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Impact of Vinyasa Sun Salutation on Knock Knee Deformity among School-Aged Children

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Abstract

Background: *Knock knee deformity is a prevalent postural issue among school-aged children that can impact gait, alignment, and long-term muscular skeletal health. While severe cases may require surgical or orthotic intervention, moderate deformities can often be addressed through targeted physical activity. Yoga, particularly the Vinyasa Sun Salutation offers a dynamic, non-invasive approach to improving muscular skeletal alignment and postural control.* ***Objective:*** *This study aimed to investigate the impact of 8-week Vinyasa Sun Salutation intervention on knock knee deformity in children aged 8–14 years.* ***Methods:*** *Thirty children with diagnosed knock Knee (intermalleolar distance ≥ 5.0 cm) were randomly assigned to an experimental group (n = 15), which practiced Vinyasa Sun Salutation five days per week, and a control group (n = 15), which followed standard school physical activities. Pre- and post-intervention intermalleolar distances (IMD) were measured and analysed using paired and independent t-tests.* ***Results:*** *The experimental group showed a significant reduction in IMD (mean gain = –1.24 cm, $p < 0.001$), while the control group showed only a minimal improvement (mean gain = –0.25 cm, $p < 0.05$). The between-group difference was statistically significant ($p < 0.001$), with a large effect size (Cohen's $d = 1.97$) for the experimental group.* ***Conclusion:*** *Vinyasa Sun Salutation significantly improved lower limb alignment in children with knock knee deformity. This structured, age-appropriate yoga intervention offers a cost-effective, scalable, and child-friendly approach for managing early-stage postural abnormalities within school settings.*

Keywords: knock knee, sun salutation, postural deformity, school-aged children

Introduction

Postural deformity during childhood is an increasing concern in physical education, paediatric orthopaedics, and developmental health. Of these, the knock knee deformity, medically referred to as Genu Valgum, is prevalent in children of school age. It is characterized by an unusual inward angle of the knees, such that the lower legs turn outwards, even when the ankles are touching (Kaspis et al., 2013). Although Genu Valgum is often a part of general developmental alignment in childhood, the progression of the condition beyond the age of 7 can indicate underlying biomechanical or musculoskeletal issues that warrant intervention (Salenius and Vanka, 1975).

Knock knee deformity in children can occur due to a variety of factors, including genetics, poor posture, obesity, rickets, sedentary lifestyle, or inappropriate biomechanics during development

(Sabarwal, 2011). If left untreated, Genu Valgum can affect a child's gait pattern, reduce the strength and coordination of the lower limb, and in severe cases, lead to long -term complications such as Patellofemoral syndrome, osteoarthritis, or lower back pain (Sharma and Ramachandran, 2020). Traditionally, orthotic devices and corrective surgery are employed in severe cases, while moderate to mild postural deformities can often be improved through therapeutic exercise and movement-based interventions Frick, 2001).

In recent years, yoga has obtained scientific and medical approval as a non-invasive, overall intervention for posture, musculoskeletal alignment, flexibility and improvement in neuromuscular coordination in children (Tales et al., 2013). Among various yogic practices, the Vinyasa Sun Salutation sequence is particularly beneficial due to its dynamic, full-body engagement. This flowing series of twelve asanas includes symmetrical movements of the upper and lower limbs, promoting muscle balance, spinal alignment and better postural control (Bhavanani et al., 2011).

A contemporary form of yoga contained in traditional Hatha Yoga, Vinyasa Sun Salutation emphasizes fluid transition between coordinated pose with breath. When the Vinyasa Sun Salutation is applied to the sequence, Vinyasa Sun Salutation enhances the neuromuscular demand of each asana and introduces rhythmic movement, which can be beneficial for children with postural disorders. This exercise not only enhances and strengthens quadriceps, hamstrings, calves, and hip abductors/ adductors, which are the major muscle groups involved in knee alignment, but also promotes body awareness, balance and symmetrical muscle engagement (Tran et al, 2001).

Many studies have highlighted the medical benefits of yoga in children. At et al. (2013) found that school-based yoga programs improved musculoskeletal health and motor skills in children aged 7–12 years. Similarly, Field (2011) reported that yoga enhanced postural control and coordination in children with developmental disorders. However, the literature is directly examining the effects of Vinyasa Sun Salutation on school-age populations—especially regarding structural postural deformities such as knock knees—is limited.

Given the increasing prevalence of sedentary behaviour in children due to the use of digital devices and lack of physical activity, early intervention that promotes dynamic movement, flexibility and muscle coordination is necessary. Implementing yoga in school physical education courses provides a cost-effective, scalable and non-pharmacological approach to address the initial-phase musculoskeletal misalignments (Nogal et al., 2012). In addition, yoga intervention is known to be favourable and durable when delivered with age-appropriate instructions, making them well-suited to primary and middle school settings.

