



# COMPARATIVE STUDY ON EFFECTS OF TABATA EXERCISES AND CIRCUIT TRAINING IN IMPROVING QUALITY OF LIFE AND SLEEP IN BREAST CANCER SURVIVORS USING EUROPEAN ORGANIZATION FOR RESEARCH AND TREATMENT– QOL QUESTIONNAIRE (EORTC QLQ-30) AND PITTSBURGH SLEEP QUALITY INDEX.

*An Experimental Study*

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## *Abstract-*

*Introduction-* Breast cancer being one of the common cancer seen nowadays, its treatment leads to many side effects over the health and quality of life of the survivors. High- intensity interval training ( HIIT) has been shown to improve quality of life (QOL) and sleep in breast cancer survivors. The aim of this study was to compare the effects of different types of exercise form, that is circuit training and tabata training ,finding out which one is more useful in improving QOL and sleep in breast cancer patients.

*Method* – Experimental study was conducted over 30 breast cancer survivors between 18 to 40 years which were randomly divided into two groups of circuit training and tabata training after the fulfillment of inclusion criteria. Metastatic cancer and recent surgery ,treatment and injury were excluded. Subjects completing sub-maximal tolerance test (6 min walk test) with RPE below 18 were included in study . Pre exercise QOL was assessed by scale - EORTC qlq -30 for both the groups and sleep by Pittsburgh Sleep Quality

Index. Subjects of two groups performed exercise for about 5 weeks (1<sup>st</sup> week mild exercise, 2<sup>nd</sup> moderate exercise and later 3 weeks of HIIT group wise i.e one group tabata training and other one circuit training). After 5 weeks of protocol pre and post results of outcome measures like EORTC- qlq 30 and Pittsburgh Sleep Quality Index were compared.

*Result-* There is no significant improvement in sleep after performing tabata training as  $p = 0.81$ , i.e  $p > 0.05$ . There is no significant improvement in sleep after performing circuit training ( $p = 0.063$ , i.e  $p > 0.05$ ) and tabata training both. Though circuit training shows comparatively better results graphically. There is significant improvement in QOL after performing circuit training as  $p = 0.0028$ , i.e  $p < 0.05$ . There is no significant improvement in QOL after performing tabata training as  $p = 0.15$ , i.e  $p > 0.05$ . Comparing circuit training and tabata training for sleep with unpaired t test, p value is 0.62 which shows no significance. Comparing circuit training and tabata training for QOL with unpaired t test, p value is 0.03 which shows significance.

*Conclusion* - Thus comparing results statistically circuit training is more effective for improving QOL and sleep in breast cancer survivors.

Short forms used -

QOL – Quality of life

EORTC QLQ -30 - European Organization for the Research and Treatment of Cancer Quality of Life Questionnaire.

Keywords – Breast cancer, tabata training, circuit training, HIIT, sleep, QOL.

## I . INTRODUCTION

Breast cancer is the most common cancer among women in developed and developing countries leading to health hazards. It is the most common malignant cancer in women with high mortality. Breast cancer is the leading cause of death in women aged 20–50 years, with diagnosis numbers growing each year. The World Health Organization (WHO) reported 2.08 million cases of breast cancer worldwide in 2019, a major contributor to the global burden of disease <sup>(1)</sup>. Breast cancer is a disease in which cells in the breast grow out of control, a type of tissue cancer mainly involving inner layers of milk glands or lobes ducts and that are divided into different kind. The kind of breast cancer depends on which cells in the breast turns into cancer. <sup>(2)</sup> Kinds - Non invasive breast cancer - 1) Ductal carcinoma in situ. 2) Lobular carcinoma in situ. Invasive breast cancer - 1) Invasive ductal carcinoma. 2) Invasive lobular carcinoma.

