EFFECT OF KNEE PAD ON KICKING A BALL AND GAIT ANALYSIS

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Abstract

Wearing kneepads is the best defence against occupational knee injury. It has been reported that the use of knee pads can reduce injuries and increase performance. Knee pads provide protection by disbursing pressure on the knees and preventing puncture wounds. This study focuses on the effect of knee pads on muscle activity and gait analysis. As a case study, measurement of muscle activities whilst kicking a ball was conducted. The normalized mean of the EMG data shows that the vastus lateralis and vastus medialis muscles are highly active when wearing a knee pad. Gait analysis was conducted on six subjects with and without wearing knee pad. Results shows that wearing knee pads increases the force (950 ~ 1150N) acting on the ground, compared with not wearing knee pads (800 ~900 N).

Introduction

The most important means of ball progression in soccer is kicking. The standard kicking technique comprises of accuracy, distance and speed of execution. Therefore, some relevant research has included a study of the kinematics of punt kicking [1] and electromyography of the soccer kick [2]. The most common injuries experienced by players in soccer are hamstring strains, knee and groin injuries. Most injuries are equally distributed between both sides of the body, although quadriceps strains are more common on the dominant kicking leg [3]. Factors that may explain the relatively higher incidence of hamstring and groin injuries include greater distance of sprinting during an average effort, the less predictable flight from the ball, greater length of the playing arena, repetitive loads in kicking and longer duration of games. Kicking almost certainly increases the rate of quadriceps strains. The lower-limb motions are very important for human daily activities, such as sitting down, squatting, walking, ascending and descending stairs. It is sometimes difficult for physically weak persons (elderly, disabled, and injured persons) to perform daily lower-limb motions [4]. Flexion/extension motion of a human hip joint is mainly actuated by the muscles of iliacus, psoas, rectus femoris, tensor fasciae latae, biceps femoris, and semitendinossus [5]. Many of these muscles are bi-articular muscles, such as the muscle of rectus femoris biceps femoris and semitendinossus, since they work on both hip and knee joint. Flexion/extension motion of a human knee joint is mainly actuated by the muscles of biceps femoris, semitendinossus, gastrocnemius,

rectus femoris, vastus lateralis and vastus medialis. Most of these muscles are bi-articular muscles such as the muscles of biceps femoris, semitendinossus, and rectus femoris since they work on both hip joint and knee joint, and the bi-articular muscle of gastrocnemius work on both knee joint and ankle joint [6,7]. Dorsiflexion/plantarflexion motion of a human ankle joint is mainly actuated by the muscles of gastrocnemius, soleus, and tibialis anterior. The muscle activity levels can be described by EMG signals [8].

Walking is simply the action of putting one foot ahead of the other to cause your body to move in a desired path. "As the body moves forward, one limb serves as a mobile source of support while the other limb advances itself to a new support site. Then the limbs reverse their roles. For the transfer of body weight from one limb to the other, both feet are in contact with the ground. This series of events is repeated by each limb with reciprocal timing until the person's destination is reached"[9]. This sequence of events describes human gait. A gait cycle is a single sequence of this function. Within this sequence there are multiple phases that contribute to a single cycle. Starting with the right leg, the right heel makes contact with the ground (initial dual stance) while the left foot is still on the ground. The left foot then leaves the ground and the weight of the person is supported on the right foot (single limb stance) until the left heel makes contact with the ground (terminal dual stance). The right foot then leaves the ground (swing) and the gait cycle is completed when the right heel makes contact with the ground again. Many methods are used to analyze gait. Kinetic, kinematic, temporal and spatial methods are commonly used. In kinetics, forces that exist between a person and an object are measured and analyzed. In gait these are generally the ground reaction forces. By using inverse dynamics, forces and moments generated by the muscles, across a joint, can be calculated [10]. In a kinematic analysis, limb and joint positions, velocities and accelerations independent of forces are measured and analyzed. Often in gait analysis, one gait cycle is examined due to the repetitive nature of gait. A temporal analysis examines kinetic or kinematic data as a function of time, or examines the time frequency of a specific task. In walking, the time of one gait cycle is described as a stride interval and multiple successive intervals are recorded over a period of time creating a stride interval time series [10]. In this study, experiments were performed to identify the relationship of muscle activity (Vastus lateralis and Vastus medialis) with and without wearing knee pad when kicking a ball (knee joint extension) and during gait.

