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Effects of eight-weeks hydrotherapy intervention on quality of life and activities of daily living in patients with non-specific lower back pain

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Abstract
Activities of daily living (ADL) are the required skills to live independently and are associated with quality of life (QOL). Sidney Katz is credited to use the term QOL in 1950. Accordingly, healthcare professionals have used patients' functional ability and degree of independence as a measure of patient QOL. Lower back pain (LBP) is a disorder that has a significant impact on a patient's ADL and ultimately well-being and QOL. LBP can cause decreased mobility, reduced flexibility and poor posture. In essence, the ability to lift, walk, stand and sit is affected. Consequently, pain disrupts the body functions and limits one's ability to participate in sports and in routine physical activities. This renders an individual to a sense of hopelessness and psychological trauma. The result is a sedentary lifestyle which has long been discouraged since it can lead to ill-health that can have major long-term effects on physical and mental well-being. Individuals will experience LBP over their lifespan. The diagnosis can be complicated since the pain may result from, among others, damage to the intervertebral discs, compression of nerve roots, and improper movement of the spinal joints and the consequences of aging. This study's results on hydrotherapy as an intervention for LBP showed positive effects on the QOL and ADL.

Keywords: Quality of life (QOL), activities of daily living (ADL), hydrotherapy; lower back pain (LBP), oswestry low back disability index

1. Introduction
The determinants of quality of life (QOL) and activities of daily living (ADL) are becoming increasingly important in assessing any medical intervention. The presence or absence of positive feelings provides a predictor of QOL. A comprehensive view of the impact of any intervention on the patient's physical, psychological, and social well-being needs to be considered. The World Health Organization identify QOL as an individual's perception of their position in life in the context of the culture and value systems in which they live and in relation to their goals, expectations, standards and concerns. The way individuals perceive their physical and mental well-being is referred to as their QOL. ADL are directly or indirectly associated with QOL. Goldstein, Shoval and Koren-Morag (2020) [8] present LBP as one of the most common and widespread health issues today, causing restricted movement, disability, and economic loss that can affect QOL. There are various causes of LBP that include: injuries, poor posture, poor mental health and physical factors and underlying medical conditions. However, it is often a result of muscle strain or tension in the lumbar region. LBP is also referred to as 'lumbago', which takes its name from the lumbar region of the spine. Well-considered physical rehabilitation programs can diffuse pain and improve mobility and strength and ultimately the activities associated with daily living and QOL. Exercises increase physical body strength, develop range of motion, activity, and functionality. Mirmoezzi *et al.* (2021) [11] contend that an important component of the prevention of LBP and avoiding its recurrence is the ability to integrate stability of the spine with the maintenance of lower back mobility. Physical therapy improves overall health that includes mental health and it reduces risks for diseases and decrease disability rating. Nemcić and Budisin (2013) [13] identify hydrotherapy as having a positive effect in patients exhibiting different pathological conditions

Water activities are known to promote and enhance physical fitness and are suitable for different age groups in the treatment of several ailments.

Hydrotherapy is a mode of activity which may reduce pain. It is considered a pool therapy programme for patients to develop musculoskeletal and neuromuscular functions. The programme utilizes a specifically built hydrotherapy pool. The use of water to treat a medical condition or to maintain the general health is hydrotherapy, earlier referred to as hydropathy. The treatment involves the therapeutic use of water to provide healing effects. The process is said use naturopathy, physiotherapy, and occupational therapy. Water has many relief-providing properties. It improves blood flow and has a soothing, calming, and relaxing effect. Certain exercises when done in water are easier to do and provide relief to painful joints. The increase in buoyancy allows for more degrees of activity. Hence, exercises done in water are equally effective as on land. Different temperature conditions inside the water also play a role in this therapy. The increase in temperature and hydrostatic pressure is said to increase blood flow and the body's flexibility. Swelling can also decrease. Hydrotherapy differs from swimming. Hydrotherapy constitutes exercises administered in a hot water pool. The water temperature of such a pool is usually maintained between 33-36 ºC. This is warmer than a typical swimming pool. The use of hydrotherapy forms the basis of this study, to manage and control LBP symptoms, correct posture and body movements, to reduce back strain, improve QOL and activities of daily living. The biopsychosocial approach to pain within the context of the environment and recognizes that pain is not only a physical sensation but also influenced by psychological and social factors. Gatchel and Howard (2021) [6] indicate that the biopsychosocial approach to pain has led to the development of the most therapeutic and cost-effective interdisciplinary pain management programs. They further add that it is far more likely for chronic pain patient to regain function and experience vast improvements in activities of daily