Although cancer usually develops after the age of 45, the age of onset is decreasing, and more young women than ever are getting affected i.e aged 15 to 39 years accounting for 5.6% of all invasive breast cancer in women. Reasons for early affection are personal history of breast conditions, family history of breast cancer, inherited genes that increase cancer risk, radiation exposure, obesity, beginning of menstrual cycle in early age, having never been pregnant, drinking alcohol, having your first child at an older age, inactivity, use of oral contraceptive, low body mass index, high caloric intake and many more <sup>(3)</sup>. Mammography, Clinical examination, BSE being methods to detect breast cancer. Among these methods mammography is the only method that has been proven

to be effective ,but the method is costly and need a strong infrasturcture. As affection is seen in early age ,its necessary to treat it as soon as possible using different treatment modes available.

Breast cancer is been treated by using different modes of treatment like chemotherapy ,radiotherapy ,hormone therapy and surgery(mastectomy ,lumpectomy) according to the stages .Though new techniques are available this modes of treatment can lead many side effects and decline in quality of life .Breast cancer survivors are suffering many problems with complications of long term medications surgery ,chemotherapy and radiation therapy such as axillary web syndrome, pain, limited ROM ,dysfunction of the upper limbs, posture imbalance, fatigue ,hair loss ,anorexia ,weight loss, lymphedema, insomnia or psychological symptoms associated with those conditions ultimately declining the quality of life .<sup>(4)</sup>Reducing effects of such modes of treatment is necessary for better quality of life and for this exercise can be used as a means of tool to reduce all this symptoms and improve other factors of health to lead a good life ahead.<sup>(5)</sup>Quality of life including sleep being major component getting affected it's important to find ways to improve both for cancer survivors.

Exercise helps us to increase the strength ,endurance ,correct posture and also boost up our mind and level of confidence preventing depressive thoughts invading our mind.High-intensity interval training (HIIT) interventions have recently been proposed as a promising method for quickly improving fitness. HIIT consists of repeated sets of short bursts of high-intensity exercise followed by a rest interval, and has been shown improve fitness in both athletes and the general population.<sup>(1)</sup>Recent research says that we can use HIIT in training of people undergoing treatment for breast cancer and people completed with there treatment for the same.<sup>(1),(4),(6)</sup>Also similar to or subtypes of HIIT training technique are present like “TABATA” (intermittent) and “Circuit training. Knowing about these techniques will help us to design exercise protocol for the breast cancer survivors.Tabata is a form of high-intensity physical training in which very short periods of extremely demanding activity are alternated with shorter periods of rest, typically over a period of four minutes.<sup>(7)</sup>Eight sets of 20 seconds exercise with 10 sec rest between the exercise bouts. The exercise intensity at which the exercise is performed during this 20 seconds plays an important role in the results. Complete stop of exercise in rest period makes the tabata an intermittent exercise training. Intensity being constant from start to end. Few exercises performed in tabata are push-up ,high knees/running in place , skate lunges mountain climbers ,burpees ,squat jumps ,crunches ,jumping jacks. Circuit training is a form of body conditioning that involves endurance training, resistance training, high-intensity aerobics, and exercises performed in a circuit, similar to high-intensity interval training. It targets strength building and muscular endurance.<sup>(8)(9)</sup>Exercises preformed are Push-ups, sit-ups, squats, chin-ups,lunges etc.

## PREVALENCE OF BREAST CANCER IN FEMALES

Earlier cervical cancer was most common cancer in Indian woman but now the incidence of breast cancer has surpassed cervical cancer and is leading cause of the cancer death.<sup>(10)</sup>The statistical data of previous data of previous study shows 30% of women suffer from benign breast lesions once in their lifetime making it compulsory to take treatment. <sup>(11)</sup>High prevalence leads to large number of surgeries like mastectomy (breast cancer surgery that removes the entire breast),lumpectomy(removes cancer cells with a small margin of healthy breast tissue) and sleep affection due to anti cancer medications and treatment procedure. The burden of insomnia (difficulty in initiate or maintain sleep

for atleast one month causing significant distress and social and occupational impairment) is multifaceted and affects several aspects of patients quality of life. Patients suffering from insomnia are prone to fatigue ,mood swings poor performance at work and dependence on sleeping pills and that may lead to other health concern.<sup>(12)</sup>

