Abstracts

Presented at
The 10th Measurement and Evaluation Symposium:
Measurement Issues and Challenges in Aging Research
October 16-18, 2003 • University of Illinois, Urbana-Champaign, Illinois, USA

Sponsors:
American Association for Physical Activity and Recreation
American College of Sports Medicine
Centers for Disease Control and Prevention
University of Illinois at Urbana-Champaign
Human Kinetics, Inc.
Active for Life
National Blueprint: Increasing Physical Activity among Adults Aged 50 or Older
Mettler Center for Whole Life Fitness
Carle Therapy Service
Dynastream Innovations
CIR Systems, Inc.
University of Illinois Campus Recreation
Ambulatory Monitoring, Inc.
American Physical Therapy Association
Body Media, Inc.
Cambridge Isotope Labs, Inc.
Mini-Mitter Co., Inc.
Partnership for Prevention

© 2007 Human Kinetics, Inc.
Aging

Changes in Elderly Normal and Fast Walking Gait Due to a General Activity Program

P. A. Macfarlane, Ph.D.1, M. F. Visser, Ph.D.2;
1Northern Illinois University, DeKalb, IL, 2Minnesota State University-Mankato, Mankato, MN

Purpose: The purpose of this study was to determine changes in gait mechanics in older adults walking at “normal” and “as fast as you can safely walk” speeds as a result of participation in a general mobility program. Methods: Thirty-three healthy, independent over 70 year-olds (13 M, 20 F) with a mean age of 78.2 (SD ± 5.6) y completed a twice a week exercise program offered in a retirement center. The program consisted of a 5-min warm up of group calisthenics, 15 min of group balance and mobility activity, 15 min of whole body progressive resistive strength using elastic tubing, and 5 min of large motion stretching. Before and after the program, gait was recorded by videotape in the sagittal plane as subjects walked across a 15 m walkway. The mean of three strides in the middle of the walkway during the third walking lap was used for analysis. Distance (step length) and phase variables (early and late stance and swing phases) were determined using a customized video analysis system. Results: Subject-selected walking speed increased for both normal (7%) and fast (4.8%) options (see table). This was predominantly due to significant increases in step length (6.8% in normal and 4.8% in fast), but was accompanied at the normal pace by a significant increase in cadence (2.0%) due to a significant decrease in the late stance phase, from mid-stance to toe off (3.8%). Conclusions: The results of this study suggest that the normal and fast walking gait of older adults can be improved as a result of participation in a general mobility program. The improvement in both self-selected speeds appears to be due to longer steps rather than more frequent steps. An unexpected finding was that minimal changes occurred in the timing of the leg movements especially at the faster speed. It cannot be determined which part of the program afforded the improvement in gait, however since balance and strength belong in a comprehensive program for older adults it may not be of consequence. Practical implications suggest that to improve walking speed in healthy older adults, it may be appropriate to stress increasing step lengths rather than taking quicker steps.

Gait variable results

<table>
<thead>
<tr>
<th>N=normal</th>
<th>Speed m/min</th>
<th>Step length cm</th>
<th>Cadence str/min</th>
<th>Early stance sec/100</th>
<th>Late stance sec/100</th>
<th>Early swing sec/100</th>
<th>Late swing sec/100</th>
</tr>
</thead>
<tbody>
<tr>
<td>F=fast N pre</td>
<td>73.4(8.4)</td>
<td>65.4(8.7)</td>
<td>55.7(3.4)</td>
<td>35.4(2.9)</td>
<td>37.0 (2.8)</td>
<td>17.6(1.6)</td>
<td>18.0(1.5)</td>
</tr>
<tr>
<td>N post</td>
<td>78.6(9.2)</td>
<td>69.8(9.0)</td>
<td>56.8(3.8)</td>
<td>34.5(2.7)</td>
<td>35.7(2.7)</td>
<td>17.3(1.9)</td>
<td>18.4(2.1)</td>
</tr>
<tr>
<td>p-level</td>
<td>&lt;0.001</td>
<td>&lt;0.001</td>
<td>0.03</td>
<td>0.14</td>
<td>&lt;0.001</td>
<td>0.260</td>
<td>0.214</td>
</tr>
<tr>
<td>F pre</td>
<td>100.5(14.9)</td>
<td>76.1(11.4)</td>
<td>65.8(5.6)</td>
<td>28.8(2.5)</td>
<td>29.8(3.0)</td>
<td>15.9(1.6)</td>
<td>16.7(1.4)</td>
</tr>
<tr>
<td>F post</td>
<td>105.3(15.1)</td>
<td>79.8(11.3)</td>
<td>66.1(5.4)</td>
<td>28.7(3.0)</td>
<td>29.8(2.6)</td>
<td>15.8(1.7)</td>
<td>16.6(1.9)</td>
</tr>
<tr>
<td>p-level</td>
<td>0.03</td>
<td>&lt;0.001</td>
<td>0.83</td>
<td>0.78</td>
<td>0.96</td>
<td>0.86</td>
<td>0.79</td>
</tr>
</tbody>
</table>
Aging
Importance of Foot Function in Reducing Falls in Elderly: A Review
B. Shetty, Ph.D.
Hampton University, Yorktown, VA
Recent studies have focused on reducing the risk of falls among elderly through strengthening muscles, increasing range of motion and flexibility, improving balance and efficiency of gait, and decreasing reaction time. It is suggested that strength, flexibility, balance, and reaction times were the factors most amenable to modification, and thus, provided rationale for exercise intervention trials measuring the efficacy of exercise in the prevention of falls in the elderly. The purpose of this review is to develop a concentrated effort in research to include foot functioning and falls in elderly. The foot is an important structure that transmits a great amount of force to the ground for acceleration or deceleration during gait. The ankle dorsiflexion strength was significantly impaired in elderly fallers compared with nonfallers, suggesting that the inability to initiate appropriate ankle dorsiflexion strength may contribute to instability and falls. Ankle limitations in range of motion, reaction time stepping, medial lateral sway, joint laxity, and muscular strength all factor into the stability of the base of support. Since general strength training and static and dynamic balance training have been shown to have a positive effect on overall stability, appropriate strength training of the ankle and foot’s dorsiflexors, plantarflexors, evertors, and invertors should also demonstrate decreases in postural sway and improve overall stability. By strengthening these muscles, elders can relearn to assist in weight acceptance and push-off as they did when they were younger. Therefore, future research also should focus on the impact of foot function on gait, balance, and falls in the elderly. Several areas that can be included for future research are strength and endurance of foot muscles, footwear design, right and left foot imbalance, and transfer of weight during gait. This will help to improve quality of life by avoiding falls and related injuries.

Measurement
Analysis of Measurement Indices of Physical Power for Match Results of J u dy Players
D. Nam, Ph.D., J. Park, Ph.D.; Yongin University, Yongin, Republic of Korea
The purpose of this study was to identify physical indices for the determination of match results of judo players through confirmation of physical factors that determine the group records of matches. This study was conducted on junior high school male judo players. Five junior high schools with judo teams were selected by random cluster sampling in Seiol and Gyeonggi provinces. Physical power was determined by examination of heights and body weights as indices and muscular strength, muscular endurance, cardiopulmonary endurance, flexibility, power, and agility were defined as sub-indices. The examination of physical power to determine these characteristics was adopted for determination measure and the examination was made. Mean and standard variation values were obtained by SPSS version 11.0 statistical program and the result of discriminant analysis for the results was as follows:
1. Determination of excellence or non-excellence was based on physical power and Wilks’ Lambda value showed statistical significance with 5% of statistical level.
2. Discriminant functions of excellent players or non-excellent players for determination of physical power levels were as follows:
   Muscular strength: \( Y = 0.267Z_{\text{grip strength}} + 0.088Z_{\text{back strength}} + 0.973Z_{\text{arm strength}} - 0.522Z_{\text{leg strength}} \)
Muscular endurance power: $Y = 0.267Z_{\text{grip strength}} + 0.088Z_{\text{back strength}} + 0.973Z_{\text{arm strength}} - 0.522Z_{\text{leg strength}}$

Six factors for physical power: $Y = 0.848Z_{\text{muscular strength}} - 0.272Z_{\text{power}} + 0.461Z_{\text{muscular endurance}} + 0.052Z_{\text{cardiopulmonary endurance}} + 0.193Z_{\text{flexibility}} + 0.302Z_{\text{agility}}$

Twelve items of physical power: $Y = 0.645Z_{\text{grip strength}} - 0.258Z_{\text{back strength}} + 0.818Z_{\text{arm strength}} - 0.452Z_{\text{leg strength}} - 0.544Z_{\text{sargent jump}} + 0.408Z_{\text{sit up}} - 0.042Z_{\text{dip press}} + 0.355Z_{\text{repeated jump}} + 0.205Z_{\text{Burpee test}} + 0.159Z_{\text{Harvard step}} + 0.033Z_{\text{trunk flexion forward}} + 0.242Z_{\text{side step}}$

3. Among the items of physical power, the contribution of the six factors for physical power determination was made in the order of muscular strength, muscular endurance, agility, flexibility, power, and cardiopulmonary endurance, and the contribution of the 12 items of physical power was made in the order of arm force, abdominal muscular endurance, leg muscle endurance power, agility, flexibility, systemic muscular endurance, power, arm muscular endurance, grip strength, back muscular strength, cardiopulmonary endurance, and leg muscular strength.

