Physical Activity, Quality Of Life, and Functional Autonomy of Adults With Spinal Cord Injuries

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This study aimed to perform a systematic review of studies that address the influence of physical activity on the quality of life and functional independence of adult individuals with spinal cord injury. The review was performed using data obtained from the MEDLINE, CINAHL, SciELO, LILACS, SPORTDiscus, Web of Science, Academic Search Premier, and PEDro databases using the following keywords: quality of life; functional independence; autonomy; independence; physical activity; activities of daily living; physical exercise; tetraplegia; paraplegia; spinal cord injury; physical disabilities; and wheelchair. Eleven studies met the inclusion criteria. Although there was a lack of consensus among the selected studies, the majority of them presented a strong correlation between physical activity and variables of quality of life and/or functional independence. Thus, physical activity appears to have an important influence on social relationships, functional independence, psychological factors, and physical aspects, which can enhance quality of life and independence in the performance of daily activities.

Keywords: spinal cord, quality of life, independence, physical activity

Although it is known that people with disabilities can achieve positive effects on physical, mental, and social health by the regular practice of physical activity, whether competitive or not (Gass, Camp, Davis, Eager, & Grout, 1981; Martin Ginis & Hicks, 2005; Noreau, & Shephard, 1995; Tasiemski, Kennedy, Gardner, & Taylor, 2005; Taylor, McDonell, & Brassard, 1986), their level of participation in such programs is still very low when compared with the remaining population. The high prevalence of a sedentary lifestyle implies a series of associated conditions, such as heart disease, diabetes, hypertension, and obesity, making an individual more susceptible to the need for health-related care. This series of problems associated with a sedentary lifestyle has a direct effect on the subjective analysis of quality of life and particularly on the independence of people with physical disabilities, specifically those who have spinal cord injury.
Spinal cord injury can be described as one of the most severe forms of disabling syndromes (Gianini, Chamlian & Arakaki, 2006), and it has become increasingly common in Brazil (Brasil–Ministério da Saúde, 2012). This is mainly due to the increase in urban violence, although automobile accidents, falls, and gunshot wounds are the most common causes of spinal cord trauma (Bampi, Guilhem & Lima, 2008; Koch et al., 2007).

Spinal cord injury is a frequent cause of mortality, and it results in a high level of individual disability, which is reflected in radical changes in lifestyle (Defino, 1999; DeVivo, & Richards, 1992; Middleton, Tran, & Craig, 2007; Price et al., 2004; Schmitz, 2004). Conditions such as accessibility to different physical spaces, education, transportation, job, independence, and social support are important predictors that undergo constant changes and directly interfere with the perceived quality of life of people with spinal cord injury (Dijkers, 1997; Rimmer, 2011).

Given this context, in recent decades, the concept of quality of life came to be studied within different academic disciplines. Concepts, research methodologies, and the rationale in the measurement of the level of quality of life have received attention in varied aspects of scientific production (Dijkers, 2005; Manns & Chad, 1999). Defined by the World Health Organization as “individuals’ 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 WHOQOL Group, 1995), quality of life can be understood as a subjective concept related to the sociocultural level, age range, and personal aspirations of an individual. For people with disabilities, the current focus has been on analyses of quality of life rather than the limitations imposed by their condition. This idea has been clearly reinforced by the creation of the International Classification of Functioning, Disability, and Health (WHO, 2001). Functional independence has been emphasized as a relevant factor in quality of life because it is an important marker of independence in the performance of everyday activities.

According to Melo (2009), the regular practice of physical activity should be seen as a tool for the facilitation of the reintegration of people with spinal cord injury, who face physical, social, and psychological challenges, by improving patterns of functional independence. In this context, positive experiences in the different domains that comprise quality of life enable individuals to more optimistically face their life (Noce, Simim, & Mello, 2009).

Physical activity can be understood in a generic way as the execution of body movements that result in energy expenditure above those at rest (Caspersen, Powell, & Christenson, 1985). Thus, the concept of physical activity encompasses daily living and professional activities that require energy exertion, fitness exercise, as well as recreational and competitive sports. These latter activities are conceptualized as specific types of physical activities systematized and structured to increase or maintain physical fitness, health improvement, or competitive performance in sports. The literature on people with spinal cord injury has, in general, focused on the potential beneficial effects of supervised physical exercise on the parameters of quality of life and functional independence, not addressing other everyday activities that may contribute to an active lifestyle (Devillard, Rimaud, Roche, & Calmes, 2007). On the other hand, shortcomings of the cited studies include lack of control over significant study variables, which has led to problems in the application of research findings to practical situations.
Thus, a systematic review is an important tool in enabling a critical analysis of the effectiveness of specific interventions. A systematic review consists of a rigorous synthesis of studies related to a specific topic that generally involves the efficacy of a given intervention to resolve a problem (Ciliska, Cullum, & Marks, 2001). In regards to the importance of a systematic review in the physical activity domain, this method may identify the beneficial and detrimental effects of different interventions on quality of life. It also may identify knowledge gaps and areas that require further research with implications for the types of assistance that might be provided to adults with spinal cord injury.

Considering the relevance of this issue, the objective of this review was to summarize and analyze the literature findings on the association between physical activity, functional independence, and quality of life in adults with spinal cord injury.

