osteoarthrosis, chondrocalcinosis and gouty arthritis at age 79. Göteborg, 1985, to be published.

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FUNCTIONAL CONSEQUENCES OF JOINT IMPAIRMENT AT AGE 79

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ABSTRACT. A study of functional ability - in relation to joint impairment and disability - in 79-year-olds was performed on representative subamples by interview (n=134) and physical examination of joints (n=109) as well as interview and functional tests regarding activities of daily living (ADL) (n=84). Joint complaints of the lower extremities were more frequent than complaints of the upper extremities. Restricted knee motion had the highest correla- tion to disability of entering public transports. Presently, sedentary caretakers were more disabled in ADL functions than those with a previous strenuous physical activity. Corre- lation was found between low physical activity in the la- ture time and impaired ADL functions. Low physical ac- tivity in the group with no definable disease was also corre- lated with greater social assistance. The reasons for com- mitment to institutional care were usually complex and, generally, not caused by joint impairment. Although dis- ability had increased within the sample since age 70, at age 79 sixty per cent of the probands could still manage home- hold tasks and personal care, and 69% did not require walking aids. The 79-year-olds thus display a high degree of musculoskeletal ability.

Key words: Ageing, population study, joint dysfunction, disabil- ity

A reduction of mobility, muscle strength and coordi- nation with increasing age can be expected to cause reduced functions of activities of daily living. On the other hand, it has been shown that a consid- erable proportion of the 70-year-olds still have really good functional capacity (3). In 79-year-olds, age 70, advanced handicaps are relatively uncommon (17-19).

The present report describes the functional con- sequences of joint impairment at age 79 and is one in a series of presentations of results derived from the gerontological and geriatric longitudinal study of a representative group of 70-year-olds in Göteborg (7, 8). The symptoms and signs of rheumatic disorders at age 79 have been described separately (7), and that report also included a prevalence study of age related changes in joint range of motion (ROM).

Beside the purpose of discovering possible associ- ations between joint impairment and altered ADL functions (and thus providing data useful for future planning or adaption of housing and environment for handicapped and/or elderly people), the aims of this investigation were to study the prevalence of locomotor disability and to check some previously developed functional tests in screening of disability caused by joint impairment.

SUBJECTS AND METHODS

The present data were obtained when the survivors of the original sample of 70-year-olds investigated in 1971/72 were reexamined at a second follow-up at the age of 79. Thus, in 1980/81, 621 probands were invited for a gen- eral physical examination which also included a home visit by a registered nurse, an ECG recording, a radiographic investigation of the chest, and blood sample analysis. Five hundred and thirty-seven probands (209 men and 328 women) took part, with a non-response of 13.5%. The method of sampling, as well as the design and performance of the general study, has been described by Rinder et al. (24).

The method of systematic selection of a proband sub- sample (n=134) for a more detailed investigation of joint motion and joint impairment was reported previously (7). One hundred and twenty-two probands were interviewed (non-response 3.7%) and 89 of these took part in the phys- ical examination of vertebral spine and peripheral joints. The subsample was representative of the total sample re- garding marital status, absence of signs of definable disease (15) and frequency of back and joint complaints. The fre- quency of cardiovascular disorders (arthritis, chest pain, congestive heart failure, hypertension, skin pain), neurological disease (central or peripheral peripheral transitory ischemic brain attack, rigidity, coarse tremor, treated Mb Parkinson) and complications or restricted range of motion (ROM) in back or peripheral joints is shown in Figs. 1 and 2.

Definitions established by WHO (13) were used in the present study. Thus, an impairment reflects disturbances at the organ level, a disability at the personal level, and a handicap is an expression for the social consequence of dis- ability. The examination methods used for the studies of
joint impairments have recently been described (7). The methods used to describe disability and handicap were based primarily on previously reported procedures (4, 18, 29). Eighty-four 70-year-old probands in the present examination of joints were also studied by Ludgren-Lindqvist et al. (17, 18, 19) which allows certain comparisons. Also, a great many data concerning e.g. manifesta-
tions of ageing, state of health, life style and social living conditions were available among the data from the lon-
gitudinal study of 70-year-olds.

From an interview at age 70, the subjects’ responses con-
taining professional work (26) and past and present leisure time physical activity were rated on a four point scale (27): 1) physically inactive (mostly sitting down), 2) moderate (walks, cycling, etc., at least 4 hours per week), 3) regular physical activity (running, swimming, playing tennis, ski-
ing at least 3 hours per week or 4) hard training and com-
petitive sports several times a week. At age 70, covering the age period 70–79, the 4th alternative was omitted.

The disabilities considered in the present study are primarily personal care, locomotor, body disposition and dexterity disabilities.

