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Intervention Of Classical Yoga In Pediatric Obesity- A Case Study

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Abstract : *Obesity is one of the world's leading diseases, and its prevalence in Malaysia has escalated over the years. Various organizations have been introducing activities to help the obese deal with psychosocial issues and also weight reduction. One of the main activities that has drawn everyone's attention in the last two decades is yoga. This ancient science may be an appropriate intervention as studies done in the past appears to point in that direction. This paper investigates the effectiveness of Classical Yoga as a complementary therapy in pediatric obesity. A qualitative single-case research study of ABAB design involving an obese adolescent was carried out. The case study revealed positive physiological outcomes in terms of mood and a small weight reduction. Due to the insignificant sample size, the data obtained is statistically insignificant; however, the outcome of this study enhances the effectiveness of yoga as therapy in the treatment of obesity. This study recommends further investigation be done on a larger sample size. Since studies on effectiveness of yoga have yet to be done on obese Malaysian adolescents, conducting an extensive study amongst Malaysian school children would augur worthwhile. It is also recommended that the duration of the study be lengthened.*
Keywords*: adolescents, intervention, obesity, therapy*

I. Introduction

Obesity, which is a complex, multifactorial condition affected by both genetic and non-genetic parameters, is one of the leading diseases worldwide today and its prevalence in Malaysia escalated from 4.4 per cent in 1996 to 14.0 per cent in 2006 [1]. Recently, the Malaysian Insider (2014) reported that Malaysia, one of the developing countries in the world, is the most obese nation in Southeast Asia followed by South Korea (33.2%), Pakistan (30.7%) and China (28.3%) [2]. A study conducted by the UK Medical Journal Lancet in 2013 reported that almost 45 per cent of the Malaysian men and 49 per cent of the women in the country are either overweight or obese [3]. In Asia, Malaysia is ranked 6th highest in the adult obesity rate [4]. The same survey revealed that 60% of Malaysians aged 18 and above have a BMI of over 25.

Malaysia is a multiracial country consisting predominantly of Malays (50.1 %), Chinese (22.6 %) and Indians (6.7 %) [5]. Based on ethnicity, one study conducted in Malaysia claimed that the Indians were the most overweight and obese compared to the Chinese and Malays [1]. This finding appears questionable as the number of Indians who enrolled in that study was relatively small compared to the Chinese and Malays. While a total of 370 Indians, 632 Chinese and 2515 Malays participated in the study, the data revealed that 64.1 per cent of the Indians (237 subjects), 40.3 per cent of the Chinese (254 subjects) and 57.2 per cent of the Malays (1438 subjects) were obese.

The significant rise in obesity has also occurred in many other countries. In the United States, which is a developed nation, more than 68 per cent of the adults are overweight and 35 per cent have been reported as being obese [6]. Even though the reason for this phenomenon is not fully understood, this increase has occurred across every age, gender, and race including those in the smoking category. In another study, conducted by the National Health and Nutrition Evaluation Survey (NHANES) in the United States, Ogden, Carroll, Kit, & Flegal (2014) disclosed that while 33.3 per cent of adults and 17 per cent of the youth are obese, the prevalence remained stable between 2003 -2004 and 2009-2010 [7]. In an extended study to provide a more up-to-date data on the occurrence of obesity, the 2011-2012 NHANES revealed that 8.1 per cent (95 % CI, 5.8 % -11.1 %) of children below the ages of two had high weight for recumbent length. Also, 16. 9 per cent (95 % CI, 14.9 % - 19.2 %) of two- to 19-year olds and 34.9 per cent (95% CI, 32.0% -37.9%) of adults were obese [7]. These findings are based on a sample size of 9120 participants of which 5181 are 20 years and older, 584 are below the age of two years, and the rest are in the category of children and adolescents. Hence, albeit there is no significant increase in obesity prevalence in the 2-to 19-year-old group or the adult group between 2003-2004 and 2011-2012, the occurrence of this deadly disease remains unfavorably high.

Several studies have reported that pediatric obesity has become the most prevalent nutritional disorder [8, 9, 10]. Based on a statistical analysis in 2010 of 144 countries globally, 43 million preschool children under the age of five were estimated to be either overweight or obese; in addition, 92 million were found to be at risk of being obese [11]. In India, approximately ten per cent of school children between the ages of five and seventeen is overweight or obese [12]. Studies have shown that the prevalence of being overweight among adolescents in India varies between 10 and 30 per cent [13].