Aging

Obesity Resistance in an Aging Population and the Gene-Gene Interaction of Two Obesity Candidate Genes

M. L. Hart, B.S., M. Bray, Ph.D.; University of Texas Health Science Center—School of Public Health, Houston, TX

Obesity is a highly prevalent disease and has become a major health crisis in the United States and throughout the world. The issue of obesity is important to older Americans because research has indicated that maintaining a lean body mass into maturity is essential for healthy aging. Though a majority of the adult population is now considered overweight, of particular interest are those mature individuals who have maintained a normal weight into late adulthood without excessive caloric restriction or physical activity. Recent research has shown that genetic variation plays a crucial role in the etiology of obesity. Therefore, there may be a genetic mechanism that enables these mature lean individuals to resist obesity despite an abundance of palatable food and lack of exercise. The human melanocortin-4 receptor gene (MC4R) regulates satiety and possibly energy expenditure. Inactivation of the MC4R gene in mice results in mature-onset obesity, hyperinsulinemia, hyperglycemia, and hyperphagia. The Val103Ile polymorphism of the MC4R gene may be linked to body size variation. The human leptin gene (LEP) also controls fat stores by influencing feeding and metabolic rate. A common polymorphism, A<G19, of the LEP gene is associated with decreased leptin levels and obesity. The purpose of this study was to investigate the association of the gene-gene interaction of these polymorphisms with obesity-related traits, including BMI, waist-hip ratio, and leptin levels, in African American participants, aged 45 to 65, from the Atherosclerosis Risk in Communities Study. Genotyping of the human LEP and MC4R genes was performed using the TaqMan assay (Applied Biosystems, Foster City, CA) in 3127 subjects. Regression analysis was used to test the association of the gene-gene interaction and the obesity-related measures, with age, gender, fasting glucose levels, leisure activity score, smoking status, and diabetic status as covariates. Those with the presence of both the LEP A19 allele and the MC4R Ile103 allele were 69% less likely to be obese ($p = 0.0037$) and had a significantly lower BMI ($p = 0.0139$). The results suggest that when these alleles are both present, a person may be resistant to obesity. Future...
analysis will investigate this gene-gene interaction effect on obesity-related measures in other populations.

**Aging**

**The Effect of Regular Exercise on Mortality Rates in Older Adults**

Korea National Sport University, Seoul, Republic of Korea; Sung Kyul University, An Yang, Republic of Korea

**Purpose:** The purpose of this study was to examine the relationship between regular exercise participation and mortality in older adults living in Seoul, Korea. **Methods:** In 1999, a total of 295 participants’ regular exercise and their background information were measured using a self-report questionnaire. The participants ranged in age from 65 to 75 y. Four years later, in 2003, a telephone interview was performed to identify participants’ existence. Thirty-eight participants out of 295 were dropped out from the study. Finally, 257 participants (128 male and 129 female) could be identified. There were 231 (89.9%) that remained, and the death of 26 (10.1%). Data was classified into four groups: exercise group with more than 20 y of participation (N = 47), exercise group between 10 and 20 y of participation (N = 74), exercise group between 5 and 10 y of participation (N = 73) and non-exercise group (N = 63). The odds ratios of the regular exercise participation were analyzed in logistic regression. Exercise group with more than 20 y of participation was set as the reference category. **Results:** The results showed that mortality rate of males was 5.66 times (p < 0.05) higher than the females. Also, the mortality rate of non-exercise group showed 6.76 times (p < 0.05) higher than the exercise group with more than 20 y of participation. Similar results were found when the age variable was controlled (5.45 and 6.01 respectively; p < 0.05). **Conclusions:** The finding suggests that regular exercise participation with more than 20 y are indirectly related to the mortality rates. As a longitudinal study, further investigation is greatly needed considering participants’ health level and health-related physical fitness.

**Aging**

**The Effects of a 13-Week Walking Program on Static and Dynamic Balance in Elderly Women**


**Purpose:** The purpose of this pilot study was to determine the effects of a 13-week walking intervention on measures of static and dynamic balance of elderly women living in an extended care retirement community. **Methods:** Ten apparently healthy women who had not participated in regular exercise 6 months prior to the study were recruited to follow a walking protocol. Five women (age = 75.00 ± 4.47) of the initial cohort completed the walking program and post-test evaluation. The participants were instructed to walk a minimum of 15 min/d, 3 to 4 times/wk, and with incremental increases occurring periodically depending on individual rate of progression. Subjects self-reported the time of their exercise in exercise journals. In addition, the research team followed up with weekly phone calls and personal communication. Static and dynamic balance were measured pre- and post-intervention. The Stand and Reach Test (SRT)
and the One Foot Stand (OFS) were used to measure static balance whereas dynamic balance was measured with the Timed Up-and-Go (TUG), Figure 8 Walk (F8W), and the Board Walk (BW).

**Results:** Paired t-tests showed no significant difference between pre- and post-test scores for either test of static balance. In addition, paired t-tests demonstrated that only one dynamic test, TUG ($p = 0.002$), elicited significant improvement from pre- to post-testing.

**Conclusions:** The SRT, OFS, F8W, and BW measured balance that require specific or functional skills for balance and were not influenced by a walking intervention, whereas the TUG measured linear movement from point to point that was more specific to a walking program and elicited significant change from pre- to post-measures. Thus, this pilot suggests that walking may elicit specific balance improvement related to ambulation; however, further research must address the need for balance intervention specific for activities of daily living common among elderly.

**Measurement**

**Anthropometric Proportion of Elite Female Bowlers**

J. Lee, M.A., S. Kang, Ed.D.; Korea National Sport University, Seoul, Republic of Korea

Many bowling-related studies have focused on biomechanical and psychological variables with only a few examining morphological characteristics of elite players. Some have suggested anthropometric proportion may be useful in estimating training effects. **Purpose:** The purposes of the study were: (a) to describe the body dimensions of elite female bowlers; (b) to compare the anthropometric data of female bowlers with different levels of sporting ability; and (c) to establish an anthropometric profile chart for female bowlers, which could be used for training and talent identification. **Methods:** Eighty-six female elite bowlers with an average age $26.5 \pm 2.1$ y, participated in this study. They were selected from three different skill levels: national representative, province representative, and business team players. The height, weight, skinfold thickness, girth, percent of muscle mass, percent of bone mass and percent fat were measured. The anthropometric data of the selected bowlers were collected by Level 2 anthropometrists, based on Anthropometry Proforma developed by the International Society for the Advancement of Kinanthropometry (ISAK). Data were analyzed with ANOVA to identify the group differences of the anthropometric measures and morphological characteristics. **Results:** There were no significant differences found ($p > 0.05$) in the anthropometric measures: height, weight, skinfold thickness, girth, and width among the three different skill levels. There was, however, a tendency for the national team bowlers to be slightly taller and heavier than other groups. They also tended to have bigger hips, ankles, and thighs. There was also no significant difference ($p > 0.05$) in the morphological characteristics: percent of body fat, percent of muscle mass, and percent of bone mass among the three skill levels. **Conclusions:** It was concluded that anthropometric measures may not be important prerequisites for success at national level of bowlers.