QOL and wellness go beyond physical health, good eating habits, and exercise and weight management. Stoewen (2017) [19] points out that wellness is living life fully through an integration of physical, mental, and spiritual well-being and free from pain and suffering. Pain can vary from mild to extreme discomfort and could be termed acute (short term) due to injuries and can become chronic (long term). According to the Global Burden of Disease Studies (2021), the term LBP, is a pain in the area on the posterior of the body from the lower margin of the twelfth ribs to the lower gluteal folds with or without pain referred into one or both lower limbs. For the purpose of the study, the term LBP will be defined as a discomfort or sometimes debilitating suffering associated with an injury or some other affliction of the back, the posterior (rear) portion of the body that extends from the lower rib cage to the hips. Lower back pain is the most prevalent chronic pain syndrome and the leading cause of limitation of activity in patients younger than 45 years. Studies show that pain and function improve substantially in most patients within one month. More than 90% are better at 8 weeks (Dixit 2013) [3], however, patients remain susceptible to future relapses that also tend to be brief. Dixit (2013) [3] provides a number of risk factors associated with LBP. These include heredity, psychosocial factors, heavy lifting, obesity, pregnancy, weaker trunk strength, and cigarette smoking. Dixit (2013) [3] further adds that disability as a result of LBP has been associated with the presence of maladaptive pain coping behaviour, nonorganic signs, functional impairment, poor general health status, and psychiatric comorbidities.

In determining a patient's pain experience, Salahuddin and Conti's (2022) [15] perspective of LBP acknowledge an interaction of physical, cognitive, affective, behavioral, genetic, and environmental factors. Psychological and social factors not only affect pain itself but also how much the pain impacts on one's life. The presence of depressive symptoms can make pain worse and increase the disability associated with pain. Grabovac and Dorner (2019) [9] point out that people with back pain are more likely than people without back pain to meet criteria for common mental health problems, including major depressive episodes, anxiety disorders. Baumeister, Hutter and Harter (2011) [2] consider that the coexistence of mental health conditions with back pain is associated with impaired QOL and increased risk of chronicity. Consequently, the treatment of LBP has expanded to include psychological therapy. A pain management programme would require multi-disciplinary approaches. Multidisciplinary pain management programs are based on the bio-psycho-social model. Shipton (2018) [17] found that multidisciplinary pain management programs are important approaches in the treatment of LBP. The guidelines are also recommended by the National Health Department of Germany for the treatment of LBP. Notwithstanding this, Foster (2011) [5] found that patients with persistent non-specific LBP received only modest benefit from a multidisciplinary pain management programme.

2 Material and Methods

2.1 Research design: This is a case series study design. Case series method is a variation of a single case report in which the author describes several cases and their relation to one another and to the existing body of literature. A case series has no control group. This approach has become increasingly important in health sciences research and provides a better understanding of patients' behaviours, attitudes, beliefs, preferences and how these change over time. According to Petersen (2016) [14], in the self-controlled case series study design, as the participants themselves serves as their own control. Comparisons are made within individuals who have experienced an event pre and post intervention.