The following ADL functions were registered for corre-
lations to joint impairments:

**Interview Items**
- Ability to go to the bathroom
- Ability to dress/undress
- Ability to eat
- Ability to wash feet
- Ability to cut toe nails
- Ability to perform household chores
- Ability to get up from a chair
- Ability to climb stairs
- Ability to enter public vehicles
- Use and type of walking aids
- Habits of walking outdoors summer and winter

**Functional tests** (4, 17, 18, 19)
- Lifting hands above head/behind neck
- Grasping an ear-lobe from behind the head
- Finger-tips on the opposite big toe in sitting position
- “Water pouring” test in standing position
- Lifting a glass to a shelf, 180 cm
- Lifting one kilogram package onto a shelf, 180 cm
- “Panel test” (ability to handle a coin, an electric plug and a light bulb, to dial a telephone number and to use a key to unlock a lock)
- “Clothes-peg test” (coordination test)

Hand strength was measured by vigrometer
Walking test (30 m, comfortable and maximum speed)
Climbing step ≥40 cm, with and without using a handrail
Getting up from a low chair (35 cm height)

Some interview data reflecting profound attitudes to, e.g., physical activity such as going out for a walk, were collected at the home visit by a registered nurse and corre-
lated to joint impairments. From the treatment of the data on disability manifestations, joint impairments were grouped into (1) cervical spine and upper extremity (u.e.) and (II) thoracic and lumbar spine and lower extremity (l.e.) (Fig. 3).

**Statistics**
Student’s t-test and the $\chi^2$-test were used together with two non-parametric tests—the Pitman test (9) and the Fisher two-tailed test (22).

RESULTS
Fifty-one per cent of the females and 15% of the males lived alone while 63% of the males but only 25% of the females lived with a spouse. Institutional care, defined as need of care for at least 3 months, was required for 9% of the subjects including 5% who lived in sheltered housing (“service house” or home for the elderly). Twenty-five per cent of the subjects did not have an access to elevator despite living upstairs. Handicap was reflected by certain factors, such as the proportion of subjects licensed for handicap transport service (females 47%, males 18%) or for need of personal care (females 9%, males 13%) or domestic assistance (females 38%, males 23%).

Current joint complaints were reported by 35% of the individuals and back problems by 29%—including 13% with combined complaints from back and peripheral joints. Disability was experienced by one third of the subjects and reduced vision (visual acuity ≤0.4) was found in 27%. One fifth of the probands had no signs or symptoms of any definable disease (15).

The prevalence of certain ADL-disabilities ac-
ting to interview criteria and reduced capacity in the performance of functional tests is shown in Table I. Table II gives the results of questions re-
arding hindrances experienced in walking out-of-
doors. The risk of being accosted was the most fre-
quent hindrance for both males and females; this fear was more frequent in females than in males.

Slightly less than 25% of the subjects reported complaints in one or both of the upper extremities and approximately 40% reported complaints in one

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Table 1. Frequency of ADL and locomotor disabil-

<table>
<thead>
<tr>
<th></th>
<th>F (%)</th>
<th>M (%)</th>
<th>Total (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>A. Interviews (at the home call)</td>
<td>n=77</td>
<td>n=57</td>
<td>n=134</td>
</tr>
<tr>
<td>Need of assistance in household</td>
<td>38</td>
<td>23</td>
<td>31</td>
</tr>
<tr>
<td>Dressing/hygiene</td>
<td>9</td>
<td>13</td>
<td>11</td>
</tr>
<tr>
<td>Going to bathroom</td>
<td>7</td>
<td>33</td>
<td>9</td>
</tr>
<tr>
<td>Eating</td>
<td>1</td>
<td>7</td>
<td>4</td>
</tr>
<tr>
<td>Making beds</td>
<td>14</td>
<td>21</td>
<td>17</td>
</tr>
<tr>
<td>Need of handicap transport service (incl. taxi)</td>
<td>47</td>
<td>18</td>
<td>35</td>
</tr>
<tr>
<td>B. Interviews (at the out-patient department)</td>
<td>n=46</td>
<td>n=36</td>
<td>n=84</td>
</tr>
<tr>
<td>Difficulty/ability</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>of Washing feet</td>
<td>9</td>
<td>8</td>
<td>9</td>
</tr>
<tr>
<td>Cutting toe-nails</td>
<td>22</td>
<td>24</td>
<td>23</td>
</tr>
<tr>
<td>Getting up from chair</td>
<td>9</td>
<td>11</td>
<td>10</td>
</tr>
<tr>
<td>Getting out of bed</td>
<td>7</td>
<td>11</td>
<td>8</td>
</tr>
<tr>
<td>Climbing stairs</td>
<td>22</td>
<td>26</td>
<td>24</td>
</tr>
<tr>
<td>Entering public transport</td>
<td>31</td>
<td>19</td>
<td>26</td>
</tr>
<tr>
<td>Entering public transport because of high steps</td>
<td>18</td>
<td>11</td>
<td>15</td>
</tr>
<tr>
<td>Entering public transport because of narrow doors, etc.</td>
<td>9</td>
<td>3</td>
<td>6</td>
</tr>
<tr>
<td>Use of walking aids</td>
<td>30</td>
<td>32</td>
<td>31</td>
</tr>
<tr>
<td>C. Functional tests (at the out-patient department)</td>
<td>n=46</td>
<td>n=36</td>
<td>n=84</td>
</tr>
<tr>
<td>Difficulty/ability in</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>“Erect knee test”</td>
<td>9</td>
<td>5</td>
<td>7</td>
</tr>
<tr>
<td>“Big-toe test”</td>
<td>9</td>
<td>9</td>
<td>9</td>
</tr>
<tr>
<td>“Hands above head test”</td>
<td>11</td>
<td>8</td>
<td>10</td>
</tr>
<tr>
<td>Difficulty/ability in</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Test on getting up step, ≥40 cm height</td>
<td>70</td>
<td>29</td>
<td>51</td>
</tr>
<tr>
<td>Without handrail</td>
<td>24</td>
<td>9</td>
<td>17</td>
</tr>
</tbody>
</table>

