# A Mathematical Model to Evaluate the Impact of Yoga Poses on Body

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**Abstract-** Daily Yoga activities are part of a ten-posture series with linked relaxation and aerobic exercise, resulting in a balancing of flexibility and extensions. Because this series is often repeated and advocated by several yoga professionals, structural modeling to justify its purported health advantages is needed. Older is recommended to do more workouts to maintain activity, given the increasing pressures in societal, economical, and health issues as a result of the elderly society. They are, regrettably, unable to do so due to a variety of physical and psychological obstacles. The whole body form changes significantly as people get older, and sag. One of the most important variables in regaining their drive and comfort throughout social activities might be the layout of their apparel. The impact of athletics on older is investigated in this study. Depending on rigid body movements and free-body diagrams, a numerical model is built for each position in the yoga exercises. The idea of static equilibrium is used to calculate the forces and moments that different joints experience. The model given in this study was developed under a variety of assumptions. But what is discovered in practice is that the knees carry the maximum joint action while the ankle and wrist are discovered to play a major part in transferring the ground response forces throughout yoga. Thus, it would imply that the model is a good tool for forecasting the forces and durations that happen not just during the yoga positions but also during other situations.

**Keywords:** Digitalization, Linear Regression, Mathematical Approach, IT, ICT.

## 1. Introduction

Most elements, when mixed properly and in the correct proportions, produce an alloy with unique qualities. The best ensembles feature a well-balanced mix of components. Similarly, comprises a precise sequence of yoga positions executed while breathing in perfect balance. This series is made up of ten energetic positions that are executed in a single, mindful, and beautiful movement as (Figure 1) [1, 2]. The movements cleverly contrast forward-bending movements with backward-bending positions. The sequencing of all these positions is said to assure that 'energy' hits all areas of the body, whilst the sunrays cover all regions of the world. The older population is among the most widespread global phenomenon, posing significant social, financial, and healthcare issues. Seniors are motivated to become more active and fit to address the problems posed by the aging workforce. Yoga is one of the most prominent and age-friendly low-intensity physical exercises for elderly ladies since it has no age restrictions.

**Fig. 1:** Yoga Poses

Yoga is well-known for its diverse positions and distinct levels of difficulty for learners of various physical abilities. Yoga can help with not only body activities like muscular endurance, bodily balance, and metabolism system, but also psychological processes like stress, late-life depression, and nervousness. Regular exercise is well proven as being important for older persons and it can be used as a strategy for improving late-life quality and achieving effective aging. Although seniors have more free time after retirement, the quantity and levels of physical activity participation tend to [3] decline as they et older.

## 1. Literature Review

The reasons for passive activity in older adults can be divided into two categories: one is the elderly's failure to trust in their ability to exercise; another is their decreasing health state. Seniors perceive themselves as a population at danger of damage throughout exercise, and they tend to exaggerate the risks associated with physical activities. Those are commonly regarded as impediments to elderly persons participating in physical activity. Some exercising psychological studies have discovered a range of psychological concepts and theories that describe older individuals' workout activities, including what encourages them to begin regular exercise and how to keep it up. A study examined the realm of health-related actions impacted by social and cognitive elements using the Information-Behavioral Skills (IMB) theories [4]. Knowledge, intention, and cognitive abilities are the primary elements of beginning activities, according to his approach. The most persuasive hypothesis, social cognitive theory (SCT), is frequently used to describe and anticipate the workout behaviors of the elderly. Self-efficacy, motives, aspirations, surroundings or social influences, and result expectations are the basic mental factors that make up that theory [5].

In other aspects, it is understandable that people may be driven to begin and sustain exercise activities if they believe they are able of doing so. This reinforces the goal to enhance their considered efficacy for adhering to the activity. According to the study self-determination model (SDT), workout inspiration stems from physiological or mental demands that lead to an action aimed at achieving a goal. The level of engagement was determined by how the location of causality was viewed. Exercise Motivational Assessment identified several motives for starting to exercise based on the frequency of SDT in the strength and conditioning behavior area [6].

Stress reduction, pleasure, difficulty, social recognition, associations, competitiveness, health demands, poor health, avoiding, favorable health, weight maintenance, attractiveness, stamina, and dexterity are some of these motives. By these ideas, the most important thing to do to encourage individuals to do yoga is to figure out what types of motives they respond to some of the most and how to internalize external reasons. Boosting their motivation can help them start and maintain this practice [7].