While 38 per cent of the child –population in Malaysia has been reported to be obese, statistics reveal that 17 per cent of the two- to 19-year olds in the United States is in the similar category of obesity [7, 9, 14]. While the data for prevalence of obesity in youth in the United States remained unchanged, data obtained for the Malaysian population implies deteriorating health amongst the young; figures which were below 10 per cent decades ago rose to nearly 14 per cent in 2008 and now it stands at 38 per cent [2]. What is more appalling is that the obesity statistics across the globe has more than doubled since 1980 [15]. In 2014, more than 1.9 billion adults of at least 18 years of age worldwide were estimated to be overweight, of which 600 million were found to be obese. In the child group, the 2013 statistics revealed that 42 million of children below the age of five were either found to be overweight or obese [15].

Even though cost of living has escalated in Malaysia over the past decade, the obese population inadvertently continues to increase amongst Malaysians from all walks of life irrespective of age, gender or creed. According to Wilding (2001), the increase in body weight in most populations is a biological response to an abnormal environment, which is characterized by several factors such as (i) food type and intake, (ii) inactive lifestyle, (iii) environmental factors, (iv) body metabolism, hormone –related diseases and medication, (v) genetics, (vi) inadequate sleep, and (vii) anxiety and depression [16]. Obesity is a leading indicator to increasing health issues, some of which were unheard of in the last five decades. Due to obesity, there has been an increase in the incidence of cardiovascular diseases, Type 2 Diabetes mellitus (DM), hypertension, depression and even some types of cancers [17, 18].

According to WHO Expert Committee (1995), body mass index (BMI) is the parameter used to assess obesity [19]. BMI is a mathematical formula of weight-for-height index. It is measured by dividing the body mass in kilograms with the square of height in meter. A normal person's BMI ranges from 18.5 to no more than 25. A BMI reading of above 30 reveals that the person is obese, while a reading of above 25 but below 30 indicates that the individual is overweight. Obesity can be further classified according to grades or stages – Grade 1: BMI 30.0-34.9, Grade 2: BMI 35.0-39.9 aTCnd Grade 3: BMI $\geq$ 40.0 [20]. A reading of above 40 implies morbid obesity. Nevertheless, it is important to note that morbidity does not necessarily occur only at BMI levels exceeding 40; it can occur at BMI levels below 40 too.

In this paper, these definitions will be used to indicate if a person is overweight, obese, or severely obese (BMI $\geq$ 40) respectively. The term 'pediatric obesity' has been used to refer to individuals between the ages of two and 19 having a BMI of above 25; hence this term will encompass those who are not only overweight, but also obese. Even though the BMI reading has been widely used as a guide to determine whether an individual is obese, overweight or within normal limits, individuals with a normal BMI reading should do regular checks on the body fat percentage to ensure that they are not clinically obese. As pointed out by Wilding (2001), BMI is not necessarily the best indicator for adiposity; fat distribution in the system is also important [16].

Intervention of yoga is beneficial for children, but current available data does not appear all that encouraging due to lots of limitations in the studies conducted [8, 10]. Yoga is usually a subset of a much more significant intervention; hence, the outcome of a study cannot be attributed to yoga alone [21]. A comprehensive literature search conducted by Ross and Thomas (2010) yielding 81 studies on the health benefits of yoga and exercise revealed that yoga supports physical and mental health via down –regulation of the hypothalamic pituitary adrenal (HPA) axis and the sympathetic nervous system (SNS) [22]. The 81 studies encompassed a variety of trial designs including controlled, wait list uncontrolled and comparison types, and the demographics of the populations varied immensely. Even though all the studies employed yoga intervention, the structure of the yoga session, yoga type and frequency of yoga class varied from study to study.

The findings of a 12-week uncontrolled pilot study employing Ashtanga yoga on 14 obese Hispanic children revealed an average weight loss of 2 kg [23]. This study showed a drop in total cholesterol (TC) levels and an increase in high-density lipoprotein levels. The anxiety symptoms had improved. The results of this study appears very positive and has serious implications for further research.

In a pilot study involving 16 severely obese adolescents with an average age of 13.4 years, Hainsworth et al. (2014) found that the eight-week hatha yoga intervention program showed marked improvements not only in physical and psychosocial functioning, but also in lower back and hamstring flexibility, findings which are consistent with that of Bernstein et al. (2014) [8, 24]. However, reduction in weight was insignificant. The adolescents were only exposed to approximately fifteen one-hour classes of Iyengar style yoga over eight weeks which were probably insufficient to bring about a marked weight reduction.

