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Enhancing Quality of Life in Sedentary Elderly Individuals: The Impact of the Home-Based Full-Body In-Bed Gym Program — A Prospective, Observational, Single-Arm Study

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ABSTRACT

INTRODUCTION. The limitations in mobility frequently encountered by the elderly, often linked to advanced age and concurrent medical conditions, have significant implications for their overall well-being and self-reliance. This decrease in physical activity not only curtails their independence but also elevates the likelihood of prolonged hospitalization and the accompanying complications.

AIM. To assess the impact of a home-based Full-Body in-Bed Gym program, a 10-exercise protocol consisting of three sessions per week for two months, on the quality of life of elderly individuals.

MATERIALS AND METHODS. The study involved participants of both genders aged over 65, who were classified as sedentary, engaging in less than one hour of physical activity per week. Participants with recent orthopedic conditions, severe cardiovascular or oncological diseases, and significant neurological disorders were excluded due to their potential to confound the effects of the Full-Body in-Bed Gym program and impact overall health and quality of life.

RESULTS. A total of 22 subjects, with a median age of 71.90 years, participated in the study.
Elderly individuals engaging in the Full-Body in-Bed Gym program, experienced improvements in their quality of life. These gains were noticeable in the 12-Item Short Form Health Survey (SF-12) Physical Component Summary ($p = 0.07$) and reached statistical significance in the Mental Component Summary ($p = 0.04$).

DISCUSSION. The observed gains in the quality of life among elderly participants engaging in the home-based Full-Body in-Bed Gym program are noteworthy. The positive impact on the mental component of the SF-12 is particularly significant, indicating improvements in mental well-being. This aligns with the broader understanding that physical activity in the elderly is intricately linked to various aspects of their health, including mental health. While the preliminary findings suggest positive outcomes, future research with larger and more diverse cohorts could provide a more robust understanding of the Full-Body in-Bed Gym program's impact.

CONCLUSION. Our findings underscore the potential of a home-based Full-Body in-Bed Gym program to enhance the quality of life in elderly participants, highlighting the need for further exploration of rehabilitation and prevention strategies in this context.

KEYWORDS: frailty, elderly, exercise, quality of life, motor function.

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Улучшение качества жизни у лиц пожилого возраста, ведущих малоподвижный образ жизни: влияние домашней программы «Полноценный тренажерный зал в лежачем положении». Проспективное, обсервационное, неконтролируемое исследование

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РЕЗЮМЕ

ВВЕДЕНИЕ. Ограничения в мобильности, с которыми часто сталкиваются пожилые люди, часто связанные с преклонным возрастом и сопутствующими заболеваниями, имеют значительные последствия для их общего благополучия и уверенности в себе. Такое снижение физической активности не только ограничивает их независимость, но и повышает вероятность длительной госпитализации и сопутствующих осложнений.

ЦЕЛЬ. Оценить влияние домашней программы тренажерного зала для всего тела в постели, разработанной для смягчения снижения физической активности, на качество жизни пожилых людей. В исследовании приняли участие участники обоих полов в возрасте старше 65 лет, которые были классифицированы как ведущие сидячий образ жизни и занимающиеся физической активностью менее одного часа в неделю. Участники с недавними ортопедическими заболеваниями, тяжелыми сердечно-сосудистыми или онкологическими заболеваниями и значительными неврологическими расстройствами были исключены из-за их потенциальной возможности свести на нет результаты программы тренажерного зала для всего тела в постели и повлиять на общее состояние здоровья и качество жизни.

МАТЕРИАЛЫ И МЕТОДЫ. В исследовании приняли участие в общей сложности 22 испытуемых со средним возрастом 71,90 года. Пожилые люди, занимающиеся по программе тренажерного зала для всего тела в постели, состоящей из трех занятий в неделю в течение двух месяцев, почувствовали улучшение качества своей жизни. Эти улучшения были заметны в кратком опроснике здоровья из 12 пунктов (SF-12) по физическому компоненту ($p = 0,07$) и достигли статистической значимости в кратком обзоре психического компонента ($p = 0,04$).

РЕЗУЛЬТАТЫ. В исследовании приняли участие в общей сложности 22 испытуемых со средним возрастом 71,90 года. Пожилые люди, занимающиеся по программе тренажерного зала для всего тела в постели, почувствовали улучшение качества своей жизни. Эти улучшения были заметны в кратком опроснике здоровья из 12 пунктов (SF-12) по физическому компоненту ($p = 0,07$) и достигли статистической значимости в кратком обзоре психического компонента ($p = 0,04$).

