



Ritualized Interventions, Expectancy Effects, and Stress Biomarkers: RCT Evidence

Introduction

Rituals are structured, repetitive behaviors imbued with meaning – ranging from secular routines to spiritual ceremonies – that humans often turn to in times of uncertainty or stress. Researchers are increasingly interested in whether such **ritualized interventions** can causally reduce stress and how **expectancy (placebo) effects** might contribute to their efficacy. In this report, we focus on controlled studies (including randomized trials) examining the impact of rituals on **stress biomarkers**, with an emphasis on **heart rate variability (HRV)** and **cortisol** as primary outcomes. We also summarize findings on immune and inflammatory markers where evidence is available. Throughout, we distinguish between **spiritual/religious rituals** (e.g. prayer, chanting) and **secular rituals** (structured routines or novel laboratory rituals), noting the cultural context of each. Finally, we consider the role of expectancy and placebo-like mechanisms, along with ethical and methodological issues in validating these effects scientifically.

Rituals and Stress: Cultural and Psychological Context

Anthropological observations have long linked ritual behavior with anxiety reduction. For example, **Bronisław Malinowski** famously noted that Pacific Island fishermen performed elaborate rituals before venturing into dangerous open waters but not before fishing in calm lagoons. Across cultures, rituals accompany many **stressful life transitions** – funerals, weddings, coming-of-age ceremonies, etc. – suggesting they serve to manage emotional upheaval during uncertainty. Even in modern contexts of acute stress, people revert to ritualistic behavior. During the 2006 Lebanon War, Israeli women living in bombarded areas who **recited Psalms (prayer rituals)** coped better and reported lower stress levels than those who did not; notably, this effect was specific to those under fire (the same practice did not correlate with stress for women in safer areas). Similarly, clinical observations show that individuals facing anxiety, trauma, or loss often develop **personal rituals as coping mechanisms** – e.g. abuse survivors and palliative patients performing small ceremonies, or those with OCD engaging in repetitive acts to quell anxiety. These patterns led scholars to hypothesize that rituals are *not only* a byproduct of anxiety but potentially a **tool to reduce anxiety**.

Psychologists have begun testing this hypothesis experimentally. Early correlational studies of athletes found that **pre-performance routines** (which often have ritualistic, rigid elements) were associated with improved focus and reduced nerves, albeit without clear causality. Building on this, recent experiments have *causally* demonstrated that performing a ritual can alleviate anxiety and improve outcomes. For instance, Brooks et al. (2016) showed that introducing a brief, novel ritual (an arbitrary sequence of symbolic actions) before a stressful task **significantly lowered participants' state anxiety and boosted performance**, compared to no-ritual controls. Likewise, in a study on grief, people instructed to perform a small ritual (such as drawing and burning a picture symbolizing their loss) reported less grief and regained a sense of control *regardless* of whether they initially “believed” in the effectiveness of rituals. These findings

underline that both **religious rituals** (e.g. prayer) and **secular rituals** (even invented ones) can produce measurable psychological relief in high-stress situations. The next sections explore how these subjective benefits translate into objective changes in key stress biomarkers.

Heart Rate Variability (HRV) and Ritual Interventions

Heart rate variability (HRV) – the moment-to-moment variation in time between heartbeats – is a sensitive indicator of stress and autonomic nervous system balance. High HRV reflects a healthy, flexible cardiovascular response (greater parasympathetic tone), whereas stress typically suppresses HRV (heart beats become more rigid and regular). Researchers often use HRV as a biomarker of physiological anxiety: when anxiety is reduced, HRV tends to increase.

Controlled studies have found that engaging in rituals can boost HRV under stress. In a field experiment, **Xygalatas and colleagues (2020)** studied women from a Hindu community in Mauritius, first inducing anxiety in all participants via a public speaking stressor. Afterward, one group was instructed to perform their **familiar temple ritual** (prayer and offerings at a shrine), while a control group sat quietly in a similar setting without performing rituals. The ritual proved to have clear physiological benefits: participants who performed it showed **significantly higher HRV during the recovery period** than those who did not, indicating lower residual stress arousal. In fact, the ritual group's heart rate variability rebounded about 30% above pre-stress baseline – a dramatic improvement – whereas the no-ritual group's HRV remained low. Correspondingly, self-reported anxiety levels after the ritual were roughly *half* those of the control group. These are no trivial differences: one analysis noted that the magnitude of the HRV and anxiety gap between the ritual versus control conditions was comparable to the difference typically seen between healthy individuals and clinically anxious or depressed patients. In other words, a simple ritual in this context was *as effective in reducing stress as some established anti-anxiety interventions*.