Biomechanical mechanisms by which Vinyasa Surya Namaskar can benefit from knee deformity:

1. Stretching the muscles of the tight adductor pulling the knees inward
2. Strengthening weak abductor and gluteal muscles to promote appropriate hip-knee-foot alignment
3. Activating Core and postural stabilizers attach to direct posture to posture
4. To encourage proprioceptive awareness and symmetrical movement patterns, which can correct habitual misalignment over time

The purpose of the current study is to evaluate the effectiveness of the Vinyasa Sun Salutation intervention over an 8-week on the degree of knee deformity. By assessing pre and post-intervention changes in intermalleolar distance (IMD)- widely accepted measures of Genu Valgum - this study tries to determine whether a structured yoga protocol can bring measurable improvement to the lower limb alignment.

Research Question

1. Does regular practice of Vinyasa Sun Salutation reduce the severity of the deformity of the knee in the children of the school-age class?
2. Can yoga-based intervention improve musculoskeletal alignment and postural control in children?

Materials and Methods

Research Design

This study employed a true experimental pre-test and post-test and control group design to assess the 8-week Vinyasa Surya Namaskar intervention on knock knee deformity in school-aged children. Participants were assigned randomly to an experimental group (receiving yoga intervention) or a control group (no intervention), with measurements taken before aafter intervention.

Participants

A total of 30 school-aged children (aged 8 to 14 years) diagnosed with knock knee deformity were selected from two schools. The participants were identified through clinical screening, with an intermalleolar distance (IMD) greater than 5.0 cm, indicating moderate to severe deformity. The inclusion criteria for the study were: children between 8 and 14 years of age, an IMD of 5.0 cm or more, no history of recent orthopaedic surgery, neurological conditions, or systemic diseases, and written consent obtained from them. Exclusion criteria included children with rigid deformities or underlying skeletal abnormalities, those currently undergoing other corrective therapies, and those unable to attend regular intervention sessions. Using a simple random sampling method, the participants were equally divided into two groups: an experimental group (n = 15) and a control group (n = 15).

Variable

1. Independent variable: Vinyasa Yoga Surya Namaskar Intervention
2. Dependent variable: Knock-knee deformity measured using degrees of knee deformity, intermalleolar distance (IMD)

Measurement Tool

Intermalleolar Distance (IMD) was used to quantify the severity of Genu Valgum. It was measured in centimetres with a flexible measuring tape.

Procedure

1. Child stood barefoot in anatomical position with knees touching and ankles apart.
2. The distance between the inner ankle bones (medial malleoli) was measured.
3. Measurements were recorded pre-intervention (Week 0) and post-intervention (Week 8) by the same trained physiotherapist.

Severity Classification of Knock Knee

The severity of knock knee deformity was classified according to IMD values, as shown below:

IMD (cm)	Severity	Clinical Interpretation
0–2.5	Normal	Within physiological range
2.6–5.0	Mild	Monitor and recommend exercise
5.1–7.5	Moderate	Corrective exercises beneficial
7.6–10.0	Severe	Therapy needed; structured intervention
>10.0	Very Severe	Likely requires orthopaedic referral

(**Source:** Salenius & Vankka, 1975; Sabharwal, 2011; Frick, 2001)

Intervention Protocol

Experimental Group: Vinyasa Sun Salutation Program

The experimental group underwent a structured 8-week Vinyasa Sun Salutation program.

Component	Duration	Description
Warm-Up	5–7 minutes	Joint mobility, light stretches, and breathing awareness
Sun Salutation (Vinyasa)	25–30 minutes	6–12 rounds coordinated with breath and movement flow
Cool-Down	5–8 minutes	Static stretching, Shavasana (relaxation), and pranayama breathing

Control Group

The control group continued with regular school physical education activities but did not participate in any yoga or special intervention during the 8-week study period.

Data Collection Procedure

Baseline (pre-test) Intermalleolar Distance (IMD) measurements were taken prior to the commencement of the first intervention session to establish initial values. Following the completion of the 8-week intervention program, post-test IMD measurements were recorded within three days. All assessments were conducted by the same trained evaluator under standardized conditions to ensure consistency and reliability in data collection.

Statistical Analysis

All data were analysed using IBM SPSS Statistics. A descriptive statistics and paired sample t-tests were applied to assess pre and post intervention differences. The level of statistical significance was set at $p < 0.05$ for all analyses.