Notwithstanding, in an earlier study conducted in Korea involving 20 obese male adolescents between the ages of 13 and 15 years, findings revealed a significant reduction in the body weight and BMI following an eight-week yoga intervention [25]. There was also a marked decrease in the TC, while the decrease in the triglicerides (TG) was insignificant. It must be noted that the frequency of the yoga intervention in Seo's at al.'s study was more intense compared to Hainsworth et al.'s; participants were subjected to three one-hour sessions of hatha yoga per week over eight weeks which added up to 24 sessions of yoga. The design of the yoga training

comprised 10 minutes of warm-up stretches, 40 minutes of sitting, lying and standing asanas and 10 minutes of relaxation. More importantly, the intensity of the asanas was gradually increased over the eight –week period. Nevertheless, in both the studies, the focus was predominantly on the physical aspect of yoga; hence 10 to 12 asanas were practiced in every session. Hardly any pranayama was incorporated in both the studies.

The intervention of yoga appears to have brought positive effects to various obesity-related health conditions. Table 1.1 summarizes selected studies done from 2009 to 2014 on the intervention of yoga. However, it is worthy to note that studies on yoga and weight loss have been challenged by several factors such as inadequate sample size, short duration of study, and also lack of control groups [24]. In addition, the duration of formal group practice sessions, duration of informal practices at home and the frequency of both appeared inconsistent in all these studies. The purpose of this paper is to investigate the effectiveness of Classical Yoga intervention in a qualitative single-case study involving an obese adolescent.

Table 1.1: Effects of Yoga Intervention on the Young Population (8-19 Years Old)

First author (Year of Publication)	Basic demographics of population	Sample population	Type of yoga intervention	Findings
Benavides (2009)	Obese children; 8-15 years of age of Hispanic population	14	12 weeks of Astanga yoga	There was a loss of an average of 2 Kg; self-esteem improved; HDL increased while total cholesterol decreased.
Berger (2009)	Inner-city children; 4th grade -5th grade	71 [Yoga group - 39; control group -32]	1 hour of yoga per week for 12 weeks	In the yoga group, there were fewer negative behaviors in response to stress; children experienced better balance.
Rajpoot (2014)	Emotionally abused children; 13-19 years of age.	40	25 mins of yoga nidra (deep relaxation); 5 days a week for 2 months.	Subjects were less stressed. Levels of nervousness dropped. Emotional stability improved. Mental health improved.
Hainsworth (2014)	16 obese youth; 11-17 years of age	16	Iyengar style; 5 min of warm-up; 45-50 min of asanas; 5-10 min of relaxation.	Non-significant decrease in BMI; significant improvements in physical and psychosocial functioning
Seo (2012)	Obese boys; 13-15 years of age of Korean nationality	20 [yoga group - 10; control group -10]	1 hour of yoga per session; 3 sessions per week for 8 weeks. [Each yoga session consists of 10 min warm-up, 40 min asana and 10 min relaxation]. Intensity of asanas increases gradually.	Significant decrease in BMI and TC was found in the yoga group; non-significant change in TG

II. Methods

2.1 Participant Selection

Since I am a qualified yoga instructor/lecturer, I conduct yoga classes at a regular basis at the college where I teach. The participant in my case study was Rachel (not her real name), one of the college students who is obese. I had to settle for one student as the others were either reluctant or their BMI readings did not fit the criteria of my study. This young girl, though has heard about yoga, has never been exposed to any yogic practices before this.

2.2 Method Selection

The obstacles an obese person go through when exercising was of concern to me. At the same time, I was interested in a method that would allow continuous assessment of the individual over a period of time with the intervention of yoga. In that manner, some aspects of human behavior in relation to yoga practice, if not all, can be assessed. Hence, for these reasons, a qualitative approach was chosen for this study. At large, qualitative research methods are especially useful in discovering the meaning that people give to events they experience [26]. Since the principal instrument for data collection and analysis in a case study research is the researcher him/herself, it gives me an opportunity to play an active role in the collection and interpretation of all the information I collect. Even though this case study was about the effectiveness of yoga in treating obesity, there was a need to incorporate interviewing sessions with the participant to study the participant's behavior in context. The single-case research of the ABAB design was applied in this study [27]. The letters A and B refer to two different phases: phase A refers to baseline condition where there is no intervention, while phase B refers to the stage when there is an intervention. Using this method, the effects of yoga intervention by alternating the baseline condition (phase A) with a condition where there is intervention of yoga (phase B) was studied. Phases A and B are then repeated to complete the four phases.