Not only religious rituals, but also secular mindfulness practices can modulate HRV. Slow, rhythmic breathing and focused attention – elements common to meditation, chanting, or prayer – naturally enhance vagal activity and HRV. For example, studies of **controlled breathing prayers** (like repeatedly reciting the Catholic Rosary or yogic mantras) have observed increases in HRV, attributed to the breath pacing and calming focus these rituals involve. The consistent finding is that rituals which incorporate controlled, repetitive actions lead to a **more balanced autonomic state** (higher HRV and parasympathetic activation), helping the body exit the “high alert” mode of stress. Improved HRV not only reflects immediate stress reduction, but is also associated with better long-term cardiovascular health and resilience. Thus, the available evidence – from field experiments in cultural settings to lab studies – indicates that ritualized behavior can produce *measurable, beneficial shifts in HRV*, aligning with participants' reports of feeling calmer.

Cortisol and Ritual Interventions

Cortisol is a hormonal biomarker tightly linked to stress: it is released by the adrenal glands during the “fight-or-flight” response, and chronically elevated cortisol can suppress immune function and contribute to health problems. A number of RCTs and controlled studies have examined whether ritual practices can attenuate cortisol levels, either acutely or over time. These studies generally show that rituals – both spiritual and secular – can indeed **dampen the cortisol stress response** or lower basal cortisol, although effect sizes vary with context and individual differences.

One striking example comes from a **recent randomized experiment (2024)** on group chanting. Perry et al. recruited healthy adults and randomly assigned them to either **vocal chanting** or **silent chanting** of the sacred sound “Om” in a group setting for 12 minutes. Salivary cortisol was measured before and after the session. The results showed **significant cortisol reductions in both groups** from pre- to post-chanting, with an average drop that was statistically and practically significant. Whether participants chanted out loud or internally made little difference in cortisol outcome (though vocalizing gave a slightly bigger anxiety self-report reduction). This suggests that even a brief ritualistic practice – in this case derived from a spiritual tradition but applied in a secular group context – triggers a rapid relaxation response reflected in cortisol levels. Another controlled study extended the timeline: Niva et al. (2021) found that people who engaged in a **daily mantra chanting ritual for 45 days** had lower cortisol levels at the end of the period compared to a no-intervention control group. This aligns with the idea that habitual ritual practice can confer sustained stress-hormone benefits.

Spiritual rituals, in particular, have shown promise in cortisol regulation, sometimes moderated by the practitioner’s level of belief or faith. In a randomized trial of adults living with HIV, **Bormann et al. (2009)** tested a 5-week intervention of daily **mantram repetition** – silently repeating a spiritual word or phrase throughout the day – versus an attention-matched relaxation control. They found that the mantram group achieved increases in spiritual “faith/assurance” and, importantly, **reductions in average daily cortisol** (measured from multiple saliva samples) relative to controls. Notably, individuals in the mantram group who had **higher initial faith** in the practice showed the greatest cortisol declines by post-intervention, a relationship not observed in the control group. This suggests that believing in the spiritual efficacy of the ritual enhanced its physiological impact (more on expectancy effects in a later section). The observed cortisol reduction is meaningful, as **lower cortisol in these patients could benefit their immune status** and has been linked to slower HIV disease progression. Other spiritual practices echo these findings: for example, devout **Catholic participants randomly assigned to recite the Rosary prayer** after a stressor showed a bigger post-stress cortisol and anxiety decrease than those assigned to watch a religious video instead – implying the act of prayer, beyond just religious content exposure, had a unique calming effect.

