controlling for month, and applying clustered standard errors. (As the Antidepressant analysis had a single country, the Country term was omitted in that analysis.) Note that individual emotions were not reversed, so positive coefficients would indicate increased search volume related to a given emotion, rather than increased well-being.

During Ramadan, there was a marginally significant decline in searches for Sadness, $b = –0.28$, $SE = 0.14$, $t = –1.93$, $p = .053$, and significant declines for Depression, $b = –0.35$, $SE = 0.15$, $t = –2.33$, $p = .020$, and Antidepressant, $b = –0.51$, $SE = 0.19$, $t = –2.70$, $p = .007$.

As an additional robustness check, we ran the same analysis but allowed up to 10% missing data in each trend. Doing this increased the number of countries for each topic: Sadness (21 countries), Depression (14), Antidepressant (2), Stress (8), and Apathy (3).

This analysis found a significant decline in searches related to all five topics during Ramadan: Sadness, $b = –0.25$, $SE = 0.12$, $t = –2.02$, $p = .044$; Depression, $b = –0.37$, $SE = 0.15$, $t = –2.28$, $p = .023$; Antidepressant, $b = –0.35$, $SE = 0.17$, $t = –2.01$, $p = .045$; Stress, $b = –0.46$, $SE = 0.15$, $t = –3.16$, $p = .002$; and Apathy, $b = –0.32$, $SE = 0.12$, $t = –2.68$, $p = .007$.

In total, we find robust effects of Ramadan on well-being in Muslim-majority countries. This effect varies little depending on different analytic choices—how much missing data to allow, which negative emotion topics to include, and which set of years to include.

Yom Kippur

The full sample included 783 weeks, with 15 coded as fasting periods (i.e., weeks containing Yom Kippur). Note that Yom Kippur is not always on the same day of the week—in some years it occurred early in the fasting week, in some years it occurred later in the week. The well-being factor had the following loadings: Sadness (0.17), Depression (0.21), Apathy (0.04), Antidepressant (0.79), and Stress (0.11).

Our main model did not find a significant effect on weeks coded as Yom Kippur, $b = –0.32$, $SE = 0.24$, $t = –1.53$, $p = .126$, nor were there any significant effects for the weeks surrounding these weeks (ps > .099).

Robustness Analysis

We conducted the same robustness analysis as above, in which we ran the same model with each possible combination of at least three of the negative emotions. (The other robustness analysis is only possible where there are multiple regions.) Weeks coded as Yom Kippur did not have significantly different well-being under any possible operationalization of well-being (all ps > .088).

Individual Emotions

Analysis of each emotion separately found marginally significant increase in search volume for Sadness, $b = 0.46$, $SE = 0.27$, $t = 1.70$, $p = .090$, but not the other emotions (ps > .110). Recall that the individual emotions were not reverse-coded, so these results suggest an increase in some negative emotions during weeks containing Yom Kippur.

In sum, we did not find consistent evidence for changes in well-being during weeks containing Yom Kippur, although these analyses are more limited than the Ramadan analysis (see Discussion).

LDS Fast Sunday

The full sample included 783 weeks, with 180 coded as fasting weeks. The well-being factor had the following loadings: Sadness (0.30), Depression (0.61), Apathy (0.21), Antidepressant (0.34), and Stress (0.56).

Relative to all other weeks, weeks starting with a Fast Sunday had significantly *lower* well-being scores, $b = –0.08$, $SE = 0.04$, $t = –2.53$, $p = .012$. There was also a significant effect for the week after Fast Sundays, $b = –0.11$, $SE = 0.04$, $t = –3.09$, $p = .002$. (In contrast to the Ramadan analysis where the weeks immediately following Ramadan often contained one or more fasting days, the weeks coded as following Fast Sunday began one full week after the day of fasting; because of this, we are hesitant to interpret this result as meaningful.)

As an exploratory analysis, we also tested a model controlling for LDS General Conference, which occurs the first Sunday of both April and October. This did not alter the negative result of Fast Sunday, $b = –0.10$, $SE = 0.04$, $t = –2.80$, $p = .005$. However, weeks beginning with LDS General Conference did have relatively higher well-being than baseline, $b = 0.24$, $SE = 0.11$, $t = 2.14$, $p = .032$.

