

Mathematical modelling of time until anxiety reduced through Sahaj Yoga meditation

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Abstract

Stress reduction is a significant goal in contemporary society, given its implications for mental and physical well-being. This research paper presents an innovative approach to studying stress reduction through Sahaja Yoga meditation, a unique form of meditation aimed at achieving self-realization and inner balance. Our study investigates the time it takes for individuals to experience a notable reduction in stress levels due to consistent Sahaja Yoga meditation practice. We employed mathematical time-to-event modeling, specifically Parametric survival curves to analyze the factors associated with the time until stress reduction.

Subject Classification: 76B75.

Keywords: Sahaj Yoga, Biomathematics, Time to event modeling, Mathematical model fitting, Stress reduction, Good health and well-being.

1. Introduction

Sahaja Yoga is a form of meditation that was founded by Shri Mataji Nirmala Devi in the 1970s. It is often referred to as a unique and holistic approach to meditation and self-realization. The term “Sahaja” in Sanskrit means “spontaneous” or “natural” and the practice aims to help individuals achieve a state of self-realization and inner balance through a simple and spontaneous process. Key aspects of Sahaja Yoga meditation include:

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Kundalini Awakening: Sahaja Yoga emphasizes the awakening of the Kundalini energy, which is believed to be a dormant spiritual energy located at the base of the spine. This energy, once awakened, is thought to rise through the spinal cord, passing through different energy centers (chakras) and eventually leading to a state of spiritual awareness and self-realization.

Self-Realization: The practice of Sahaja Yoga is said to lead to a state of self-realization, where individuals gain a deeper understanding of their inner being and the connection between their physical, mental, emotional, and spiritual aspects.

Spontaneous Meditation: Sahaja Yoga meditation is known for its emphasis on spontaneous meditation. Practitioners are encouraged to allow their thoughts and emotions to settle naturally without forceful concentration. The goal is to achieve a state of thoughtless awareness, where the mind is free from unnecessary mental clutter.

Balancing Chakras: The practice involves focusing on and balancing the body's seven main energy centers or chakras. Each chakra is associated with different qualities and aspects of life, and through meditation, individuals are believed to cleanse and balance these energy centers.

Collective Meditation: Sahaja Yoga often involves group meditation sessions, where practitioners come together to meditate collectively. This is thought to enhance the overall meditative experience and create a positive, supportive atmosphere.

Healing and Well-Being: Advocates of Sahaja Yoga suggest that the practice can improve physical, mental, and emotional well-being. The balanced flow of Kundalini energy is believed to contribute to healing and inner harmony.

No Cost: Sahaja Yoga is typically taught freely, as Shri Mataji Nirmala Devi believed that spiritual awakening should be accessible to everyone without financial barriers.

Sahaja Yoga meditation is often promoted as a practice that can help reduce stress and promote overall well-being. The practice's emphasis on achieving a state of thoughtless awareness, balancing energy centers (chakras), and experiencing inner peace can contribute to stress reduction in several ways:

Relaxation Response: Sahaja Yoga meditation encourages individuals to enter a state of deep relaxation and thoughtless awareness. This can trigger the relaxation response in the body, leading to a decrease in stress hormones like cortisol and an increase in relaxation-inducing chemicals.

Calming the Mind: The practice aims to quiet the mind and bring it to a state of stillness, allowing individuals to detach from the constant stream of thoughts and worries that can contribute to stress. This mental calmness can lead to reduced anxiety and an increased sense of inner peace.

Balancing Energy Centers: Sahaja Yoga focuses on balancing the body's energy centers (chakras) through meditation. When these energy centers are balanced, it is believed to promote physical, emotional, and mental well-being. Any imbalances in these energy centers are thought to contribute to stress and negative emotions.

Emotional Regulation: Regular practice of Sahaja Yoga meditation is said to help individuals regulate their emotions. By achieving a state of self-awareness and inner balance, practitioners may be better equipped to manage their emotional reactions to stressors.

Mind-Body Connection: Sahaja Yoga encourages the exploration of the mind-body connection, helping individuals become more attuned to the signals their bodies send. This awareness can lead to a better understanding of how stress manifests physically and mentally, allowing individuals to address it more effectively.

Release of Tension: The process of Kundalini awakening in Sahaja Yoga is thought to release pent-up energy and emotional blockages, which can contribute to feelings of relaxation and relief from stress-related tensions. For more details on how Sahaj Yoga reduces mental stress, one may refer to [1] - [5].