2.3 Assessments

The participant was asked to fill out a simple questionnaire on disease history including duration and complications, treatment details including drug, dosage and duration of treatment besides age and gender. Baseline parameters like her body weight, height, and waist and hip circumferences were measured using standard protocols with her wearing light clothing and barefooted. Subsequently, her BMI was calculated. All these data are tabulated in Table 2.1.

2.3.1 Physical Observation And Examination

Rachel reported absence of medical history of any sorts even though she appeared sluggish. She said she is relatively healthy but admitted that she gets tired easily, which was something evident even after her first yoga class. She was gasping for breath during the sun salutation vinyasa. The rate or depth of breath is a general indicator of the level of exertion one is being subjected. Basically, on a similar exertion level, an individual who lacks stamina and cardiovascular fitness will experience more shortness of breath than the person who is more resilient and fit. In Rachel's case, her breath was generally short. In the initial stages (first phase B of the study), she was almost always short of breath during the stay in the asanas.

I got her to observe her breath before and during the three phases of the asanas in all the subsequent classes. The three phases include the journey into the asana, the stay in the asana and the journey out of the asana. All this data was recorded. The duration of the 'stay' in most of the asanas did not exceed five seconds in the initial stages.

Rachel was quite flabby; she had excess weight on her thighs and in the frontal abdominal region. Observation on the body alignment did not reveal any significant postural misalignment. Level of the shoulders appeared in line with each other. The curvature of the spine was normal with no lateral deviation. Her hips appeared protruding due to excess flesh on the buttocks, but both legs are of equal length. Her knees are not hyperextended but appeared deviated laterally inward slightly.

2.3.2 Assessment Of Physical Strength

I started off by assessing Rachel's abdominal muscles, hip flexibility and back extensors. In order to assess the strength of Rachel's abdominal muscles, I decided to use a simple asana that is apanasana (energy freeing pose). Upon doing it, she said that the asana was too easy for her, so I got her to do urdhvaprasrtapadasana (leg lifting pose) which she found a little challenging. She was not able to lift the leg more than two feet of the floor. Secondly she found it a struggle to keep the leg straight for ten seconds. I also noticed that she was unable to keep her neck on the floor during the pose. This could be due to lack of strength in the neck.

To assess the strength of the back extensors, I got her to do shalabasana (locust pose). That was too strenuous on her back, so I got her to do cakravakasana (cat-cow stretch) which was more doable. Her hip flexibility was assessed using pascimatanasana (seated forward bend). Since she was unable to reach out to her toes, I got her to hold her knees instead. The results showed that her hip joints were relatively tight and her hamstrings were not stretched enough. From time to time, whenever I saw her forcing herself into a pose, I had to remind her to respect the limits of the body as I did not want any untoward effects on her. It is the benefits derived from the movement and the coordination with breath which are more imperative than the full pose itself.

Since I wanted a more complete assessment, I decided I would make multiple observations in one asana in addition to assessing one parameter using one asana. While Rachel was in the cakravakasana pose, I took the opportunity to also assess other parts of her body. Since the pose was easy enough for her to hold for a couple of breaths, I was able to assess the flexibility of her ankles (plantar flexed in this position). From cakravakasana, I got her to return to the starting position which is vajrasana. That was a bit challenging for her and I reckon it was due to the excess weight that she was unable to bend fully over the thighs. She could not bring her buttocks to her heels.

In short, Rachel's physical strength was assessed using apanasana, urdhvaprasrtapadasana, shalabasana, cakravakasana and pascimatanasana. These five asanas gave me sufficient insights with regard to Rachel's stamina.

2.4 Designing The Yoga Intervention Program

Based on the assessment, I then selected asanas suitable to Rachel's level of flexibility and strength. I also had to keep in mind the muscles that she has to strengthen and stretch. At the same time, I was conscious of the fact that yoga, specifically Classical Yoga is not a stretching exercise, but it is concerned with steadiness, comfort and relaxation of effort [28]. Keeping in mind to start off with simple asanas and gradually moving into more challenging asanas, I came up with a list of asanas deemed suitable for Rachel. To ensure that there is balance, I included seated, forward-bending, back-bending and standing asanas in the sequence.