**Measurement**

**Anaerobic Power Production of Female Athletes Using Modified Ascent Methods for the Margaria-Kalamen Power Test**

R. DiBrezzo, Ph.D.1, R. H. Ferguson, Ph.D.1, S. Sawchak, M.S.2;  
1University of Arkansas, Fayetteville, AR, 2University of Houston, Houston, TX
The Margaria-Kalamen Step Test (M-K), which is used to assess anaerobic power, was developed using male college athletes. It has been used to assess power in female athletes, although it has been suggested that the standard three steps per stride ascent may not be ideal for females. **Purpose:** The purpose of this study was to compare M-K power output for female athletes using modified ascent methods. **Methods:** Thirty-three female athletes from a NCAA Division I school participated in the study. The participants performed the M-K using three different ascent methods: the standard three steps per stride ascent, a modified two-step ascent, and a ramp ascent. The ramp was affixed to the steps and had marking to indicate foot placement. This enabled the participants to ascend the ramp with the same number of steps and with the same stride length as the standard three-step ascent. The participants completed eight trials under each condition after three practice trials. Mean ascent times were determined for each condition from the eight trials. Mean power was then determined for each participant. **Results:** A repeated measures ANOVA revealed that there was a significant difference in mean power between the three ascent methods ($F = 41.768, p < 0.0001$). Tukey post hoc analyses revealed significant differences between the two-step ascent (99.17 ± 14.77 kg-m/sec) and both the standard (120.70 ± 20.76 kg-m/sec) and ramp ascents (121.90 ± 27.03 kg-m/sec) ascents. There was no significant difference between the standard and ramp ascents. **Conclusions:** Results of this study suggest that the standard three-step ascent is an appropriate part of the M-K protocol for female college athletes. It also suggests that the ramp ascent can be used in place of the standard ascent for this population. The ramp therefore would be a viable option if individuals were reluctant to negotiate steps using a maximal effort. It is suggested that additional research be conducted to determine which ascent methods are most appropriate for assessing power in other females.

**Measurement**

**Methodological and Psychometric Concerns of Neuropsychological Tests of Mild Traumatic Brain Injuries**

University of Illinois at Urbana-Champaign, Urbana, IL

Concussions are very serious injuries, often times resulting in permanent brain damage and ending careers of many. Repetitive head injuries increase the likelihood of serious consequences (CDC, 1997). There are an estimated 300,000 sports-related concussions every year (Thurman et al., 1998). This has increased the awareness of concussions which has forced the development of better measurement tools to study the effects including neuropsychological components. Concussions can impair memory, attention, concentration, and reaction time (Levin et al., 1987). While there have been many neuropsychological tests used to identify the effects of concussion, there are several major concerns of methodological soundness and psychometric quality of these tests. The purpose of this study was to examine commonly used neuropsychological concussion tests for validity, reliability, and other psychometric characteristics. Several neuropsychological concussion tests were investigated including paper and pencil tests and computerized ones. Four criteria were used to evaluate the tests: design and construction, testing paradigm and score interpretation, reliability, and other psychometric properties. Upon examination of the tests, some major concerns were identified with the method of identifying and measuring change from concussion. There is a discrepancy between testing paradigms. An individual-centered method, which compares a person’s post-concussion test results to their baseline performance, is the most
commonly used in sports medicine, while others have suggested a criterion-referenced interpretation and design for their test. Another psychometric concern that was identified was poor psychometric properties. Ceiling effects are often experienced. This could indicate the test has not been designed to meet the prescribed individual-centered method and associated testing paradigm. The caliber and range of the items may not be measuring the full dimension of the various cognitive functions. These tests also experience poor performance in reliability, and they use outdated methods for identifying change in performance. The majority of the tests use the Reliable Change Index, confidence intervals based on the standard error of the difference, to identify change from baseline to post-concussion results. Further investigation in the development and construction of these tests are needed to address the alarming psychometric concerns. It is important for these tests to be constructed and evaluated with sound modern measurement theory. Currently, these tests are potentially riddled with significant issues and problems.

Measurement
Testing the Significance of Correlations in a Matrix
H. H. Morris, P.Ed.
Indiana University, Bloomington, IN

A correlation coefficient (Rho) represents the degree of relationship between two variables in a population. As with other parameters, the sample correlation coefficient is subject to sampling error. Tests of significance have been developed to determine whether an obtained correlation coefficient differs from zero or from another in the same population, and whether the correlation between two variables differs in various populations. Tests are also available to determine simultaneously whether the correlation coefficients in a matrix are significantly different from zero. Nevertheless, such procedures are infrequently used in the research literature. Instead, the elements of the correlation matrix are usually individually tested with a t-test procedure. Testing individually the significance of the correlations in a matrix leads to an inflation of the experiment-wise error rate as the number of variables in the matrix increase. This is similar to testing the significance of all possible pairs of means in a study to examine the effects of more than two levels of an independent variable. The purpose of this paper will be to present four procedures for testing the significance of correlations in matrices (Bartlett, 1950; Kullback, 1959, 1967; Steiger, 1980; and Brien et al., 1984). Also, the results of a Monte Carlo study by Silver and Dunlap (1989) will be presented. The analysis of an exemplar correlation matrix will be presented. Two of the procedures require the calculation of the determinant of the correlation matrix and the other two require the use of Fisher’s Z prime transformation. The Brien et al. (1984) procedure is recommended based on ease of calculation, but primarily because of its ability to control Type I error rates while maintaining maximum power, as contrasted with the other three procedures.

Measurement
Learning and Outliers: Factors in the Reliability of Reaction Time and its Fractionated Components
H. Guan, M.Ed., H. H. Morris, P.Ed.; Indiana University, Bloomington, IN
Purpose: Researchers in human motor control and learning are often required to record numerous observations to assure the validity and reliability of their measures. To assure that baseline measures are free of factors caused by learning, fatigue, or other time-related variables, researchers have been advised to analyze data for trends, and where possible select the mean of those observations that are trend free, thereby supporting the fundamental assumption that measurement error is a random rather than systematic factor (Kroll, 1967; Liba, 1962). Further, outliers can introduce biases that affect the validity and reliability of these measures. The purpose of this investigation was to estimate the reliability of two data sets designed to provide valid criterion scores for simple reaction time (RT) and its fractionated components, premotor (PMT) and motor time (MT).

Methods: The measurement schedule was based on all of the trials of eight right-hand dominant volunteer college age participants who were measured for four successive days. On each day, subjects responded to a visual stimulus on 20 successive trials, with a supination movement of the right hand. A second analysis, however, screened the data for outliers. When detected, the outlier trial was removed, and the mean of the remaining trials for that specific participant on that day was included. The data was analyzed using a two-way repeated measures ANOVA (completely random model) with days and participants serving as the independent variables. Following an assessment of the day-to-day and trial-to-trial trends, a measurement schedule was selected that was trend free. Intraclass correlation coefficients (ICC; Shrout & Fleiss, 1979) were completed for each of the data sets.

Summary of Results: Significant day-to-day variation occurred for both RT and PMT, while the day-to-day variation for MT was not significant. ICC values for RT improved across the 4 d, ranging from 0.445 on Day 1 to 0.86 on Day 4. Data screened for outliers showed somewhat higher reliability estimates on each of the test days, ranging from 0.51 on Day 1 to 0.93 on Day 4. Similar values were recorded for the PMT data. The ICC values for the screened MT data were above 0.90 for Days 2, 3, and 4.

Conclusions: To improve the reliability of reaction time measures, the analysis of these results support assessing the data for day-to-day for trends (Kroll, 1967; Liba, 1962) and for the detection and replacement of outliers.

Measurement and Aging
Computations and Presentation of Physical Activity Space Using ArcGIS

T. T. Yilmaz, B.A., W. Zhu, Ph.D.; University of Illinois at Urbana-Champaign, Urbana, IL

The purpose of this study is to show how to compute and present physical activity space (a new measure of physical activity behavior), and its interaction with the environment by using ArcGIS (a geographic information system software). There is a rapidly growing interest in determining the impact of environment on physical activity. The commonly used physical activity measures, however, could not meet the need since they only measure the physical activity itself, not the surrounding environment and their interactions. To address this need, Zhu (2003) has proposed a new concept and measure called “physical activity space (PAS),” which is defined as “the area or space where an individual spends time and engages in physical activities.” The physical activity space of an individual is comprised of: home, other activity areas (e.g., workplace, schools, restaurants, shops), and the routes (either pathway or road) traveled between home and other activity areas. Spatial statistics and graphics (e.g., confidence ellipses, kernel density, and minimum) have been demonstrated to be useful indices or means to compute and present PAS, but GIS-related software is usually required. Using ArcGIS software, the purpose of this study is
to illustrate how to compute and present PAS data accurately and effectively. Some research data from two PAS pilot studies will be used for the illustration. ArcGIS has been shown to be a powerful analytical and graphical presentation tool to conduct spatial and temporal analyses, and powerful visualization of the GPS data collected by the sample group. ArcGIS has been demonstrated to be a useful tool to illustrate PAS, with the following characteristics and advantages, which will be presented. First, displaying the GPS data on top of the existing condition (roads, parks, university, etc.) so the user got a sense of the physical activity patterns in the real world. Second, providing several different analysis methods (kernel density, classification methods, buffering, etc.). Third, creating different maps that display and visualize the analysis in a powerful way. It will also be shown that comparison of locations and intensities of activity spaces between different days of an individual and also between different individuals are made possible by using the ArcGIS software. Finally, future improvement directions will briefly be described. Using the ArcGIS software, measurement and presentation of physical activity space have been demonstrated to be possible and convenient.