## II . METHODOLOGY

This experimental interventional study is conducted on 30 subjects who were breast cancer survivors of age between 18-40 years living in Pune, PCMC. Ethical approval was obtained from the committee and permission was taken from the department . Subjects completing sub-maximal tolerance test (6 min walk test) with RPE below 18 were selected according to inclusion and exclusion criteria. Written consent letter were taken from the subjects and were distributed in two groups. The subjects were informed about interventions ,effects and purpose of the study. Pre exercise QOL was assessed by scale - EORTC qlq -30 for both the groups and sleep by Pittsburgh Sleep Quality Index. Exercise protocol of about 5 weeks were set in which 1<sup>st</sup> week mild exercise ,2<sup>nd</sup> week moderate exercise were done for both the groups and 3<sup>rd</sup> week onwards one group was started with tabata training and other group with circuit training continued for 3 weeks. Post intervention values for outcome measures like EORTC- qlq 30 and Pittsburgh Sleep Quality Index were noted and compared with pre interventional values of the same.

### II A. INCLUSION CRITERIA

- Females of age group 18 to 40 yrs.
- Atleast 12 weeks post operation and adjuvant therapy.
- Non invasive type of tumour.
- Completing sub-maximal tolerance test (6 min walk test) with RPE below 18.

### II B. EXCLUSION CRITERIA

- Not willing.
- Recent musculoskeletal injury like fracture etc.
- And other comorbidities.
- Recent surgery
- Metastatic cancer
- Mentally unstable patients.

### II C. OUTCOME MEASURE

#### a) PITTSBURGH SLEEP INDEX

The PSQI has been used to examine sleep among various clinical, experimental, and normative samples. During the instrument's development, both quantitative and subjective aspects of sleep, such as depth and comfort, were taken into consideration. The PSQI consists of seven components, each of which assesses a particular clinical aspect of sleep. The scores from each component are added to give a sum score, also called a global score (range 0 to 21). Combined, these numerical scores provide the clinician with an efficient overall summary of a patient's quality of sleep and sleep health.

the cut-off score is sensitive to culture and population and we recommend that a cut-off score of >6 be used in the Indian population.

### b) EORTC QLQ 30

The EORTC Core Quality of Life questionnaire (EORTC QLQ-C30) is designed to measure cancer patients' physical, psychological and social functions. The questionnaire is composed of multi-item scales and single items. The EORTC module QLQ-C30 is a 30-item questionnaire composed of 5 multi-item functional subscales: physical health, role function, emotional function, cognitive function and social functioning; 3 multi-item symptom scales measuring fatigue, pain and emesis; a global health subscale and 6 single items to assess financial impact and general symptoms.

#### CALCULATION

QLQ-C30 summary score = (physical functioning + role functioning + social functioning + emotional functioning + cognitive functioning + 100- fatigue+100-pain+100-nausea-vomitting+100-dyspnea+100-sleeping disturbances+100-appetite loss + 100-constipation+100-diarrhea)/13.

## II D. INTERVENTION PROTOCOL

Mild exercises for 3 days 40%-50% of HRR

Same for both the groups.

3 days protocol include –ROM exercises,stretching,breathing exercises.

Duration – 25 to 30 mins.

Moderate exercise for 4-5 days in next week 55%-60% of HRR

Same for both the groups.

5 days protocol included – Aerobic exercises ,Resisted exercises + Flexibility exercise.

Duration – 25 to 30 mins /day.

HIIT For 3 weeks -70% -80% of HRR

3days/ week

Tabata exercises 4 times a day (one session of 4 mins each)

Including –high knee run +jumping jacks+plank +side skaters  
mountain climbers+ push ups +lunges+plank punch  
burpees +Russian twist+ squats +lunges<sup>(10)</sup>

Circuit training –Aerobic exercises+ Resisted exercises+ Flexibility exercises

Duration –aerobic exercises for 75mins /week

Resisted exercises 8-12 reps /set.(2-3 sets)

Including –walking+ functional weight bearing exercises+stretching exercises or ROM exercises for major muscles .<sup>(11)</sup>

AEROBIC EXERCISES-squats ,lunges ,mountain climbers, high knees, pushing activities.