Throughout, I continued to observe her before she started doing the asana, while she moved into and remained in the asana, as she came out of the asana and finally after she completed the asana. I also told her to focus on these phases herself. This would make it easy whenever we met up to discuss her progress. Even though she attended seventy-five minute classes twice a week, she was asked to practice on a daily basis at home on the days she did not attend class. There was no lifestyle or diet modification imposed on Rachel, and that made her very happy as she confessed that she loved bingeing on certain types of food especially chocolates.

2.4.1 A Specially Designed Yoga Intervention For The Study

By the next class, I came up with a comprehensive yoga program for Rachel. Table 2.2 lists all the components in her practice. Each yoga session consisted of about five minutes of awareness practice, 20 minutes of wind releasing series – the pawanmuktasana series (Table 2.3), 10 minutes of sun salutation, 25 minutes of asanas (Table 2.4), five minutes of shavasana (dead corpse pose for relaxation), five minutes of pranayama (Table 2.4), and the class ended with a short practice of dhyana (meditation).

2.4.2 The Awareness Practice, Surya Namaskar, Asana And Pranayama

The awareness practice is for the purpose of centering the mind and body. In every yoga session, I tell Rachel to witness everything that goes on inside the body and mind. I tell her to do so preferably with their eyes closed. From my own experience, whenever the eyes are open, I tend to process everything I see around me. I remind her to refrain from being judgmental of the thoughts that come and go but to be mindful of them at all times. The Pawanmuktasana series, on the other hand, aims to provide suppleness in the areas of body joints. According to Swami Satyananda Saraswati, this series comprises merely three parts {29]. Part one, which is made up of anti-rheumatic asanas, starts with the toes and ankles, and gently moves up to the knees, hips, torso and spine, and concludes with the neck. The digestive or abdominal group of asanas, which is part two, is concerned with strengthening the digestive system region, while part three consists of shakti bandha asanas that work on releasing energy blocks in the whole body [29]. In this study, Rachel did most of the movements in part one, but a selected few from part two and part three respectively. Table 2.3 shows all the movement and asanas attempted by Rachel in the pawanmuktasana series. Even though a significant number of asanas for parts two and three are highlighted, not all were practiced in the same session. For instance, if the first three asanas of part 2 are practiced in the first week, then the next three asanas are practiced in the subsequent week, and the asanas are rotated from time to time to avoid boredom.

The pawanmuktasana series has a tremendous effect on the physical body, primarily the muscles, brain, joints, veins and the lymphatic system [29]. It is so powerful that it can stimulate the healing process by simply redistributing the prana (life force) and removing pranic blockages. Thus it can stabilize not only the irregular occurrences of pain, but also the underlying energetic imbalance. In this study, each movement or asanas in this series was done once or twice. After the first class, I sat down with Rachel to evaluate her joint suppleness. I also told her to take note of her joint suppleness in every class. I wanted her to be more aware of the change that would take place in her body during the yoga session. Though she indicated to me that the pawanmuktasana series was banal and wanted to proceed to asanas straight away, I had to explain to her the importance of this series in not only making the joints supple, but also in removing hardness of the muscles.

The pranayama consisted of alternate nostril breathing (nadi shodhana), kapalabathi, anuloma viloma, bhramari and bastrika, while seated in thunderbolt or easy pose. After a couple of sessions, I introduced the half-lotus seated pose and got Rachel to attempt it. However, she was only comfortable sitting in the easy pose while doing pranayama. Ujjayi pranayama was also practiced during asanas.

In the first week, Rachel started off with just one cycle of sun salutation at a slow pace. In the second week, she did three cycles at a slightly faster pace. From the third week onwards, she performed three to five cycles and this number of cycles was maintained throughout the study. The asanas introduced in this study for Rachel are trikonasana, pascimattanasana, urdhvaprasrtapadasana, shalabasana, half-lotus forward bend, dhanurasana and several others as listed in Table 2.4. The asanas primarily focused on the quality and ease of breath, isometric muscular contractions, flexibility, balance and concentration. Not all the asanas listed in Table 2.4 were practiced in every session. Considering the time and the number of repetitions done for each asana, usually up to eight asanas were practiced in every class. Basically a couple of new asanas were introduced every week to avoid boredom. After the fourth week, I spoke to Rachel about her yoga experience and progress. The questions asked and feedback have been tabulated in Table 2.5.