Methodology

The six subjects were aged between 22 to 28 and did not have any obvious gait abnormalities. The subject was videotaped while kicking the ball as shown in Figure 1 (a). The player was instructed to kick a football towards an imaginary target. The surface EMG of the major muscle groups was acquired using MESPEC 4000 Telemetry. The MESPEC4000 is an electromyography (EMG) radio telemetry system, which comprises of an EMG unit, radio telemetry transmitter and receiver used to capture data on muscle activation levels during tests via telemetry. The EMG data was acquired at 500 Hz and sensitivity of 1μV. Eight channels of EMG data were acquired, i.e. right hamstring, left hamstring, right quadriceps, left quadriceps, right gluteal, left gluteal and rectus abdominus muscle groups as shown in Figure 2 (b). In order to analyze the EMG signals, features should be extracted from the raw EMG data as shown in Figure 2. Normalized by mean has been applied as a feature extraction method of the EMG signals in this study. Gait was measured with a multi axis force plate (AMTI OR6 series) and six different subjects were chosen for the experiment. The test procedure for measuring gait consisted of two different phases; walking with the knee pads and walking without the knee pads. All subjects in this procedure wore their own shorts and were barefooted. The data recorder was carried by the person administering the test so no extra loads were carried by the subjects.

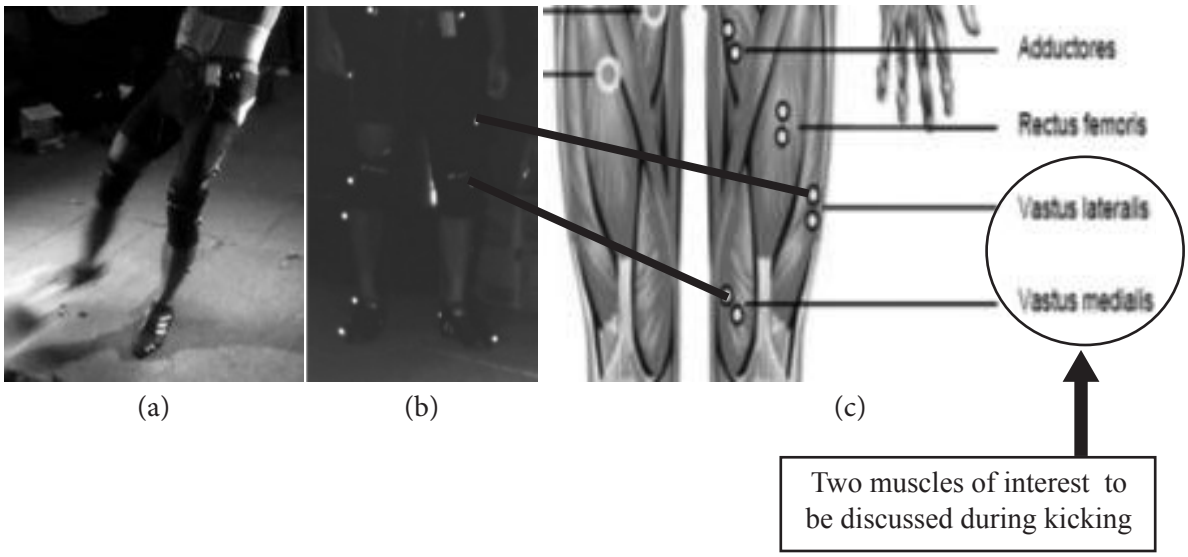

Figure 1: (a) Subject kicking the ball; (b) subject with the EMG system; (c) Muscles of interest