Measurement
Instructional Issues in Reliability
L. R. Odom, M.A.
University of North Texas, Denton, TX

The issue of instrument reliability is one of the most important and fundamental aspects of measurement and evaluation. However, many misconceptions persist regarding what reliability is and what information it provides. For example, the phrase: “The test is reliable” is often used as justification for selecting one assessment instrument over another. Such a decision is usually based on the published internal consistency reliability coefficient (e.g., Cronbach’s alpha) or test-retest values reported in the instrument’s manual. In all fairness, such documentation will also contain a description of the sample characteristics from which the reliability coefficients were derived. Yet, even when a researcher selects a comparable sample to administer the same assessment instrument, there is no guarantee that the administration will yield a reliability coefficient of the same magnitude as the value(s) published in the instrument’s documentation. There are a variety of factors that affect/influence a reliability coefficient. To facilitate an understanding of the general concepts related to reliability, a Microsoft Excel spreadsheet workbook was created to (a) provide an interactive heuristic dataset that students can manipulate to see the immediate impact of their changes on the reliability coefficient; (b) provide an interactive teaching tool that instructors can use as a visual aid for presenting issues related to reliability; and (c) provide a means to dispel some of the common misconceptions relating to factors affecting reliability. This poster session will include a demonstration of the many features of this reliability instructional tool. Additional topics to be presented include the following: KR$_{20}$ and KR$_{21}$ computation examples, Cronbach’s alpha computation examples using both dichotomous scoring and Likert-type scaling, example of a “zero reliability” scenario, and Spearman-Brown prophecy calculations for estimating a reliability value and determining the test length for a new reliability. Conference participants may obtain copies of the reliability tool provided they bring an IBM-formatted 3.5” floppy disk to the poster site.
Measurement and Aging
Implications for Measurement and Evaluation of the National Blueprint
C. Park, M.S.¹, L. Sheppard, M.S.¹, J. Senior, B.S.², T. Bazzarre, Ph.D.³, W. Chodzko-Zajko, Ph.D.¹;
¹University of Illinois at Urbana-Champaign, Urbana, IL, ²American College of Sports Medicine, Indianapolis, IN, ³Robert Wood Johnson Foundation, Princeton, NJ

In this paper, the authors will provide an overview of the National Blueprint and summarize the major implications of the Blueprint for research and clinical practice in kinesiology. In recent years increasing attention has focused on the importance of regular physical activity for the older adult population. This is due, in part, to a growing awareness of the significance of predicted

Measurement
Goal Orientation, Motivational Climate, and Beliefs About the Causes of Success Among Athletes
K. E. Tower, D.P.E.;
Central Connecticut State University, New Britain, CT

The constructs of sport achievement orientation have been examined from multidimensional perspectives. Various researchers (Atkinson, 1964; Harter, 1978; McClelland, Atkinson, Clark, & Lowell, 1953; Murray, 1938; Nicholls, 1984, 1989; White, 1959) have explored achievement motivation by examining different goal orientations toward competitive situations. Perceptions of performance outcome or beliefs about the causes of success are influenced by numerous variables, such as goal orientations, competence, perceived ability, perceived motivational climate, and past experiences (Ames, 1992; Ames & Archer, 1988; Harter, 1978; Nicholls, 1984, 1989).

Purpose: The present study was designed to investigate goal orientations, perceived motivational climate, and beliefs about the causes of success among youth sport participants.

Methods: Psychometric properties of an adapted Beliefs About the Causes of Success in Sport Questionnaire (BACSSQ; Duda & Nicholls, 1992; Duda & White, 1992; Nicholls, Patashnick, & Nolen, 1985) and Perceived Motivational Climate in Sport Questionnaire-2 (PMCSQ-2; Newton, Duda, & Yin, 2000) were examined through confirmatory and secondary factor analyses. Following examination of the psychometric properties, relationships among Task and Ego Orientations; Task-Involving and Ego-Involving Climates; and Beliefs of Ability and Effort as the cause of success were examined using structural equation modeling. Questionnaires (N = 1348) were collected from 22 sport camps in New England. Participants included male (n = 531) and female (n = 817) youth sport participants who responded based on their experience on developmental youth, middle school, or high school teams.

Results: Proposed two-factor structure of the belief scale provided adequate fit to the data. Two-factor, six-factor, and hierarchical factor structures of the motivational scale were examined. The six-factor structure, which broke down Task-Involving and Ego-Involving Climates, fit the data better, as compared to two-factor and hierarchical factor structures.

Conclusions: Based on the two structural models tested, athletes who have higher levels of Task Orientation attribute success based on self-referenced standards and are more likely to perceive their current environment as having components of a Task-Involving Climate. Athletes who have higher levels of Ego Orientation base success in reference to interpersonal comparisons are more likely to perceive components of an Ego-Involving Climate. In addition, goal orientations appeared to be the dominant predictor of subsequent beliefs about the causes of success.
increases in the size of the older adult population over the next 25 y. In addition, an abundance of studies have demonstrated that participation in regular physical activity is essential in order to preserve health and functional ability and to maintain a high quality of life in old age. Unfortunately, in spite of a wealth of evidence about the benefits of physical activity for older people, there has been little success in convincing older adults to adopt physically active lifestyles. On May 1, 2001, a coalition of USA national organizations released a major planning document designed to develop a national strategy for the promotion of physical activity among adults age 50 and older. The National Blueprint was developed to explore issues related to health, medicine, social and behavioral sciences, epidemiology, gerontology/geriatrics, clinical science, public policy, marketing, medical systems, community organizations, and environmental factors. The Blueprint identifies barriers to physical activity in the areas of research, home and community, medical systems, public policy, and marketing. In a National Blueprint Consensus Conference, held in October 2002, participants from more than 50 national organizations identified the 18 highest priority strategies for overcoming barriers to physical activity. Many of the 18 strategies identified in the Consensus Conference have significant implications for researchers and practitioners with an interest in measurement and evaluation. In addition to presenting information on future funding priorities, the authors will also present information about the implications for new test development, field testing, and the development and maintenance of normative databases. The presentation will provide conference attendees with an up-to-date summary of national initiatives in the area of aging and physical activity with particular emphasis on their implication for measurement and evaluation in kinesiology.

Measurement and Aging

**Functional Fitness and Lifelong Physical Activity as Predictors of Health in Older Adults**

G. R. Regan, M.S. 1, D. L. Filion, Ph.D. 1, R. E. Lee, Ph.D. 2, J. M. McDowd, Ph.D. 2;

1University of Missouri-Kansas City, Kansas City, MO, 2Kansas University Medical Center, Kansas City, KS

The fitness-health relationship has been well established in young and middle-aged adults. But despite the increasing importance of health-related issues associated with aging, less is known about the impact of fitness on health of older adults. The current study investigates whether functional fitness is a predictor of health in community-dwelling older adults. Functional fitness is defined here as the ability to perform normal daily activities safely and independently without becoming fatigued. This study will also examine the relationship between health and physical activity over the course of adult life. A group of 30 men and 30 women ages 65 to 90, all community-dwelling, has been solicited and data collection is underway. Functional fitness is assessed with Rikli and Jones’ Senior Fitness Test which includes six subtests: muscular strength and endurance, flexibility, aerobic endurance, agility, and one measure of body composition. Lifelong physical activity is assessed with a questionnaire that asks participants to report frequency and intensity of occupational, leisure, and household activity by decade of life. Health is self-reported with an instrument oriented toward health-related quality of life (Short Form-36). Correlational analyses will be completed to determine the strength of the relationship between functional fitness and health variables, and between lifelong activity and health variables. It is hypothesized that there will be a medium strength or greater positive relationship between functional fitness and self-reported health, and the same or slightly lower between lifelong activity and health. If the hypotheses are supported, the results will suggest that functional fitness
level and activity history are both important predictors of current health status in older adults. This study would provide a foundation for future exercise interventions that target areas of low functional fitness in seniors with goals of preserving independence in everyday activities and improving health.

**Measurement and Aging**

**Short-term Variability of Maximal Voluntary Contraction During an Isometric Leg Press Test in Elderly Females**

P. Caserotti, P. Aagaard, L. Puggaard;
Institute of Sports Science and Clinical Biomechanics, Odense, Denmark

Changes in maximal voluntary contraction (MVC) following physical training have been shown to vary considerably in different studies dealing with elderly subjects. This may be due to differences in training protocols (i.e., frequency, intensity, muscle groups involved) or testing protocols. However, in order to evaluate the magnitude of training-induced changes on MVC it would be relevant to estimate the short-term variability occurring with the measurement.