Table 2.1: Rachel's Biodata

Parameter	**Measurement**	
	Pre	Post
Body weight (kg)	70	68
Height (m)	1.55	1.55

Waist circumference (cm)	90	88
Hip circumference (cm)	123	122
Waist to hip ratio	0.732	0.721
BMI (Kg / m^2)	29.14	28.30

Pre: Before commencement of yoga
Post: After completing 14 sessions of yoga

Table 2.2: Yoga Program Specifically for Weight loss

Components in the Practice	***Duration (min)**
Practice of awareness	5
Pawanmuktanasana series (wind relieving exercise)	20
Surya Namaskar (sun salutation)	10
Asanas (poses)	25
Shavasana (dead corpse pose)	5
Pranayama (breathing techniques)	5
Dhyana (meditation)	5

*Duration varied slightly from class to class.

Table 2.3: Components of the Pawanmuktasana Series

Pawanmuktasana Series	***Duration (min)**
Part one Padanguli naman (toe bending) Goolf naman (ankle bending) Goolf chakra (ankle rotation) Goolf ghoornan (ankle crank) Janufalak akarshan (kneecap contraction) Janu naman (knee bending) Janu chakra (knee crank) Shoni chakra (hip rotation) Poorna titali asana (full butterfly) Mushtika bandhana (hand clenching) Manibandha chakra (wrist joint rotation) Kehuni naman (elbow bending) Kehuni chakra (elbow rotation) Skandha chakra (shoulder socket rotation) Greeva sanchalana (neck movements)	10
Part two Padachakrasana (leg rotation) Supta pawanmuktasana (leg lock) Jhulana lurhakanasana (rocking and rolling) Udara karshanasana (abdominal stretch pose) Padothanasana (raised legs pose) Pada sanchalanasana (cycling) Naukasana (boat pose) Supta udarakarshanasana (sleeping abdominal stretch pose)	5
Part three Chakki chalanasana (churning the mill) Nauka sanchalanasana (rowing the boat) Gatyatmak meru vakrasana (dynamic spinal twist) Kauva chalasana (crow walking)	5

*duration varied slightly from class to class

Table 2.4: Asanas and Pranayama Used in the Study

Component	***Duration (min)**
Asana: Pascimottanasana (seated forward bend) Ushtrasana (Camel pose) Dhanurasana (bow pose) Yoga mudranasana (psychic union pose) Shashank bhujangasana (striking cobra pose) Setu bandhasana (bridge pose) Sarvangasana (shoulder stand) Parivatha trilokasana (revolving triangle pose) Shalabasana (locust pose) Ardha-halasana (half plough pose) Utkatasana (energy pose) Trikosana (triangle pose) Vyaghrasana (tiger pose) Urdhvaprasrtapadasana (leg lifting pose)	25
Pranayama:	5

Kapalabathi (deep exhalation) Bastrika (inhalation and exhalation) Anuloma viloma Brahmari (humming bee's breath) Nadi shodana (alternate nostril breathing) Ujjayi (psychic's breath)	

*duration varied slightly from class to class

III. Results And Discussion

Rachel attended a total of 14 sessions of yoga over 10 weeks- six sessions of yoga in the first B phase and eight sessions in the second B phase. From the results obtained, the study showed that 14 sessions of yoga over a duration of 10 weeks (inclusive of the two-week break) resulted in a non-significant decrease in BMI from 29.14 Kg/m^2 to 28.30 Kg/m^2. However, there was a weight reduction of 2 kilograms.

Table 3.1 highlights the feedback obtained from Rachel in the first week and after four weeks of doing yoga. From that data, it can be deduced that the intervention of yoga has impacted Rachel to a great extent. She no longer feels lethargic but feels more relaxed. In fact when she took the two-week break from yoga, she professed that she started feeling lethargic and her stress level increased. During that period, she did not feel as energetic as compared to when she was doing yoga. After resuming yoga, she admitted that she could feel a sudden change in her energy level and her mood improved. She was able to concentrate better in her studies. She felt more flexible and her muscles were not as stiff as before. One significant comment made by Rachel was that she always felt very light and vibrant after a yoga session. She also said that she sleeps better on days that she has done yoga.

This single research case study reveals that yoga appears to be beneficial as a therapy in improving sleep quality, managing mood, overcoming lethargy, and relieving stress. However, it must be noted that the findings are based on the qualitative assessment of the single participant in my study.

It has been reported that meditative movement interventions such as yoga leads to improved physiological responses for example, improved sleep quality [30]. Improved sleep quality can lead to weight loss – a parameter related to the reduction in the risk for diabetes and CVD through improvements in BP, TG and HDL in obese individuals [31].