Analysis and Results

The purpose of this study was to examine the effect of the intervention of 08-week Vinyasa Sun Salutation on the Inter-weekly class (IMD) in school-class children with knock-knee deformity (Genu Valgum). A total of 30 participants were randomly equally divided into an experimental group (n = 15) and a control group (n = 15). Pre and post-test IMD values were recorded, and statistical analysis was done using the IBM SPSS Statistics version 25.0.

Descriptive Statistics

Table 1 presents the pre-test and post-test IMD means and standard deviations for both groups.

Table 1 Descriptive Statistics of IMD (cm)

Group	Pre-Test Mean ± SD	Post-Test Mean ± SD	Mean Gain (cm)
Experimental	6.53 ± 0.63	5.29 ± 0.69	–1.24
Control	6.46 ± 0.63	6.21 ± 0.65	–0.25

Note: Negative gain indicates a reduction in deformity (improvement).

Within-Group Comparison (Paired Sample t-Test)

Paired sample t-tests were performed to assess whether the reduction in IMD within each group was statistically significant.

Table 2 Paired Sample t-Test Results

Group	t	df	p-value
Experimental	8.42	14	0.000***
Control	2.64	14	0.020*

*p < 0.001, *p < 0.05*

The experimental group demonstrated a highly significant decrease in IMD (P <0.001), indicating improvement in knock knee deformity. The control group also showed a statistically significant reduction (P <0.05), but the change was minimal, possibly due to natural variation or daily physical activity.

Group comparison (independent sample t-test on profit score)

To determine whether the experimental group has significantly improved compared to the control group, an independent sample was done on a T-Test profit score (post-pr).

Table 3 Independent Sample t-Test on Gain Scores

Comparison	t	df	p-value	Mean Difference	Result
Experimental vs. Control	6.77	28	0.000***	–0.99 cm	Significant

***p < 0.001**

Interpretation

The experimental group showed significantly greater improvement in IMD compared to the control group, confirming the effectiveness of the Vinyasa Sun Salutation program in reducing knock knee deformity.

Explanation and Discussion

The objective of this study was to evaluate the effectiveness of the 8-week Vinyasa Sun Salutation program in correcting the knock knee deformity (Genu Valgum) among the school-age children. The results demonstrated that the structured yoga intervention produced a statistically significant and clinically meaningful reduce in the intermalleolar distance (IMD), indicating improvement the lower limb alignment.

Interpretation of Major Findings

The experimental group, which regularly practiced Vinyasa Sun Salutation, showed a decrease of 1.24 cm in IMD, while compared to a minimum 0.25 cm improvement in the control group. This difference was not only statistically important (P <0.001), but also by a large impact size. These findings suggest that Vinyasa Yoga, when applied in a structured and age-appropriate manner, can lead to meaningful improvement in postural alignment and lower limb biomechanics in children.

The control group, although it showed a statistically significant change (p = 0.020), had a small effect impact size (D = 0.51), suggesting that minor improvements could be caused by natural physical development or casual activity rather than target intervention. This strengthens evidence for specific contribution to postural improvement of yoga program.

Conclusion of Discussion

The study concludes that Vinyasa Sun Salutation is an effective, joint-friendly intervention to reduce knock knee deformity between school-age children. A significant decrease in intermalleolar distance after just eight weeks of practice suggests that yoga paediatrics yoga can play a meaningful role in postural health. With proper instructions and integration in school settings, yoga has the ability to serve as a non-invasive, overall tool to improve musculoskeletal alignment in yoga and to promote functional well-being in growing children.

Participant ID	Group	Pre-Test IMD (cm)	Post-Test IMD (cm)
P1	Experimental	6.1	4.9
P2	Experimental	7.4	6.5
P3	Experimental	6.9	6.1
P4	Experimental	6.6	5.1
P5	Experimental	5.6	4.1
P6	Experimental	5.6	4.2
P7	Experimental	5.3	4.3
P8	Experimental	7.2	6.3
P9	Experimental	6.6	5.3
P10	Experimental	6.8	5.7
P11	Experimental	5.2	4.3
P12	Experimental	7.4	6.3
P13	Experimental	7.1	6.3
P14	Experimental	5.7	4.3
P15	Experimental	5.6	4.6
P16	Control	5.6	5.3
P17	Control	5.9	5.7
P18	Control	6.4	6.1
P19	Control	6.2	5.9
P20	Control	5.9	5.7
P21	Control	6.6	6.2
P22	Control	5.5	5.2
P23	Control	5.9	5.5
P24	Control	6	5.6
P25	Control	6.2	5.9
P26	Control	7	6.6
P27	Control	5.7	5.6
P28	Control	6.4	6.2
P29	Control	6.6	6.5
P30	Control	5.3	5.1

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