**Purpose:** The aim of this study was to evaluate the short-term variability of MVC assessed on a single isometric leg press model in a group of elderly women. **Methods:** Ten elderly moderately trained women, age 64 to 79, with no known neuromuscular diseases, were included in the study. Participants were asked to push as hard and as fast as possible with their dominant leg. Signals from a three-component force link piezoelectric sensor (Kistler 9367/8 B) were sampled at 1 KHz and fed into a computer for further analysis. At least five trials were given to each subject. MVC was accepted if, within the five trials, at least two recordings showed less than 5% of difference; otherwise more trials were given until the mentioned condition was fulfilled. Four sessions were separated at least by 1 d and no more than 3 d. Prior to testing, familiarization was performed on a separate day. A repeated measurement ANOVA was used to determine differences between days. Furthermore, a nested ANOVA was performed to discriminate the total coefficient of variation (CV) in components of between-subjects (b-s) and within-subjects (w-s) CV. **Results:** As expected, a relatively large b-s CV was observed indicating a non-homogeneous group in respect to MVC enrolled in the study. This may be due to the large age span of the participants. However, a non-significant and small w-s CV (4.9%) was observed. **Conclusion:** The MVC test seems to be highly reproducible and MVC a feasible variable to detect training-induced changes in the elderly population.

**Measurement and Aging**

**Detecting True Changes in Patient’s Functional Independence**

S. Kang, Ed.D.1, M. Han, Ph.D.1, H. Chun, Ph.D.2, M. Kang, M.A.3;
1Korea National Sport University, Seoul, Republic of Korea, 2Soonchunhyang University, Ahsan, Republic of Korea, 3University of Illinois at Urbana-Champaign, Urbana, IL

The functional independence measure (FIM) assesses physical and cognitive disability in terms of burden of care. It is applicable to patients of all ages, especially older adults, and has been widely adopted by the rehabilitation community. The FIM has been used to monitor patients’ progress across time by comparing changes in scores at different occasions. The properties of certain items may change from the first administration to the second. Being able to identify these items help us to better estimate a person’s measures at different administrations and, thus, reflect
the true changes experienced by individuals. **Purpose:** The purpose of the study was to test the stability of the FIM items and to compare uncorrected patient measures with the corrected measures using Wright’s correction procedure (1996). **Methods:** A total of 188 stroke patients’ records were collected from the national medical center in Korea. The data were analyzed by a Rasch rating scale model with facets program. Model-data fit was determined by in-fit and out-fit statistics (< 0.5 or > 1.5). The standardized differences (root mean square error of measurement: $z$) were computed between each pair of step calibrations and FIM item calibrations to determine whether differences between admission and discharge estimates in patient measures are valid indicators of change over time. **Results:** Two FIM items, i.e., bladder and bowel movement, with poor fit statistics found in both admission and discharge data were eliminated from the final estimations. The rating scale steps used were different across two occasions with large $z$ statistics greater than 2.0 from four of the six scales. Eleven items have absolute differences greater than 2.0 of $z$ statistics across two occasions. Based on our findings of uncorrected measures, some FIM items and rating scale steps were functioning differently across two occasions. In order to compare the change in patient measures independent from the changes in items or rating scale step functioning across two occasions, the $z$ statistics were examined by Wright’s correction procedure. One hundred and six patients’ functional independences were significantly changed across two occasions. The comparison of patient measures revealed that misfitting patients were slightly fewer in the corrected method (30.3%) than in the uncorrected method (32.2%). The discrepancies were found from five patients (2.7%) in standardized differences between the corrected and uncorrected method. **Conclusions:** Wright’s correction procedure could provide a stable frame of reference and, thus, give better estimates of the changes in persons’ performance.

**Measurement and Aging**

**Functional Fitness in Brazilian Active Older Adults and its Association with Risk Factors**

**S. Santos**$^1$, R. Linares$^2$, M. Oliveira$^1$, J. J. Xavier$^1$;  
$^1$School of Physical Education and Sport/University of Sao Paulo, Sao Paulo, Brazil, $^2$Center of Sport Practice/University of Sao Paulo, Sao Paulo, Brazil

There are several evidences showing that an active lifestyle can be considered a protective factor during the lifetime, meaning that in old age it is not only important to be active, but it is crucial. This is because physical frailty typically associated with advanced age could be prevented or delayed with an active lifestyle that could represent autonomy and lower costs in public health care. **Purpose:** The main purpose of this study was to assess physical performance of older adults by Fullerton’s Functional Fitness Test battery. It also examined the association between risk factors (smoking, alcohol consumption, hypertension, high cholesterol, and obesity) and physical performance scores. **Methods:** The sample comprised 79 participants ($M = 68.41$, $SD = 6.81$) from a physical activity program offered by the sport center of the University of São Paulo. The battery consists of six items designed to assess the physiological parameters associated with independent functioning: lower and upper body strength, aerobic endurance, lower and upper body flexibility, and agility/dynamic balance. It also assessed body mass index (BMI) and blood pressure. In addition, participants were interviewed to verify the level of physical activity (Baecke Questionnaire), smoking and drinking habits, presence of hypertension, and high cholesterol levels. **Results:** Correlation analysis did not show an age effect on any variable which may be explained by the small age range but, since all participants were active, there may
be an effect of physical activity. One-way ANOVA was performed for five different subgroups (5 y range) with BMI, blood pressure, Baecke scores, and for each functional test. The results did not show any significant difference between groups. Participants were then classified by the number of risk factors accumulated (none, one, two, or three) to verify the association between risk factors, physical performance, and Baecke scores. The sample was divided into four groups: 25 individuals with no risk factors, 21 with one, 22 with two, and 11 with three. One-way ANOVA showed a significant effect on lower strength (chair stand: $F = 4.070, p < 0.05$) and agility/dynamic balance (8 ft up-and-go: $F = 2.784, p < 0.05$). Tukey HSD found difference between mean groups with no and three risk factors for both chair stand ($p < 0.01$) and 8 ft up-and-go ($p < 0.05$).

Conclusions: We concluded that (a) the tests seemed feasible for use in a country with large regional differences such as Brazil, and (b) only the accumulation of three risk factors could somewhat affect the functional performance of active older adults. We recommend that these tests be extended to a sedentary sample.

Measurement and Aging
A Look at Fitness Aging Through the Czech Unifit-Test 6-60

P. Blahus, Ph.D.;
Department of Kinanthropology, Charles University, 162 52 Praha 6, Czech Republic

The Unifit-Test 6-60 is a synthetic result of several already completed projects by different research groups, universities, ministries, and sport organizations, originally made for their different needs. These studies were carried out over a period of about 20 y; the largest sample consisted of 30,667 persons, and the smallest 190. The first attempts to synthesize the findings started from 1988, and the last version was represented in the recent version of the Unifit-Test 6-60 Manual (2002) issued by the Department of Kinanthropology at Charles University under coordination by Professors Rudolf Kovar and Jitka Chytrackova with many co-authors. The author of the present conference communication actively participated in the very early stages while later he just consulted on some methodological and statistical aspects. This presentation will comment only on four age groups, male and female, namely 21 to 30, 31 to 40, 41 to 50, 51 to 60 years in four tests: standing broad jump, 1-min sit-ups, 12-min run, and 2 km walk allowing for comparisons. The results represent rather a product of a team expertise than a rationale outcome of a meta-analytic study. The main purpose was to offer a kind of norms, values that could be recommended and would help teachers, trainers, fitness specialists, physicians, and others as certain reference data. They still yield information suitable for assessing developmental tendencies in the Czech population and Europe, for some cross-cultural comparisons. The measurement comparing age groups of gross physical fitness dates to the times of J.C.F. Guts-Muths (1759-1839) the European “grandfather” of physical education in his German philanthropino school. In the Czech Republic, we have the first similar comparative study by E. Roubal and J. Roubal (1923). The worldwide wave of fitness research after the World War II is well known, and it has been followed also in the Czech Republic for several decades. The definite motivation for the synthesis and the creation of the Unifit-Test had been the movement known as Eurofit (1988), which was not quite compatible with older Czech fitness studies.
Effects of a Community Activity Program on Functional Fitness of Older Adults
P. A. Plato, Ph.D., C. L. Christensen, Ph.D., J. Han, M.A.;
San Jose State University, San Jose, CA

Purpose: This study evaluated whether a weekly group activity program would improve functional fitness of older adults. Methods: The 1-h program was led by a physician and offered free of charge to community residents. Chair and resistance exercises using Thera-Bands, focusing on balance and strength, were performed for 20 to 30 min, with the remaining time used to answer participants' questions about medications, treatments, exercise, and nutrition. The group met once a week, and participants were provided Thera-Bands and encouraged to exercise at home. Functional fitness was assessed using the test battery developed by Rikli and Jones (1999). Three groups of participants were assessed for baseline measures and 4 to 5 months later to evaluate improvement: participants currently attending the program (Current), participants who started the program (New), and a control group (Control) that played bridge once a week at a senior center. Demographic data and functional fitness test results are shown in the table below.