Yoga, as a type of fitted facility, can enable workouts to meet their physical and psychological requirements. It's also been recognized as significant athletic apparel that plays a vital part in boosting exercising capacity, preventing exercise-induced diseases, and increasing mental stability. Furthermore, just a few studies have looked into physical development for seniors beyond the age of 55. Many people in this age group have different health beliefs, which has affected their physical and psychological requirements.

Yoga assessment study has traditionally emphasized the assessment of human body movements. A most extensively adopted technology for tracking the users' motions placed upon the human body throughout Yoga activities has been the performance capture system. There have been few studies on measuring people when they are engaged in activities. The acceleration is regulated by the supported rate and also modifying the exercise intensity, according to one finding from the dynamic measurements (yoga, walking versus running, rope skipping).

It's therefore important to describe the causes for seniors' participation in yoga workouts to keep improving their encouragement in yoga workouts through having a mental high level of satisfaction. As per prior research, senior citizens weighed the projected advantages against the cost and risk involved with participating in physical activities. The elderly on the other hand, are greatly motivated by health-related aspirations that try to keep them healthy. As a response, research into elderly perceptions of the consequences of yoga fitness is required [8].

The next approach has been to look at how seniors participate in yoga activities and what types of yoga aspects affect their attitudes and requirements. As a result, this question has been included in the survey. Different yoga workout histories have been presumed to have various impacts on senior choices and expectations, and the evaluated variables while exercising have been also involved in the questionnaire and intended as multiple-choice questions, that can also be utilized to develop criteria specializing for seniors.

## 2. Design of Mathematical Modeling

Because measuring forces and moments can be difficult, mathematics techniques are commonly applied to approximate these pressures within rigid body motion. The hard body dynamics technique assumes several things about the body, like non-deformability, a stable center of gravity, and substance uniformity. We should identify facts such as bending stresses, geometry, and supportive practices to do appropriate analysis. The concept of superposition is used to calculate forces and instances that assert that "the present on any level owing to the entire stress is the arithmetic average of the instants due to different sections of the pressure." The theory of superposition is highly useful in determining the duration acting at any point on a body exposed to multiple pressures. There are ten poses in Yoga. As a result, the duration exerted on the muscles is determined by the body's arrangement in each position. As a result, the load to be addressed while computing the moments is varied. Because the body is separated into several parts that are each applied to a distinct loading, the bending moment at each location must equal the sum of the individual bending moments. When a tissue simply supports the body at its ends, it performs the function of load transmission and no time is formed. However, if there is an overhanging over the joints that support the body, the weight of the body will cause a small quantity of action [9, 10].

Knowing free body models are required for evaluating the elements that determine normal and prosthetic joint strength. A free-body chart is used to illustrate all of the forces applied graphically operating on a joint. The wrists, elbows, shoulders, hips, knees, and ankle joints were all taken into consideration. The body can be separated into 4 major divisions for the assessment of such 6 joints: head, arms, trunk, and legs (Table 1). The idea of equilibrium is crucial for comprehending and estimating the forces and times that occur throughout specific Yoga poses. The joint reactive forces and times for various situations can be calculated by using the equation of plane equilibrium state.

**Table 1:** The proportional weight and size of the human body segments

| Segment | Relative weight | Relative length |
|---|---|---|
| Head | 0.07 | 0.121 |
| Arm | 0.0311*2 | 0.241 |
| Trunk | 0.314 | 0.127 |
| Leg | 0.1114*2 | 0.423 |

To evaluate the weights at every segment, we have to determine the body's overall weight and length variation. It was accomplished with the help of Table.1's dispersion graph. While estimating the joint values, the following conditions are formed: The body has already been described as an array of stiff links joined by the 6 primary pivot joints that include the wrists, elbows, shoulders, hip, knee, and ankle. The hips and lower back have already been combined into one ideal joint. The human body has now been simplified as a one-dimensional system that moves in the sagittal plane. The sagittal view was chosen since the Yoga actions take place largely in this plane. The outcomes of sagittal plane kinetic assessment have produced extremely useful characteristics for evaluating normal and abnormal gait muscle processes.

## 3. Results and discussion

We offer a sample computation of the values at every one of the 6 joints arising from position 8 to explain the study of yoga positions (Figure 1). Figure 2 depicts the equivalent free-body graph using the data from Table 1.