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Joint impairments have recently been described (7). The methods used to describe disability and handicap were based primarily on previously reported procedures (4, 18, 29). Eighty-four 70-year-old probands in the present examination of joints were also studied by Lundgren-Lindqvist et al. (17, 18, 19) which allows certain comparisons. Also, a great many data concerning e.g. manifestations of ageing, state of health, life style and social living conditions were available among the data from the longitudinal study of 70-year-olds.

From an interview at age 70, the subjects' responses concerning professional work (36) and past and present leisure time physical activity were rated on a four point scale (27); 1) physically inactive (mostly sitting down), 2) moderate (walks, cycling, etc., at least 4 hours per week), 3) regular physical activity (running, swimming, playing tennis, skiing) at least 3 hours per week or 4) hard training and competitive sports several times a week. At age 70, covering the age period 75-79, the 4th alternative was omitted. The disabilities considered in the present study are primarily personal care, locomotor, body disposition and dexterity disabilities.

The following ADL functions were registered for correlations to joint impairments:

**Interview items**
- Ability to go to the bathroom
- Ability to dress/undress
- Ability to eat
- Ability to wash feet
- Ability to cut toe nails
- Ability to perform household chores
- Ability to get up from a chair
- Ability to climb stairs
- Ability to enter public vehicles
- Use and type of walking aids
- Habits of walking outdoors summer and winter

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- Lifting hands above head/behind neck
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- Finger-tips on the opposite big toe in sitting position
- "Water pouring" test in standing position
- Lifting a glass to a shelf, 180 cm
- Lifting one kilogram package onto a shelf, 180 cm

**Student's test** and the "j test" were used together with two non-parametric tests—the Pitman test (9) and the Fisher two-tailed test (22)

**RESULTS**

Fifty-one per cent of the females and 15% of the males lived alone while 63% of the males but only 25% of the females lived with a spouse. Institutional care, defined as need of care for at least 3 months, was required for 9% of the subjects including 5% who lived in sheltered housing ("service house" or home for the elderly). Twenty-five per cent of the subjects did not have an access to elevator despite living upstairs. Handicap was reflected by certain factors, such as the proportion of subjects licensed for handicap transport service (females 47%, males 18%) or need of personal care (females 9%, males 13%) or domestic assistance (females 38%, males 23%).

Current joint complaints were reported by 35% of the individuals and back problems by 29%—including 13% with combined complaints from back and peripheral joints. Disability was experienced by one third of the subjects and reduced vision (acuity 0.10-4) was found in 27%. One fifth of the probands had no signs or symptoms of any definable disease (15).

The prevalence of certain ADL-disabilities according to interview criteria and reduced capacity in the performance of functional tests is shown in Table I. Table II gives the results of questions regarding hindrances experienced in walking out-of-doors. The risk of being accosted was the most frequent hindrance for both males and females; this fear was more frequent in females than in males.