Secular analogues to ritual can likewise blunt cortisol responses via expectancy and relaxation. Simply believing one has an effective remedy can trigger hormonal changes. An illustrative study examined the **placebo effect on cortisol during acute stress**: participants underwent the Trier Social Stress Test (a standardized stressor) and some were given a placebo pill described as a “calmative” beforehand. Those who took the placebo showed a **significantly smaller rise in salivary cortisol** and reported less tension than those who got no pill ¹. Intriguingly, their cortisol dampening was *comparable to that of a group who received a pharmacological anxiolytic* in the same experiment. This placebo-driven cortisol reduction highlights how expectation alone – a key element often present in rituals – can modulate stress biomarkers. In fact, recent trials of **open-label placebos** (where people knowingly take an inert pill but are encouraged that “mind-body self-healing” can occur) have found reduced exam anxiety and cortisol reactivity in participants, despite the absence of any active chemical ¹. Such findings reinforce that part of a ritual’s power to lower cortisol may come from the **belief and structured comfort it provides**, as much as from the specific actions performed.

Across these studies, effect sizes for cortisol changes vary but tend to be in the small-to-moderate range. A brief chanting or prayer session might reduce cortisol by a modest percentage in the immediate term, whereas multi-week ritual practice could shift baseline levels more substantially. These magnitudes are similar to those achieved by other behavioral stress-management techniques (and even some medications). The key point is that **ritual interventions consistently trend toward lowering cortisol**, indicating a

reduction in physiological stress. By keeping cortisol in check, such practices could have downstream health benefits, from improved immune function to better mood regulation.

Other Biomarkers: Immune and Inflammatory Markers

Stress doesn't only manifest in heart rate and hormones – it also affects the immune system and inflammation levels. Chronic stress is known to raise **pro-inflammatory cytokines** (like interleukin-6 and TNF- α) and can impair certain immune responses. If ritual interventions truly alleviate stress, we would expect, over time, to see **reductions in inflammation** and possibly improvements in immune function. Research in this area is still emerging, but some promising findings have been reported.

Mind-body rituals such as meditation and yoga (often secularized from spiritual traditions) provide the clearest evidence for immune impacts, since many RCTs have examined their biological effects. A 2016 systematic review of randomized trials concluded that **mindfulness meditation may have beneficial effects on specific markers of immune activity**, including lowering circulating inflammatory proteins and altering gene expression related to inflammation. Though results across studies were heterogeneous, there were indications that meditation training could **reduce pro-inflammatory cytokine levels** (for example, decreases in IL-6 or CRP have been noted in some interventions). One highlight from a narrative review is that **meditation tends to decrease cortisol and cytokine levels in parallel**, supporting the idea that calming the mind can quell the body's inflammatory stress response. Additionally, mindfulness and related practices have been linked to enhanced cell-mediated immunity and even improved antibody responses in some cases – for instance, a frequently cited study found that people who underwent an 8-week meditation program developed more robust antibodies to a flu vaccine compared to controls, suggesting a functional boost to their immune system.

Spiritual forms of coping have similarly been associated with better immunological profiles, though direct experimental evidence is limited. In epidemiological research, individuals who engage in regular **religious or spiritual practices** often show lower levels of inflammatory markers and stronger immune parameters, partly mediated by lower stress. Among HIV patients, as mentioned earlier, those who rely on spiritual coping and maintain hope/faith tend to experience **slower CD4 T-cell decline and slower disease progression**, an effect possibly facilitated by lower stress and cortisol levels. In clinical trials, approaches that integrate patients' spirituality have yielded intriguing results; for example, one study found that a **religiously-tailored cognitive-behavioral therapy** and a conventional secular therapy produced similar overall stress biomarker reductions, but IL-6 (an inflammatory cytokine) dropped more in patients for whom the therapeutic approach aligned with their personal religiosity. This hints that when a ritual or intervention "resonates" with the individual's beliefs (enhancing comfort and expectancy), it might exert stronger effects even on immune-related outcomes.

Overall, while **immune markers are not as extensively studied as HRV or cortisol in ritual research**, the evidence so far aligns with the idea that reducing psychological stress through ritual practice can lead to *tangible immunological benefits*. Reductions in stress hormones like cortisol likely mediate many of these effects, given cortisol's role in suppressing immune function. It should be noted, however, that findings on inflammation are still tentative – changes in cytokines are often small and sometimes inconsistent across studies. Strong, reliable effects on immune biomarkers tend to appear in studies where the ritual intervention produced a significant stress reduction to begin with. In sum, **rituals that meaningfully lower perceived stress and cortisol may also help normalize inflammatory processes**, potentially contributing to better health and resilience against diseases in the long run.