RESISTED EXERCISES- bodyweight squats with hold ,plank ,lunges with hold,step ups.

FLEXIBILITY EXERCISES-stretching of all major joints and muscles.eg stretching of hamstrings ,quadriceps ,lion stretch etc



fig 1.



fig .2



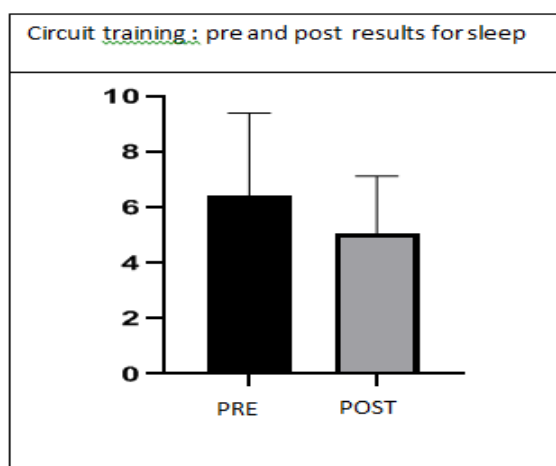
fig .3



### III. DATA ANALYSIS

- Data was collected and analysed by using proper statistical tests.
- To compare the pre and post results of Circuit training Exercises, Paired t test was used for both sleep and QOL respectively.
- To compare the pre and post results of Tabata training Paired t test was used for both sleep and QOL respectively.
- To compare the mean of post exercise results (for both Circuit training and Tabata training) Unpaired t test was used.

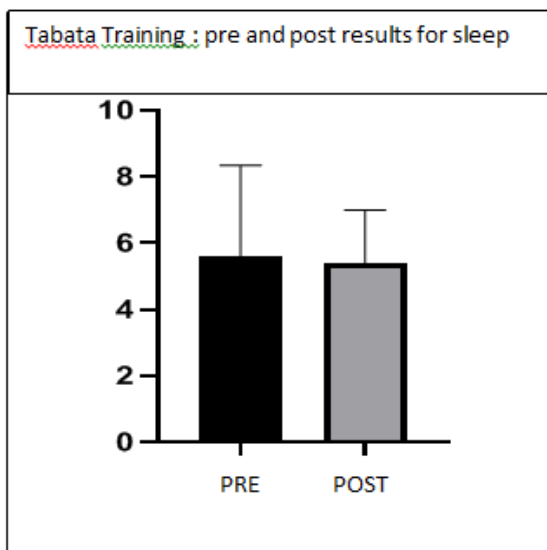
### IV. RESULTS



graph 1

table 1 :this table shows paired t test for pre and post sleep results for circuit training. this table interprets that there is no significant improvement in sleep after circuit training as  $p > 0.05$ .

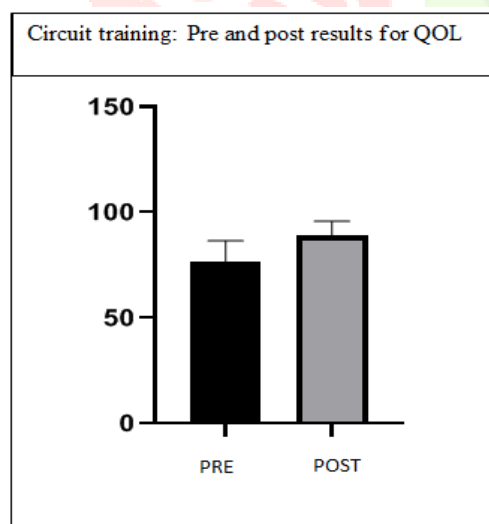
Circuit training	Mean	STD deviation	mean diff	p value	t obd	df	t critical
Pre exercise values	6.4	3	1.33	0.063	2.022	14	2.145
Post exercise values	5.06	2.05					



graph 2

table 2 :this table shows paired t test for pre and post sleep results for tabata training. this table interprets that there is no significant improvement in sleep after tabata training as  $p > 0.05$ .

