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### Original article

# Pilot randomized controlled trial to evaluate the effect of aquatic and land physical therapy on musculoskeletal dysfunction of sickle cell disease patients



Camila Tatiana Zanoni, Fábio Galvão, Alberto Cliquet Junior,  
Sara Teresinha Olalla Saad\*

Universidade Estadual de Campinas (UNICAMP), Campinas, SP, Brazil

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#### ABSTRACT

**Objective:** To compare the effect of aquatic and land-based physiotherapy in reducing musculoskeletal hip and lower back pain and increasing overall physical capabilities of sickle cell disease patients.

**Methods:** Informed written consent was obtained from all volunteers who were submitted to evaluations using different functional scales: Lequesne's Algofunctional Questionnaire and Oswestry Disability Index, trunk and hip range of motion, goniometry, trunk and hip muscle strength assessment using load cell, and surface electromyography of the iliocostalis, long dorsal (longissimus), gluteus maximus, gluteus medius and tensor fasciae latae muscles. Ten patients were randomized into two groups: aquatic physiotherapy with a mean age of 42 years (range: 25–67) and conventional physiotherapy with a mean age of 49 years (range: 43–59). Both groups were submitted to a twelve-week program of two sessions weekly.

**Results:** After the intervention, significant improvements were observed regarding the Lequesne index ( $p$ -value = 0.0217), Oswestry Disability Index ( $p$ -value = 0.0112), range of motion of trunk extension ( $p$ -value = 0.0320), trunk flexion muscle strength ( $p$ -value = 0.0459), hip extension and abduction muscle strength ( $p$ -value = 0.0062 and  $p$ -value = 0.0257, respectively). Range of motion of trunk and hip flexion, extension, adduction and abduction, trunk extensor muscle strength and all surface electromyography variables showed no significant statistical difference.

**Conclusion:** Physical therapy is efficient to treat musculoskeletal dysfunctions in sickle cell disease patients, irrespective of the technique; however, aquatic therapy showed a trend toward improvement in muscle strength. Further studies with a larger patient sample and longer periods of therapy are necessary to confirm these results.

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\* Corresponding author at: Hemocentro Unicamp, Instituto Nacional de Ciência e Tecnologia do Sangue, Rua Carlos Chagas, 480, Cidade Universitária Zeferino Vaz, 13083-878 Campinas, SP, Brazil.

E-mail address: [sara@unicamp.br](mailto:sara@unicamp.br) (S.T.O. Saad).

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## Introduction

Sickle cell disease (SCD) is a genetic disorder that results in the sickling of red blood cells, triggering vaso-occlusion episodes which lead to pain and organ damage. This inherited disorder is caused by a point mutation in the beta-globin gene. The mutant form of hemoglobin in SCD (Hb S) is capable of polymerization and complex molecular and structural changes within the red cell. Occurring in homozygotes (Hb SS) and in compound heterozygotes, such as those carrying Hb S and beta-thalassemia (Hb SB<sup>+</sup> or Hb SB<sup>0</sup>) and Hb S and hemoglobin C (Hb SC), hemolytic anemia and vaso-occlusion crises are the main complications of SCD. The illness tends to gradually develop toward multisystem organ failure.<sup>1</sup> Bone involvement, frequently causing painful vaso-occlusive crises, is the most common clinical manifestation. Furthermore, bone involvement is a source of chronic, progressive disability, with long-term effects upon bone mass density, growth, and bone damage such as avascular necrosis and osteomyelitis. Osteopenia and osteoporosis are often asymptomatic; however, pain, fractures, deformities, and vertebral collapse may occur and require chronic analgesia, mechanical support, and surgical interventions.<sup>2,3</sup>

Chronic and progressive damage such as, for example, avascular necrosis of the femoral head, the leading cause of hip deformity in these patients, commonly results in gait disturbances, pain, and activity and functional limitations in adult patients. Lower back pain is one of the main complaints among SCD patients and occurs due to the flattening and widening of the vertebral bodies with biconcave depressions of the endplates, probably caused by infarction of the central portion of the vertebral body.<sup>4,5</sup> There are few studies in the literature on the role of physiotherapy as a resource to prevent and treat locomotor system disorders in SCD individuals.