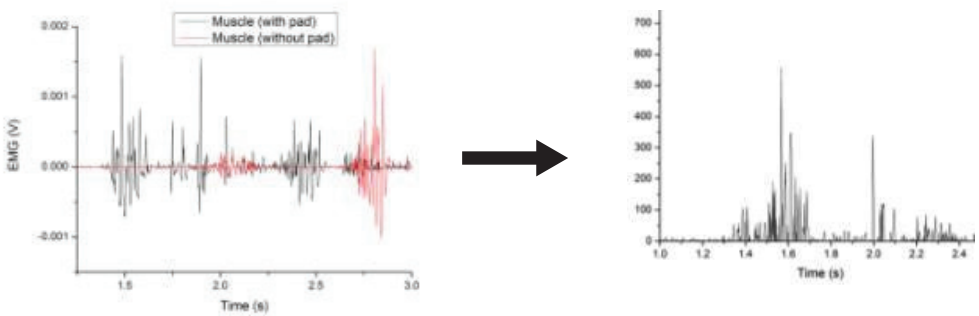

Figure 2: EMG raw data convert to normalized by mean

Results and Discussion

It was observed that the Vastus lateralis and Vastus medialis (Figure 1) are highly activated when wearing a knee pad compared with not wearing one.(Figures 3 and 4). McCrudden and Reilly [9] have compared EMG findings on punt kicking a soccer ball with drop kicking. Bollens, De Proft & Clarys [2] divided the soccer kick into six phases and measured EMG activity for six muscles in the kicking leg during these phases. They called their phases: (1) first step; (2) second step; (3) loading phase; (4) swinging phase; (5) ball impact; (6) follow- through. They found that vastus medialis and lateralis contractions were maximal during the loading phase, at which time the knee was still flexing. They called this part the 'soccer paradox' where a substantial amount of muscle work appears to be done eccentrically during soccer kicking. The rectusfemoris, vastus lateralis and vastus medialis muscles are mainly activated for knee joint extension [10]. This phenomenon is known as the force-length relationship or the length-tension curve which relates the strength of an isometric contraction to the length of the muscle at which the contraction occurs. Muscles operate with the greatest active force when close to an ideal length (often their resting length).

When stretched or shortened beyond this (whether due to the action on the muscle itself or by an outside force), the maximum active force generated decreases [11]. This decrease is minimal for small deviations, but the force decreases rapidly as the length deviates further from the ideal. As a result, in most biological systems, the range of muscle contraction will remain on the peak of the length-tension curve, in order to maximize contraction force (a notable exception is cardiac muscle which functions on ascending limb so it can increase force when stretched by an increase in preload-Starling's law) [11]. Due to the presence of elastic proteins within a muscle (such as titin), as the muscle is stretched beyond a given length, there is an entirely passive force, which opposes lengthening. Figure 5 shows a normalized stride with force obtained with the kneepad and without knee pad from the force plate. It shows that the force pattern is almost the same with and without knee pad from force plate. The force seems slightly higher (1150 N) when wearing a knee pad. Tests on the six subjects showed there were no significant changes in the correlation coefficient between wearing knee pads and not wearing knee pads. Hence, this result could mean that there are no variations in the gait pattern or that there were enough inaccuracies in the measurement to cause the α values to vary. As stated in [12] normal human gait has an α value between 0.5 and 1 with 0.75 being the theoretical normal value. Trials with knee pads and trials without knee pads were compared as well as data from the left foot compared to the right foot. The tests showed consistently that no significant differences were found between the trials with knee pads and the trials without knee pads as well as left foot compared to right foot. To add further creditability to this study the findings of this study coincide with studies performed by West et al. In his study, West states that the stride-interval time series is fractal and there are long-time correlations in walking. In the studies performed by Hausdorff [12], he had his subjects walked for around 9 minutes creating a time series of almost 500 foot falls. His findings from this study did not vary from his previous studies, it only helped to validate the length studied previously. In a study by Keenan [13] to determine how many stride intervals were needed to calculate a fractal pattern in gait he determined that only 25 successive foot falls were necessary to accurately determine the fractal pattern.