Tabata training	Mean	STD deviation	mean diff	p value	t value obd	df	t critical
pre exercise values	5.6	2.746	0.2	0.81	0.24	14	2.145
post exercise values	5.4	1.595					



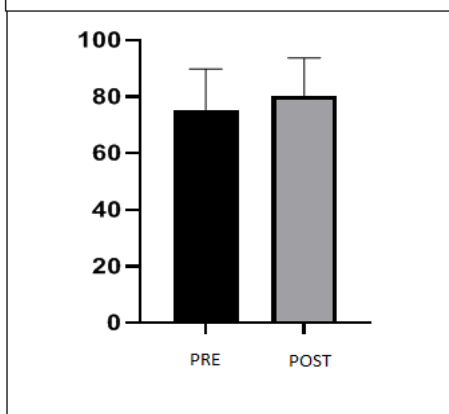
graph 3

table 3 :this table shows paired t test for pre and post qol results for circuit training. this table interprets that there is significant improvement in qol after circuit training as  $p < 0.05$ .



Circuit training	Mean	STD Deviation	mean diff	p value	t value obd	df	t critical
pre exercise values	76.2	10.23	-12.7	0.0028	3.61	14	2.145
post exercise values	89	6.74					

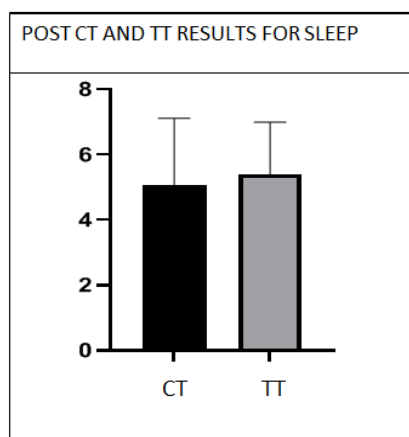
Tabata training : Pre and Post results for QOL



graph 4

table 4 :this table shows paired t test for pre and post qol results for tabata training. this table interprets that there is no significant improvement in qol after tabata training as  $p > 0.05$ .

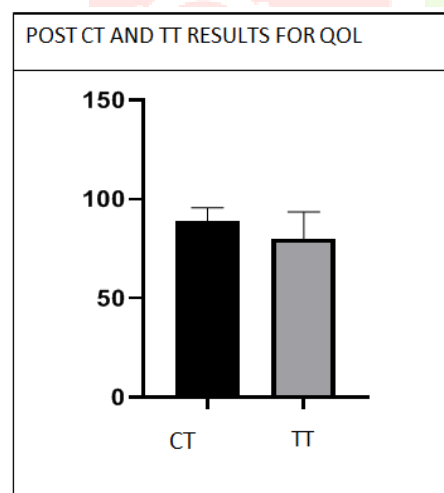
Tabata training	Mean	STD deviation	mean diff	p value	t value obd	df	t critical
pre exercise values	75.4	14.44	-4.74	0.15	1.54	14	2.145
post exercise values	80.2	13.55					



graph 5

table 5 :this table shows unpaired t test for post sleep results for circuit training and tabata training.this table as the p value is more than 0.05.this that the difference is not statistically significant.

mode of ex	Mean	SEM	mean diff	p value	t value obd	df	t critical
CT training	5.06	0.529	0.33	0.62	0.5	28	2.048
TT training	5.4	0.411					



graph 6

table 6 :this table shows unpaired t test for pre and post qol results for circuit training and tabata training. this table as the p value is less than 0.05.this that the difference is statistically significant.

mode of ex	mean	SEM	mean diff	p value	t value obd	df	t critical
Ct training	88.9	1.741	-8.75	0.03	2.23	28	2.048
TT training	80.2	3.5					

## V. DISCUSSION

The aim of the study was to compare the effects of different types of exercise form, ie circuit training and tabata training on sleep and quality of life of breast cancer survivors. Circuit training is a form of HIIT exercise which works over improving endurance ,strength, flexibility and aerobic capacity. Tabata is a HIIT in which exercise is performed within 4 mins with 20 seconds of high intensity exercise and 10 seconds break ,concluding in 8 rounds in 4 mins.