Methods

Search Strategy

This review began with a literature search for studies that evaluated the potential association between physical activity and autonomy/and or quality of life in adults with spinal cord injury. The research strategy was formulated by the authors and assisted by a subject specialist librarian. To conduct the research, the following databases were used: MEDLINE—Medlars Online (1950–September 2012); CINAHL—Cumulative Index to Nursing and Allied Health Literature (1982–September 2012); SciELO—Scientific Electronic Library Online (1998–September 2012); LILACS—Latin American and Caribbean Health Science Literature (1982–September 2012); SPORTDiscus (1975–September 2012); Web of Science (1900–September 2012); Academic Search Premier (1975–September 2012); and PEDro—Physiotherapy Evidence Database.

The following keywords were used in the search: quality of life; functional independence; autonomy; independence; physical activity; activities of daily living; physical exercise; tetraplegia; paraplegia; spinal cord injury; physical disabilities; and wheelchair. These descriptors were individually manipulated and then combined into groups of three, four, or five terms, and they were combined with the operators and or or to provide an amplified search. The research was not restricted to any particular language.

After the search, we selected studies that met the following inclusion criteria: the sample should consist of adults with spinal cord injury of both genders and who practice some type of physical activity or who are involved in a group where the intervention method was physical activity. In such a case, the intervention method (physical activity) should be evaluated with respect to its effects on quality of life and/or autonomy. Thus, a review of experimental studies, case series, and cross-sectional studies, which were developed in various ways, such as cross-sectional exploratory studies, cross-sectional investigations and cross-sectional surveys, were used.

This review excluded articles in which physical activity was not evaluated or in which it was described as an intervention method for the analysis of influences on the quality of life and/or autonomy. In addition, selected publications with samples that did not include adult individuals with spinal cord injury and studies that did
not evaluate the quality of life and/or autonomy were excluded. Monographs, dissertations, and theses were also excluded from the study due to the difficulty of systematic searching.

Moreover, publications that have completely met the inclusion criteria were tabulated and analyzed considering the following factors: (a) year of publication; (b) level of spinal cord injury; (c) age group of the sample; (d) study design; (e) type of instrument used to measure the level of autonomy and quality of life; and (f) characteristics of the physical activity described in the study.

After assessing the studies, an analysis of the quality of the studies was performed. We used two specific instruments: the PEDro Scale (Physiotherapy Evidence Database—http://www.pedro.org.au/) for the analysis of the experimental intervention studies and the STROBE Scale (Strengthening the Reporting of Observational Studies in Epidemiology—http://www.strobe-statement.org/) for verification of the quality of the cross-sectional studies.

The PEDro Scale was used in the experimental studies and had a total score of 10 points, including assessment criteria for internal validity and presentation of statistical analysis employed. For each criterion defined in the scale, one point was assigned for the presence of quality indicators of the evidence presented and zero points were assigned for the absence of these indicators. The PEDro Scale consists of the following criteria: (1) specification of the inclusion criteria (item not scored); (2) random allocation; (3) allocation concealment; (4) similarity of the groups in the initial or basal phase; (5) blinding of the subjects; (6) blinding of the therapist; (7) blinding of the evaluator; (8) measure of at least one primary outcome in 85% of the subjects allocated; (9) analysis of the intention to treat; (10) comparison between the groups of at least one primary outcome; and (11) report of the measures of variability and an estimation of the parameters of at least one primary variable (Maher, Sherrington, Herbert, Moseley, & Elkins, 2003).

The STROBE Scale analyzes the quality of the observational studies. Frequently, the description of studies of observational nature is inadequate, which hinders the evaluation of the study’s strong and weak points and, as a consequence, generalizes their results. This scale consists of a checklist of 22 items and the STROBE Statement with recommendations on what should be included with a more accurate and complete description of the observational studies (Malta, Cardoso, Bastos, Magnanini, & Silva, 2010). Thus, the observational studies included in the present review were evaluated using the STROBE Scale to verify whether they met the points established as quality indicators.

Results

Studies Selection

During the research phase in the different databases, 359 studies related to the research subject and descriptors were selected. These studies were subsequently refined through a careful reading of each title, which confirmed the study’s relationship with the topic. Of this refined group of studies, 163 publications were selected. Of this total (n = 163), 52 articles were excluded, as they were indexed in more
than one database. Thus, a total of 111 articles were included. Next, a new screening was performed on the title of each publication, in which 31 publications were eliminated for not being closely related to the topic. The results of the database searches are described in Table 1, and the respective selection strategies used in the study are described in Figure 1.

After this initial selection, a second screening was performed on the remaining 80 titles, based on reviewing their abstract. Among these abstracts, 3 studies were excluded because they addressed a sample that was different from the one proposed by this study (adults with spinal cord injury); 8 were discarded because they were reviews; three presented data on rehabilitation but did not describe the subjects’ quality of life and/or independence; 29 studies evaluated neither quality of life nor independence; 25 referred to quality of life and/or independence but did not have physical activity as an intervention factor; and 1 study proposed to measure physical activity and quality of life but did not draw any association between the two factors. Thus, a total of 11 studies were selected and included in this review.