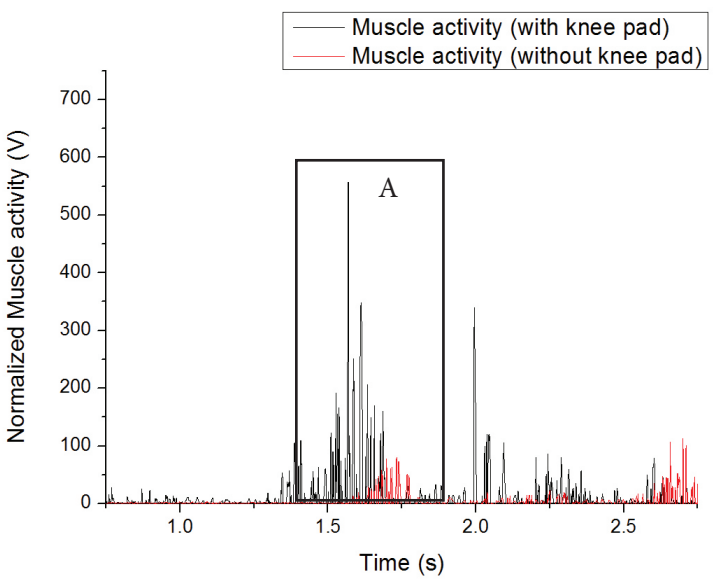

Figure 3: Vastus lateralis activity

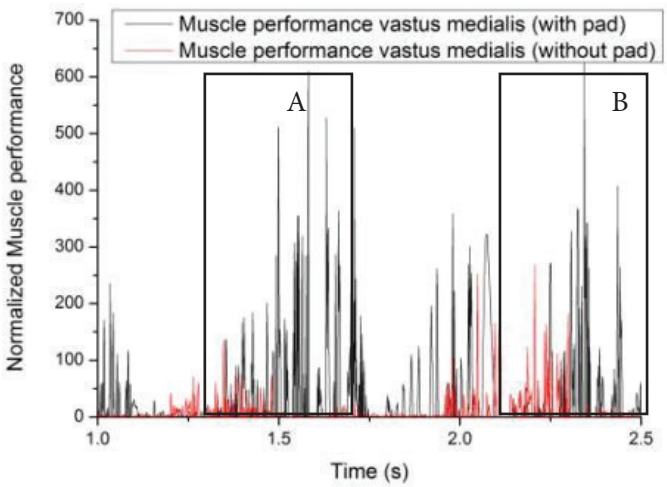

Figure 4: Vastus medialis activity

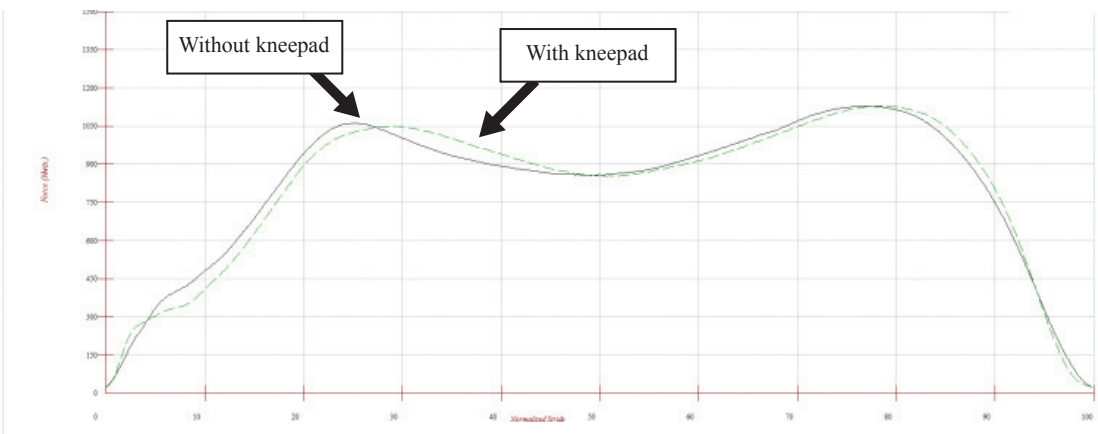

Figure 5: Gait analysis

Conclusion

It can be concluded that the vastus laterlis and vastus medialis muscles are highly activated when kicking a soccer ball whilst wearing a knee pad. This phenomenon known as the force- length relationship or the length-tension curve relates the strength of an isometric contraction to the length of the muscle at which the contraction occurs. Muscles operate with the greatest active force when close to an ideal length (often their resting length). In gait analysis, there is slight difference in terms of force when wearing knee pad and without knee pad. It seems that wearing a knee pad impacts high force on the ground compared to without wearing it.

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Acknowledgement

The authors would like to express their deep gratitude to Ministry of Education Malaysia for providing the grant for this research.

USING SOSIAL COGNITIVE THEORY TO UNDERSTAND EXERCISE MAINTENANCE IN WOMEN BREAST CANCER SURVIVORS ADOPTING GUOLIN QIGONG

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Abstract

The purpose of this study is to explore and understand the exercise maintenance in women with breast cancer survivors adopting Guolin Qigong using the Social Cognitive Theory related constructs. A qualitative approach using in-depth interviews were employed in this study. 22 participants of the Malaysia Guolin Qigong Association from five regions in Peninsular Malaysia were purposely selected to participate in this study. Data was collected through a series of audio-tapes during the interview sessions. They were asked on how do they maintain in their Guolin Qigong exercise. Three themes related to the Social Cognitive Theory constructs emerged from the data collected. (i) Personal Factors; (ii) Environmental Factors and (iii) Tailored Program. The belief in Guolin Qigong or in an exercise program is crucial in helping one to maintain with the exercise program and this findings is consistent with literature that those responded favourably to an exercise will have greater positive attitudes to exercise maintenance. To keep these women maintain the exercise it is important that these women have friends who understand them better to share their experiences related to their disease. It has been suggested that connecting to other survivors contributes to the survivors' positive well-being and to deal with their everyday living. Lastly, the type of exercise should be tailored to the physical condition of these women to