Robustness Analysis

We conducted the main analysis with each combination of at least three emotions (as above). The coefficients did not vary greatly across these combinations, ranging from $b = –0.12$ to $b = –0.08$. The *p*-values were statistically significant in nine out of the 16 combinations (including the complete set used in our main analysis), and marginally significant in four more.

Individual Emotions

As above, we tested the effects for individual emotions. On weeks beginning with Fast Sundays, search volume was marginally higher for Depression, $b = 0.12$, $SE = 0.07$, $t = 1.66$, $p =$

.096, and significantly higher for Stress, $b = 0.15$, $SE = 0.07$, $t = 2.18$, $p = .030$. (All other ps > .473.)

In sum, we find some evidence for *decreased* well-being in Utah on weeks beginning with Fast Sunday. However, these findings are less consistent across different emotional combinations than the positive effects of Ramadan. Additionally, there are several limitations that make these results less conclusive.

Daylight Moderation: Does Ramadan Intensity Amplify Effects of Fasting on Well-Being?

The interaction between daylight hours and the combined Ramadan period was not statistically significant, $b = 0.18$, $SE = 0.13$, $t = 1.43$, $p = .153$.

Looking at individual weeks of Ramadan, the strength of the daylight moderation effect varied across individual Ramadan weeks; no weeks reached statistical significance:

- **Week 1 × Daylight**: $b = 0.14$, $SE = 0.10$, $t = 1.31$, $p = .190$
- **Week 2 × Daylight**: $b = 0.42$, $SE = 0.28$, $t = 1.49$, $p = .136$
- **Middle Week × Daylight:** $b = 0.17$, SE = NA, t = NA, p = NA
- **Second-Last Week 3 × Daylight**: $b = 0.12$, $SE = 0.10$, $t = 1.15$, $p = .515$
- **Last Week × Daylight**: $b = 0.02$, $SE = 0.11$, $t = 0.14$, $p = .887$

Table 2 shows results of the Ramadan × Daylight interaction. Though the interaction is marginally significant when allowing some additional missing data, these results do not provide strong support for the notion that longer daylight hours amplify the positive effects of Ramadan on well-being. If there is such an effect, it is likely a small effect that requires precise measurement to detect.

Table 2. Interaction between Ramadan and daylight hours under different missingness thresholds.

Missingness Threshold	Number of Countries	Ramadan × Daylight (*SE*)	*t*	*p*
Data				
0%	16	0.18 (0.08)	1.43	.153
5%	20	0.19 (0.11)	1.75	.081
15%	23	0.20 (0.12)	1.67	.096
30%	25	0.20 (0.11)	1.84	.066
50%	28	0.20 (0.11)	1.82	.069

Discussion

We investigated (a) whether well-being increases during religious fasting periods, (b) whether these effects last beyond fasting periods or whether well-being increases *before* fasting periods, and (c) whether longer Ramadan fasts have stronger effects.

Using 15 years of internet search data, we found, first, robust evidence that Ramadan increases well-being in countries with homogenous Muslim populations. However, we did not find comparable effects for other the Yom Kippur fast in Israel or the LDS Fast Sunday in Utah.

What happens in the weeks preceding and following the fast? Our event study suggests that well-being in Muslim-majority countries increases the week before Ramadan fasting begins—perhaps in anticipation for the fast—and returns to baseline within approximately two weeks after Ramadan ends. (Note, however, that the week before and the week after Ramadan often included some days of Ramadan.) Results were again less consistent for other fasts: There were no significant effects in the Yom Kippur event period, and well-being declined somewhat in the week after LDS Fast Sunday.

Did the effect of Ramadan show a "dosage" effect? No. We did not find evidence that longer or shorter daily fasts (more or fewer daylight hours) moderated the effects of Ramadan.

Potential Mechanisms

What is it about Ramadan fasting that improves well-being? All religious fasts include many practices, making it difficult to know the "active ingredients" without an experimental design. Would the religious practices related to fasting be similarly effective if adherents were not hungry? Are certain associated rituals especially beneficial? Does fasting help adherents foster certain mindsets that increase well-being?

We suggest several possible mechanisms. Future research is needed to understand which of these—or combinations of these—drive the effects of religious fasting.