Expectancy Effects and Mechanistic Considerations

One of the central questions in this field is *how* rituals exert these stress-reducing effects. Is it the specific content of the ritual (the prayers said, the movements made), or is it the psychological context – the **expectancy, belief, and meaning** – that matters most? The answer, based on current evidence, is that both play a role, often in combination. Here we examine the **placebo-like effects** of expectancy and other proposed mechanisms, as well as confounding factors and ethical issues in studying ritual interventions.

Expectancy – the belief that a given action or treatment will help – can significantly influence stress outcomes. We see this clearly in placebo studies: if a person firmly expects that a pill or procedure will calm them, the body often responds accordingly. For example, as discussed, merely taking a placebo described as a stress-reliever before a lab stress test led to **lower anxiety and cortisol** compared to no treatment ¹. What's remarkable is that this effect occurred even without any pharmacological ingredient, underscoring the power of **mindset and suggestion**. In the context of rituals, many are taught or culturally understood to be calming or healing (think of the reassurance a person might feel that "*saying this prayer will protect me*"). Such belief can trigger real physiological changes – a classic placebo effect. Recent trials even suggest we don't need to *deceive* people for expectancy to work: **open-label placebo** treatments, where individuals know they're basically engaging in a ritual of pill-taking, have reduced stress and test anxiety so long as participants **believe in the mind-body connection** and the rationale given. Researchers found that an open placebo given to student drivers before a high-stakes exam significantly eased pre-test anxiety and improved pass rates, offering an "ethical and unproblematic" way to tap into expectancy benefits. The implication is that part of what makes rituals effective is that they harness our brain's innate placebo response – if you trust the process, your physiology will follow.

At the same time, expectancy is not the whole story. Experiments with **novel rituals** suggest that even when people don't initially have a belief in the ritual (because it's something they've never done before), performing structured, symbolic actions can still provide relief. Norton and Gino's grief study is telling: participants who were not habitual ritual-users and held no particular belief in the efficacy of the assigned ritual *still* experienced less grief and greater perceived control after doing it. Similarly, in Brooks et al.'s anxiety experiments, even skeptics who performed the quirky lab ritual (involving tasks like sprinkling salt and counting) ended up less anxious than those who did nothing, indicating a benefit beyond conscious belief. Why might this be? Rituals engage mechanisms of stress reduction that go deeper than explicit expectancy. They are **highly structured, repetitive, and familiar** (or made to feel familiar through clear instructions). This structure itself seems to confer a sense of order and control in an otherwise chaotic moment. Psychologists refer to a *compensatory control* process: when we face uncertainty and lack control, we psychologically grasp for patterns and order to regain equilibrium. **Rituals supply that order** in a reliable, concrete way – they tell you *exactly* what to do, how to do it, and often have an outcome to focus on. By imposing predictability, rituals restore a **subjective sense of control**, which is profoundly anxiety-relieving. As one scholar put it, "*Whether the sense of control is illusory is of little importance. What matters is that ritual can be an efficient coping mechanism*". In other words, even if part of you knows pouring water in a ceremony doesn't literally influence external events, the mere act of doing something rhythmic and purposeful convinces your mind that you are *not helpless* – and your physiology correspondingly downshifts out of panic mode.

Beyond expectancy and control, rituals likely activate several other **complementary mechanisms** that soothe the stress response. Researchers have proposed a multifaceted explanation for the anxiolytic

(anxiety-reducing) effects of ritual, encompassing psychological, physiological, and social factors. Some key mechanisms include:

- **Belief and Placebo Response:** Simply believing in the ritual's power can trigger real biochemical changes. Expectation activates brain regions (prefrontal and opioid pathways) that can inhibit stress and arousal, much like a placebo pill reducing cortisol and anxiety ¹. In spiritual contexts, faith in the ritual (e.g. faith in prayer or mantra) can amplify its impact on stress hormones. Conversely, lack of belief may blunt the effect – studies have noted that religious rituals reduce anxiety most in those who are deeply religious. This placebo-like component means mindset is a mediator of outcomes.
- **Sense of Control and Predictability:** Rituals create a micro-world of order. Performing fixed sequences of actions – whether it's aligning tennis water bottles like Rafael Nadal (a famous sports ritual) or lighting incense and offering prayers – gives a feeling of control amidst uncertainty. This **restored agency** directly counteracts anxiety, which often stems from feeling out of control. The compensatory control model explains that people turn to ritualistic behavior to regain mastery when faced with unpredictable threats. By focusing on the precise steps of a ritual, individuals divert attention from chaotic worry to a structured task they can successfully complete, thereby calming the mind.
- **Physiological Self-Regulation:** Many rituals inherently incorporate elements that engage the body's natural relaxation response. **Rhythmic breathing**, for example, is built into chanting, singing, praying the rosary (which involves regulated breaths during recitation), meditation, etc. Slow, deep breathing increases vagal tone and can lower heart rate and blood pressure, opposing the sympathetic "fight-or-flight" response. Similarly, repetitive movement or swaying (in dance rituals or worship) and even the **cadence of spoken chants** can induce a mild trance or meditative state, reducing physiological arousal. Over time, rituals can become conditioned signals of safety for the body – just starting the familiar routine (like rolling out a prayer mat or sitting in a meditation posture) might cue the brain that "relief is coming," initiating a parasympathetic shift that is reflected in HRV and cortisol improvements.
- **Social Support and Collective Emotion:** Rituals are often communal. Participating in a group prayer, a ceremony, or even a group mindfulness class means one is **not facing stress alone**. Social support is a well-known buffer of stress reactivity – the presence of others who share your ritual or belief can increase feelings of safety and solidarity. Group rituals often synchronize people's actions and even physiological states (research has shown, for instance, that heart rates can synchronize among performers and spectators during intense collective rituals). This synchrony and shared meaning foster a powerful sense of **belonging and mutual support**, which can lower stress. In the group chanting study, aside from reducing cortisol, the ritual also **enhanced feelings of social connection** – participants reported increased altruism and closeness after chanting together. Likewise, anthropological accounts describe how community rituals during crises (like wartime prayers or memorials) help individuals feel supported and less anxious, as they see others coping alongside them. The social bonding releases oxytocin and endorphins which can further blunt stress responses. In sum, performing rituals in a supportive group amplifies their calming effect through the additional pathway of human connection.

While these mechanisms help explain *why* rituals work, they also highlight potential **confounds** in research. Because expectancy, context, and social setting all influence outcomes, experimental designs must be

carefully controlled. Unlike a drug trial, you usually **cannot “blind” a ritual** (participants know if they performed it or not), and you cannot give a convincing “sham ritual” without it either having some calming elements or tipping people off. Thus, classic double-blind placebo control is challenging. Researchers compensate by using comparison groups that control for certain factors – for example, having one group perform a ritual and another group spend the same time **relaxing quietly** or engaging in some generic activity, to see if the structured ritual yields extra benefit beyond mere rest. In the Mauritius temple study, the control condition was designed to mimic the environment and time spent at the temple but without the ritual actions, helping isolate the effect of the ritual itself. Additionally, it’s recommended to **measure participants’ expectations and beliefs** about the intervention. If those who expect the ritual to help are the ones who benefit most, that’s important data. In fact, a review of trials in analogous areas (like psychedelic therapy, which also has strong expectancy effects) found that many studies failed to measure expectancy at all. Experts have argued that **blinding and expectancy confounds should be routinely assessed** in any trials of such interventions. By collecting data on how much each participant believed in the ritual or anticipated relief, researchers can statistically control for expectancy or at least acknowledge its role. In Bormann’s mantra trial, for instance, the team explicitly looked at **faith/assurance levels** as a moderator and found it to be a key variable for cortisol outcomes.

Ethical considerations come into play when harnessing rituals and placebo effects in practice. Is it ethical to use a ritual or a placebo-based method to reduce stress? If the goal is to help patients or participants and there is no harm, many ethicists say yes – with some caveats. Deception should be minimized; hence the interest in open-label placebos and informed use of rituals. If, say, a therapist encourages a client to adopt a **daily personal ritual** (be it journaling in a ceremonial way, lighting a candle and breathing each night, or praying according to the client’s faith), it can be done transparently: “Many people find that doing XYZ each day gives them a sense of control and reduces stress.” This way, the person knows the ritual is a tool for managing stress (not a magical cure), yet through that positive expectation and the act itself, benefits can still occur. Indeed, studies have shown that even when people *know* an intervention is largely psychological, it can work if they embrace it. Cultural sensitivity is paramount here. Prescribing a **religious ritual** across the board would be inappropriate – what soothes one person might conflict with another’s beliefs. The research indicates that a ritual resonates best when it aligns with the individual’s cultural or personal framework. For example, a devout person may derive great comfort and cortisol reduction from prayer, whereas an atheist might get equal benefit from a secular breathing ritual but be stressed by being asked to pray. Ethically and practically, then, the **personal meaning of the ritual** should guide its use as an intervention.