keep them sustain the exercise. This theory can be used by the health practitioners to develop more effective interventions for increasing exercise maintenance in sedentary cancer survivors by taking into special attention personal factors particularly one's beliefs and inner motivation. Having to embark and engage into an exercise program of their preferred choice will help one to maintain an exercise program.

Keywords: breast cancer; survivors; Guolin Qigong; Social Cognitive Theory

Introduction

Breast cancer is the leading cause of cancer among women (American Cancer Society, 2008) and the cause of cancer death among females in economically developing countries (Ferlay et. al, 2008). The incidence of breast cancer has escalated in most Asian countries over the past two decades (Sim et al., 2011). Cancer has increased in these countries due to changes in reproductive factors, environmental exposures, and lifestyle such as dietary intake and physical activity which have all been proposed to explain the escalation trend (Bhoo Pathy et al., 2011). In Malaysia, the overall age standardized incidence rate was 46.2 per 100,000 women with more than 40% of patients presented at advanced stages (National Cancer Registry, 2011). Incidence of breast cancer varies by ethnicity: the age-standardized ratio (ASR) per 100,000 population was 38.1, 33.7 and 25.4 among the Chinese, Indian and Malay women, respectively (Pathy et al., 2011; Rajan et al., 2011).

Substantially, with the increased number of breast cancer patients and survivors, it means that cancer must now be managed as a chronic illness and the community must find ways to modify the health behaviour of cancer patients and survivors after diagnosis. Once diagnosed with breast cancer, a breast cancer patient will be given the conventional treatments such as surgery, chemotherapy and radiation therapy. Apparently, not only the diagnosis of the disease itself affects the lives of breast cancer patients, but the presence of depression and treatments has been also been associated negatively with the quality of life (QoL) in breast cancer survivors (Frazzetto et al., 2012). These conventional treatments given to breast cancer patients are vastly more toxic and invasive than treatments for other prevalent chronic diseases, such as diabetes and heart disease. The process of treatment such as chemotherapy and radiation therapy destroys normal healthy tissues and results in side effects including physical weakness such as muscle wasting and emotional strains such as anxiety, depression, and fatigue which result in immobility, loss of physical fitness and balance with the whole body feeling much weakened (Rao & Wahnefried, 2006).