Consider the following equation for the ankle joint's energy balance;

$$\sum M_A=0 \quad (1)$$

$$(0.324W)(0.1242L) + (0.3214W)(0.3574L) + (0.07W)(0.3258L) + (0.052W)(0.4251L) - R\_w\,(0.568L) = 0$$

Here $R_w$ (ground reaction force on wrist) $= 0.5221W$ and $R_A$(Ground reaction force on Ankle) $=1 - R_w = 0.4121W$.

$$A_K = Knee\ activity = R_A = (0.1235L) = (0.4212\ W)(0.3214\ L) = 0.0645\ WL \quad (2)$$

$$A_H = Hip\ activity = R_A = (0.2255L) - (0.4011\ W)(0.2201\ L) + 0.0045\ WL = 0.1541WL \quad (3)$$

$$A_E = Elbow\ activity = R_W = (0.1375L/2) = (0.4011\ W) \quad (4)$$

$$A_S = Shoulder\ activity = R_W = (0.1043L) - (0.602\ W)(0.6174\ L) + 0.214 = 0.094WL \quad (5)$$

$$A_A = Ankle\ activity = 0\ WL \quad (6)$$

$$A_w = Wrist\ activity = 0\ WL \quad (7)$$

Where W and L are the weight and length of body, respectively.

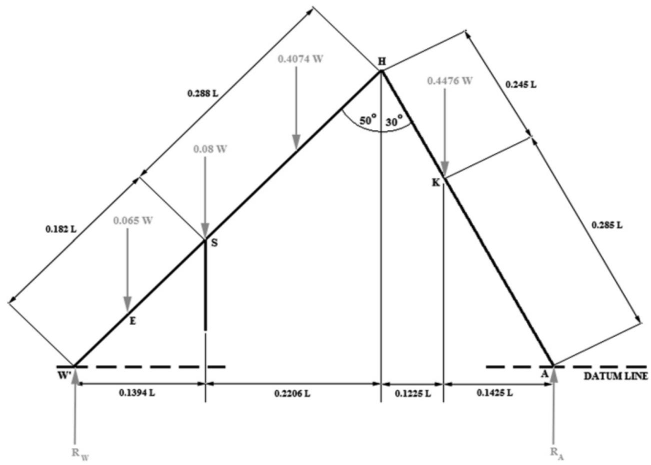


**Fig. 2:** Eight Postures of W0 = Wrists, E = Elbows, S = Shoulders, H = Hips, K = Knees, A = Ankles, W = Weight of Body, L = Length of Body

Because the individual is upright in posture 1, there is no action occurring on either of the joints. Caused by the weight of the body, the foot experiences a reaction effect. This position strengthens the posture musculature and improves lower back wellness. In posture 2, the person tries to lean backward as far as feasible, lengthening the back as far as potential and bending the arms well above the forehead.

The person leans forward into postures 3 and 10 and puts their hands below their feet. The position of the arm is diminished in this position, and the hip, knee, and ankle take up a large portion of the weight and motion produced by this position. The hamstrings and gluteal musculature benefit from enhanced flexibility in this position.

In position 4, the individual crosses one leg in front of another. The hip (which is shown by the highest hip motion in Table 1) and leg are attempting to expand forward in this position. The knee and ankle of the forward-moving leg endure a significant situation. This position encourages movement. The analysis of stance 4 applies to posture 9, with the exception that in the former, the driving leg now makes room for the opposite leg and moves backward.

We examine the durations on another leg that is now leading and see that the knee action increases significantly when it is exposed to the response force that was previously overtaken via the ankle in position 4.

The shoulder and ankle help the entire body in position 5, maintaining the trunk horizontal to the floor. As a consequence, the hip receives a lot of attention. The elbow is extended and the body is perpendicular to the floor in position 6.

## 4. Conclusion

Daily Yoga activities are part of a ten-posture series with linked relaxation and aerobic exercise, every position combatting the one before it, resulting in a balancing of flexibility and extensions. Because this series is often repeated and advocated by several yoga professionals, structural modeling to justify its purported health advantages is needed. The requirements of elderly yoga participants are investigated using the special effects data of older participants. Age-friendly design specifications for multiple elements and structures will be beneficial to the growth of yoga. Extrinsic motivation is more successful than internal motivation in the early phase, thus age-friendly will not only fulfill physical demands but also emotional needs, motivating participants to perform yoga and to start and maintain a fitness routine. Those who have exercised regularly for a prolonged period are more self-sufficient when performing yoga postures.

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