In validating ritual effects scientifically, we are essentially validating the mind-body connection: demonstrating that structured symbolic actions (and the mindsets around them) produce **real, quantifiable changes in the body**. The evidence we’ve reviewed – lowered cortisol, boosted HRV, modulated cytokines – confirms that connection. The challenge moving forward is to refine our understanding of when and for whom rituals work best, and to separate, as much as possible, the “active ingredients” from the placebo ingredients. Even if we find they are intertwined (which they often are), that does not negate the value of rituals. As one article on the topic concluded, *rituals can be as effective in reducing stress as some of our best medications, but without the side effects*. From an ethical standpoint, leveraging such effects is a positive, so long as we do so with honesty and respect for individual beliefs.

Conclusion

Controlled research to date supports the idea that rituals – both spiritual and secular – can meaningfully reduce stress, as evidenced by improvements in objective biomarkers and subjective reports. Ritual practices have been shown to **increase HRV** and **lower cortisol** in various populations under stress. These physiological changes correspond with reduced anxiety, faster recovery from stressors, and an overall calming effect. Notably, the magnitude of stress reduction from some ritual interventions is on par with standard treatments; for example, performing a ritual after a stress trigger produced differences in anxiety and autonomic response comparable to those seen between non-anxious and clinically anxious individuals.

Both **religious rituals** (prayer, chanting, mantra repetition) and **structured secular rituals** (breathing routines, symbolic gestures) have demonstrated efficacy, though their success can depend on personal and cultural relevance. Engaging in a ritual that one finds meaningful tends to enhance the effect – higher spiritual faith or strong expectation can amplify the reduction in stress hormones like cortisol. However, even novel and non-faith-based rituals provide benefits, indicating that beyond belief, the very act of ritualizing behavior (through repetition, order, and focus) confers psychological stability.

A key insight from this body of work is the potent role of **expectancy and placebo mechanisms**: part of why rituals work is that they leverage the mind's predictive power to calm the body. This underscores the importance of **context and belief** in healing practices. At the same time, the **biomedical effects are real** – lower blood pressure, reduced cortisol, improved immune profiles – and thus worthy of integration into holistic approaches to stress management. Researchers are approaching these phenomena with both curiosity and rigor, using randomized trials and biomarkers to validate what traditional wisdom has long suggested: rituals can heal. Going forward, addressing confounds (like placebo effects) with careful experimental design will further strengthen the evidence base.

In summary, **ritualized interventions offer a complementary strategy for stress reduction** that bridges mind and body. Whether it's a few minutes of meditation, a prayer, or a personal pre-game routine, these practices help people navigate uncertainty and stress by inducing a state of calm focus. The ethical use of such approaches – being transparent about how they work and tailoring them to individuals' belief systems – can enhance well-being in an accessible way. Backed by emerging scientific validation, ritual and expectancy effects are gaining recognition as legitimate factors influencing our stress physiology. Embracing this knowledge allows both clinicians and individuals to more deliberately harness the "placebo power" of rituals to improve health and resilience.

Sources: The information above is drawn from a range of interdisciplinary studies and reviews, including experimental trials of rituals on stress biomarkers, anthropological and psychological analyses of ritual behavior, as well as research on placebo and expectancy effects in stress reduction ¹. These connected sources provide converging evidence on how ritual actions and the beliefs surrounding them can translate into measurable changes in cortisol, HRV, and immune function, highlighting both the promise and the complexity of ritual as a therapeutic modality.

- ① Open-label placebos enhance test performance and reduce anxiety in learner drivers: a randomized controlled trial | **Scientific Reports**

https://www.nature.com/articles/s41598-024-56600-6?error=cookies_not_supported&code=95669b01-babe-43e8-82fd-ce5f74029bc9