Physical exercise has been suggested as a possible intervention for cancer-related symptoms and offers numerous advantages for quality of life outcomes during and after cancer treatment (American Cancer Society, 2007). In several studies, exercise has shown positive effects in improving quality of life and was highlighted in their studies of a close association between physical activities with the quality of life of these cancer patients and survivors (U¨ lger and Yag˘lı, 2010; Bicego et al., 2009). Although breast cancer patients may have particular limitations and problems associated with the disease and treatment, they will still be able to reap many of the benefits associated with most forms of physical exercise. Several studies have shown that, regular exercise can reduce many of the disturbances caused by cancer treatment and have beneficial effects on an individual's quality of life (Ingram, Wessel, & Courneya, 2010; Kaltsatou, Mameletzi, & Douka, 2011; Vallance, Courneya, Plotnikoff, Dinu, & Mackey, 2008).

Even with vast past studies showing the benefits of exercise towards physical and psychological benefits for the cancer patients and survivors (Ingram et al., 2010; Peeters et al., 2009), but when a suggestion to exercise is recommended, it seems to be so difficult for some cancer survivors to get into exercise. Therefore, health care providers, educators, support groups and exercise trainers need to recommend exercise regimens that are tailored to the physical and psychological characteristics of these cancer patients and survivors. Further understanding of why breast cancer women held certain exercise beliefs, knowledge, attitudes and behaviour associated to exercise could result in a more-effective public health's interventions to promote exercise maintenance among this vulnerable

population. As part of a larger study concerning the experience of learning Guolin Qigong among breast cancer survivors, for the present paper, this paper only reports on the exploration of Social Cognitive Theory Constructs in exercise maintenance among women breast cancer survivors adopting Guolin Qigong exercise.

Methodology

Design of the study
Qualitative approach using in-depth interviews was used to draw upon the rich descriptive of the life experience of breast cancer exercise maintenance.

Sampling
Criterion, purposive and snowballing techniques were used to recruit the participants for the interviews. The participants' criteria were: (1) female breast cancer survivors; (2) members of Malaysia Guolin Qigong Association; and (3) have adopted Guolin Qigong for more than 6 months. All the participants were well informed about the study and consent forms were given prior to the interviews.

Twenty-two breast cancer survivors from the Malaysia Guolin Qigong Association from the five regions, namely South (Johor Bahru), Upper North (Butterworth) and North (Ipoh), East (Kota Bahru) and Central (Klang Valley) participated in the in-depth interview. The researcher was first introduced to the Qigong Master by one of the cancer survivors. The researcher mentioned to the Qigong Master the study purpose and the inclusion criteria of who could become participant of the study: (1) adult female breast cancer survivors known to have adopted Guolin Qigong for more than 6 months; (2) capable and willing to share her experience in practicing Guolin Qigong; (3) speak English, Malay or Chinese. The contact numbers of four participants within Klang Valley were first obtained from the Master. The researcher contacted the participants to invite them to participate in the study. All the participants contacted in Klang Valley agreed to participate and to be interviewed.

During the data collection in Klang Valley, the researcher was invited to participate in a week's course on Guolin Qigong theory and practical session with the Guolin Qigong Great Grand Master from Beijing, China at the Kuala Lumpur Qigong Headquarters. The researcher was introduced to several Qigong instructors and assistant instructors from Klang Valley by the Vice President of Guolin Qigong during the workshop. Later, snowballing sampling technique was employed in Klang Valley with four more participants meeting the criteria including the instructors and assistant instructors. Two weeks after the intensive course, the researcher was invited by the President of Malaysia Guolin Qigong Association to join the Beijing Guolin Qigong Great Grand Master in her travels to selected regions in Peninsular Malaysia to meet with the potential participants from other regions. Fifteen participants were identified through the respective regional Qigong Master. The purpose of the study was mentioned to the participants and a consent letter were given to the participants from other regions. Appointments were made with the regional participants to have the in-depth interview at the participants' selected venue and time.