First, many positive effects of religion are driven by social factors, such as an social support and stronger close relationships (Dunbar, 2021; Moon et al., 2023). To the extent that religious fasting represents a subjectively difficult experience shared with one's group, then this sense of difficulty might increase group cohesion and cooperation (Bastian et al., 2014).

Relatedly, one common theme across the three religious fasts studied is that they typically break the fast in a communal meal. Food sharing is a cultural universal, and often plays an important role in regulating social relationships (Kaplan et al., 1985). Sharing meals seems to make people feel closer and more trusting of each other (Dunbar, 2017). This suggests the possibility that breaking a fast communally is a critical "ingredient" for making religious fasting (at least the Ramadan fast, where we observed significant effects) effective.

The experience of hunger may also facilitate shifts in attention and mindset during fasting periods. Ramadan, for example, involves restructuring of daily routines—altered sleep-wake cycles, synchronized prayer times, collective *Iftar* meals, and refraining from certain activities during daylight hours. These redirected activities, combined with persistent feelings of hunger, might serve as consistent reminders of the reasons behind the fasting practice. Thus, another

possibility is that the experience of hunger itself might help amplify positive mindsets or re-interpret discomfort, which in turn facilitate well-being.

Limitations

Our measures of well-being are limited in that, unlike some previous uses of Google Trends to assess well-being (Algan et al., 2019; Foa et al., 2022), we were unable to compare our measures against high-frequency survey data to ensure a close link. However, given that negative emotion topics provide a valid proxy for well-being in multiple countries (Foa et al., 2022; Greyling & Rossouw, 2025), and given that our Ramadan results hold for every combination of negative emotions, it is unlikely that each of the topics assessed is spuriously and negatively associated with Ramadan periods.

Our analyses of Yom Kippur and LDS Fast Sundays are additionally limited in several ways: First, whereas Ramadan spans several weeks—allowing us to code several consecutive weeks as fasting periods—both Yom Kippur and LDS Fast Sundays last only a single day. As daily data were not available for these trends, we coded as fasting periods the weeks containing these fasting days. This means that, to find a significant effect, these single-day fasts would need to increase well-being to a large enough extent to cut through the noise of six additional days during which no positive effect would be expected.

Moreover, whereas we were able to select many large countries with at least 75% Muslim populations, where most Muslims are likely to fast (Pew Research Center, 2012), Israel and Utah are relatively small, and neither has such a strong religious majority with such a high fasting rate. About 71% of Israel is Jewish, and of those, one survey estimated that only 61% planned to fast on Yom Kippur (Ynetnews, 2010). In Utah, self-identified LDS individuals may no longer be a majority in Utah (Cragun et al., 2023), and even a minority of active LDS individuals might

regularly fast (Horne et al., 2008). Thus, not only would these fasting days need to have large enough effects to cut through the noise of the rest of the week, but the effect for adherents would also need to be large enough to cut through the noise of a significant proportion of the population not engaging in the fast.

For these reasons, one should draw conclusions about the effects of Yom Kippur and LDS fasting with limited confidence. In contrast, these limitations do not affect our Ramadan findings, where the month-long duration, high participation rates, and presence of 16 large countries with Muslim majorities above 75% allow us to examine sustained effects over multiple weeks with adequate statistical power.

Conclusions

The present study provides the strongest evidence to date that the Ramadan fast is associated with increased society-level well-being, shown across several Muslim-majority countries and over 15 years. Moreover, these findings are robust across different operationalizations of well-being and analytic choices. By examining week-by-week trends we find that well-being increases shortly before Ramadan and begins to return to baseline shortly after the fast ends—a temporal pattern that would be difficult to detect with most self-report designs.

Religious fasting is one of humanity's most widespread religious practices, observed by billions across diverse faith traditions. Our findings suggest that this ancient practice may contribute to human flourishing at the population level. Understanding how and why religious practices such as fasting affect well-being remains an important question for psychological science—one with both theoretical and practical implications for promoting individual and

societal flourishing. As societies secularize, insights from the study of religious practices may offer valuable lessons, even for those who do not identify as religious.