2.2 Study population: Volunteers from selected practices throughout Johannesburg were invited. The volunteers were confirmed as having non-specific LBP and that hydrotherapy posed no risks. Twenty subjects between the ages ranging from 35 to 58 were finally selected to participate. Since this is a case series method, a sample of 20 volunteers was considered adequate. Faber and Fonseca (2014) [4] point out that sample size for case series should not be either too big or too small since both have limitations that can compromise the conclusions drawn from the studies. The sample size of 20 makes this research more manageable in a case series study design. The number of variables tested was adequately large, thus the in-depth data of patients gathered provide answers to the research questions related to this study. A series of progressive water-based exercises was administered to treat non-specific LBP. This focused on developing aerobic, strength, balance, core stability and functional movements. The guidelines for flexibility of the quadriceps and hamstrings, which would relieve the muscular imbalances were followed and all tests were conducted in a standardized fashion in accordance with the 2018 American College of

Sports Medicine Guidelines for Exercise Testing and Prescription. All pre-intervention and post-intervention physical tests were land-based.

2.3 Measuring tools and instruments

Medical interventions are not evaluated solely on their ability to treat a specific condition. The World Health Organization QOL (WHOQOL) Questionnaire (2012) was used in this study. The questionnaire is designed to measure an individual's perception of their QOL, defined by the WHO as individuals' "*perceptions of their position in life in the context of the culture and value systems in which they live and in relation to their goals, expectations, standards and concerns*". The QOL across 4 domains (Physical Health, Psychological, Social Relationships, and Environment) was measured. This reflects the patient's perspective on their overall well-being. This questionnaire has become an important outcome measure in the evaluation of treatments. This study recorded the patients' overall experience, including their ability to function in their daily life, their satisfaction with the treatment, and the impact on their mental health. The WHOQOL questionnaire was administered prior to the hydrotherapy intervention and post intervention and the differences in each of the domains were recorded.

The second questionnaire used in this study was the Revised Oswestry Disability Index as used by Evidence in Motion (https://evidenceinmotion.com). This questionnaire is designed to enable one to understand how much LBP has affected the patient's ability to manage everyday activities. Each of the 10 sections of the questionnaire required one well-considered response out of six alternatives. This questionnaire was administered before the intervention and post intervention. These tests were chosen for two specific reasons, namely, they were easily administered and the data gathered from these tests provided adequate information to make statistical inferences.

2.4 Data analysis

The responses to the World Health Organization QOL (WHOQOL (2012) Questionnaire were captured using the neuro toolkit https://neurotoolkit.com/whoqol-bref/. The scores were automatically generated and provided the measures of QOL across 4 domains (Physical Health, Psychological, Social Relationships, and Environment). The scores were calculated by summing the point values for the questions corresponding to each domain and then transforming the scores to a 0 -100-point interval. The first two questions of the WHOQOL-BREF do not correspond to a domain but are meant to provide a global assessment of quality of life. Higher scores in each of the domains correspond to greater perceived quality of life. In this study, the Revised Oswestry Disability Index as used by Evidence in Motion (https://evidenceinmotion.com) was obtained using the online questionnaire located at the following site: https://ipmhealthcare.com/wp-content/uploads/2022/05/Oswestry.pdf. This questionnaire is designed to enable one to understand how much one's LBP has affected one's ability to manage ADL. The sample of patients was required to answer each of the 10 sections by selecting one option only out of 6 that closely describes the pain at the moment.

2.5 Presentation of results

A brief demographic overview of the sample is provided in Table 1. A total of 20 patients (n = 20) who were confirmed with LBP constituted the sample. The sample was equally divided between males (nmales = 10) and females (nfemales = 10). Lower back pain has been associated with several predisposing factors that include age, height, weight and other socio-economic factors, income, lifestyle, education and occupation. The average age of the overall sample was 41.05±5.817 years. This appears to be consistent with the findings of the National Institute of Neurological Disorders and Stroke that the first attack of low back pain typically occurs between the ages of 30 and 50. This is also consistent with the findings of the Spine Institute of Southeast Texas that the initial LBP symptoms arise between age 30 and 50 and become worse. Age-related LBP can be attributed to general degeneration.

