THERAPEUTIC LISTENING: A NOVEL TOOL TO IMPROVE QUALITY OF LIFE IN INSTITUTIONALIZED ADOLESCENTS WITH DEPRESSION.

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ABSTRACT

Introduction: Depression is a typical, constant, and debilitating issue occurring during adolescence and influencing near a fourth of all grown-ups. In adolescents depression related to impaired social connections, lower educational accomplishment, poor scholarly execution, family and social brokenness, physical sick wellbeing, and expanded danger of self-destruction. Therapeutic Listening programme (TLP) has been emerged as one of nonpharmacological approaches to reduce depression with insufficient evidence.

Objective: To determine the effects of therapeutic listening programme (TLP) on Quality of Life (QoL) in Institutionalized Adolescents with depression (AWD).

Methods: In this single-center, single-blinded, single-group pretest-posttest trial, 18 institutionalized AWD were recruited through simple random sampling. They were provided with the TLP session for 30 min per session twice a day for 5 days a week for 8 weeks. The primary outcome was measured with the help of the Children's Depression Inventory (CDI) and Youth Quality of Life Instrument – Short Form (YQOL-SF). Electroencephalogram (EEG) was recorded in addition to CDI-2 and YQOL-SF. All the outcome measures were measured at baseline and 8 weeks post-intervention.

Results: Age, weight, height and BMI of recruited institutionalized adolescents with depression were 15.1 (14.4 to 15.8), 46.5 (41.3 to 51.7), 150.3 (146.5 to 154.1) and 20.4 (18.8 to 22.0) respectively. Baseline and post TLP intervenen changes were CDI-2 and YQoL-SF, 122.5 to 135 (p=0.061) and 59.5 to 65 (p=0.016) respectively. Significant EEG changes were observed at F3 frequency [13.2 (12.2 to 14.2) to 8.5 (7.4 to 9.6); p<0.001] and F3 amplitude [56.7 (53.6 to 59.7) to 48.2 (43.5 to 52.8); p=0.001]

Conclusion: TLP might have the augmenting potential a to reduce depression and improve QoL among institutionalized AWD.

Keywords: Adolescents; depression; music therapy; quality of life; therapeutic listening program.

I. INTRODUCTION

More than 264 million of the world population are suffering from depression.¹ The worst consequence of depression is suicide which ranks second in the leading cause of death among the age groups between 15 and 29 years.² Depression is a typical, constant, and debilitating issue occurring during adolescence and influencing near a fourth of all grown-ups. Around 21–28% of youth encountering major depression by the age of 19 years.³ World Health Organization evaluates that depression is the third leading cause for worldwide illness, and will be the first leading causes by 2030.⁴ Depression is related to numerous physical, passionate, mental, and social changes in youngsters. They experience intense emotions and may go through many stressful events in this period. These rapid changes in all aspects of their life affect their mental health and increase the risk of depression.

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Depression is the significant reason for morbidity among youths, frequently taking a constant, repetitive, and episodic course. Major Depression episodes are weight or appetite changes, sleep difficulties (sleep deprivation or hypersomnia), exhaustion or loss of vitality, psychomotor agitation or impediment, reduced capacity to concentrate, sentiments of uselessness or guilt, suicidal thoughts and thereby reducing the overall Quality of Life (QoL). Cognitive dysfunction, age, psychosis, joblessness, self-destruction thoughts are related to the severity of depression. Bill Ahessy surveyed if investment in music therapy can decrease depressive symptoms and improve quality of life and cognitive functioning in the older population. In the music therapy group, depressive symptoms were decreased by 54%, 57% improvement in QoL score and there was a critical increment in cognitive functioning. The investigation inferred that music therapy intervention essentially diminished symptoms of depression increased cognitive functioning and improved quality of life.

One such strategy, TLP utilizes electronically modified music using high-quality headphones. Auditory input adds to arousal, self-guideline, and emotions. It was created by Sheila Frick in the 1990s for people with sensory processing difficulties.

TLP expands on altered music in recurrence zones. These frequency zones affect the functional capabilities. Zone one lower-recurrence sounds (0–750 Hz) help with sensory integration which incorporates rhythm, coordination, balance, muscle tone, laterality, and right/left discrimination, sense of direction, and body awareness. Zone two spotlights on midrange recurrence sound (750–4000 Hz) and connected to language and speech development. Abilities in this zone incorporate language, speech, focus, memory, attention, and vocal control. Zone three connects to high-recurrence sounds (4000 Hz or more) intended to improve abilities, for example, ideas, energy, spirituality, intuition, and creativity. Although TLP has numerous benefits in the management of psychiatric related issues, there is a dearth of evidence supporting the use of TLP in people having depression. Literature on TLP had been limited to children with sensory processing disorders. Hence, we aimed to explore the effect of TLP on the severity of depression and QoL in institutionalized AWD.