ОБСУЖДЕНИЕ. Заслуживают внимания наблюдаемые улучшения качества жизни среди пожилых участников, занимающихся по домашней программе «Полноценный тренажерный зал в лежачем положении». Положительное влияние SF-12 на психический компонент особенно значительно, что свидетельствует об улучшении психического самочувствия. Это согласуется с более широким пониманием того, что физическая активность пожилых людей неразрывно связана с различными аспектами их здоровья, включая психическое. В то время как предварительные результаты предполагают положительные результаты, будущие исследования с участием более крупных и разнообразных групп могли бы обеспечить более четкое понимание воздействия программы «Полноценный тренажерный зал в лежачем положении».

ЗАКЛЮЧЕНИЕ. Эти результаты подчеркивают потенциал домашней программы тренажерного зала для всего тела в постели для повышения качества жизни пожилых участников, подчеркивая необходимость дальнейшего изучения стратегий реабилитации и профилактики в этом контексте.

КЛЮЧЕВЫЕ СЛОВА: слабость; пожилой возраст; физические упражнения; качество жизни; двигательная функция.

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INTRODUCTION

The challenges associated with physical inactivity in the elderly, often attributed to factors like age and concurrent medical conditions, have far-reaching implications for their well-being and independence. This lack of physical activity not only curtails their autonomy but also increases the risk of extended hospitalization, leading to issues such as neuromuscular weakening, functional limitations, and substantial healthcare expenses [1–4]. Managing these progressive physical inactivity-related impairments demands ongoing attention. While pharmaceutical interventions are currently under consideration, it should be accepted that physical exercise regimens represent a highly promising and multifaceted option. This approach can contribute to global health promotion by enhancing cardiovascular fitness, muscle strength, flexibility, and mental well-being, making it a preventive, low-risk, and cost-effective strategy that can be tailored to individual needs and preferences. Beyond physical benefits, exercise positively impacts mental health and can serve as a complement to pharmaceutical interventions [5]. However, community-based exercise initiatives can face various challenges, including financial constraints, difficulties in accessibility, time limitations, and a shortage of specialized guidance [6, 7]. Hence, advocating for the adoption of home-based physical exercise routines, presents a viable and economically efficient substitute.

AIM

The «Full-Body in-Bed Gym» protocol, designed for home use, can represent a viable option, comprising 10 exercises that can be executed while lying in bed [1, 8–10]. Its primary aim is to alleviate the consequences of physical inactivity and enhance the physical well-being of sedentary individuals, ultimately leading to an improved quality of life. The exercises integrated into this program enhance cardiac, respiratory, and vascular function, as well as fortify limb and trunk muscles, building upon established in-bed cardio-respiratory rehabilitation techniques [9, 10].

Since previous studies had demonstrated the utility of this type of protocol in improving motor function in sedentary elderly patients [1, 11], with this study, we aimed to highlight whether the performance of 10 full-body in-bed gym exercises, repeated three times a week, can indeed contribute to improving the quality of life of sedentary elderly individuals.

MATERIALS AND METHODS

Study Design

This prospective, observational, single-arm study was conducted at the Neurorehabilitation Unit, University of Padua, Padua, Veneto, Italy, between October 2022 and October 2023.

Participants

The study involved individuals of both genders, aged 65 and older, who were classified as sedentary due to their engagement in less than one hour of physical activity per week. To be eligible for participation, individuals were required to have the capacity to maintain both sitting and standing positions. The non-inclusion criteria were set to maintain the homogeneity of the study group and avoid potential confounding factors. Specifically, those under the age of 65 were not considered for inclusion in the study. In addition, we excluded individuals with recent orthopedic

Table 1. Full-Body in-Bed Gym exercise protocol. The protocol includes a variety of upper limb, lower limb, and trunk exercises that can be performed by elderly individuals

Neck and upper limb exercises	1. Arms extension on frontal plane: position the arms with an abduction, flex the elbows, and clench the fists while lying on the bed. Proceed to extend the arms forward while opening the fists, and then return to the initial position. 2. Arms flexion-extension: initiate the exercise by extending the arms along the sides while lying on the bed. Proceed to bend the arms over the head, taking a deep breath as the arms are raised, and exhale while returning to the initial position. 3. Cervical stretching: while sitting on the edge of the bed, flex and extend the head, tilt it, and then rotate it in both directions
Lower limb exercises	1. Ankles flexion-extension: perform ankle flexion and extension while lying in bed. 2. Bed cycling: replicate a pedaling motion by flexing and extending the hips and knees while lying on the bed. Begin by performing the movement with one leg and subsequently progress to using both legs simultaneously. 3. Leg extension: while sitting at the edge of the bed, raise the leg by extending the knee and lifting it off the floor in a leg extension. 4. Stand on tiptoe: while sitting at the edge of the bed, rise onto the tiptoes to stand up and then return to a seated position
Trunk exercises	1. Abdominal exercise: engage the abdominal muscles and raise the upper body while lying on the bed, simultaneously extending the arms. Then, return to the initial position. 2. Pelvis lift: gently raise the pelvis off the bed surface and hold this elevated position for 2 seconds while lying in bed. 3. Trunk lift: While seated at the edge of the bed, use the arms to push against the mattress and lift the upper body in a trunk lift

issues requiring limb immobilization, a history of severe cardiovascular or oncological conditions, and those afflicted by significant neurological disorders, such as limb paralysis, as these conditions could potentially affect their ability to participate in the study or influence the outcomes.