In mathematical biology, time-to-event modeling, also known as survival analysis, is a crucial analytical method used to analyze the time it takes for specific events to occur in the context of biomedical research and healthcare studies. This type of modeling is particularly valuable for studying the duration until an event of interest happens, such as disease onset, recovery, relapse, or death. Time-to-event modeling in biomathematics helps researchers understand the timing, risk factors, and predictors associated with these events. For further details on time-to-event modeling, one may refer to [6], [7].

This research paper presents a time-to-event modeling approach to investigate the duration until stress reduction occurs through Sahaja Yoga meditation. The study aims to quantitatively analyze the factors influencing the time required for individuals to experience a reduction in stress levels through consistent meditation practice. The event of interest is defined as the subjective perception of reduced stress. Data were collected from a

cohort of individuals practicing Sahaja Yoga meditation, capturing self-reported stress levels at regular intervals.

2. Methodology

Modeling the time until stress reduction through Sahaja Yoga meditation using time-to-event modeling involves adapting the technique to fit the specific context of stress reduction and meditation practice. Here's a general approach that has been considered.

Defining the Event of Interest: In this case, the event of interest is the reduction of stress to a certain level, as perceived by the individual practicing Sahaja Yoga meditation.

Data Collection: The data for this study was collected through a combination of self-reporting and structured monitoring methods to capture information related to stress levels and Sahaja Yoga meditation practice. The cohort consisted of 500 participants who were asked to self-report their stress levels using a standardized stress assessment scale namely the Perceived Stress Scale (PSS). The study started in July 2021 and was conducted till July 2022. At regular intervals, the participants were requested to rate their stress levels. This self-assessment provided a subjective measure of the stress levels that participants experienced.

Censoring and Follow-Up: Since the event of stress reduction might not have occurred for all individuals during the study period, it was required to handle the censoring. Individuals who hadn't experienced stress reduction by the end of the study were to be censored. However, all the individuals experienced a reduction in stress before the study ended and none of the participants were censored.

3. Data Analysis

The data analysis for the paper has been conducted using R software. The various parametric distributions used in the paper are described below [8-9].

3.1 The Burr distribution

The pdf of Burr distribution used by R software is.

$$f(x|\alpha, \beta, \gamma) = \frac{\alpha \gamma \left(\frac{x}{\beta}\right)^\gamma}{x \left[1 + \left(\frac{x}{\beta}\right)^\gamma\right]^{\alpha+1}} \quad (1)$$

For $x > 0$, $\alpha > 0$, $\beta > 0$ and $\gamma > 0$

3.2 The Gamma Distribution

The pdf of Gamma distribution used by R software is.

$$f(x|\alpha, \sigma) = \frac{x^{\alpha-1} e^{-x/\sigma}}{\sigma^\alpha \Gamma \alpha} \quad (2)$$

For $x > 0$, $\alpha > 0$ and $\sigma > 0$

3.3 The Gaussian Distribution

The pdf of Gaussian distribution used by R software is.

$$f(x|\mu, \sigma) = \frac{e^{-(x-\mu)^2/2\sigma^2}}{\sqrt{2\pi}\sigma} \quad (3)$$

For $-\infty < x < \infty$, $-\infty < \mu < \infty$ and $\sigma > 0$

3.4 The Weibull Distribution

The pdf of Weibull distribution used by R software is.

$$f(x|\alpha, \beta) = \left(\frac{\alpha}{\beta}\right) \left(\frac{x}{\beta}\right)^{\alpha-1} e^{-\left(\frac{x}{\beta}\right)^\alpha} \quad (4)$$

For $x > 0$, $\alpha > 0$, $\beta > 0$

3.5 The Log-normal distribution

The pdf of Log normal distribution used by R software is.

$$f(x|\mu, \sigma) = \frac{e^{-(\log(x)-\mu)^2/2\sigma^2}}{\sqrt{2\pi}\sigma x} \quad (5)$$

For $x > 0$, $-\infty < \mu < \infty$ and $\sigma > 0$

3.6 The Inverse Burr distribution

The pdf of Inverse Burr distribution used by R software is.

$$f(x|\alpha, \beta, \gamma) = \frac{\alpha \gamma \left(\frac{x}{\beta}\right)^{\gamma\alpha}}{x \left[1 + \left(\frac{x}{\beta}\right)^{\gamma}\right]^{\alpha+1}} \quad (6)$$

For $x > 0$, $\alpha > 0$, $\beta > 0$ and $\gamma > 0$

3.7 The Inverse Gamma Distribution

The pdf of Inverse Gamma distribution used by R software is.

$$f(x|\alpha, \beta) = \frac{\alpha^{\beta} e^{-\alpha/x}}{x^{1+\beta} \Gamma(\beta)} \quad (7)$$

For $x > 0$, $\alpha > 0$ and $\beta > 0$

3.8 The Inverse Gaussian Distribution

The pdf of Inverse Gaussian distribution used by R software is.