<table>
<thead>
<tr>
<th></th>
<th>Current</th>
<th>New</th>
<th>Control</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (y)</td>
<td>74.5 ± 3.1</td>
<td>76.1 ± 7.9</td>
<td>70.7 ± 3.1</td>
</tr>
<tr>
<td>Weight* (kg)</td>
<td>60.0 ± 3.9</td>
<td>77.1 ± 12.4</td>
<td>75.3 ± 11.1</td>
</tr>
<tr>
<td>Height** (cm)</td>
<td>156 ± 6</td>
<td>158 ± 6</td>
<td>169 ± 8</td>
</tr>
<tr>
<td>n</td>
<td>8 (F)</td>
<td>8 (1 M, 7 F)</td>
<td>6 (1 M, 5 F)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>Pre</th>
<th>Post</th>
<th>Pre</th>
<th>Post</th>
<th>Pre</th>
<th>Post</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chair stand (reps)</td>
<td>11 ± 3</td>
<td>13 ± 4</td>
<td>8 ± 5</td>
<td>9 ± 4</td>
<td>16 ± 3</td>
<td>17 ± 4</td>
</tr>
<tr>
<td>Arm curl† (reps)</td>
<td>14 ± 5</td>
<td>15 ± 5</td>
<td>11 ± 4</td>
<td>13 ± 6</td>
<td>20 ± 7</td>
<td>22 ± 5</td>
</tr>
<tr>
<td>Step test‡ (reps)</td>
<td>81 ± 15</td>
<td>84 ± 15</td>
<td>67 ± 17</td>
<td>57 ± 25</td>
<td>105 ± 32</td>
<td>106 ± 22</td>
</tr>
<tr>
<td>Sit &amp; reach (cm)</td>
<td>-11 ± 20</td>
<td>-2 ± 19</td>
<td>-12 ± 11</td>
<td>-9 ± 9</td>
<td>5 ± 6</td>
<td>5 ± 5</td>
</tr>
<tr>
<td>Back scratch (cm)</td>
<td>-2 ± 8</td>
<td>-4 ± 10</td>
<td>-10 ± 14</td>
<td>-12 ± 9</td>
<td>0 ± 15</td>
<td>1 ± 12</td>
</tr>
<tr>
<td>Up &amp; go (s)</td>
<td>7.05 ± 1.85</td>
<td>6.33 ± 1.38</td>
<td>10.61 ± 3.06</td>
<td>11.05 ± 6.03</td>
<td>5.02 ± 0.78</td>
<td>4.92 ± 0.55</td>
</tr>
<tr>
<td>BMI</td>
<td>24.8 ± 2.0</td>
<td>24.7 ± 2.2</td>
<td>31.3 ± 6.8</td>
<td>32.0 ± 6.1</td>
<td>26.2 ± 2.2</td>
<td>26.3 ± 2.3</td>
</tr>
</tbody>
</table>

Note. Values are M ± SD; M = male, F = female; BMI = body mass index.
* p < 0.05 Current vs New, and Current vs Control; ** p < 0.05 Current and New vs Control; † p < 0.05 New vs Control, and Pre vs Post; ‡ p < 0.05 New vs Control

Two-way repeated measures ANOVA was used to evaluate differences between groups and over time for the arm curl, step test, and BMI test items. Results: There were no significant interaction effects, but group and time effects were significant for arm curls (p < 0.05), and group effects were significant for the step test and BMI. Data for the other test items did not
meet the normality assumption; thus, change scores (post - pre) were evaluated between groups using 1-way repeated measures ANOVA. There were no significant differences between groups on these test items. **Conclusions:** Although participants were very positive about the program and particularly appreciated the opportunity to have questions answered by a physician, it was concluded that this type of community-based activity program is not of sufficient intensity or frequency to significantly improve functional fitness.

(Funded by a grant from The Health Trust)

**Measurement and Aging**

**Maximal Strength (1RM) Testing in Older Adults: Are Women More “Reliable” Than Men?**

W. T. Phillips¹, A. M. Batterham²; ¹Arizona State University, Mesa, AZ, ²University of Bath, Bath, United Kingdom

**Purpose:** We have previously reported the reliability of one repetition maximum (1RM) testing in older adults. The purpose of this study was to determine the comparative reliability of this test in older adult men (M) and women (W) with at least three periods of familiarization. **Methods:** Independently living men (n = 12) and women (n = 33), mean age 74.9 ± 7.0 y, range 60 to 91 y, performed at least three sessions of familiarization (mean 4.7 ± 1.7), followed by three trials of 1RM testing for (a) bench press and (b) leg press exercise. Tests were separated by at least 1 d. Systematic bias (percent change in mean) and typical error (coefficient of variation, CV), was assessed between consecutive pairs of trials. **Results:** Major findings were summarized below:

<table>
<thead>
<tr>
<th></th>
<th>Chest press</th>
<th>Leg press</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Trial 2-1 (W)</td>
<td>Trial 2-1 (M)</td>
</tr>
<tr>
<td>Change in mean (%)</td>
<td>1.1</td>
<td>5.0</td>
</tr>
<tr>
<td>CI</td>
<td>-1.5 to 3.8</td>
<td>1.1 to 9.4</td>
</tr>
<tr>
<td>Typical error (%CV)</td>
<td>5.2</td>
<td>5.4</td>
</tr>
<tr>
<td>CI</td>
<td>4.3 to 7.3</td>
<td>4.0 to 8.7</td>
</tr>
</tbody>
</table>

**Conclusions:** No meaningful differences in reliability of 1RM test performance were apparent between older men and women following three sessions of familiarization and two test trials.
Acceptable reliability was obtained with two 1RM test trials. Little or no improvement in reliability was obtained with the addition of a third 1RM trial.

**Measurement and Aging**

**Validation of the Late-Life Function and Disability Instrument (LLFDI)**

S. P. Sayers, Ph.D., A. M. Jette, Ph.D.\textsuperscript{1}, S. M. Haley, Ph.D.\textsuperscript{1}, T. C. Heeren, Ph.D.\textsuperscript{1}, J. M. Guralnik, M.D., R. A. Fielding, Ph.D.\textsuperscript{1};

\textsuperscript{1}Boston University, Boston, MA, \textsuperscript{2}Epidemiology, Demography, and Biometry Program, National Institute on Aging, Bethesda, MD

**Purpose:** The purpose of this study was to assess the concurrent and predictive validity of the Late-Life Function and Disability Instrument (LLFDI). **Methods:** The study employed a cross-sectional design to validate self-reported functional ability and disability against functional performance and mobility tasks. One hundred and one older men and women (M ±SD: 80.8 ± 0.4 y) were administered a short physical performance battery (SPPB) and 400-m walk as performance tests of lower extremity function. The LLFDI was used to assess self-reported function and physical disability. Partial correlations adjusted for age and body mass index (BMI) were used to determine the concurrent and predictive validity of the LLFDI. Statistical significance was accepted at \textit{p} < 0.004 using a test-wise correction. **Results:** LLFDI overall function scores were strongly associated with the SPPB (\textit{r} = 0.65; \textit{p} < 0.001) and 400-m walk, gait speed (\textit{r} = 0.69; \textit{p} < 0.001), measures of lower extremity function. Correlations of the two Lower Extremity sub-scores of the LLFDI (\textit{r} = 0.63-0.73; \textit{p} < 0.001) were greater than for the LLFDI Upper Extremity sub-scores (\textit{r} = 0.19-0.26; \textit{p} > 0.004). Performance measures of function predicted disability with Disability Limitations in the range of \textit{r} = 0.37-0.44 (\textit{p} < 0.001) and Disability Frequency in the range of \textit{r} = 0.16-0.20 (\textit{p} > 0.004). **Conclusions:** These findings support both the concurrent and predictive validity of the LLFDI. Associations of the LLFDI with physical performance tests were comparable to those observed for the widely used SF-36 physical functioning subscale. Results support the use of the LLFDI Function and Disability scales as a substitute for physical performance tests when self-report is a preferred data collection format.