Intervention

The Full-Body in-Bed Gym program was designed to be performed in the comfort of one's home, featuring a set of 10 exercises to be performed three times a week over a span of two months, with sessions on non-consecutive days. These exercises were carefully crafted to target various muscle groups and functional movements, ultimately enhancing overall physical well-being. The set of ten exercises involved a variety of movements: 1) simultaneous ankle flexion and extension with arm movements, 2) frontal arm extension while clenching the fists, 3) replicating a pedaling motion through bed cycling, 4) coordinating arm flexion-extension with deep breathing, 5) performing careful pelvis lifting, 6) engaging in abdominal exercises while extending the arms, 7) stretching the cervical region, 8) lifting the trunk, 9) extending the legs, and 10) standing on tiptoe (Table 1). These exercises are often recommended for individuals who may have physical limitations, are new to exercise, or need to be particularly careful due to medical conditions or previous injuries.

The study's participants received guidance from their Physical Medicine and Rehabilitation physician to manage any minimal exercise-related discomfort or strain. The exercise routine commenced with five repetitions of each exercise and gradually increased in increments of five repetitions over one to two weeks, eventually reaching a maximum of 30 repetitions per exercise per session. Each session could range from approximately 15 minutes to 25–30 minutes. To facilitate participant comprehension and execution of the exercises, instructional materials and video demonstrations were provided (Figure 1). For a dynamic visual representation of the Full-Body in-Bed Gym sessions, a video can be accessed at the following link: https://youtu.be/pcHKmxCLYFs

Fig. 1. An example of bed cycling exercise. The subject is performing a pedaling motion by flexing and extending the hips and knees, replicating a cycling movement while in a supine position

The quality and quantity of exercises were closely monitored through weekly phone calls to ensure participants' safety and compliance with the program.

The study acknowledges the principles outlined in the Helsinki Declaration as revised in 2013 and adheres to the ethical guidelines recommended therein.

Outcomes evaluations

Outcome measurements were assessed at two time points: before the start of the intervention (referred to as T0) and after two months of training (referred to as T1). Each patient's evaluation included parameters such as gender, age, weight, height, and Body Mass Index (BMI). Additionally, a validated Italian version of the 12-Item Short Form Health Survey (SF-12), derived from the larger 36-Item Short Form Health Survey (SF-36), was employed. This survey is frequently used to gauge individuals' perceptions of their psychophysical well-being, particularly in the context of rehabilitation. The SF-12 provides outcomes in two dimensions: the Physical Component Summary (PCS) and the Mental Component Summary (MCS), offering insights into a patient's well-being from both physical and mental perspectives.

Statistical analysis

We performed the statistical analysis using Microsoft Excel software, and the data were presented in medians along with interquartile ranges, taking into account the variable distributions. To evaluate the normality of the data distribution, we applied the Shapiro-Wilk test. The changes between the initial measurement (T0) and the one made after two months of training (T1) were evaluated using paired t-tests for continuous variables that followed a normal distribution, and Wilcoxon signed-rank tests for variables that did not exhibit a normal distribution. A significance level of $p < 0.05$ was used for all statistical analyses.

RESULTS

The study successfully enrolled and assessed a cohort of 22 individuals, all of whom met the inclusion criteria. These participants, with a median age of 71.90 years, represent a diverse age range from 65 to 85 years, reflecting the older adult population's variability. The study also considered the participants' BMI, which ranged from a minimum of 18.75 to a maximum of 39.21.

The gender distribution within the sample was balanced, with 12 female participants and 10 males.

In assessing the quality of life using the SF-12 survey, the study found notable trends in the physical and mental well-being of the participants. The SF-12 PCS demonstrated an improvement, with a median score of 42.41 at T0, ranging from a minimum of 25.26 to a maximum of 59.8. At T1, the median SF-12 PCS score increased to 48.39, with values ranging from a minimum of 31.64 to a maximum of 59.6. While this increase indicated a positive trend towards the improved physical quality of life, the p-value of 0.07 suggested that this improvement did not reach statistical significance within the limited intervention duration.