In this study, a small weight loss was observed after yoga intervention. Since there was no dietary modifications imposed on Rachel, and she was not involved in any other physical activity besides the minimal amount of walking done on campus, it is probable that the loss of weight is due to yoga intervention. The reduction in the waist to hip ratio after the intervention of yoga in Rachel appears to be consistent with that reported by Sahay (2007) [32]. Shantakumari, Sequeira and El Deeb (2013) concur that yoga helps in the redistribution of body fat and reduction in central obesity [33].

Benavides and Caballero (2009) reported that yoga had significantly decreased body weight in children. However, in their study, Ashtanga yoga – a more strenuous form of yoga, was used as intervention. I believe that if Rachel continues doing yoga diligently, though not of Ashtanga style, she may experience a more significant drop in her body weight.

Even though Rachel experienced stress relief as a consequence of doing yoga, to my knowledge, hardly any studies have examined the effects of yoga on physiological stress reactivity in pediatric samples [34]. Nevertheless, there is evidence that dhyana and biofeedback can reduce stress [35, 35, 36]. In this study, Rachel only did five to 10 minutes of meditation in each session with me. I believe certain asanas and pranayama techniques taught to her may have a role to play in helping her relieve stress. I state this because Rachel acknowledged that she only practiced the sun salutation, a few of her favorite asanas and pranayama at home on days that there was no yoga class. Hence, I reckon it is not only the meditation, but also the very relaxing asanas and specific pranayama techniques that has helped her achieve that state of relaxation and be stress-free. The stress relief effect is due to the functioning of the ANS, which consists of the SNS and the PNS. Both are interlinked in such a way that when one shoots up, the other drops [38]. Stress is one of the main culprits responsible for the activation of the SNS and increase in cortisol levels. Research has shown that frequent episodes of stress can lead to obesity ([39, 40].

Gentle yoga (that is yoga comprising mild asanas and lots of relaxation in between asanas) has been known to help normalize the functioning of the ANS by deviating the SNS and PNS indices towards mid region of the reference values [41]. Similarly, Raghuraj, Ramakrishnan, Nagendra & Telles (1998) have shown that the practice of pranayama specifically diaphragmatic breathing helps in overcoming stress through the reduction of the sympathetic tone and increase in the parasympathetic activity [42]. The stimulation of the PNS causes blood flow to be channeled to the digestive organs and endocrine glands. The heart rate plummets; at the same time, the blood pressure is lowered. The body then enters a realm of restoration and healing [43]. Mood improves, cortisol level drops and the physical and psychosocial well-being improves [44]. This probably explains what Rachel was going through during the yoga sessions, and that is why she could attest to feeling so

relaxed after every yoga session. The effects of yoga in down-regulating the HPA axes has also been established [45, 46].

From my own experience not only as a yoga instructor/therapist, but also as a zealous yoga practitioner, I believe that active practices like the sun salutation (done in a brisk manner) and pranayamas like kapalabathi and bastrika can also stimulate the SNS. However, if these practices are followed by mild asanas like marjari, apanasana or shavasana, the individual will be able to go into deeper relaxation. In this study, the sun salutation was initially done at a very slow pace (approximately three to four minutes per cycle), but I gradually increased the pace to approximately two minutes per cycle and maintained it at that pace throughout the study. I am not certain if Rachel kept to this pace when she practiced on her own at home even though I had advised her to do so. I also made sure there was enough time for relaxation (approximately five to ten seconds) in between asanas. The relaxation pose incorporated in the sun salutation is the extended child's pose. However, in between asanas, she either did the standing or lying down shavasana.

When I designed the yoga intervention program for Rachel, I felt a need for a well-rounded yoga practice and not one that would just induce perspiration in the hope of losing weight. The way I see it, a well-rounded practice entails awareness of being in the present, coordinating breath with every movement and these movements include the journey into the asana, the stay and the journey out of the asana. In addition, it encompasses the wind relieving series, sun salutation, asanas, pranayama, shavasana and meditation. These are the pointers I precisely took into account and incorporated when designing the intervention program for Rachel.

IV. Conclusion

The single case study showed that yoga was effective in managing mood, overcoming lethargy, relieving stress and improving sleep quality in my participant. Nevertheless, there was an insignificant weight loss. Based on the literature review and case study, several potential limitations are evident. I had only accessed English language articles and those published in open access peer-reviewed journals. Even though many studies have been done and reviewed, there is simply too much heterogeneity across all the studies that have been included in this article. This is probably due to the fact that the practice of yoga had been customized to the individual participants. Also, the study is limited by an insignificant sample size. Even though this study has revealed invaluable information about the benefits of yoga in obesity, it cannot be generalized to a larger obese population. The results of this case study merely appears to strengthen the evidence that yoga is a potential effective therapy for not only obesity, but also physiological disorders.