General Characteristics of the Included Studies

Of the 11 studies selected, 6 only transversely evaluated the influence of physical activity by using questionnaires to measure physical activity and verifying its influence on the variables of quality of life and/or independence. The other 5 studies effectively used physical activity as an intervention factor, subjecting the individuals with spinal cord injury to programs of physical activities that varied between weight training, swimming, and treadmill walking.

Table 1  Results of the Search

<table>
<thead>
<tr>
<th>Databases</th>
<th>Period of Search</th>
<th>Articles Found</th>
</tr>
</thead>
<tbody>
<tr>
<td>MEDLINE</td>
<td>1950–2012</td>
<td>49</td>
</tr>
<tr>
<td>CINAHL</td>
<td>1982–2012</td>
<td>17</td>
</tr>
<tr>
<td>SciELO</td>
<td>1998–2012</td>
<td>-</td>
</tr>
<tr>
<td>Academic Search Premier</td>
<td>1975–2012</td>
<td>06</td>
</tr>
<tr>
<td>Web of Science</td>
<td>1900–2012</td>
<td>01</td>
</tr>
<tr>
<td>LILACS</td>
<td>1982–2012</td>
<td>03</td>
</tr>
<tr>
<td>PEDro</td>
<td>1929–2012</td>
<td>01</td>
</tr>
<tr>
<td>SPORTDiscus</td>
<td>1975–2012</td>
<td>03</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td></td>
<td><strong>80</strong></td>
</tr>
</tbody>
</table>

*Note:* MEDLINE—Medlars Online; CINAHL—Cumulative Index to Nursing and Allied Health Literature; SciELO—Scientific Electronic Library Online; Academic Search Premier; Web of Science; LILACS—Latin American and Caribbean Health Sciences Literature; PEDro—Physiotherapy Evidence Database and Sport Discus.
In regards to the general characteristics of the selected studies, the sample size ranged from 7–277 participants and all of them presented subjects of both sexes. The total number of individuals evaluated in the 11 studies was 634. Moreover, the degree of injury of the selected individuals in the sample population, whenever mentioned, varied from cervical (C4) to lumbar (L5) and included participants with complete and incomplete injuries.

The findings of the articles are summarized in Tables 2 and 3. The first table refers to studies that used cross-sectional assessments of physical activity to determine their relationship with independence and/or quality of life. The second table describes studies that used physical activity as an intervention strategy to improve independence and/or quality of life.
## Table 2  Cross-Sectional Studies

<table>
<thead>
<tr>
<th>Authors (year)</th>
<th>Database</th>
<th>Sample</th>
<th>Intervention or assessment of the application of physical activity</th>
<th>Instruments to assess quality of life and/or functional autonomy</th>
<th>Main findings</th>
</tr>
</thead>
</table>
| Anneken, Hanssen-Doose, Hirschfeld, Scheuer & Thi-etje (2010) | CINAHL | • 277 individuals  
• 16–65 years  
• Injury below C5 | • No intervention  
• QOL—feedback (Quality of Life Scale) (used one of the categories to measure the level of physical activity) | • QOL—feedback | The practice of physical activity had a positive effect on the variable quality of life in all four domains assessed by QOL. |
| Lannem, Sorensen, Froslie & Hjeltnes (2009) | Academic Search Premier | • 69 individuals  
• Mean age 48 years  
• ASIA: “D” | • No intervention  
• Physical activity evaluated through a questionnaire elaborated by the researchers | • Life Satisfaction Scale  
This questionnaire was elaborated by Fugl-Meyer et al.  
• Self-Perception in Exercise Questionnaire (SPEQ) | Participants who claimed to regularly practice physical activity experienced a greater perception of life satisfaction when compared with those categorized as inactive. |
| Manns & Chad (1999) | CINAHL | • 38 individuals  
• 35.9 ± 9.3 years  
• Injury: C5 to C8 and below T1 | • No intervention  
• Leisure Time Exercise Questionnaire | • Quality of Life Profile: Physical and Sensory Disabilities Version (QOLP-PSD)  
• Craig Handicap Assessment and Reporting Technique (CHART) | No correlation was found between physical activity and quality of life. Functional independence was significantly higher in physically active individuals. |

(continued)
<table>
<thead>
<tr>
<th>Authors (year)</th>
<th>Database</th>
<th>Sample</th>
<th>Intervention or assessment of the application of physical activity</th>
<th>Instruments to assess quality of life and/or functional autonomy</th>
<th>Main findings</th>
</tr>
</thead>
<tbody>
<tr>
<td>Miki, Kanayama, Nakashima, &amp; Yamasaki (2012)</td>
<td>SPORTDiscus</td>
<td>• 81 individuals</td>
<td>• No intervention</td>
<td>• Medical Outcomes Study Short Form–SF36 (Japanese version)</td>
<td>The regular physical activity showed a positive correlation on the perception of overall health of people with spinal cord injury.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>60 paraplegics and 21 tetraplegics</td>
<td>• Sample comprised of regular practitioners of sports (wheelchair basketball)</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Injury below the C4</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Stevens, Caputo, Fuller &amp; Morgan (2008)</td>
<td>CINAHL</td>
<td>• 62 individuals</td>
<td>• No intervention</td>
<td>• QWB (Quality of Well-Being Scale)</td>
<td>Strong association between physical activity and quality of life.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>18–50 years</td>
<td>• Activity measured by the PASIPD (Physical Activity Scale for Individuals with Physical Disabilities)</td>
<td></td>
<td></td>
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<tr>
<td></td>
<td></td>
<td>• Injury below the C6</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tlili et al. (2008)</td>
<td>Academic Search Premier</td>
<td>• 25 paraplegics</td>
<td>• No intervention</td>
<td>• Short Form–36 Item Health Survey (Arabian Version)</td>
<td>Regular physical activity had a positive effect and optimized functional capacity, directly reflecting the perceived quality of life.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>29 ± 7.6 years</td>
<td>• Sample divided into athletes (<em>n</em> = 10) and nonathletes (<em>n</em> = 15)</td>
<td>• FIM (Functional Independence Measure)</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Injury: from T8 to L3</td>
<td>• Practitioners or nonpractitioners of wheelchair basketball</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