Slightly less than 25% of the subjects reported complaints in one or both of the upper extremities and approximately 40% reported complaints in one or both of the lower extremities.
or both of the lower extremities. Fifty per cent of the subjects reported one or more complaints from either the upper or the lower extremities whereas 13% had complaints from upper as well as lower extremities (Fig. 3). Among individuals reporting complaints from one or more joints of the upper extremities, restricted ROM was found predominantly in the wrists or shoulders (Table III) whereas, in subjects with complaints from the lower extremities, hip motion was limited in 84% of the subjects and ROM of thoracolumbar spine in nearby 75%.

Among subjects with restriction in ROM (Fig. 3), 12-23 reported that they did not experience any symptoms (Table IV A and b). Table V shows the relationship between restricted ROM versus that of ADL activities. Correlations were found between difficulties in climbing stairs or getting up from a chair or the bed, as well as need for walking aids versus impaired ROM in the lower extremity (i.e., leg) and, furthermore, between the tested ability of grasping opposite ear-lobe and restricted ROM in the upper extremity (i.e., hand).

When probands reporting both joint complaints and restricted ROM within the same extremity group were compared to those who had neither symptoms nor restricted ROM in the same extremity group, significant differences were found concerning ability of entering public transport vehicles (i.e., p<0.05), ability of climbing stairs (i.e., p<0.05), need for walking aids (i.e., p<0.05), and performing the "big toe" test (i.e., p<0.001). On the other hand, no significant differences were found between the two groups regarding the ability of managing personal care and domestic tasks in ADL.

The ability of entering public transports was dependent on joint function in the upper, as well as in the lower, extremities. When mobility of shoulders, hips and knees were compared, knee motion had the strongest correlation to the ability of entering transport vehicles. There was also a strong co-variation between motion impairment of hips and knee joints. Regarding complaints, hip complaints dominated knee problems as the primary disability associated with entering public transports.

Body weight and body mass index (BMI) were correlated to complaints of knee joints (p<0.01), predominantly in females (p<0.001). Restricted ROM of the knees showed no such correlation, while instable knee joints were correlated to BMI (p<0.05).

Lean subjects reported shoulder problems and had restricted range of shoulder motion to a greater extent (p<0.05) than nonlean individuals. This was reflected in a significantly higher need of assistance in ADL functions such as dressing/undressing, eating and going to the bathroom (p<0.001). Consequently, we also found a tendency of more frequent use of social services in these subjects.

Individuals with symptoms of general disease, RA or previous injuries to joints or bone structures had a significantly diminished ability of reaching the opposite ear-lobe or the opposite big toe with the hand than those without (p<0.01). The test of ability to reach the opposite big toe was further correlated to subjects whose joint problems were caused by osteoarthrosis of the hip joint (p<0.001). There was a highly significant correlation between probable rheumatoid arthritis (defined by ≥3 criteria according to ARA (25)) and failure of the upper extremity tests (p<0.01-0.001). As might be expected, this implied a higher frequency of ADL dependency for personal care and household chores (p<0.01).

The subjects were divided into 3 groups with restricted ROM of the cervical spine (Table III).

Table III. Frequency of restricted range of motion (ROM) in probands reporting joint complaints, N=89

<table>
<thead>
<tr>
<th>Restricted ROM</th>
<th>n</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>I. Proponents reporting complaints from upper extremity/cervical spine, n=22</td>
<td>11</td>
<td>50</td>
</tr>
<tr>
<td>Shoulder</td>
<td>14</td>
<td>63</td>
</tr>
<tr>
<td>Wrist</td>
<td>15</td>
<td>68</td>
</tr>
<tr>
<td>Hand/finger</td>
<td>18</td>
<td>46</td>
</tr>
<tr>
<td>Cervical spine</td>
<td>8</td>
<td>36</td>
</tr>
<tr>
<td>II. Proponents reporting complaints from lower extremity/thoracic/lumbar spine, n=77</td>
<td>31</td>
<td>84</td>
</tr>
<tr>
<td>Hip</td>
<td>21</td>
<td>57</td>
</tr>
<tr>
<td>Thoracolumbar spine</td>
<td>27</td>
<td>73</td>
</tr>
</tbody>
</table>

Table IV A. Frequency of complaints from (I) upper extremity and (II) lower extremity in probands with restricted range of motion (ROM)