Table 1: Brief demographic Overview of the Sample

Sample	Age in years x̄±SD	Height in metres x̄±SD	Weight in kg x̄±SD	BMI x̄±SD	Occupation
Female n = 10	42.1±7.03	1.594±0. 0806	66.3±12.31	26.1939±1.485	Artist; Biokineticist; Doctor; Teacher (2); Stay at home mom; Judge; Fitness Instructor; Forensics analyst; Marketing Manager
Male n = 10	40±4.422	1.74 m±0.121	81.48±18.816	27.0315±1.637	Lecturer; Solution Architect; Chiropractor (2); Sales Rep (3); Medical Rep; Businessman; Sport scientist
Total n = 20	41.05±5.817	1.66±0.123	73.89±17.32	26.6127±1.080	

The overall impact of hydrotherapy on the patient's physical, psychological, and social functioning, was ascertained. Physical and environment produced significant results. Higher scores indicate higher levels of satisfaction. Psychological and social did not show improvement and were not significant. Table 2 shows the QOL across 4 domains (Physical Health, Psychological, Social Relationships, and Environment). The transformed scores are automatically generated. The questionnaire was filled out for each patient before the intervention and after the intervention. The measure is calculated by summing the point values for the questions corresponding to each domain and then transforming the scores to a 0 to 100-point interval. The t-test was used to compare the means of the two groups as it used in hypothesis testing to determine whether a process or treatment actually has an effect on the population of interest, or whether two groups are different from one another. In the literature, Muller (2022) finds evidence that the two-sample t-test is robust with respect to departures from normality, and departures from homogeneity of variance. The t-test is a statistical tool that determines if two sample means are significantly different from each other. In this study, the test is particularly useful since the objective is to determine significant differences between pre and post intervention.

Table 2: Findings of the World Health Organization QOL (WHOQOL) Questionnaire

Domain/Gender	Female	Male	Total
Physical	Test Stat = 2.3556570 p value = 0.02145279 Significant	Test Stat = 2.7896173 p value = 0.01053350 Significant	Test Stat = 3.6053421 p value = 0.00094269 Significant
Psychological	Test Stat = 0.72152083 p value = 0.24445419 Not significant	Test Stat = 1.53766 p value = 0.0792547 Not significant	Test Stat = 1.6835755 p value = 0.05431129 Not significant
Social	Test Stat = 0.62128439 p value = 0.27491126 Not significant	Test Stat = 0.26835356 p value = 0.39723838 Not significant	Test Stat = 0.6525491 p value = 0.26093230 Not significant
Environment	Test Stat = 2.25897986 p value = 0.025130161 Significant	Test Stat = 2.4902179 p value = 0.01720485 Significant	Test Stat = 3.4014425 p value = 0.00149734 Significant

Table 2 presents the statistical findings of the improvement in QOL pre-intervention and post intervention. There were two significant findings related to the Physical and the Environmental factors.

The Oswestry Low Back Disability Questionnaire was used to obtain information as to how the patients' back pain has affected their ability to manage everyday life. It is the oldest and most thoroughly researched instrument designed to assess functional status and disability. Moreover, the questionnaire possesses strong psychometric properties. For this study, the questionnaire was used as a self-report instrument that provided clinically meaningful change. Table 3 shows the statistical findings of the study.

Table 3: Findings of the Oswestry Low Back Disability Questionnaire

Pre-Intervention $\bar{x}$±SD	Post-Intervention $\bar{x}$±SD	test statistic
33.7±8.4	26.2±6.5	-6.22599356 $\alpha = 0.05$ $p = 0.00$

The mean scores of 26.2 and 33.7 fall into the range of 21 - 40 that implies moderate disability. The statistical finding is significant. Patients reported improved changes in QOL and activities of daily living.