**Measurement and Aging**

**Considerations for Cross-national Aging Research: Development and Implementation**


Indiana University, Bloomington, IN

The global aging initiative encompasses more than 15 countries in a collaborative, cross-national study coordinated by a team at Indiana University. The goal is to test an empirically-based model for aging well appraising conditions that support healthy, productive, and active aging. The aging well model is based on interactive processes between the environment (social, cultural, and economic) and the individual (behavior and cognitive choices) as a means of measuring success and productivity in older adulthood. Structural equation modeling analysis (SEM) will be used to estimate both the measurement and structural parameters of five latent variables (physical health and functional status, cognitive efficacy, social support resources, life activity, and material security) on the outcome variable aging as well as the impact of mediating and intervening variables within and across collaborating countries. Data was collected from approximately 3000 participants.
adults between 50 and 90 years of age in each country using a questionnaire composed of multiple well-validated instruments. Trained interviewers native to each country are gathering the data. The overarching goal of this research is to apply the findings in policy analysis and community development to target improvements in social context, economic circumstances, environmental conditions, available programs, public policies, and business practices which promote a positive, productive, and healthy aging process. A secondary objective is to expand global participation and cooperation within a working partnership of interdisciplinary experts from countries worldwide, thus creating a shared voice on the trends of global aging. This latter objective can only be effectively addressed by taking into consideration cultural, political, and semantic differences between the collaborating countries and subcultures within each country at all stages of the research process. The lessons learned from this cross-national research can be used to increase the validity of comparative research and to design appropriate instruments for use with older adults in the United States and across countries. Specific inquiry practices include: (a) incorporating qualitative research methods (using field notes, acknowledging gatekeepers within subcultures, utilizing multiple modes of presentation of questions); (b) cross training and monitoring/interviewers; (c) pilot testing instruments; (d) addressing cultural, disciplinary, and political differences of both subjects and researchers; (e) using purposeful, clear wording; (f) documenting protocols; and (g) emphasizing shared objectives.

Aging

**National Strategy for Promoting Physical Activity Among Older Adults—Challenges and Implications for Our Profession**

W. J. Chodzko-Zajko, Ph.D.
University of Illinois at Urbana-Champaign, Urbana, IL

Recently, in the United States several national organizations announced a major new initiative in the area of public health—The National Blueprint Partnership. The National Blueprint is a coalition of major public health organizations, professional groups, and foundations seeking to contribute to research, education, and practice in the area of physical activity and aging. The Blueprint is under the leadership of Dr. Wojtek Chodzko-Zajko and includes the following organizations: National Institute on Aging; Centers for Disease Control and Prevention; Robert Wood Johnson Foundation; American Association of Retired Persons; American Geriatrics Society; The National Council on Aging; and the American College of Sports Medicine. The Blueprint recently released a major national planning document in the area of physical activity and public health. “The National Blueprint: Increasing Physical Activity Among Adults Aged 50 and Older” was developed to serve as a guide for multiple organizations, associations, and agencies, to inform and support their planning work related to increasing physical activity among America’s aging population. The Blueprint for action was intended to outline broad strategies that will lead to increasing physical activity among older Americans. The plan was developed with input from more than 60 individuals, representing 46 organizations with expertise in health, medicine, social and behavioral sciences, epidemiology, gerontology/geriatrics, clinical science, public policy, marketing, medical systems, community organization, and environmental issues. In this presentation, Chodzko-Zajko will summarize the research, education, and clinical practice goals of the National Blueprint. He will discuss the implications of the National Blueprint for research and practice in exercise science, focusing closely on implications for the measurement and evaluation of physical activity and functioning. Chodzko-Zajko will argue that in the 21st
century, there is a need to focus increasingly on alternative approaches to health and well-being. This new focus can then assist in the compression of the period of morbidity, which all too often accompanies advancing age. Chodzko-Zajko will discuss the implications of the Blueprint for exercise prescription and future research.

### Aging

**Recruitment of Frail Elderly Women to a Training Study with a Two-Step Communication**

**S. Vestergaard, L. Puggaard;**
University of Southern Denmark, Institute of Sports Science and Clinical Biomechanics, Odense M, Denmark

**Purpose:** To elucidate the feasibility to recruit frail elderly women to a home-based physical activity program with a two-step communication consisting of a letter followed by telephone contact (TC). **Methods:** Community-dwelling women (n = 550) aged 75+, getting personal and/or practical public home care received a letter with written information about the training study. The letter was worked out according to the standards of the Local Ethical Committee (LEC), written in font size 14 and resulted in 2½ pages. A pamphlet with general information about rights for subjects in research projects was included in the envelope as requested by the LEC. During the TC, a questionnaire was used to get information about their ability to perform some activities of daily living (transfer, get outdoors, walk indoors, walk outdoors in nice weather, manage stairs, and walk outdoors in poor weather) and their feeling of tiredness when executing the activity in question. The latter resulted in the mobility tiredness score (0 = worst, 6 = best). Furthermore, the questions: “Do you participate in regular physical activity?” and “Have you been outside your home the last 14 days without help from another person or other aids?” were asked. **Results:** Seven percent (n = 38) participated in the survey. Some women did not want to participate in either the study or in the interview by telephone. There were also some women who had not read the written information, but threw it away instead. Some were excluded because they were dependent on others to move from bed or chair, and others because they already were active or had very high self-mobility. **Conclusion:** During recruitment with a two-step communication, the telephone interview seemed to be an appropriate tool to differentiate between the very good and the more frail receivers of home care before the first home visit. However, the written information in the first step seemed to be “too much” for this group, since some could not be bothered to read it at all, which hampers the representativity of the group and may influence the interpretation of the results after training. Therefore, it can be suggested that personal communication in the first step, within the limits of the LEC, may be more successful in recruiting frail elderly women in a training intervention study.

### Aging

**Grip Strength in Relationship to Overall Strength and Functional Capacity in Oldest Old Females**

T. M. Tietjen-Smith, D.A.1, R. Henry, D.A.2, A. Bryant, M.S.3;
1Texas A & M-Commerce, Commerce, TX, 2Lipscomb University, Nashville, TN, 3Belmont University, Nashville, TN

**Purpose:** The purpose of this study was to determine whether grip strength correlated with overall strength and functional capacity in females over 75 years of age. This study was
performed using data from female individuals over the age of 75 living in assisted living centers. **Methods:** Participants in the study were 102 female volunteers between the ages of 75 and 101 years of age who resided full-time in seven assisted living centers in middle Tennessee. Participants were divided into two groups: very old (75 to 84 y) and oldest old (over 85 y). Seventeen of the very old participants needed some form of assistance (cane or walker), while 32 of the oldest old participants needed similar assistance. Each participant was administered the Barthel Index, grip strength test, Mini Mental Status Examination (MMSE), overall strength test, and Timed Get-Up-and-Go test (TUG). The grip strength test, overall strength test, and TUG were counterbalanced in order to decrease skewed results due to a learning curve. The following scores were correlated to determine existing relationships: Barthel Index, grip strength, overall strength, and TUG. Differences between very old and oldest old age groups were also ascertained. **Results:** Females who used assistive devices tended to function better overall on all measures. The oldest old age group performed more poorly than the very old age group on all activities, with the exception of subjective ranking on the Barthel Index. The oldest old age group reported an exaggerated functional capacity level (Barthel Index) that did not match their actual functional capacities (TUG). Conversely, the very old age group showed a high correlation between self-reported and performance-based scores. **Conclusions:** Grip strength was moderately correlated with overall strength in the total population, but there was a weak correlation between grip strength and functional capacity as evidenced by the TUG and Barthel Index. The same was true for both age groups.

**Aging**

**Hand Weight Exercise Program Improves Physical Function and Quality of Life of Community-Dwelling Older Adults**

**B. Lanier, Ed.D.**, R. Burke; 1Kennesaw State University, Kennesaw, GA, 2University of Tennessee, Knoxville, TN

**Purpose:** Based upon research, resistance exercise is effective for improving the physical function of older adults. Many senior centers do not have the resources for purchasing expensive resistance equipment. Hence, the use of less expensive hand weights may be useful for improving the physical function and quality of life for rural, community-dwelling older adults. The purpose of this study was to assess the effectiveness of group hand weight exercise for improving assessments of physical function and quality of life for older adults. **Methods:** Forty-eight rural, community-dwelling older adults (age = 76 ± 8 y; males = 15, females = 33) participated in this study. Some were put into a control group that did not participate in any exercise. The rest of the participants completed 6 wk of group hand weight training 3 d/wk. Pre- and post- 6-wk tests of physical function included 6-min walk distance, number of arm curls in 30 s, back-scratch distance, and sit-and-reach distance. In addition, quality of life was assessed by the pre- and post-administration of the SF-12v2 survey. The data was analyzed using a two-way repeated measure analysis of variance. **Results:** Exercise participants increased their distance covered in 6 min, but the control group covered less distance in 6 min from pre to post (p = 0.03). Number of arm curls in 30 s, back scratch distance, and sit-and-reach distance improved in the exercise group. The control group had either no change, or decreased in these physical function measures (p = 0.03). In addition, the control group reported to have accomplished less in the past 4 wk due to physical and emotional limitations as revealed in the post surveys (p = 0.04). **Conclusions:** Based on the results of this preliminary study, group hand
weight exercises may be effective for improving the physical function and quality of life of rural, community-dwelling older adults.