References

Aarøe, L., & Petersen, M. B. (2013). Hunger games: Fluctuations in blood glucose levels influence support for social welfare. *Psychological Science*, *24*(12), 2550–2556. https://doi.org/10.1177/0956797613495244

Ackermans, M. A., Jonker, N. C., Bennik, E. C., & De Jong, P. J. (2022). Hunger increases negative and decreases positive emotions in women with a healthy weight. *Appetite*, *168*, 105746. https://doi.org/10.1016/j.appet.2021.105746

Aksoy, O., & Gambetta, D. (2022). Commitment through sacrifice: How longer Ramadan fasting strengthens religiosity and political Islam. *American Sociological Review*, *87*(4), 555–583. https://doi.org/10.1177/00031224221101204

Algan, Y., Murtin, F., Beasley, E., Higa, K., & Senik, C. (2019). Well-being through the lens of the internet. *PLOS ONE*, *14*(1), e0209562. https://doi.org/10.1371/journal.pone.0209562

Allen, C., & Nettle, D. (2021). Hunger and socioeconomic background additively predict impulsivity in humans. *Current Psychology*, *40*(5), 2275–2289. https://doi.org/10.1007/s12144-019-0141-7

Al-Ozairi, E., Al Kandari, J., AlHaqqan, D., AlHarbi, O., Masters, Y., & Syed, A. A. (2015). Obesity surgery and Ramadan: A prospective analysis of nutritional intake, hunger and satiety and adaptive behaviours during fasting. *Obesity Surgery*, *25*(3), 523–529. https://doi.org/10.1007/s11695-014-1373-0

Bastian, B., Jetten, J., & Ferris, L. J. (2014). Pain as social glue: Shared pain increases cooperation. *Psychological Science*, *25*(11), 2079–2085. https://doi.org/10.1177/0956797614545886

Campante, F., & Yanagizawa-Drott, D. (2015). Does religion affect economic growth and happiness? Evidence from Ramadan. *The Quarterly Journal of Economics*, *130*(2), 615–658. https://doi.org/10.1093/qje/qjv002

Cebrián, E., & Domenech, J. (2023). Is Google Trends a quality data source? *Applied Economics Letters*, *30*(6), 811–815. https://doi.org/10.1080/13504851.2021.2023088

Cragun, R. T., Gull, B., & Phillips, R. (2023). Mormons are no longer a majority in Utah: Causes, consequences, and implications for the sociology of religion. *Journal of Religion and Demography*, *10*(1–2), 162–184. https://doi.org/10.1163/2589742x-bja10019

Curtis, D. W., Evans, V., & Cnaan, R. A. (2015). Charitable practices of Latter-day Saints. *Nonprofit and Voluntary Sector Quarterly*, *44*(1), 146–162. https://doi.org/10.1177/0899764013508010

Database of Religious History. (2024). *Does membership in this group require fasting?* University of British Columbia. https://religiondatabase.org/visualize/3369/

Demmrich, S., Koppold-Liebscher, D., Klatte, C., Steckhan, N., & Ring, R. M. (2023). Effects of religious intermittent dry fasting on religious experience and mindfulness: A longitudinal study among Baha'is. *Psychology of Religion and Spirituality*, *15*(4), 459–470. https://doi.org/10.1037/rel0000423

Dunbar, R. I. M. (2017). Breaking bread: The functions of social eating. *Adaptive Human Behavior and Physiology*, *3*(3), 198–211. https://doi.org/10.1007/s40750-017-0061-4

Dunbar, R. I. M. (2021). Religiosity and religious attendance as factors in wellbeing and social engagement. *Religion, Brain & Behavior*, *11*(1), 17–26. https://doi.org/10.1080/2153599X.2020.1712618

Edmunds, D., Wigby, S., & Perry, J. C. (2021). 'Hangry' Drosophila: Food deprivation increases male aggression. *Animal Behaviour*, *177*, 183–190. https://doi.org/10.1016/j.anbehav.2021.05.001

Fattorini, N., Brunetti, C., Baruzzi, C., Macchi, E., Pagliarella, M. C., Pallari, N., Lovari, S., & Ferretti, F. (2018). Being "hangry": Food depletion and its cascading effects on social behaviour. *Biological Journal of the Linnean Society*, *125*(3), 640–656. https://doi.org/10.1093/biolinnean/bly119