3 Discussions

Enhanced changes in lifestyle are critical in individuals, even those with serious mental illness. The importance of exercise needs to be adequately understood or appreciated by care-providers and patients alike. Mitchell and Barlow (2011) [12] have argued that the use of exercise for improving health has been the subject of research for several decades. Integrating physical activity into daily routine even those with mental illness could reduce the risk of chronic diseases associated with sedentary behavior, medication side effects, diabetes, hyperlipidemia, and cardiovascular disease. Exercise is one of the constants in lifestyle modification. Studies have shown unequivocally that exercise is beneficial for preventing and/or treating numerous medical conditions. Smith and Merwin (2021) [18] found that exercise is an often-neglected form of intervention especially in mental health care. A number of activities that include, aerobic exercises, jogging, swimming, cycling, walking, gardening, and dancing, have been proved to reduce anxiety and depression.

The assessment of health-related wellbeing is an important priority in the management of health care. Primary health care providers have a critical role in the provision of health and wellness of these patients through various forms of exercise therapy and changes in lifestyle. The American College of Sports Medicine (2018) [20] promotes exercise as a therapeutic modality and considers "Exercise is Medicine. Accordingly, LBP is one of the conditions that can be successfully treated and managed by the different rehabilitative professions in South Africa. Exercise and lifestyle changes that have positive effects on long-term wellness are important non-pharmacological approaches for the management of several symptoms. Vina *et al*. (2012) [22] find exercise as beneficial for health and accordingly considered it a drug with moderate doses. However, the effectiveness of exercise therapy continues to be uncertain and the evidence is not adequate. In this study, physical and environment domains of WHOQOL Questionnaire provided significant improvements. Notably, the significant improvements resulted in an increase in the patients' abilities to perform ADL and QOL. Physical activity should ideally reverse exercise intolerance and improve patient's mood. This finding is consistent with that of Mitchell and Barlow (2011) [12] who address the role of exercise in improving quality of life in healthy individuals and in those with chronic diseases. Social and psychological domains did not produce significant improvements. This is surprising as one would ascribe social and psychological wellness to the positive aspects of physical well-being. Lifestyle changes that accompany an increase of moderate-intensity activity throughout the day is an appropriate therapy for almost all patients. Physical activity reduces anxiety, depression, and negative mood and by improving self-esteem and cognitive function. In this study physical and environmental factors improved significantly. Improvement in physical factors suggests that there was a reduction in the patient pain and discomfort. Sleep and rest progression also improved. Mobility and activities of daily living increased. This may be attributed to patients becoming aware of body mechanics during the session and how they relate to ADL. The improvement in environmental factor is related to the patients' perception of new information about physical safety and participation in leisure activities. Due to the awareness of body mechanics, this allows the individual to step out of their comfort zone and improve their QOL.

Exercise has also been found to alleviate symptoms such as low self-esteem and social withdrawal. Exercise is especially important in patients who are vulnerable to obesity. Sharma *et al*. (2006) [16] posit thirty minutes of exercise of moderate intensity, such as brisk walking for 3 days a week, are considered adequate for health benefits. Moreover, Sharma *et al*. (2006) [16] argue that these 30 minutes need not to be continuous; three 10-minute walks are believed to be as equally useful as one 30-minute walk. Health benefits include the following: improved sleep; increased interest in sex; better

endurance; stress relief; improvement in mood; increased energy and stamina; reduced tiredness that can increase mental alertness; weight reduction; and reduced cholesterol and improved cardiovascular fitness. Biokineticists and other primary health care providers can provide effective, evidence-based physical activity interventions for individuals suffering from LBP.

