Resonance breathing exercise using Oxa has a beneficial effect on perceived sleep quality.

A product evaluation project

Abstract This project assesses the effects of Oxa breathing exercises on sleep quality. The project involved volunteers who participated to improve Oxa. Slow-paced breathing exercises at the individual resonance frequency (RF) were performed before bedtime using Oxa. The study included 12 volunteers, and their perceived sleep quality was evaluated before and after nights with the RF exercise. Additionally, sleep parameters were measured using the DREEM band in 8 participants. The results showed improved perceived sleep quality and a tendency towards reduced sleep onset and deep sleep latency after the RF exercise. This project provides valuable insights into the development potential of Oxa breathing exercises for enhancing sleep quality.

Introduction Sleep quality is crucial for overall well-being, and various factors can affect it. Slow-paced breathing exercises and especially resonance breathing have been proposed as an easy method to improve sleep quality. In this product development project, the focus was on assessing the potential of performing a resonance frequency (RF) exercise before sleep using Oxa. Initially, Oxa, a smart-garment offering real-time biofeedback, was utilized to determine the individual RF. In a next step, the impact of an Oxa RF breathing exercise on sleep quality was evaluated. The aim was to investigate Oxa's potential for sleep improvement.

Method Volunteers from the Nanoleq employee pool participated in the project. The project involved assessing sleep quality at baseline and after a 10-minute Oxa breathing exercise just before bedtime. Participants conducted the exercise for up to two nights. Sleep quality was evaluated using a questionnaire, including the Groningen sleep quality scale (GSQS). The questionnaire also included a rating of sleep quality on a scale of 1-4 and an opportunity for participants to provide open feedback on the exercise's impact. Additionally, sleep parameters were measured using the DREEM band, which was worn during the night by a subgroup of 8 participants.

Results Twelve volunteers, 6 males and 6 females, with an average age of 36.8±9.6 years, participated in the project. The majority had little to no prior experience with breathing exercises. The data analysis included 23 RF exercises with Oxa. Data was averaged per participant. The results showed that participants perceived an improvement in sleep quality and a decrease in GSQS scores (-50%) after the RF exercise compared to baseline (Figure 1). This indicates a subjective improvement of sleep perception after the RF exercise. In the subgroup analysis, participants slept significantly longer after the exercise, and there was a trend towards reduced sleep onset (-51%) and deep sleep latency (-5.6min) as analyzed by the DREEM band (Table 1, Figure 2). The open feedback from participants highlighted the exercise's positive impact on sleep onset and relaxation.

Conclusion The findings of this product evaluation project support the notion that conducting a 10-minute RF breathing exercise using Oxa before bedtime can enhance perceived sleep quality. The results align with previous studies on the benefits of slow-paced breathing exercises on sleep. The DREEM data indicated potential improvements in sleep parameters, including sleep length, sleep onset latency, and deep sleep latency. Participants' feedback further confirmed the exercise's positive effects on sleep onset and relaxation. These insights contribute to the ongoing development of the Oxa product and its potential to improve sleep quality.

Figure 1: Improvement in perceived sleep quality when conducting a 10-minute RF breathing exercise before bedtime. The sleep quality was assessed using a single question (left: high is good) and the GSQS (right: low is good, 50% improved score). Data are given as mean±stdev.

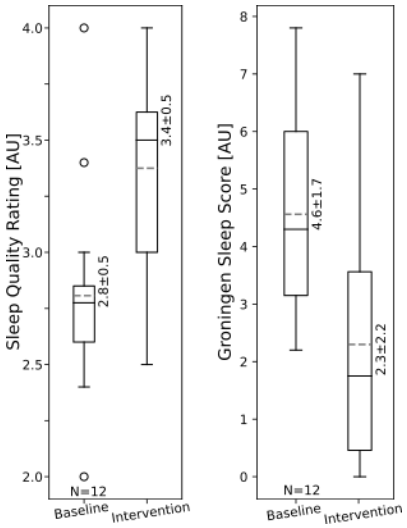

Figure 2: Trend towards decreased sleep onset latency (left, -51% in avg, not considering 2 subjects with no sleep issues and an initial onset time > 10min) and deep sleep latency (middle) after a 10-minute RF exercise before bedtime. There was a tendency for an increased portion of the recording being asleep after the exercise (right). Data are given as mean±stdev.

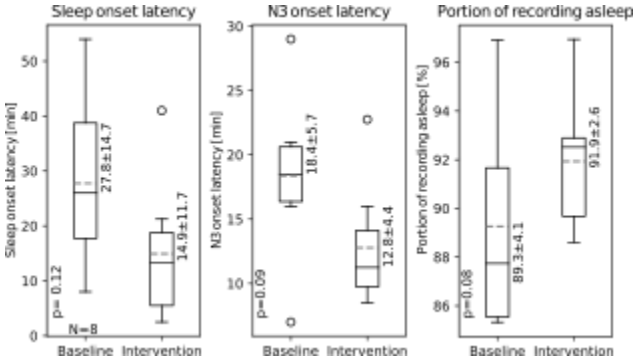

Table 1: Results of sleep parameters assessed by the DREEM band. Data for the baseline of all participants (N=10) are given. In addition, the baseline and post intervention outcome is presented for the subgroup of 8 participants. P values from the paired t-test between baseline and intervention of the subgroup are shown. Data are given as mean±stdev.

Parameter	All(10)	$Base_{sub}$ (8)	$Intervention_{sub}$	p
Total sleep time [min]	387.4±42.3	389.8±47.6	420.0±59.9	0.05
Sleep onset latency [min]	23.9±16.1	27.8±15.7	14.9±12.5	0.13
Wake after sleep onset [min]	21.8±17.3	19.2±14.9	18.3±9.6	0.85
Proportion of REM [%]	24.3±4.7	25.5±2.5	25.9±5.5	0.84
Proportion of N3 [%]	21.3±6.3	21.5±7.2	23.1±7.6	0.52
Latency to N3 [min]	20.0±8.3	18.4±6.1	12.8±4.7	0.09
Awakenings [N]	16.9±8.6	15.1±5.9	15.3±5.3	0.9
Portion of recording asleep [%]	89.4±4.4	89.3±4.4	91.9±2.8	0.08
Number of shifts [N]	87.7±32.5	83.8±27.5	79.5±17.5	0.43