According to recent studies, the life expectancy of SCD patients' has improved dramatically over the last century.<sup>6</sup> However this longer life span has, as an unfortunate consequence, the development of progressive organ damage which includes osteoarticular lesions.<sup>7</sup>

Chronic pain is considered a serious public health problem which negatively affects the quality of life of individuals. Therefore, a multi-action therapeutic plan, specifically physiotherapy, could help decrease pain, and improve mobility and the rehabilitation of osteoarticular disorders, positively impacting on the quality of life.<sup>8</sup>

Despite this fact, there are few studies in the literature on the role of physiotherapy as a resource to prevent and treat locomotor system disorders in SCD patients. One study<sup>9</sup> compared the efficacy of physiotherapy alone with physiotherapy associated with surgical femur decompression in SCD patients with osteonecrosis of the femoral head. The results showed no significant difference between these two approaches, suggesting that physical therapy alone appeared to be as effective as surgical decompression to improve hip function, thus deferring the need for surgery.

Within the existing physiotherapy resources, aquatic physiotherapy used in rehabilitation has demonstrated positive effects against pain, in regaining physical function and in improving quality of life in adults with musculoskeletal

conditions.<sup>10</sup> Movements performed in the water are facilitated by the elimination of the effects of gravity, resulting in increased muscle strength (MS) and flexibility. The benefits of water are mainly explained by the physiological effects of immersion and by the hydrodynamic principles of exercise, such as buoyancy, in this environment thereby enabling functional exercises with a reduced gravitational load. Furthermore, the immersion in thermo-neutral water (34 °C) in combination with the effects of hydrostatic pressure reduces the perception of pain. The physical properties and heated water play an important role in improving and maintaining the range of joint motions, reducing muscular tension and promoting relaxation, as well as preparing the muscle for stretching. The buoyancy induces muscle relaxation and the decrease in impact enables increased mobility and flexibility.<sup>11,12</sup>

This study aimed to evaluate the efficacy of aquatic and land-based physical therapy in decreasing hip and lower back musculoskeletal pain and increasing overall physical well-being in SCD patients.

## Methods

Adult SCD patients who regularly attended (at least three times a year during the previous three years) the Outpatient Clinic of the Hemocentro of the Universidade Estadual de Campinas (UNICAMP) with chronic hip and lumbar spine pain, and who had not participated in a physical therapy program during the previous 12 months, were invited to participate in this study. Patients with acute episodes, absence of over three physical therapy sessions without justification, or any dermatological issue which would prevent them from entering a therapeutic pool, were excluded from the study. The National Ethics Board approved this study, and all patients provided written informed consent.

### Study design

Initially, the volunteers were evaluated according to functional scales, including the Lequesne's Algofunctional Questionnaire and Oswestry Disability Index (ODI), range of motion (RoM) measurements of trunk flexion and extension, hip adduction and abduction, assessment of MS of the trunk flexors and extensors, and the flexors, extensors, adductors and abductors of the hip through load cell and surface electromyography (SEMG) of the iliocostalis, long dorsal (longissimus), gluteus maximus, gluteus medius and tensor fasciae latae muscles. Volunteers were then randomized by an investigator not involved in data collection, using the blind allocation method of sequentially numbered, opaque sealed envelopes,<sup>13,14</sup> into two different program groups: aquatic physiotherapy (AP) and conventional or land physiotherapy (CP). A total of 24 sessions over a twelve-week period (two sessions per week) were administered. Patients were assessed after the intervention comparing the results before and after the sessions according to data obtained for the dominant side of each patient.<sup>15,16</sup>

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