II. MATERIALS AND METHODS

Ethical statement

This is a Single blinded, single group pretest-posttest study trial was approved by the institutional ethics committee, and the study was performed according to the principles laid by, declaration of Helsinki (Revised 2013), Council for International Organizations of Medical Sciences (CIOMS) guidelines, International ethical guidelines for health-related research involving humans (2016) and National guidelines for biomedical and health research involving human participants by Indian Council of Medical Research (ICMR), 2017. The ethical guidelines that followed the National Ethical Guidelines for Biomedical and Health Research involving human participants by the ICMR, 2017. Consent for participation in the study was obtained from the participants and their parents/guardians before the start of the study.

Sample recruitment

Sample size required for the study was estimated using the thumb rule for the pilot study proposed by Julious in his report on 2005. Accordingly, n=12 was required to determine scientific standard in reporting cause-effect relationship. Thus after considering 40% drop-outs, the minimum required sample was estimated to be, n= 17. While recruiting the sample in the study, we have observed two sample during final recruitment after recruiting, n=16. Hence, we have recruited, n=18 in the pretest-posttest design as the final sample size for the study. The institutionalized AWD were recruited for the study by a qualified physiotherapist (QP) based on the selection criteria. mentioned in table 1
Table 1: Selection criteria for the study

<table>
<thead>
<tr>
<th>Inclusion criteria</th>
<th>Exclusion criteria</th>
</tr>
</thead>
<tbody>
<tr>
<td>Institutionalized AWD boys and girls (age 12-18 years) Participants Assessed by Children depression Inventory (having average/lower, high average, and elevated)</td>
<td>Presence of any other psychiatric disorder (Schizophrenia, Bipolar Disorder, Anxiety Disorder etc) Hearing impairment Untreated active ear infection</td>
</tr>
</tbody>
</table>

Procedure

After recording the demographic dimensions, anthropometrics, and baseline outcome measures of the recruited AWD, TLP was administered by a QP who is certified and trained in delivering TLP. All the recruited AWD were administered with the TLP for the duration of 30 min per session twice a day for 5 days a week for 8 weeks. The detailed weekly TL therapy protocol is listed in Table 2 and the details of the whole study progression are summarized in Figure 1.

The type of sound used here is rhythm and Rhyme, Peach Jamz, Nature Winds, Mozart for modulation, and Strawberry Jamz, Vivaldi for modulation and is delivered in a quiet room using Headphones - High-quality Sennheiser headphones having high resistance- impedance with a minimum of 150 ohms and 23,000 Hz frequency sensitivity. Post-intervention evaluation of the outcomes will be measured by using the Children's Depression Inventory (CDI-2), Youth Quality of Life Instrument – Short Form (YQOL-SF), and EEG.

Table 2: Week wise proposed intervention for the therapeutic listening program

<table>
<thead>
<tr>
<th>SN</th>
<th>Total Duration</th>
<th>Mode</th>
<th>Weeks</th>
<th>Album Title</th>
<th>Dose</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>4 weeks</td>
<td>Engagement</td>
<td>Week 1</td>
<td>Rhythm &amp;Rhyme</td>
<td>30 min per session twice a day for 5 days a week</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Week 2</td>
<td>Peach Jamz</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Week 3</td>
<td>Nature winds</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Week 4</td>
<td>Mozart for modulation</td>
<td></td>
</tr>
<tr>
<td>2.</td>
<td>2 weeks</td>
<td>Interaction</td>
<td>Week 5</td>
<td>Strawberry Jamz</td>
<td>30 min per session twice a day for 5 days a week</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Week 6</td>
<td>Vivaldi for Modulation</td>
<td></td>
</tr>
<tr>
<td>3.</td>
<td>2 weeks</td>
<td>Discrimination</td>
<td>Week 7 &amp; Week 8</td>
<td>More Mozart for modulation</td>
<td>30 min per session twice a day for 5 days a week</td>
</tr>
</tbody>
</table>
Figure 1: Study progression flow chart

Outcome measures

Children’s depression Inventory- Self Report (CDI-2)

CDI-2 Self-report contains 28 items including questions about emotional problems and functional problems and also yields four additional subscale scores, labelled negative mood/physical symptoms, negative self-esteem, ineffectiveness, and inter-personal problems. These subscales scores reflect, respectively the extent of: (a) core depressive mood and neurovegetative symptoms, (b) negative self-perception, (c) general functional problems due to depressive symptoms and (d) interpersonal expression of depression. Adolescents marked one of the three statements regarded the most appropriate for the past two weeks. For the half of the items, the negative statement is first, for the half the order is reversed.