<table>
<thead>
<tr>
<th>No. of probands with restricted ROM</th>
<th>Frequency of complaints as probands with restricted ROM</th>
<th>n</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>I. Shoulders</td>
<td>Active</td>
<td>34</td>
<td>11</td>
</tr>
<tr>
<td>Passive</td>
<td>33</td>
<td>11</td>
<td>33</td>
</tr>
<tr>
<td>Wrist</td>
<td>45</td>
<td>15</td>
<td>33</td>
</tr>
<tr>
<td>Finger</td>
<td>23</td>
<td>8</td>
<td>33</td>
</tr>
<tr>
<td>II. Hip</td>
<td>Active</td>
<td>34</td>
<td>11</td>
</tr>
<tr>
<td>Passive</td>
<td>33</td>
<td>11</td>
<td>33</td>
</tr>
<tr>
<td>Knee</td>
<td>15</td>
<td>7</td>
<td>47</td>
</tr>
<tr>
<td>Foot/toe</td>
<td>13</td>
<td>6</td>
<td>39</td>
</tr>
<tr>
<td>Lumbar spine</td>
<td>20</td>
<td>11</td>
<td>55</td>
</tr>
</tbody>
</table>

Table IV B. Frequency of complaints of joint pain in probands with restricted range of motion (ROM)

<table>
<thead>
<tr>
<th>Complaints from</th>
<th>n</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>I. Proponents with restricted ROM in upper extremity/cervical spine, n=69</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Shoulder</td>
<td>13</td>
<td>19</td>
</tr>
<tr>
<td>Wrist</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Finger</td>
<td>6</td>
<td>4</td>
</tr>
<tr>
<td>Cervical spine</td>
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<td>10</td>
</tr>
<tr>
<td>Upper extremity/cervical spine</td>
<td>19</td>
<td>28</td>
</tr>
<tr>
<td>II. Proponents with restricted ROM in lower extremity/thoracic/lumbar spine, n=78</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hip</td>
<td>12</td>
<td>15</td>
</tr>
<tr>
<td>Knee</td>
<td>18</td>
<td>23</td>
</tr>
<tr>
<td>Foot/toe</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>Thoracic/lumbar spine</td>
<td>21</td>
<td>27</td>
</tr>
<tr>
<td>Lower extremity/thoracic/lumbar spine</td>
<td>36</td>
<td>46</td>
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</table>

Table V. Correlations (r=correlation coefficient) between restricted range of motion (ROM) of joints and functional disability in 76-year-old men and women (n=89)

<table>
<thead>
<tr>
<th>Restricted ROM of Cervical spine</th>
<th>Use of walking aids</th>
<th>Getting up from a chair</th>
<th>Climbing stairs</th>
<th>Difficulty in entering public transports</th>
<th>Ear-lobe test</th>
<th>Hands absence head test</th>
<th>Difficulty with clothes-peg test</th>
<th>Big-toe test</th>
<th>r</th>
<th>n</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wrist</td>
<td>-0.35**</td>
<td>-0.34**</td>
<td>-0.38**</td>
<td>0.19</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Slight impairment</td>
<td>-0.12</td>
<td>0.18</td>
<td>0.16</td>
<td>0.14</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Moderate or severe restriction</td>
<td>-0.08</td>
<td>0.33**</td>
<td>0.28</td>
<td>0.27</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
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</tr>
<tr>
<td>Finger joints</td>
<td>-0.31**</td>
<td>0.18</td>
<td>0.15</td>
<td>0.14</td>
<td>-</td>
<td>-</td>
<td>-</td>
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<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Moderate restriction</td>
<td>-0.05</td>
<td>0.41**</td>
<td>0.37**</td>
<td>0.09</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
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</tr>
<tr>
<td>Severe restriction</td>
<td>-0.12</td>
<td>0.18</td>
<td>0.15</td>
<td>0.14</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Shoulder</td>
<td>-0.08</td>
<td>0.19</td>
<td>0.17</td>
<td>0.16</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Actine</td>
<td>-0.30**</td>
<td>0.36**</td>
<td>0.40**</td>
<td>0.29</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Lumbar spine</td>
<td>0.15</td>
<td>0.20</td>
<td>0.22</td>
<td>0.07</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
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</tr>
<tr>
<td>Thoracic spine</td>
<td>0.31**</td>
<td>0.07</td>
<td>0.20</td>
<td>0.32</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
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<td>-</td>
</tr>
<tr>
<td>Hip</td>
<td>0.27**</td>
<td>0.26</td>
<td>0.43**</td>
<td>0.35**</td>
<td>-</td>
<td>-</td>
<td>-</td>
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</tr>
<tr>
<td>Knee</td>
<td>0.31</td>
<td>0.44**</td>
<td>0.36</td>
<td>0.49**</td>
<td>-</td>
<td>-</td>
<td>-</td>
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<tr>
<td>Thoroaxic/lumbar spine</td>
<td>0.27</td>
<td>0.26</td>
<td>0.43</td>
<td>0.35</td>
<td>-</td>
<td>-</td>
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p<0.05 = NS, p<0.05 = *, p<0.01 = **, p<0.001 = ***

Table VI. Functional consequences of joint impairments at age 79

<table>
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<th>Functional consequences of joint impairments at age 79</th>
<th>187</th>
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or both of the lower extremities. Fifty per cent of the subjects reported one or more complaints from either the upper or the lower extremities whereas 13% had complaints from upper as well as lower extremities (Fig. 3). Among individuals reporting complaints from one or more joints of the upper extremities, restricted ROM was found predominantly in the wrists or shoulders (Table III) whereas, in subjects with complaints from the lower extremities, hip motion was limited in 8% of the subjects and ROM of thoracolumbar spine in nearly 75%.