\( n \) = number of subjects

Injury: C = cervical, T= thoracic, and L= lumbar
<table>
<thead>
<tr>
<th>Authors (Year)</th>
<th>Database</th>
<th>Sample</th>
<th>Intervention or Assessment of the Application of Physical Activity</th>
<th>Instruments to Assess the Quality of Life and/or Functional Independence</th>
<th>Main Findings</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ditor et al. (2003)</td>
<td>MEDLINE/ Pubmed</td>
<td>• 7 individuals • 42.3 ± 3.6 years • Injury: from C5 to T12</td>
<td>• Assessment of the adherence to the program of physical activity • The sample participated in a program of physical activity for nine months</td>
<td>PQOL (Perceived Quality of Life)</td>
<td>Withdrawal from physical activity resulted in reduced scores of perceived quality of life in individuals with spinal cord injury.</td>
</tr>
<tr>
<td>Durán, Lugo, Ramírez &amp; Eusse (2001)</td>
<td>MEDLINE/ Pubmed</td>
<td>• 13 individuals • 17–38 years • Injury: from T3 to T12</td>
<td>• Assessment pre- and postintervention • Activities combined strength, coordination, resistance, aerobic, relaxation, and aquatic activity • 16 weeks • 3 times per week • 120 min per session</td>
<td>Scale FIM (Functional Independence Measure)</td>
<td>Physical activity had a positive effect on physical ability and functional independence.</td>
</tr>
<tr>
<td>Hicks et al. (2003)</td>
<td>MEDLINE/ Pubmed</td>
<td>• 34 individuals • 19–65 years • Injury: from C4 to L1</td>
<td>Training: • 9 months • 2 times per week • 90–120 min per session • Aerobic activities and weight training • Sample divided into exercise group (n = 21) and control group (n = 13)</td>
<td>PQOL (Perceived Quality of Life)</td>
<td>The group subjected to physical activity had a better perceived quality of life and greater satisfaction in relation with the physical function.</td>
</tr>
</tbody>
</table>

(continued)
### Table 3 (continued)

<table>
<thead>
<tr>
<th>Authors (Year)</th>
<th>Database</th>
<th>Sample</th>
<th>Intervention or Assessment of the Application of Physical Activity</th>
<th>Instruments to Assess the Quality of Life and/or Functional Independence</th>
<th>Main Findings</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lucareli et al. (2008)</td>
<td>MEDLINE/Pubmed</td>
<td>• 12 individuals</td>
<td>• Walking on a treadmill</td>
<td>WHOQOL-bref</td>
<td>No significant difference was found when assessing the quality of life relative to gait training</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Age not informed</td>
<td>• 4 months</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>• ASIA “C” and “D”</td>
<td>• 2 times a week</td>
<td></td>
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<tr>
<td></td>
<td></td>
<td></td>
<td>• 30 min</td>
<td></td>
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</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>• Pre- and postassessments</td>
<td></td>
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</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>• Gait assessment (video)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Silva, Oliveira, &amp; Conceição (2005)</td>
<td>LILACS</td>
<td>• 16 individuals</td>
<td>• Swimming</td>
<td>Scale FIM (Functional Independence Measure; pre- and postintervention)</td>
<td>Swimming was effective for functional skills and functional independence.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• 21–41 years</td>
<td>• 2 times per week</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>• ASIA: “A”</td>
<td>• 45 min</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>• 30 sessions</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>• Sample divided into experimental group ($n = 8$) and control group ($n = 8$)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

$n =$ number of subjects

Injury: C = cervical, T = thoracic, and L = lumbar
Cross-Sectional Studies

Of the studies considered in the present review, six were cross-sectional. That is, they sought to analyze the influence of physical activity on the quality of life and/or functional independence of individuals with spinal cord injury but without performing interventions with the sample. This design obtained important information regarding the potential associations between variables, but its application was weakened by not providing a clear guideline on which physical activities were more effective in improving the variables of interest for individuals with spinal cord injury.

Anneken et al. (2010), Lannem et al. (2009), Miki et al. (2012), and Stevens et al. (2008) aimed to analyze the effects of physical activity on the quality of life of participants with spinal cord injury. Although these four studies demonstrated a strong association between physical activity and a better perceived quality of life, some methodological differences must be considered.