Data collection
In-depth interviews were held with participants to gain insight on how they maintain the exercise program. Written consents were obtained from all participants before the in-depth interview was

conducted. All the participants were given the opportunities to withdraw from the interview at any time. Socio-demographic data was collected via a brief written questionnaire at the end of the interview.

The questions were designed using Social Cognitive Theory constructs to understand exercise maintenance among these women. The interviews were conducted by the first researcher in a mixture of English, Bahasa Melayu and Chinese, as the breast cancer Guolin Qigong exercisers from North and South region commonly speak a mixture of English and Chinese and participants from the East region speaks Bahasa Melayu and English. The researcher is fluent in English, Bahasa Melayu and Chinese with spoken language of Cantonese, Hokkien and Mandarin and shared a common cultural heritage with the participants. This proved and helped in establishing the rapport and confidence of the participants who openly shared their stories and point of view. The interviews were tape recorded with the consent of the participants.

Data analysis

The tape recorded interviews were transcribed verbatim for English and Bahasa Melayu. Interviews in English and Bahasa Melayu were audio-recorded and transcribed within two days after the interview to establish confirmability. The interviews in Chinese were translated and transcribed by one bilingual person. The interviews in Chinese at the North Region and South Region were translated and transcribed by a language expert back in Klang Valley. The transcripts were read repeatedly and the recorded raw data were saved into the software QSR Nvivo 7.0. In the analyses, the computer program software QSR Nvivo 7 was used to structure the coded material into sets of categories. The interview material was first read in its entirety. The entire interviews were then coded at a very general level in order to condense the data into analyzable units or categories. In the next phase of analysis, these preliminary categories were subjected to a "constant comparative analysis" in order to condense them into fewer and more comprehensive categories. These categories were then sorted, organized and reorganized into a framework of main themes, giving a deepened description of the experiences. The usage of QSR Nvivo 7 was to facilitate in the analysis of themes and systematic comparisons across transcripts.

Findings

22 participants were interviewed from four regions in Peninsular Malaysia determined by the Association. The interviews were based on the guided questionnaire merely on how the participants maintain their Guolin Qigong exercise. Three major themes related to the explanatory constructs emerged: (i) Personal factors; (ii) Environmental factors and (iii) Tailored Program.

Exercise Maintenance Using Social Cognitive Theory

(i) Personal Factors

Fear of recurrence often lingers in most of the women's mind that led them to maintain the exercise as to ensure that their body are well fed with oxygen with this exercise. A majority of the informants reported that their belief in Guolin Qigong in enhancing their health and increasing their stamina and energy level. These women felt the physical and psychological changes in them after months and years of experiencing and engaging in this exercise program. They felt good after the workout.

Having strong and positive internal motivation helps these women to maintain with the exercise. They often self-talk to remind themselves about the benefits of exercise in enhancing their quality of life. They want to be independent and to be strong again.

(ii) Environmental Factors
These women reported that by coming out to do the Guolin Qigong, it provided the opportunity for these women to share their cancer experience and most importantly they realized that they were not alone and able to dispel feelings of loneliness experienced by them. Social connections with other survivors during exercise helps to establish an empathetic environment and sharing of information about cancer among them. These women shared the same sentiments of the needs to proper guidance, and to gain latest information from a knowledgeable master in their workout.

(iii) Tailored Program
These women further shared the general consensus that Guolin Qigong was gentle in nature, not vigorous and most important this Guolin Qigong was specifically tailored for cancer patients and survivors. Majority felt that this exercise suits them, slow but effective in enhancing their energy level.

Discussion

The belief in Guolin Qigong to "cure" their cancer is based from observing others played a big role in determining exercise maintenance. This was confirmed by Kwan and Bryan (2010) that those who responded favourably to an exercise will have greater self-efficacy and more positive attitudes to exercise maintenance. To keep these women going, they felt that by maintaining the exercise, they are able to keep intact with other survivors as mirrored by Parry (2008) that connecting to other survivors contributes to their positively well-being and to demonstrate the capability in thriving their everyday living. Lastly, the type of exercise should be tailored to the physical condition of these women to keep them sustaining with the exercise.