Adolescents were informed that their answers would be kept confidential. Therapist calculated the total raw scores, T- scores and percentile ranks by sex and age groups. The total scores reflect the overall extent of depressive symptoms, their age specific manifestations, and associated functional difficulties. The emotional program scale score mirrors item endorsements that tap dysphoric affect including sadness and guilt, as well as
the neuro vegetative symptoms of depression. The functional program scale score taps symptoms that have evident functional consequences with regard to peers, school and family life (for e.g., declining school grades, difficulty getting along with others due to irritability).

Based upon inclusion criteria adolescents who were classified under average, lower average and elevated were included in the study. In this study, CDI-2 self-report used as a screening tool as well as an outcome measure. Post outcome measures of same were taken after 8 weeks.

Youth Quality of Life- Short Form (YQOL-SF)
This instrument measures quality of life in youth ages 12-18 years with and without chronic conditions and disabilities. It consists of 27 items measuring the domains of sense of self, wide range of concerns and feelings, social relationship, environment and general quality of life. This instrument was developed by asking the youth about both positive and negative aspects of the life. The response scale of items number 1-16 ranges from 0 = not at all to 10 = very much or completely measures individuals’ feelings about his/ her life. Item number 17-18 checks the five most important areas of their life in order of importance from the options provided in the questionnaire. Item number 19-26 provides general information regarding individuals life. The scores are summed and then transformed to a 0-100 scale with a higher score representing better quality or higher quality of life.

Electroencephalography (EEG)
Electroencephalography (EEG), a non-invasive medical imaging technique, is defined as an electrical activity recorded from the surface of the scalp with the help of metal electrodes and a conducting medium. A local current is generated when neurons in the brain are activated during synaptic excitations of the dendrites, and is measured as EEG. The highest influence on EEG comes from electrical activity of the cerebral cortex, due to its surface position. For clinical neurophysiology and neurology, EEG has been found to be very useful.

Brain waves are oscillating electrical voltages in the brain measuring just a few millionths of a volt. International electrode placement (10–20 system) was used to record EEG from frontal, parietal, and occipital regions (F3, P1, O1 as left and F4, P2, O2 as right leads) bilaterally with reference electrodes placed on the left and right earlobes (A1 and A2). The impedance of each electrode was kept at <5 kΩ. Digital EEG machine (Medicaid System, India) was connected with these electrodes for EEG acquisition. 10 to 15 minutes recording done with eyes closed and at standard settings of EEG.

Amplitude and frequency of right and left frontal (F4 and F3 respectively) leads calculated using automated software system. These values recorded before and after intervention and compared statistically.

Data analysis
All the collected data were analysed by Statistical Package for the Social Sciences Version 20.0 (IBM SPSS V 20 for Windows, Armonk, NY: IBM Corp) for Windows 10 Home Edition. Normality of the collected data were analysed with Shapiro Wilk test 17 as the sample size was lesser than 50. As the data does not follow normal distributed continuous variables were summarised as mean and 95% Confidence interval (CI) and discrete variables as median and inter-quartile range. The demographic dimensions of the collectd data were expressed as, mean (95% CI) and range. The sample group were compared on baseline with 8 weeks in variables using Wilcoxon signed rank test for the outcome measures CDI 2, YQOL-SF, and EEG. P value of ≤0.05 was considered as statistically significant. Effect size and post hoc power analysis were performed to determine the level of type-II error.

III. RESULTS
The sample group consisted of 18 adolescent aged between 13 to 17 years. Detailed demographic data are displayed in Table 3. Baseline and post- intervention changes on CDI 2, YQOL-SF, and EEG are given in Figure 2, Figure 3 and Table 4 respectively. Significant changes were observed in YQoL-SF and EEG changes observed at F3 frequency and F3 amplitude.

Table 3: Demographic characteristic of the adolescents recruited with depression recruited in the single group pretest-posttest design
### Table 1: Physical Characteristics of Participants

<table>
<thead>
<tr>
<th>Parameters</th>
<th>Mean (95% CI)</th>
<th>Median (IQR)</th>
<th>Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (years)</td>
<td>15.1 (14.4 to 15.8)</td>
<td>15 (13.7, 16)</td>
<td>13 - 17</td>
</tr>
<tr>
<td>Weight (kg)</td>
<td>46.5 (41.3 to 51.7)</td>
<td>44.7 (41.5, 48.5)</td>
<td>31 – 71.4</td>
</tr>
<tr>
<td>Height (cm)</td>
<td>150.3 (146.5 to 154.1)</td>
<td>150 (145, 155.5)</td>
<td>134 - 168</td>
</tr>
<tr>
<td>BMI (kg/m²)</td>
<td>20.4 (18.8 to 22.0)</td>
<td>19.5 (17.9, 155.5)</td>
<td>15.6 – 27.2</td>
</tr>
</tbody>
</table>