The study of Anneken et al. (2010) evaluated subjects within a greater age range (16–65 years) and degrees of injury (below C5). In addition, the sample included both physically active and sedentary subjects. The authors verified that among the physically active group, there was a greater prevalence of individuals who were employed. Although no analysis was performed on the different age ranges, it was possible to conclude that the degree of spinal cord injury, the practice of physical activity, and employment were factors that influenced the subjects’ quality of life. Interestingly, the subjects who were already physically active before the injury, in general, presented active behaviors after the injury. The authors also reported that physically active individuals presented a better perceived quality of life, regardless of other associated factors. However, the article did not include any detailed information on the activities considered in the assessment.

No association between the degree of spinal cord injury and quality of life was observed in the study of Lannem et al. (2009). Moreover, the authors sought to generate a more homogeneous population sample, and thus included only selected subjects with an incomplete spinal cord injury (ASIA D) who were less than 60 years old. When applying the Satisfaction with Life Scale, those who were physically active showed a better perceived quality of life. Despite using a nonvalidated instrument to measure the performed physical activity, the authors also analyzed how the individuals perceived their physical fitness using the Self-Perception in Exercise Questionnaire (SPEQ). They also concluded that the subjects who claimed to be physically active and perceived themselves to have better physical fitness also presented better results of quality of life.

Miki et al. (2012) examined the specific effects of the practice of wheelchair basketball on the quality of life related to health. The SF-36 instrument was applied to a group of 81 athletes (21 quadriplegics and 60 paraplegics), which identified the quality of life in 8 domains: physical function (PF), role physical (RP), bodily pain (BP), social function (SF), general health (GH), vitality (VT), role emotional (RE), and mental health (MH). The only significant association was found between GH and weekly practice, demonstrating that the higher the frequency of weekly workouts, the better the perceived quality of life. It also was verified that residual function of movement was positively associated with quality of life. However, the lack of a control group and the disregard for other influential factors hindered a more accurate analysis of these results.
Using a specific instrument to measure the physical activity of people with a physical disability (PASIPID), Stevens et al. (2008) analyzed the general influence of physical activities (day-to-day life, leisure, and physical exercises) on the quality of life of individuals with spinal cord injury. For the analysis of quality of life, the authors used the Quality of Well-Being Scale (QWB), a questionnaire that evaluates issues related to the perception of mobility, physical activity, social activity, functions performed in daily living, and overall health. The fact that the authors contacted many of their subjects in sport clubs may explain their finding that the most of the subjects were considered physically active. Despite these subjects being evaluated as individuals with injuries from C6 and below and aged between 18 and 50 years, the only significant association was verified between the level of physical activity and quality of life, as evidenced by more active subjects, who presented the best results.

Although the three previous studies presented significant associations between physical activity and quality of life, differences in the sample regarding the degree of injury and age of the participants, combined with varied measurement instruments, make it difficult to compare the results. With the exception of Stevens et al. (2008), the other studies did not specific how physical activity was quantified.

Still among cross-sectional studies, Manns and Chad (1999) and Tlili et al. (2008) expanded beyond the quality of life in their studies to examine the functional independence of individuals with spinal cord injury and its association with physical activity.

Manns and Chad (1999) investigated the potential influence of physical activity performed during leisure on subjects’ quality of life and on the general sequels of disability. They used instruments that were specifically validated for people with disabilities: the Quality of Life Profile: Physical and Sensory Disabilities Version (QOLP-PSD) and the Craig Handicap Assessment and Reporting Technique (CHART). The Quality of Life Profile: Physical and Sensory Disabilities Version (QOLP-PSD) consists of nine domains and was validated on the basis of qualitative studies involving people with spinal cord injury. This specific instrument effectively assesses the quality of life of a population. The Craig Handicap Assessment Reporting Technique (CHART) was developed to be applied to people with spinal cord injury, and it suggests indicators of quality of life. This instrument brings together objective information of the five domains related to quality of life: mobility, financial state, social integration, physical independence, and occupation (Whiteneck et al., 1992). Among the indicators evaluated by the CHART, one of the indicators (physical independence) was particularly objective in the interest of the study. The subjects were divided into tetraplegics (injuries from C5 to C8) and paraplegics (injuries from T1 and below). None of the groups had a verified association between physical activity and perceived quality of life or between the quality of life and functional independence. The only association was found between physical activity and functional independence for tetraplegic individuals. These results show that, for the sample studied, physical activity played a role in the functional independence of tetraplegic individuals but not of paraplegic individuals.

With divergent results, Tlili et al. (2008) found a high correlation between physical activity, perceived quality of life, and functional independence of individuals with spinal cord injury. In this case, the SF-36 questionnaire for the analysis of quality of life and the Functional Independence Measure (FIM) for functional
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Independent freedom was used. FIM is an instrument that assesses the capacity of individuals with this injury in relation to self-care, sphincter control, mobility, communication, and social integration. For the analysis, subjects were categorized into two groups: wheelchair basketball players and sedentary subjects. One potential explanation for these different results may be due to the degree of injury of the participants (between T8 and L3), and the mean age of the sedentary group was much higher than that of the group composed of wheelchair basketball players. Thus, the heterogeneity between the groups precludes the inference that a lifestyle of physical activity was the major influential factor in the improvement of functional independence and perceived quality of life.