$$f(x|\mu, \sigma) = (2\pi\phi x^3)^{-\frac{1}{2}} e^{-(x-\mu)^2/2\phi\mu^2x} \quad (8)$$

For $x > 0$, $\mu > 0$ and $\phi > 0$

3.9 The Log-logistic distribution

The pdf of the Log-logistic distribution used by R software is.

$$f(x|\alpha, \beta) = \left(\frac{\alpha}{\beta}\right) \left(\frac{x}{\beta}\right)^{\alpha-1} / \left(1 + \left(\frac{x}{\beta}\right)^{\alpha}\right)^2 \quad (9)$$

For $x > 0$, $\alpha > 0$ and $\beta > 0$

Next, the descriptive analysis of the data is presented in Table 1. The minimum time for anxiety reduction is 0.34 days, while the maximum time is 11.05 days. The median time to reduction is 3.61.

Table 1
Descriptive Analysis of Data

Min.	Ist Quartile	Median	Mean	III Quartile	Max.
0.34	2.23	3.61	3.68	4.82	11.05

Table 2 shows the summary of various Parametric Models. Weibull distribution fits best as it has the lowest AIC and BIC values. Figure 1 shows how well the fitted Weibull density covers the empirical density. Figure 2 shows QQ Plot. Along with KS goodness of fit test.

Table 2
Summary of Various parametric distributions.

Distribution	AIC	BIC
Burr	461.235	595.546
Gamma	887.453	958.875
Gaussian	398.484	465.945
Weibull	387.174	425.495
Inverse Burr	867.452	886.956
Inverse Gamma	536.564	634.772
Inverse Gaussian	578.387	656.753
Log-normal	673.387	726.656
Log-logistic	389.367	446.531

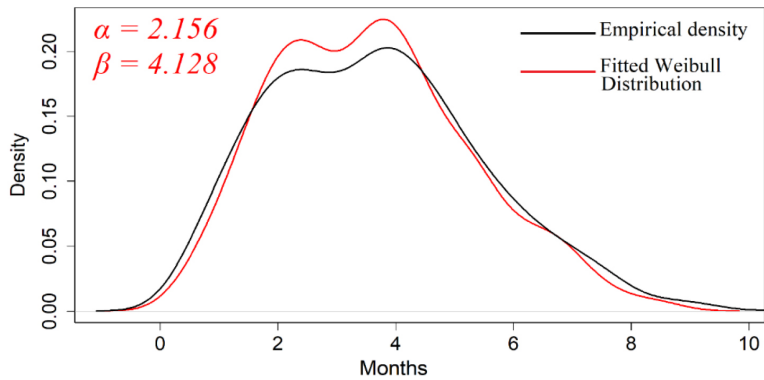


Figure 1
Plots of Empirical density and fitted Weibull density

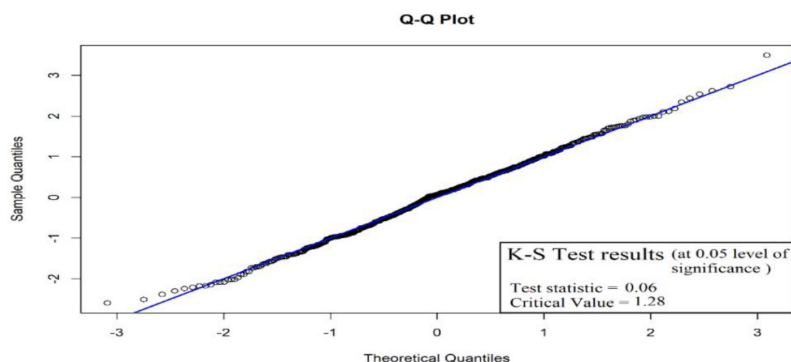


Figure 2

Q-Q Plot of fitted Weibull density

4. Conclusion and future prospectus

From the analyzed data, we can conclude that the Weibull distribution best describes the time until stress reduction is felt in Sahaja Yoga meditation practice. In this study, the analysis of the specific dataset highlights the appropriateness of the Weibull distribution for capturing the time to event scenario. However, it's crucial to emphasize that this favorable fit does not imply universal applicability across all contexts. Different scenarios and datasets might require alternative distribution choices that more accurately reflect the underlying dynamics. We are among the pioneers in fostering this kind of research, and no one else has used advanced mathematical techniques on such data.

Further work in this stream may involve employing the Cox Proportional Hazard model. This can incorporate additional relevant covariates that influence the time until vibrations are felt, such as age, gender, etc. As a counterpart to the distributions mentioned in the paper, the finite mixture of heavy tailed distributions can also be used to model the data.

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