Future studies should involve larger sample population. Also, the reporting of methodology such as the entire lesson plan for a yoga session and the outcomes should be in great depth. The scientific work carried out must be one that is able to explicate not only the effects but also the mechanisms of the effects of yoga on the body and mind. Researchers may want to consider lengthening the duration of the intervention. It would be quite interesting to study the effects of short term versus long term intervention of yoga on children. Alternatively, the effects of the intervention can be analyzed in stages, for example after 10, 20 and 30 yoga sessions respectively. Another factor to consider is to monitor the dietary plan. Comparative studies can be done to study the effects of yoga and healthy diet versus effects of yoga and a normal diet on a young obese population.

Recommendations

The findings of this literature review and qualitative study point to some recommendations for addressing the issue of obesity in schools and colleges in Malaysia. Here are the suggested recommendations:

Recommendation 1: Creating awareness on obesity

Posters highlighting the diseases or disorders caused by obesity must be made readily available to all schools and colleges. At preschool and primary levels, the academic department could develop programs focused on behavior modification, improved nutrition, and increased physical activity for the students.

Recommendation 2: Creating awareness on yoga and obesity

Qualified yoga instructors can be invited as guest speakers to facilitate a workshop on yoga. Students must be encouraged to attend these sessions free of charge. In order to ensure full attendance, students can be made to write a reflective paper on the usefulness of the workshop attended. Prior to the workshop, the academic department in the school will have to link this activity to a particular subject taken by all students as part of a summative assessment.

Recommendation 3: Offer yoga as part of the curriculum

Most schools tend to inform parents that their children should be exposed to more physical activity. Medical practitioners, on the other hand, say that not only exercise, but also proper nutrition is crucial for the prevention

of obesity and optimal health. Increased physical activity may help prevent and reduce childhood obesity, but recommending more exercise will not have much impact if physical education programs are not available in the school. Also nutritional information may not have any impact if schools do not take the trouble to change their menus. Hence, it is suggested that yoga be part of the physical education program at preschool level itself. It shall be during these sessions that the students be advised on health and nutrition.

Recommendation 4: Enforcing national guidelines on food advertising

Relevant authorities may want to consider and enforce national guidelines when it comes to advertising and marketing of foods. There should be stricter guidelines to protect children and also adolescents from unscrupulous advertisers who go all out to promote unhealthy dietary choices.

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Table 3.1: Qualitative Assessment of Rachel's Yoga Experience

Question	**Feedback from the participant**	
	After one session of yoga	**After one month of yoga**
Did you experience pain during the yoga session?	"There was a lot of pain especially when I did the sun salutation. The joint exercises were more manageable. The abdominal exercises were tough for me."	"I am able to manage the pain now. It is not as bad as when I first started."
Besides pain, what else occurred as a result of the yoga sessions?	"I just found it difficult to do most of the asanas. Considering the pain I was experiencing, I was not sure if I wanted to continue with yoga"	"Somehow after attending classes more regularly, I began to feel more energized. Surprising but true, I also feel more flexible. Generally, I get stressed out quite easily, but after doing yoga, I find myself being calmer. I feel more relaxed and good about myself."
What do you think made yoga more doable for you?	"I was motivated by the fact that yoga may help me lose weight."	"I was seeing results. My breathing has improved. The more I practiced, the more flexible I became. The encouragement I got from the instructor and also the home practice made me feel good about myself."
What do you think was really easy about the yoga practice?	"Instructions were very clear, so it was easy for me to follow especially the joint exercise. The only problem was that my body, due to my size, was resisting certain asanas."	"I feel good because I can quite easily flow into some of the asanas now. I do not need any equipment; with just a mat, I can do so many things with my body."
What do you think was really hard about the yoga practice	"The asanas and having to remember the steps of the sun salutation. I could not bend easily. I also found it hard to get into position for certain asanas. The pain was unbearable."	"The meditative poses are challenging. I cannot sit still.
Do you wish to continue practicing yoga?	"I think I would."	"I definitely want to continue doing yoga. I feel so light after every session. Even though I am not sure if I have lost any weight, I am sure if I keep on practicing diligently, I will see change in my physical appearance."