**Intervention Studies**

With respect to the type of workout in studies that have proposed periods of intervention, three studies (Hicks et al., 2003, Ditor et al., 2003; Durán, Lugo, Ramírez, & Eusse, 2001) used aerobic activities and weight training; one study (Lucareli et al., 2008) used gait, and one study used swimming (Silva, Oliveira, & Conceição, 2005) as an intervention method. The time-frame of the training programs ranged from 3 to 9 months, from 2 to 3 times a week, and from 30 to 120 min duration per training session. Of the studies involving physical activity as an intervention factor, two (Silva et al., 2005; Durán et al., 2001) focused on the assessment of functional independence, and the other three (Ditor et al., 2003; Hicks et al., 2003; Lucareli et al., 2008) studies aimed to analyze quality of life.

Durán et al. (2001) and Silva et al. (2005) used the Functional Independence Measure (FIM) to evaluate the influence of a program of physical activity on the independence of individuals with spinal cord injury. Although both studies identified significant improvements in groups subjected to physical activity, Silva, Oliveira and Conceição (2005) also observed improvements in the control group. Despite the study’s inclusion of individuals with cervical injuries, all of the subjects had over 12 months of injury, and the division of the groups (experimental and control) sought a homogeneous distribution for the degrees of injury.

The study conducted by Durán et al. (2001) included only individuals with thoracic injuries. However, the authors did not follow up with a control group, which makes it difficult to make inferences regarding the impact of physical activity; moreover, all of the participants attended physical therapy and some had less than six months of injury. Thus, the postinjury evolution associated with physical therapy may have influenced improvements in functional independence.

Ditor et al. (2003), Hicks et al. (2003), and Lucareli et al. (2008) aimed to analyze the quality of life of individuals with spinal cord injury subjected to systematized exercises. In the two first studies, the authors used the Perceived Quality of Life Scale (PQOL). This instrument originally consisted of 12 items. It can be described as a model of measurement in the way it defines quality of life. This instrument encompasses various categories that researchers have identified as fundamental and each item on this scale was carefully analyzed on the basis of interviews with elderly people and people with disabilities. It is a very useful tool to assess the quality of life, particularly of samples with populations that include people with disabilities. Lucareli et al. (2008) applied the WHOQOL, an abbreviated version of the instrument Quality of Life, which was elaborated by the World
Health Organization, to investigate the quality of life of the population in four domains: physical, psychological, social, and environmental.

In the study conducted by Hicks et al. (2003), individuals with spinal cord injury were subjected to nine months of aerobic and resistance training, and significant improvement was observed in the experimental group compared with the control group. Although all of the subjects had at least one year of injury, the degree of the injury varied from C4 to L1 and the age ranged from 19–65 years. These factors make it difficult to analyze the results obtained.

In contrast, Lucareli et al. (2008) investigated the effect of four months of treadmill walking on the quality of life of individuals with spinal cord injury. The participants were subjected to gait training on a treadmill through a mechanism that supported subjects’ body weight using a brace that stabilized the entire pelvis and trunk. Different from the previous study, no significant difference in quality of life was detected before and after the training period. However, the subjects presented low and incomplete injuries, and all of the subjects were able to walk. In addition, the initial values obtained by the individuals via the questionnaire evaluating the quality of life (WHOQOL—brief) were already high, which may have contributed to the lack of improvements observed in this variable.

Ditor et al. (2003) performed an intervention of nine months involving aerobic and resistance exercises for 11 individuals with spinal cord injury. Of these individuals, seven were invited to participate in a new study investigating the effect of adherence for three months to an exercise program on quality of life. Among these seven participants, the degrees of spinal cord injury ranged from C5 to T12 (ASIA A–ASIA D), all with more than three years of injury. The authors observed that the subjects with low adherence to physical activity also presented worse results in perceived quality of life and incidence of pain. Nevertheless, the authors assumed the hypothesis that higher levels of pain may explain the drop out of physical activity and the worsening of quality of life. Thus, it is not possible to establish a direct relationship between physical activity and a more positively perceived quality of life. Furthermore, the absence of a control group and the nonassociation of the results of the quality of life question with the degree of spinal cord injury hinder the interpretation of these results.

**Analysis of the Studies Quality**

The area of adapted physical activity has developed an increasing number of scientific studies focused on improvements in the intervention. However, some quality criteria should be verified, so that the evidence found is indeed relevant. Reid, Bouffard, and MacDonald (2012) affirmed that some points should be taken into account so that evidence found in studies on the area of adapted physical activity may be used in a practical application. Among these points, the authors highlighted that interventions should be designed to consider the individualization of the program: i.e., the activity should be compatible with the interests, needs, and particularities of each participant. Thus, some studies may show different responses to similar interventions, owing to variability between the subjects. In addition, this finding raises the question of multifactorial complexity, which should be considered when performing studies in the area of adapted physical activity. Factors such as socioeconomic status, motivation, and the skill level of the practitioners may lead to a partial interpretation of the
results and hinder the practical application of the study’s findings. The importance of controlling such factors has been observed in studies with individuals without disabilities, in which it was observed a significant influence of socioeconomic status and education on the perceived quality of life (Martins, França & Kimura, 1996).

Studies including intervention are of great importance in the area of adapted physical activity, particularly, for its potential to provide scientific evidence to guide the practice of professionals working in the field. Of the studies selected for this review, the quality of the studies conducted by Silva, Oliveira, and Conceição (2005) and Hicks et al. (2003) were assessed by the PEDro Scale. It uses the Kappa index (K), which is a measure of agreement that corrects for chance agreement.