**Abbreviations:** TLP – Therapeutic listening programme; CI – confidence interval; IQR – interquartile range

**Figure 2:** CDI-2 at baseline and end of 8 weeks comparison after TLP intervention among institutionalized AWD
Figure 3: YQoL-SF at baseline and end of 8 weeks comparison after TLP intervention among institutionalized AWD

Table 4: EEG Changes of the recruited adolescent with depression recruited after the application of TLP

<table>
<thead>
<tr>
<th>EEG Parameters</th>
<th>TLP (n=18)</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Baseline</td>
<td>Post intervention</td>
</tr>
<tr>
<td>F4 – Right – F (Frequency)</td>
<td>12.6 (11.3 to 13.8)</td>
<td>10.9 (9.5 to 12.2)</td>
</tr>
<tr>
<td>F4 – Right – A (micro Volt)</td>
<td>55.5 (53.5 to 57.5)</td>
<td>57.1 (53.3 to 60.8)</td>
</tr>
<tr>
<td>F3 – Left – F (Frequency)</td>
<td>13.2 (12.2 to 14.2)</td>
<td>8.5 (7.4 to 9.6)</td>
</tr>
<tr>
<td>F3 – Left – A (micro Volt)</td>
<td>56.7 (53.6 to 59.7)</td>
<td>48.2 (43.5 to 52.8)</td>
</tr>
</tbody>
</table>

Abbreviations: TLP – Therapeutic listening programme

IV. DISCUSSION

The study was conducted on 18 institutionalized AWD. TLP was found to have significant effect on YQoL-SF and EEG changes observed at F3 frequency and F3 amplitude. But non-significant pre-post changes have been observed in CDI-2. This reason might be due to small sample size included which was recruited without sample size estimation. Future studies with larger sample size would overcome these shortcomings. F4 (amplitude) in EEG in both right and left hemisphere did not remarkably change post intervention in present study which may lead to recommendations in dose management to achieve desired results in amplitude. This explains how the brain activity level was impacted in reducing the negative emotions of right hemisphere (F4). Similarly, Significant changes were noted in EEG frequency of F3 inducing positive emotions of left hemisphere (F3) among institutionalized AWD.
QoL was significantly changed in the study confirming the overall improvement of AWD. Improvement was not confirmed to particular domain of depression and brain activity. Overall holistic approach of TLP was evident from this improved YQoL-SF among AWD. Similar improvement in QoL was observed in previous research executed on children with CP. Results indicate a positive association between engagement in physical activities and psychosocial well-being. These findings suggest that school-aged children with Cerebral palsy who participate more actively in physical activities get around more easily to do basic activities, without pain and with a good energy level, and feel better about their social life, school functioning, and their emotions, according to parent-report.

Within the group, which reflects the various potential factors triggering the negative emotions for the institutionalized adolescents females were with respect to their closed society, loss of parents, isolation from the community, lack of kind behavior towards them were not controlled. Moreover, the therapeutic listening tool was aimed to increase the positive emotions rather than acting on decreasing the negative emotions specifically which is visible from the increased mean difference in F3 frequency and amplitude in the group.

This study was hypothesized and conducted to address the research gap in this area by delivering TLP, to provide a continuously variable stimulus with other external noise filtered towards brain through the auditory pathway, the study results shown significant changes of activation of depression centers in brain recorded through EEG when compared with the control group where traditional music with basic earphones were used as intervention. Through the results of the study we suggest TLP holding a modulated and regulated music channelized through high end filter headphones can be used as an adjunct tool in treatment of depression in institutionalized adolescents.

This would be the first step in conducting larger experimental study to gain deeper understanding on the effect of therapeutic listening technique on depression and outlines the importance of therapeutic listening programme on institutionalized adolescents with depression. As this study was single group pretest-posttest, the external validity cannot be determined by the absence of comparrision group. Successful completion of larger sample RCT would create high level of evidence on the best treatment options for institutionalized adolescents with depression. The feasibility of implementing TLP would be confidently tested by the end of this trial and thereby, TLP could be an adjunct tool along with exercises to decreases the depressive symptoms in adolescent.

**V. CONCLUSION**

There is sufficient hope to create evidence regarding the augmenting effect of TLP to reduce the depressive symptoms and improving QoL among the institutionalized adolescent adolescent with depression.

**REFERENCES**