Among subjects with restriction in ROM (Fig. 3), 12-23 reported that they did not experience any symptoms (Table IVa and b). Table V shows the relationship between restricted ROM versus that of ADL activities. Correlations were found between difficulties in climbing stairs or getting up from a chair or the bed, as well as for walking aids versus impaired ROM in the lower extremity and, furthermore, between the tested ability of grasping opposite ear-lobe and restricted ROM in the upper extremity (i.e.) and, functional disability in ADL functions such as dressing/undressing, eating and going to the bathroom (p<0.001). Consequently, we also found a tendency of more frequent use of social services in these subjects.

When probands reporting both joint complaints and restricted ROM within the same extremity group were compared to those who had neither symptoms nor restricted ROM in the same extremity group, significant differences were found concerning ability of entering public transport vehicles (i.e., p<0.05), ability of climbing stairs (i.e., p<0.05), need for walking aids (i.e., p<0.05) and performing the “big toe” test (i.e., p<0.001). On the other hand, no significant differences were found between the two groups regarding the ability of managing personal care and domestic tasks in ADL.

The ability of entering public transports was dependent on joint function in the upper, as well as in the lower, extremities. When mobility of shoulders, hips and knees were compared, knee motion had the strongest correlation to the ability of entering transport vehicles. There was also a strong co-variance between motion impairment of hips and knee joints. Regarding complaints, hip complaints dominated knee problems as the primary disability associated with entering public transports.

Body weight and body mass index (BMI) were correlated to complaints of knee joints (p<0.01), predominantly in females (p<0.001). Restricted ROM of the knees showed no such correlation, while instable knee joints were correlated to BMI (p<0.05).

Lean subjects reported shoulder problems and had restricted range of shoulder motion to a greater extent (p<0.05) than nonlean individuals. This was reflected in a significantly higher need of assistance in ADL functions such as dressing/undressing, eating and going to the bathroom (p<0.001). Consequently, we also found a tendency of more frequent use of social services in these subjects.

Individuals with symptoms of general disease, RA or previous injuries to joints or bone structures had a significantly diminished ability of reaching the opposite ear-lobe or the opposite big toe with the hand than those without (p<0.01). The test of ability to reach the opposite big toe was further correlated to subjects whose joint problems were caused by osteoarthrosis of the hip joint (p<0.001). There was a highly significant correlation between probable rheumatoid arthritis (defined by ≥ 3 criteria according to ARA (25)) and failure of the upper extremity tests (p<0.01-<0.001). As might be expected, this implied a higher frequency of ADL dependency for personal care and household chores (p<0.01).

The subjects were divided into 3 groups with restricted ROM of cervical spine, thoracolumbar spine and lower extremity.
spect to physical strain during their professional work (26). Thus, when two groups, one with previously sedentary work and the other with previous strenuous manual work, were compared, it was found that the latter had restriction of ROM of three or more fingers and the other a greater extent than the former (p<0.05); this was not re-
lected in the variables tested on disability factors, however. Formerly sedentary workers had, at age 79, a greater need for assistance with dressing/un-
dressing and going to the bathroom than the rest of the sample (p<0.05)—no such significant correla-
tions were found concerning the heavy workload group.

When probands were divided into 3 groups (27) regarding leisure time activities before age 70—
physically inactive, group 1 (18%), moderately ac-
tive, group 2 (72%) and more physically active, group 3 (8%)—and compared on impairment and disability variables at age 79, a statistically signifi-
cant difference was found between group 1 and groups 2 and 3 concerning restricted spinal motion (p<0.05). The active groups also showed a re-
duced need of assistance in ADL (p<0.05). Many disabilities, especially reduced ADL functions and difficulties in walking or climbing stairs, were re-
lated to a sedentary life in the preceding 4 years (p
-values<0.001-0.01). This also concerned probands
free from disease and joint disorders at age 79. They displayed a high correlation between low physical activity and diminished ability to dress/undress (p<0.001), make beds (p<0.01) and go to the bat-
hroom (p<0.001).