After analysis using the PEDro Scale, we verified that the studies of Silva, Oliveira, and Conceição (2005) and Hicks et al. (2003) achieved a score equal to six, which indicated a high quality. Nevertheless, both studies failed to score in three items that could have a positive influence on the scores: allocation concealment, blinding of the subjects, and blinding of the therapist.

The quality of the cross-sectional studies was evaluated using the STROBE Scale. This scale does not provide a number value but only elements that should be included in the observational studies. The studies by Anneken et al. (2010), Lannem et al. (2009), Manns and Chad (1999), Miki et al. (2012), Stevens et al. (2008), and Tlili et al. (2008) were assessed using the STROBE Scale to check for elements that were not observed by the authors. The studies by Ditor et al. (2003), Durán et al. (2001), and Lucareli et al. (2008) were also assessed. Although these three studies used physical activity as an intervention, they were categorized as observational because of the lack of a control group, which, according to the norms of the PEDro Scale, doesn’t allow their categorization as experimental studies.

Following this analysis, we listed some elements that were not included in the studies of the present review that could have caused a negative influence on its quality. As a first negative aspect, some studies did not clearly present key elements related to their methodological design (Durán et al., 2001; Lucareli et al., 2008; Miki et al., 2012; Stevens et al., 2008). Within the description of the methodological procedures, some studies did not clearly define all of the outcomes, exposures, predictors, potential confounding factors, and effect modifiers (Anneken et al., 2010; Ditor et al., 2003; Durán et al., 2001; Lucareli et al., 2008). However, with respect to the method description, five studies did not explain all of the measures adopted to prevent potential bias (Durán et al., 2001; Lucareli et al., 2008; Miki et al., 2012; Stevens et al., 2008; Tlili et al., 2008). Regarding the analyses, Tlili et al. (2008), Anneken et al. (2010), and Stevens et al. (2008) did not describe all of their statistical methods, including those used to control for confounding factors. The lack of these features in the studies hindered the authors’ understanding of the methodological design and the precautions taken by the authors to minimize intervening variables that may have influenced the results.

In the analysis of the results, studies conducted by Durán et al. (2001) and Lucareli et al. (2008) did not describe the number of participants in each stage of the study, nor did they clarify the reasons for the loss of participants. Finally, in the discussion of the findings, Manns and Chad (1999), Ditor et al. (2003), Tlili et al. (2008), Lucareli et al. (2008), Lannem et al. (2009), and Stevens et al. (2008) did not present the limitations of their study and failed to note potential sources of bias or inaccuracies.
Discussion

This review brings together works to evaluate the effects of physical activity on the quality of life and/or functional independence of adults with spinal cord injury through the application of different types of instruments. The main findings of most selected studies showed a positive, strong association between physical activity and the variables of quality of life and functional independence. (Gianini et al., 2006; Kroll et al., 2012; Martin Ginis, & Hicks, 2005; Norrbrink, Lindberg, Wahman, & Bjerkefors, 2012; van der Scheer, Groot, Postema, Veeger, & van der Woude, 2013; Silva, Oliveira, & Conceição, 2005).

Although the individuals analyzed in the several works have presented diverse features for height and time of injury, we can analyze some aspects in concerning the prescription of physical activity. The intervention programs have been developed with different protocols of physical activity in relation to the type, duration, and weekly frequency. Among these programs, those that combined aerobic and resistance exercises showed a more positive influence on the parameters of quality of life (Hicks et al., 2003) and functional independence (Durán et al., 2001). The practice of swimming, although recognized as a beneficial activity for fitness improvement, have been a slight influence on the functional independence, once only the ability to transfer from the wheelchair showed different evolution for the swimming trained group (Silva, Oliveira, & Conceição, 2005). Likewise, the treadmill walking with body weight suspension did not showed efficiency to promote improvement in the perception of quality of life (Lucareli et al., 2008).

Actually, the current guidelines from the main research entities on physical activity and health recommend the inclusion of both aerobic and resistance exercises for maintaining positive health and independent life (ACSM, 2009). Therefore, for people with spinal cord injury, the recommendation of physical activity programs that contemplate aerobic and resistance exercises may be considered valid and would need to be examined in further studies that intend to analyze the impact of intervention on quality of life and functional independence linked parameters.

Moreover, the weekly volume of physical activity has demonstrated positive relation to the perception of quality of life and functional autonomy. Programs with accumulated weekly volume of physical activity at least of 4 hr resulted in a more positive impact on both variables (Durán et al., 2001; Hicks et al., 2003; Miki et al., 2012; Tlili et al., 2008). In the other hand, sessions of exercises of 30 min twice a week were not efficient (Lucareli et al., 2008), and those of 45 min twice a week showed a limited effect on the functional independence (Silva, Oliveira & Conceição, 2005). Thus, the recommendations to the general population with regard to the weekly volume of physical activity, again, also can be adopted for people with spinal cord injury, i.e., which are accumulated a minimum of 150 min per week of moderate activity and that the activity is preferentially performed in most days of the week (ACSM, 2009).