In contrast, the SF-12 MCS exhibited a notable and statistically significant improvement. The baseline score was measured at a median of 45.28, with a range from a minimum of 22.36 to a maximum of 60.7. At T1, the SF-12 MCS score increased to 50.85, with values ranging from a minimum of 31.8 to a maximum of 60.7, reflecting the participants' enhanced mental well-being and quality of life with a p-value of 0.04.

It is noteworthy that no adverse effects or complications were reported by any of the participants throughout the study.

DISCUSSION

As the global population continues to undergo demographic shifts and the proportion of elderly individuals increases, the close connection between maintaining an active lifestyle and their overall health and quality of life becomes more apparent [12]. These insights are emphasized by the physiological changes inherent in the aging process, often leading to declines in various aspects of health, such as muscle strength, bone density, cardiovascular fitness, and overall functional capacity [13, 14]. Consequently, promoting an active lifestyle should be a central focus of public health efforts [14].

Ensuring a high quality of life for the elderly is of great significance, as it profoundly influences their overall well-being and happiness. The concept of quality of life for elderly subjects encompasses a broad spectrum, including physical, mental, emotional, social, and environmental dimensions, with health and independence serving as its core [13, 14]. Elderly individuals who enjoy good health and well-being can maintain their autonomy, engage in fulfilling activities, and experience fewer health-related limitations [7, 13]. Emotional and mental well-being, including lower levels of stress and mental health issues, can contribute significantly to a higher quality of life [15]. Additionally, being engaged in meaningful activities is integral to achieving and maintaining a high quality of life in the elderly [4, 16].

In this study, we investigated a cohort of elderly patients who participated in a home-based exercise program specifically designed for sedentary individuals challenged by their advanced age and associated health conditions. The exercises in our program were carefully tailored to address the limitations imposed by advanced age and aimed at targeting multiple physiological systems, including cardiovascular, respiratory, and muscular functions. Our assessments documented noticeable improvements in the patients. Participants engaged in the Full-Body in-Bed Gym program for two months showed an overall enhancement in their quality of life. These improvements encompassed both physical and mental well-being, although the increase in physical well-being did not reach statistical significance.

This implementation of the Full-Body in Bed Gym program aligns with the growing understanding that exercise benefits not only physical health but also plays a substantial role in enhancing emotional and mental well-being in elderly individuals [16, 17]. An active lifestyle has been shown to have a profound influence on psychological well-being in the elderly, affecting different emotional aspects, including mood, anxiety, and depression [18–22], with these psychological improvements attributed to a multifaceted range of factors, including neurochemical release and physiological adaptations stemming from exercise [5].

A comprehensive regimen of rhythmic aerobic exercises, such as the Full-Body in-Bed Gym program, aligns with research indicating that aerobic exercises conducted regularly for at least 10 weeks have consistently shown positive effects on psychological well-being in the elderly [18, 23–26]. Moreover, the Full-Body in-Bed Gym program has the potential to boost self-efficacy by fostering a sense of achievement and self-confidence as participants progress, thereby enhancing emotional well-being and overall quality of life in elderly individuals [13, 16].

The absence of reported adverse effects among elderly participants highlights the program's safety and potential for managing age-related inactivity, although further research is needed to establish its effectiveness conclusively, given limitations in sample size, lack of a control group, and short study duration. In our study, we encompassed a diverse group of participants, including both elderly patients aged 65–74 and senile patients aged 75–80, as classified by the World Health Organization (WHO). Additionally, our sample comprised individuals with a range of body weights, from normal weight to obesity. This diversity in terms of age and physical condition introduced variability that may have affected the reliability of our findings regarding the positive effects of the program on physical health. These differences in age and physical condition could have contributed to variations in individual responses to the Full-Body in-Bed Gym program, which may have influenced the outcomes observed. Consequently, future studies with larger sample sizes and more homogeneous groups should be considered to gain a clearer understanding of the program's effects and to refine its suitability for different demographic subgroups.

In summary, this study addresses age-related quality of life issues through the introduction of the home-based Full-Body in-Bed Gym program, which aims to enhance physical and mental well-being in sedentary elderly individuals by involving a series of 10 in-bed exercises. The absence of reported adverse effects underscores its safety and potential for managing age-related inactivity at home. Nevertheless, further research is needed to confirm and build upon these promising findings.

CONCLUSION

Integrating physical activity into the lives of older adults has the potential to enhance their quality of life and independence. Our study suggests that a short series of home-based Full-Body in-Bed Gym exercises can positively impact the overall well-being of sedentary elderly individuals. Although the results are encouraging, more comprehensive research involving larger sample sizes, control groups, and extended follow-up periods should be conducted to gain a more profound insight into the effectiveness of such exercise programs in promoting healthy aging and averting functional decline.

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Consent for Publication. Written consent was obtained from all patients (legal representatives) for publication of all relevant medical information included in the manuscript.
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