Conclusion

The theory can be used to develop more effective interventions for increasing exercise maintenance in sedentary cancer survivors giving special attention to personal factors such as beliefs and enhance positive internal motivation. Besides that to ensure exercise maintenance among breast cancer patients and survivors, the exercise program has to be tailored to the needs of the physical and psychological conditions of the exerciser. By understanding which explanatory constructs determine exercise adherence among these women, health professional can help this population in planning the methods to help them stick with an exercise purportedly to be of their preference.

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Acknowledgement

This paper is a result of research funded by Fundamental Research Grant Scheme (FRGS) awarded by Universiti Teknologi MARA Malaysia. (#Project : 600-IRDC/ SSP/ FRGS 5/3/2052).

GUIDELINE TO CONTRIBUTORS

1. GENERAL

Manuscripts submitted for publication in Movement, Health & Exercise should adhere to the guidelines provided in the Publication Manual of the American Psychological Association, fifth edition onwards. Submission of manuscripts is via online (MoHE Portal) and must be written in English or in Bahasa Malaysia. All English spellings must conform to UK English. Authors not sufficiently familiar with English or Bahasa Malaysia are advised to seek the aid of a competent translator. All manuscripts are subject to a blind review process by two or more referees. Acceptance is based on significance to the fundamental objectives of the Ministry of Education Malaysia, Sport Division, originality, and validity of the material presented.

2. MANUSCRIPTS

Manuscript should be typed in double-line spacing, using Times Roman (size 12). The length of a manuscript must be limited based on allowances of the online submission system. Pages are numbered consecutively, and include the references, tables, and legends to figures. Author(s) should indicate where figures and tables are to be inserted. Organization of the manuscript are as follows:

- the title page should include the complete tile, the name(s) of the author(s) and location of the institution where the research was carried out. This location must be written in English. The name, address and email or website information of the contact author should be typed at the bottom of the title page.
- an abstract (maximum 300 words) must precede the manuscript, stating the main problem, methods, results and conclusions. Four keywords, arranged in alphabetical order, must be included in the specific column provided.

The accepted arrangement for the body of text must be organized as follows:

- Introduction states the purpose of the research, and preferably accompanied with a short review of the pertinent literature.
- Materials and methods describe the appropriate information in detail, so as to facilitate replication by future researchers in the related research domain.
- Results report the findings concisely.
- Discussions interprets the results and their significance in terms of contribution to the existing body of related literature.
- A brief paragraph to include recommendations for the practical use of the research findings ends the body of text.

3. REFERENCES

Only works that are cited in the text, and that have been accepted for publication should be included in the list of references (separate sheet). The citation of references in the text should mention author's name and year of publication in brackets referring to the alphabetically arranged list. All authors should be listed. Abbreviations should be avoided. Each reference should include:

Journals – authors name and initials, years, title of article, journal name, volume number, first

and last pages:
[e.g. Taha, Z. (2008). A study of the impact of sepak takraw balls on the head. International Journal of Sports Science and Engineering, 2, 107–110.]

Books – author's names and initials, year, title, city of publication, publisher.
[e.g. Corbin, C. B., Welk, G. J., Corbin, W. R., & Welk, K. A. (2004). Concepts of physical fitnes (12th ed.). New York: McGraw-Hil.

For further information see APA Manual.

4. TABLES AND FIGURES

The number of tables and figures is to be kept to a minimum. Preparation of figures and tables must conform to the online specifications. Table should be self-explanatory, supplementing but not duplicating the text. A brief title should be provided for each table and figures. Abbreviations used in tables should be defined. Figures and any other forms of illustration should be numbered in the order in which they are first mentioned in the text.

5. CHANGE OF ADDRESS

Any change of address should be notified immediately via the first author's account in the MoHE online system.

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