Foa, R. S., Fabian, M., & Gilbert, S. (2022). Subjective well-being during the 2020–21 global coronavirus pandemic: Evidence from high frequency time series data. *PLoS ONE*, *17*(2), e0263570. https://doi.org/10.1371/journal.pone.0263570

Greyling, T., & Rossouw, S. (2025). Development and validation of a real-time happiness index using Google Trends. *Journal of Happiness Studies*, *26*(3), 39. https://doi.org/10.1007/s10902-025-00881-9

Hackett, C., Stonawski, M., Tong, Y., Kramer, S., Shi, A., & Fahmy, D. (2025). *How the Global Religious Landscape Changed From 2010 to 2020*. Pew Research Center. https://www.pewresearch.org/religion/2025/06/09/how-the-global-religious-landscape-changed-from-2010-to-2020

Harder-Lauridsen, N. M., Rosenberg, A., Benatti, F. B., Damm, J. A., Thomsen, C., Mortensen, E. L., Pedersen, B. K., & Krogh-Madsen, R. (2017). Ramadan model of intermittent fasting for 28 d had no major effect on body composition, glucose metabolism, or cognitive functions in healthy lean men. *Nutrition*, *37*, 92–103. https://doi.org/10.1016/j.nut.2016.12.015

Haruvy, E. E., Ioannou, C. A., & Golshirazi, F. (2018). The religious observance of Ramadan and prosocial behavior. *Economic Inquiry*, *56*(1), 226–237. https://doi.org/10.1111/ecin.12480

Horne, B. D., May, H. T., Anderson, J. L., Kfoury, A. G., Bailey, B. M., McClure, B. S., Renlund, D. G., Lappé, D. L., Carlquist, J. F., Fisher, P. W., Pearson, R. R., Bair, T. L., Adams, T. D., & Muhlestein, J. B. (2008). Usefulness of routine periodic fasting to lower risk of coronary artery disease in patients undergoing coronary angiography. *The American Journal of Cardiology*, *102*(7), 814-819.e1. https://doi.org/10.1016/j.amjcard.2008.05.021

Hothorn, T., Zeileis, A., Farebrother, R. W., Cummins, C., Millo, G., & Mitchell, D. (2025). *Lmtest* (Version 0.9-40) [Computer software]. https://cran.r-project.org/web/packages/lmtest/lmtest.pdf

Kadri, N., Tilane, A., El Batal, M., Taltit, Y., Tahiri, S. M., & Moussaoui, D. (2000). Irritability during the month of Ramadan. *Psychosomatic Medicine*, *62*(2), 280–285. https://doi.org/10.1097/00006842-200003000-00021

Kaplan, H., Hill, K., Cadelina, R. V., Cadeliña, R. V., Hayden, B., Hyndman, D. C., Preston, R. J., Smith, E. A., Stuart, D. E., & Yesner, D. R. (1985). Food sharing among Ache foragers: Tests of explanatory hypotheses. *Current Anthropology*, *26*(2), 223–246.

MacCormack, J. K., & Lindquist, K. A. (2019). Feeling hangry? When hunger is conceptualized as emotion. *Emotion*, *19*(2), 301–319. https://doi.org/10.1037/emo0000422

Martin, A. D., Quinn, K. M., & Park, J. H. (2011). MCMCpack: Markov Chain Monte Carlo in R. *Journal of Statistical Software*, *42*(9). https://doi.org/10.18637/jss.v042.i09

Mehmood, S., Seror, A., & Chen, D. L. (2023). Ramadan fasting increases leniency in judges from Pakistan and India. *Nature Human Behaviour*, *7*(6), 874–880. https://doi.org/10.1038/s41562-023-01547-3

Moon, J. W., & Barlev, M. (in press). Google search data for psychological scientists: A tutorial and best practices. *Advances in Methods and Practices in Psychological Science*. https://doi.org/10.31234/osf.io/af7b2_v3

Moon, J. W., Cohen, A. B., Laurin, K., & MacKinnon, D. P. (2023). Is religion special? *Perspectives on Psychological Science*, *18*(2), 340–357. https://doi.org/10.1177/174569162211004

Mousavi, S. A., Seifi, M., Baghni, S. A., & Dolat, E. (2015). The effects of fasting on the level of happiness in the general population of Kermanshah, Iran. *Journal of Fasting and Health*, (3), 29–34.