DISCUSSION

In accordance with previously reported studies of joint impairments in 79-year-olds (7), the present re-
sults further indicate that a restriction in ROM com-
pared to what is considered “normal” in younger in-
dividuals (1, 6) is common in elderly subjects who do not show any evidence of joint disorders or have joint complaints. Our conclusion is that the manifes-
tations of ageing often imply such a restriction, and that this should be taken into account when “nor-
mality” of joint motion (clinical reference values) in the elderly is considered. Reference values for joint motion are often given without adjustment for age
(1, 6), although a few studies have contributed to our knowledge of ROM in elderly subjects (12, 28, 33). Furthermore, as also reported by Jette & Brench (1983) (14), considerable impairment and restriction in ROM can exist in the elderly without causing obvious disability.

Previous morbidity statistics suggests joint impair-
ment and disability to be the most frequent health problems (10, 11, 16). Our comparison between the upper and lower extremity groups of joints showed that complaints were more often directed to the lower extremity group. This would indicate a higher frequency of locomotor disabilities such as reduced walking capacity, but 80% of the 79-
year-olds were still able to climb stairs and walk above 1000 m.

One of the aims of this study was to look for pos-
sible relations between functional disturbances that are easy to measure and practically important dis-
abilities. The “car-lobe test” was shown to reflect the ability of combing or washing hair, and the abil-
ity to perform the “big toe test” seems to be related to the ability of washing feet or putting on stockings and shoes. Thus, a negative outcome on these tests would imply a diminished active life. The step-test, reflecting the ability to use public transportation, would obviously be meaningful to perform more often considering its important implications.

Impaired joint motion was not found to be a major cause of loneliness or sparse contact with chil-
dren or friends. Besides direct motor disturbances, the prevalence of general disease, dizziness or other neurological symptoms and decreased sensory func-
tions—such as visual or auditory impairment—could influence the living situation. The frequency of car-
 diovascular disorders in combination with joint im-
pairment made certain conclusions regarding the de-
finite cause of disability impossible. The use of pre-
scribed drugs might also contribute to restrictions of moving about, i.e. use of diuretics or side effects of sedative drugs; only 5% of the females and 23% of the males were totally without current medication.

Furthermore, within the locomotor system, it was previously reported that the reduction of muscle strength associated with ageing had an earlier onset and was more pronounced in the lower extremities than in the upper ones (10). As a consequence, the re-
duced ability of e.g. climbing stairs (4, 5, 23). The force of the quadriceps is muscle of significant im-
portance for the ability to enter a bus or a train (4).

Regarding joint problems, we found that restricted ROM was of greater importance to the occurrence of a disabil-
ity than the proband’s complaints on joint prob-
lems—this was shown for shoulder involvement in the “car-lobe test”, knee involvement in the “big-toe
test” and hip and/or knee impairment when trying to eat a banana.

Strenuous manual work in earlier life was not negatively related to the ADL functions at age 79.

Such a correlation might traditionally have been ex-
pected as a consequence of “wear-outs joints”; however, to the contrary, the sedentary workers were more disabled than those with a previous strenuous oc-
cupation. However, this might also be due to selection of individuals to specific jobs, and thus reflect per-
sonal capacity and interests at younger ages. Fur-
thermore, it might illustrate selection of survivors up to age 79. No significant differences of mortality rate in the age 70–75 or 75–79 were found between the heavy and the sedentary worker groups.

Those who reported a low physical activity at age 79 usually had been rather inactive throughout most of their adult life. Two thirds of individuals report-
ing sedentary life styles had displayed the same style throughout their lives. This seems to indicate that their higher prevalence of disability was not an obvi-
ous cause for their sedentary life at age 79. The same rather constant activity traditions were reported by the physically active; 90% of these also reported a similar life style throughout their adult life.

The results show that the practical consequences of the studied disability parameters often had dif-
ferent practical implications for females and males. In daily life, females experienced a greater need for domestic help and transport service; this was also re-
lected in their greater difficulty in entering public transports. This could partly be explained by a higher prevalence of peripheral joint disorders in females than in males (7), but social factors could be of some importance, especially the need of domestic help (30). Thus, more than half of the females of the sub-sample were living alone compared to one fifth of the males. Furthermore, nearly 2/5 of the males were married and would probably expect their wives to perform household chores and assist on personal care, whether they were able to do these things themselves or not. Females experienced more fear of going outdoors alone, partly due to the risk of fal-
lng down, but to a great extent, due to fear of being submitted to violence. The climate plays a role, too, as the number of probands unwilling to walk out-
doors due to the risk of falling was 3 times higher during the winter season than during summer. Of joint motion impairments, restricted hip ROM was found in all men with chronic disease, but a negative attitude towards going outdoors during winter.