In this study we found both circuit and tabata training have effects over the sleep of breast cancer survivors but circuit training(p value =0.063) had better results over tabata training(p value =0.81). .Horne and Moore 1985,Driver and Taylor 2000,Li et al (2004), proposed that the exercise training improves sleep quality through increase in energy consumption ,increased endorphins and body temperature in a manner that facilitates sleep recuperation of body .Leizi Min ,Dizhi Wang in “effects of high intensity interval training on sleep” (2021)proposed that HIIT can be promising alternative for the treatment of sleep disorders. Resistance training in form of HIIT significantly decrease levels of interleukin (IL 6).Interleukin is substance which induce non rapid eye movements thus decrease level of interleukins will help in increase in quality and over all sleep.

The total participants in this study were 30 ,between the age of 18 to 40 yrs. Most of them had a difficulty in sleep which shown a better result after both exercise forms but more in circuit training .This was seen while comparing the scores of Pittsburgh Sleep Index pre and post.

Quality of Life is one of the important factor which is affected by chemotherapy, radiotherapy and other adjuvant therapy in breast cancer survivors .Quality of life includes depends on pain ,physical ,social ,cognitive and other components which are hampered by treatment for cancer patients. As per the results of the study it concludes that circuit training has a better effects over improving quality of life in cancer patients .Article published by Ingrid c. De ,Backer ,Eric Van Breda Art al,(2007)in “high intensity strength training improves quality of life in cancer survirors” proposed that strength training has beneficial effects on of quality of life and reduces fatigue. Strength is closely related to physical functioning.<sup>(6)</sup>

Andrea Dias et al (2018) carried out a study in which they concluded that aerobic +resistance and flexibility had effects on improving pain. Aerobic exercises raise the peripheral levels of beta-endorphins, which reduces the sympathetic system activity, increases sleepiness, and produces psychological stability, in addition to improving the serotonergic system and the relation between nerve endings and the size of muscle fibers. Resistance exercises produce better synchronization of motor unit firings, more efficient motor unit recruitment, central nervous system activity, and motor-neuron excitability, in addition to depressing the inhibitory neural reflexes and inhibiting Golgi tendon organs. Finally, flexibility exercises produce better control over the articular structures and soft tissues.

Thus circuit training including all the components it helps in improving sleep and quality of life by improving strength, flexibility and cardiopulmonary endurance.

## VI. CONCLUSION

Both tabata and circuit training had effects over improving sleep, but circuit training showed more improvement over sleep in cancer patients. Though tabata and circuit training had effects over improving quality of life. Circuit training is more effective for improving QOL and sleep.

## VII. CLINICAL IMPLICATIONS

Both tabata and circuit training can be used to improve quality of life and sleep in breast cancer patients according to the health, availability of time and demands of the patients. Its important to use different types of exercise forms to increase interest and physiological effects of the exercise over the body. Also exercise will help the patients to improve psychological state and help to lead a better life ahead with positive attitude.

## VIII. LIMITATION OF THE STUDY

- Patients were not considered according to the stages and had different recovery period.
- Mostly the protocol was conducted in evening period without considering level of fatigueness due to day time work.
- Menstrual cycle was not considered, thus impairing the generalization of data for women.
- Few exercises were replaced in the same group if not possible to do the activity.

## IX. RECOMENDATION AND FUTURE SCOPE OF STUDY

- Further studies can be done according to stages and different types of cancer.
- For any other age group
- Longer weeks of protocol for further improvements of health components and other results.

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