In transversal studies, the wide range of instruments used for measurement the physical activity complicates the analysis of the results. In some cases, the use of nonstandardized and validated instruments may produce a misinterpretation of results, beyond it did not make clear what the real volume of physical activity performed. Only two studies in this review have used validated instruments for measurement of physical activity. First, Manns and Chad (1999) opted for the
Leisure Time Exercise Questionnaire, which proposes to measure the quantity of physical activity performed in the last seven days during leisure time. A possible criticism for this instrument is that it doesn’t consider the physical effort accomplished in the work or household activities. Second, Stevens et al. (2008) have used the Physical Activity Scale for Individuals with Physical Disabilities (PASIPID), a seven days recorder specifically validated to measure the physical activity for people with disabilities. This instrument have advantages because questions are targeted to people with disabilities and the analysis of physical activity is made in a wider way, also taking account the household activities or those accomplished in the workplace. Therefore, recommended the adoption of valid instruments for measurement to the further studies to examine possible associations between the volume of physical activity and some aspects such as quality of life and functional autonomy of people with disabilities.

It is also important to note the diversity of questionnaires proposed to analyze the quality of life of individuals with spinal cord injury, since those nine studies used seven different instruments of measure. Of these, we highlight the Quality of Life Profile: Physical and Sensory Disabilities Version, created specifically for people with disabilities (Manns & Chad, 1999). The Perceived Quality of Life Scale used by Ditor et al. (2003), as well as the Quality of Life Scale used by Anneken et al. (2010), were developed for people with chronic diseases and both have been chosen in studies involving people with disabilities because it evaluate the physical restriction impact on perception of quality of life. The other tools used (WHOQOL, SF-36, Satisfaction with Life Scale, and Quality of Well-Being State), although they have proven scientific authenticity, were created for general population and may have its efficiency limited for assessing the quality of life of individuals with disabilities. Just as in the physical activity analysis, it is recommended to use tools specifically designed for people with disabilities to portray situations that are part of reality of this population.

Regarding the variability in the degree of the subjects’ injury and the time of injury, in general it was observed a care from authors to establish homogeneous groups for injury level. In this way, individuals with greater injury and with less time of injury benefited more from physical activity with respect to perceived quality of life and functional independence (Manns & Chad, 1999), while elevated injuries showed negatively related to perception of quality of life (Anneken et al., 2010). Researches in people with a few months of injury (Durán et al., 2001) may have affected the analysis of real influence of physical activity, since in this recent time of injury, the rehabilitation process and the actual time required to adapt to the new condition can have much more influence than a physical activity program. For this reason, we suggest future studies to analyze the influence of physical activity practice on the quality of life and functional independence in subjects with, at least, a year of spinal cord injury.

In the general analysis of the quality of studies included in the present review, most of them showed a lack of relevant elements in the description of the methodological procedures and explanations on the limitations of the study. Although none of these items alone disqualifies the studies, certainly the lack of such information hinders the understanding of the potential intervening factors that may have interfered with the results. An example is the absence of control group in some experimental works (Ditor et al., 2003; Durán et al., 2001; Miki et al., 2012),
impairing in part the analysis of real influence of physical activity on the quality of life and/or on the functional independence.

Another potential limitation in some studies concerns the researchers’ lack of control over the variables, which can interfere with findings related to quality of life. Among these variables, socioeconomic status, housing conditions, and education were relevant factors at the time that the results of the questionnaires were verified (Martins, França & Kimura, 1996). Correlations between such indicators may better explain the findings of the studies and reinforce the strong relationship between subjects’ social, economic, education, and infrastructure-access level. These factors, when negative, frequently reduce the adherence of individuals with spinal cord injury to the practice of physical exercises. These factors could also change the subjective perceived quality of life and functional independence of the subjects.

When considering a study that includes people with disabilities—in this case, people with spinal cord injury—there is a challenge when considering the selection of individuals. Usually, researchers prefer convenience sampling, in which subjects are selected by voluntary participation or are chosen on the basis of a particular issue that meets the study’s demands. This methodology for sample selection can present an obstacle for studies performed in the field of adapted physical activity, given the difficulty in locating and enlisting participants in a random manner. The criteria used for sample selection in the articles of this review corroborate this fact, because, in all of the publications, the participants of the studies were selected by convenience. However, it is noteworthy that randomized trials do not always provide the most appropriate and generalizable answers, especially in the area of adapted physical activity, whose philosophy of individuality recommends that treatments should be directed to the interests and needs of each individual (Bouffard & Reid, 2012).

From this review, we conclude that there is a lack of works in the area of adapted physical activity to investigate important issues such as perceived quality of life and the level of independence of people with spinal cord injury. These facts taken together with the inconsistency of variables of the assessment methods, the divergent physical exercises applied, and the way that each study measured the effectiveness of the program implementation, including these exercises, demonstrate that this matter requires further exploration.

**Conclusions**

In summary, despite an apparent convergence of results indicating the beneficial influence of physical activity on the quality of life and/or functional independence of people with spinal cord injury, there are still inconsistencies in several factors, such as the assessment method, type of activity prescribed, and selected sampling method, in addition to the lack of instruments specific for this population, which has been increasingly studied.

Thus, further studies must be conducted systematically to support the effectiveness of physical activity on the quality of life and/or functional independence of people with spinal cord injury; moreover, greater investments are required in intervention studies. In this way, it will be possible to establish minimum standards of activity that are most beneficial for study participants.
References