Previous reports from the longitudinal study of 70-
year-olds have shown that institutional care, defined as need of care for at least 3 months, was required for 3% at age 70 and 5% at age 75 (21). Although at age 79 this percentage had increased to 8.5% (20), no significant correlation was found between joint impairment and institutional care; the reasons for commitment to care or sheltered housing were gen-

erally complex and based on a combination of so-
cial, psychiatric and somatic factors. The present re-
sults indicate, however, that the prevalence of dis-
abilities and handicaps increases markedly towards the age of 80 compared to the age interval 70–75 as previously observed in the same subjects (31).

On the other hand, at least 80% of the 79-year-
olds were capable of performing basic personal care functions, over 90% could manage their own house-
keeping and more than two thirds never used a walking aid despite the fact that restricted ROM of separate joints was found in one fifth to two thirds of all subjects. This implies that the elderly are able to cope with a minor diminishment in ROM. Further-
more, one fifth of the probands displaying restricted ROM of either upper or lower extremity compen-
sated for the impairment mainly by using the opposite joint group, e.g. by using a hand-
rail for entering a bus or getting up from a chair. A general conclusion is that disability directly due to joint impairment is not very frequent even at the age of 79.

ACKNOWLEDGEMENTS

The population study of 70-year-olds in Göteborg (H 70) became possible through grants from Delegation for Social Research within the Ministry of health and Social Affairs, Göteborg Administration of Social Services, Göteborg Medical Services Administration, Swedish Medical Research Council and Wilhelm and Martina Lundgren’s Foundation.

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Changes in Histochémical Profile of Muscle after long-term electrical stimulation in patients with idiopathic scoliosis

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ABSTRACT. Adolescent patients with idiopathic scoliosis were treated with long-term electrical stimulation (30 Hz) at the posterior axillary line on the convex side of the curve in order to correct the spinal deformity. The patients were also followed with muscle biopsies from the latissimus dorsi of the stimulated side taken before, after 3 months and 2 years of electrical stimulation. There was a tendency for an increase in the percentage of type I fibers and especially the type II C (differentiated) fibers after stimulation. The mean muscle fiber area and the fiber areas of the various fiber types did not change significantly. Histopathological findings were generally comparable with those after 3 months of electrical stimulation. The present study gives some evidence of an adaptive process caused by electrical stimulation towards a more fatigue-resistant muscle.

Key words: Electrical stimulation, muscle morphology, muscle enzymes, scoliosis

The present report has a twofold background: 1) It is part of a clinical study on the long-term use of electrical muscle stimulation in patients with idiopathic scoliosis in order to prevent further development of the curvature without the use of braces. It was considered important to examine any significant changes in the muscle structure in these otherwise healthy subjects; 2) to gain unique information on the effect of long-term electrical stimulation in human muscle and look for confirmation of previous reports from animal studies on muscle fiber transformation.

In the present report the main emphasis will be placed on the effects on the muscle structure, whereas the effect on the scoliotic deformity of the treatment with electrical stimulation in a larger material will be reported in detail elsewhere (Nordwall—unpublished). There are a number of experimental reports (17) on the effect of electrical stimulation on skeletal muscle. By chronic low frequency stimulation a fast twitch muscle will be transformed to a slow twitch muscle with increased oxidative enzymatic activity and capillary density (5, 8, 13, 14, 15). Changes in the connective tissue properties will occur with increased time to peak twitch tension (14) and an increased resistance to fatigue (10). The overwhelming evidence points to a transformation within the individual fiber and not to proliferation of slow- twitch (type I) fibers concomitant atrophy and degeneration of fast-twitch (type II) fibers (17), e.g., in the experimental long-term stimulation where no signs of extensive degenerative or regenerative changes have been found and a mosaic fiber pattern was seen.

Relatively few studies have been reported on the effect of electrical stimulation on muscle structure and function in humans, and then usually only over a relatively short period of up to two to three months. Munster et al. (12) found, after stimulation for 5-12 weeks at 33 Hz, an increase in the percentage of type I fibers of 4.4% in the quadriceps muscle of four patients with extreme muscle atrophy due to disease. The oxidative enzymatic activity and fiber size also increased.

We will in the present report give some evidence of changes in the fiber population and an increase of the oxidative enzymatic activity after three to six months’ electrical stimulation with no major histopathological findings.

MATERIAL

The study was performed in 10 young patients (9 girls and 1 boy) with recently detected moderate, progressive idiopathic scoliosis. All curves were thoracic with the curve vertex at T7 or T8. Mean chronological age of the patients was 12 years and 9 months (range 11.0-13.2 years) and the mean skeletal age was 12 years and 5 months. None of the