Petersen, M. B., Aarøe, L., Jensen, N. H., & Curry, O. (2014). Social welfare and the psychology of food sharing: Short-term hunger increases support for social welfare. *Political Psychology*, *35*(6), 757–773. https://doi.org/10.1111/pops.12062

Pew Research Center. (2012). *The World's Muslims: Unity and Diversity*. https://www.pewresearch.org/religion/2012/08/09/the-worlds-muslims-unity-and-diversity-executive-summary/

Rad, M. S. (2023). From self-deprivation to cooperation: How Ramadan fasting influences risk-aversion and decisions in resource dilemmas. *Current Research in Ecological and Social Psychology*, *5*, 100152. https://doi.org/10.1016/j.cresp.2023.100152

Raubenheimer, J. E. (2024). Of babies, bathwater, and big data: Going beneath the surface of Franzén's (2023) Google Trends recommendations. *Acta Sociologica*, *67*(2), 251–256. https://doi.org/10.1177/00016993231187489

Ring, R. M., Eisenmann, C., Kandil, F. I., Steckhan, N., Demmrich, S., Klatte, C., Kessler, C. S., Jeitler, M., Boschmann, M., Michalsen, A., Blakeslee, S. B., Stöckigt, B., Stritter, W., & Koppold-Liebscher, D. A. (2022). Mental and Behavioural Responses to Bahá'í Fasting: Looking behind the Scenes of a Religiously Motivated Intermittent Fast Using a Mixed Methods Approach. *Nutrients*, *14*(5), 1038. https://doi.org/10.3390/nu14051038

Roky, R., Iraki, L., HajKhlifa, R., Ghazal, N. L., & Hakkou, F. (2000). Daytime alertness, mood, psychomotor performances, and oral temperature during Ramadan intermittent fasting. *Annals of Nutrition and Metabolism*, *44*(3), 101–107. https://doi.org/10.1159/000012830

Slingerland, E., Monroe, M. W., & Muthukrishna, M. (2024). The Database of Religious History (DRH): Ontology, coding strategies and the future of cultural evolutionary analyses. *Religion, Brain & Behavior*, *14*(2), 131–160. https://doi.org/10.1080/2153599X.2023.2200825

Spanaki, C., Rodopaios, N. E., Koulouri, A., Pliakas, T., Papadopoulou, S. K., Vasara, E., Skepastianos, P., Serafeim, T., Boura, I., Dermitzakis, E., & Kafatos, A. (2021). The Christian Orthodox Church fasting diet is associated with lower levels of depression and anxiety and a better cognitive performance in middle life. *Nutrients*, *13*(2), 627. https://doi.org/10.3390/nu13020627

Stephens-Davidowitz, S. (2017). *Everybody lies: Big data, new data, and what the internet can tell us about who we really are*. Bloomsbury.

Swami, V., Hochstöger, S., Kargl, E., & Stieger, S. (2022). Hangry in the field: An experience sampling study on the impact of hunger on anger, irritability, and affect. *PLOS ONE*, *17*(7), e0269629. https://doi.org/10.1371/journal.pone.0269629

Ugur, Z. B. (2018). Does Ramadan affect happiness? Evidence from Turkey. *Archive for the Psychology of Religion*, *40*(2–3), 163–175. https://doi.org/10.1163/15736121-12341358

Wojciak, R. W. (2014). Effect of short-term food restriction on iron metabolism, relative well-being and depression symptoms in healthy women. *Eating and Weight Disorders - Studies on Anorexia, Bulimia and Obesity*, *19*(3), 321–327. https://doi.org/10.1007/s40519-013-0091-2

Ynetnews. (2010, September 16). *61% of Israeli Jews to fast on Yom Kippur*. https://www.ynetnews.com/articles/0,7340,L-3955440,00.html

Zeileis, A., Köll, S., & Graham, N. (2020). Various Versatile Variances: An Object-Oriented Implementation of Clustered Covariances in R. *Journal of Statistical Software*, *95*(1). https://doi.org/10.18637/jss.v095.i01