Having identified that exercise is good for the body, it can also boost one's mood, improve sleep, and helps deal with depression, anxiety and stress. Physical activity is consistent with improvement in aerobic capacity, muscle size and physical health and add years to one's life. However, individuals who exercise regularly are provided with a better sense of well-being and a feeling of being energetic throughout the day. Smith and Merwin (2021) [18] found that exercise provide better sleep, feelings of relaxation and is considered an effective medicine for many common mental health challenges. These include: depression, anxiety, and other attention deficits and mental health problems. Identified physical activity as a feasible mental health promotion strategy and cite studies that physical activities in the form of exercises are consistent with positive changes in emotional well-being. Smith and Merwin (2021) [18] conclude that exercise is promised to alleviate symptoms of mental health and that researchers have accordingly remained interested in the antidepressant effects of exercises. Smith and Merwin (2021) [18] contend that exercise compares quite favorably with standard care approaches to depression in the few studies that have evaluated their relative efficacy. Running was compared with psychotherapy in the treatment of depression, with results indicating that running is just as effective as psychotherapy in alleviating symptoms of depression. Accordingly, Smith and Merwin (2021) [18] posit that exercises have huge potential to enhance patient wellbeing and regular physical activity can increase self-esteem and can reduce stress and anxiety. Consequently, exercise helps prevent the development of mental health problems. An improvement in the QOL of individuals experiencing mental health problems is consistent. Grabovac and Dorner (2019) [9] suggest that individuals who exercise regularly have better emotional wellbeing and mental health, and ultimately lower rates of mental illness. Karlsson *et al*. (2020) [10] contend that the importance of exercise, it not only boosts one's mood, concentration and alertness, but also improves overall physical health and reduces associated cardiovascular diseases. The exercises do not have to be arduous and well-structured to have benefits. The Australian Department of Health and Aged Care (2023) [21] has a website that is provides exhaustive information that not exercising can have detrimental effect on one's self-esteem. Individuals who exercised regularly and fail to get back to it, have reported lower energy levels and self-esteem. Physical activity is considered an outlet for one's frustrations. To help Australians understand how much activity they need, the Australian Government's Department of Health and Aged Care(date), developed guidelines to promote physical activity and reduce sedentary behaviour for each age group and for pregnancy. Staying active is essential for good physical and mental health and wellbeing

In this study, functional outcome was assessed using the Oswestry Low Back Disability Questionnaire to obtain information as to how the patients' back pain has affected their ability to manage everyday life. The Oswestry Dsability Index (ODI) has become a widely used questionnaire to assess patient functional status and QOL impairment in patients with LBP and injury in research and clinical settings. The mean scores of 26.2 and 33.7 obtained in this study fall into the range of 21- 40 that implies moderate disability. The change in well-being is significant - post-intervention. Hydrotherapy had a positive effect on the patient's reporting of changes in QOL and activities of daily living.

4 Study Limitations

Patients were invited to participate in the research and all of them were from Gauteng. The results are based on patients reporting their perceived pain situation and therefore validity and reliability of responses may be compromised. Patients may have been biased with their answers not wanting to show regression after 8 weeks so they would give themselves a higher score. The platforms within the pool were not wide enough for some patients which forced them to have a narrower stance thus limiting how much effort they can put into an exercise. The pool, although very effective, can be very costly. This limits who can use the pool.

5 Conclusion

Qualified exercise professionals can advance the notion that exercise is medicine. Health care providers are called to expand their reach of care and refer patients for exercise guidance. The findings of the study suggest that hydrotherapy intervention provided relief to LBP and can be considered an effective tool for improving well-being. Of the four domains physical and environment produced significant improvement. There was an improvement in sleep and rest, as well as a reduction in pain and discomfort. Activities of daily living (ADL) are the required skills to live independently and are associated with quality of life (QOL). Lower back pain (LBP) is a disorder that has a significant impact on a patient's ADL and ultimately well-being and QOL. The effects of eight-weeks hydrotherapy intervention on QOL and ADL in patients with non-specific lower back pain provided positive results.

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