**Aging**

**The Effect of Combined Strength and Endurance Training on Functional Capacity of a Female Octogenarian**

G. E. Fincher II, Ph.D.;
Ashland University, Ashland, OH

**Purpose:** The purpose of this case study was to evaluate the effectiveness of a combined strength and endurance exercise program on the functional capacity of an 87-year-old female with limited functional capabilities. **Methods:** Prior to implementation of the training program the subject was asked to (a) stand up from a seated position as many times as possible; (b) walk as far as possible; and (c) curl a 5 lb weight until limited by fatigue. A training program consisting of both strength and endurance exercise was implemented for 12 wk. The first 4 wk consisted of strength training only. During the first week, isometric contractions were performed for the major muscle groups twice per week. During weeks two through four, isotonic contractions were introduced, and the exercise frequency was increased to three times per week. At week five, cycle aerometry training was added to the exercise program, starting with 2 min and working up to 15 min by week ten. After the 12 wk were over, the same measurements that were taken at the beginning were then taken again for comparative purposes. **Results:** The changes in functional tests were as follows (represented by percentage improvement): (a) stand up test (700%), (b) walking test (1400%), and (c) curl test (340%). **Conclusion:** This case study indicates that a combined strength and endurance program can favorably affect the functional capacity of a female octogenarian with limited initial functional capabilities.

**Aging**

**Differential Age-Related Changes in Swim Times for Top Ten US Masters Swimmers**

J. T. Fairbrother, Ph.D., J. B. Shea, Ph.D.

1University of Tennessee, Knoxville, TN, 2Indiana University, Bloomington, IN

Physical activity plays a key role in maintaining personal health and physical performance capabilities throughout the lifespan (e.g., Cartee, 1994; Paffenbarger et al., 1986). Since the percentage of the US population aged 65+ is expected to increase from 12.4% in 2000 to 20% in 2030 (Administration on Aging, 2002), interest continues to grow regarding the relationship between age and physical performance. One approach to investigating this relationship involves the examination of competitive sports that include participants from a wide range of different ages. Previous research has reported general declines in swimming speed with increasing age (e.g., Tanaka & Seals, 1997). However, it has not yet been determined if the characteristics of such declines are the same for different levels of performance across age groups. **Purpose:** The purpose of this study was to describe age-related changes in swim times for the top ten performers in each age group. **Methods:** A retrospective analysis was conducted on the USMS men’s 50 m short-course freestyle top ten swim times from 1993 to 2002. The analysis included consecutive age groups ranging from 19 to 24 to 80 to 84 y. For each year, three-dimensional surface plots and regression equations were calculated and compared. **Results:** A highly reliable parabolic function was obtained for all analyses (p < 0.0001). Examination of residuals revealed...
increasingly large deviations from actual data as age increased and place in top ten decreased. These results indicated that age-related changes in swimming occur differentially across younger and older age groups. Moreover, higher performance levels show markedly less change in swim times as a function of age as compared to lower performance levels. **Conclusions:** Thus, it might be concluded that physical activity leading to higher levels of performance may be critical to achieving less pronounced age-related changes.

**Measurement**

**Changes in Health-Related Fitness of Chinese Children and Youth: A Cross-Sectional Analysis**

S. C. Hui, Ed.D., C. M. Chan, Ph.D., H. S. Wong, Ph.D., S. C. Ha, Ph.D., Y. Hong, Ph.D.; The Chinese University of Hong Kong, Shatin, Hong Kong, Hong Kong Special Administrative Region of China.

**Purpose:** Currently there is limited data available to reflect health-related physical fitness profiles of Hong Kong children and youth. Changes in health-related fitness reflect the growth patterns of children and youth. Such information is valuable for teachers, parents, and coaches to evaluate the growth and physical improvement of Chinese children. The purpose of the present study was to evaluate changes in health-related fitness profiles of Chinese children and youth from a cross-sectional fitness survey. **Methods:** Health-related physical fitness parameters, which included a 1-mile run, push-up, cadence curl-up, modified back-saver sit-and-reach, and skinfolds (triceps + calf) of 9960 school children from primary 4 (age 8) to secondary 7 (age 20) were collected. The sample was a stratified random sample, which reflected similar distribution of the population in Hong Kong in terms of age, gender, school types, and district allocations. Informed consent and ethical approval were obtained. The sample was further divided into three age groups (12 and below, 13 to 15, and 16 or above) for analysis. **Results:** Results indicated that for both boys and girls, health-related physical fitness improved in a non-linear fashion as age increased. Most fitness parameters improved with age in S-shape, except the curl-up performance of boys was in inverted-U shape where the best performance occurred at age 15. Two-way (gender × age groups) MANOVA indicated that the two main effects and interaction effect were significant ($p < 0.001$), which implied that overall physical fitness profiles between boys and girls, and between age groups, were different. The differences in physical fitness between boys and girls were also changed as they grew up. The trends of better aerobic fitness, muscular endurance, body composition, and poorer flexibilities in boys, as compared to girls, were consistent across different age groups. However, for muscular strength, the mean push-up performance of elementary girls (16.6 reps) was higher than elementary boys (10.0 reps), and had similar performances during junior grades (21.6 reps for girls and 20.8 reps for boys). But during senior grades, boys became better than the girls (20.7 reps for girls and 22.8 reps for boys). **Conclusions:** Changes in health-related fitness of Chinese children demonstrated S-shapes as they grow. The patterns between boys and girls are distinctly different. Data collected in this study was valuable for the understanding of the growth pattern of Hong Kong children and youth, and serve as benchmark information for normative tables development and cross-cultural comparison.
Measurement Issues and Challenges in Children’s Physical Activity Recall

M. Kang, M.A., W. Zhu, Ph.D.;
University of Illinois at Urbana-Champaign, Urbana, IL

The ability to accurately measure children’s physical activity is essential in understanding their physical activity participation and in designing effective physical activity interventions. Several methods have been developed to measure physical activity in children. Self-reported questionnaires and diaries are among the most popular ones. This is because they can be administered relatively quickly and are easy to obtain, inexpensive, unobtrusive, and nonreactive.
(Baranowski, 1988). Both of them are based on a child’s recall of physical activity participation during a certain time period in the past (e.g., past 24 h or 7 d). The validity and reliability of these recall measures in children, however, vary greatly among studies. Many factors may contribute to the inconsistency, e.g., inappropriate criterion standards used, different instruments employed, and different populations compared. Another major factor believed to cause varying results is that many instruments and diaries have not been designed and administered according to children’s cognitive characteristics in the recall. Memory decay, recall primarily of rare-event and planned activities and lack of motivation in self-reported form completion are important issues for consideration. It has been generally acknowledged that by taking cognitive characteristics into the considerations of survey research design and administration, more valid recall information can be achieved by increasing comprehension, and accurate reporting and retrieval of information. Even though there has been a growing interest in applying the cognitive model to physical activity recall research (e.g., Durante & Ainsworth, 1996), little is known about its applicability for children. This study provides a review of children’s physical activity recall, related measurement issues, and challenges. Several factors that may directly or indirectly influence the recall accuracy of children’s physical activity based on the cognitive model will be examined. Finally, the design of an ongoing, cognitive-model based study of children’s physical activity recall characteristics will be demonstrated.

Measurement

Item Parameters and Differential Item Functioning of Physical Fitness Knowledge Test

E. Kim, Ph.D., S. Kang, Ed.D.; Korea National Sport University, Seoul, Republic of Korea

If tests are planned having both genders involved, the measurement equivalence of the instrument should be assessed. These measuring instruments may not be equivalent for both genders. Most of the research in sport science has examined college-age, male individuals. As a result, conclusions from the research may not be applicable to all individuals of the other gender. Many studies investigating the difference between genders have been done without examining differential item functioning (DIF) of the scale/test used in the studies. Evaluation of physical fitness knowledge has been an interest in physical education teachers and researchers. Many studies reported that subjects’ start and maintenance of physical activity were very closely related to their health and exercise knowledge (Sallis, Haskell, Fortmann, Vranizan, Taylor, & Solomon, 1986; Godin & Shepard, 1990). Purpose: The purpose of this study was to examine the three item parameters of difficulty: discrimination, guessing, and to test DIF between male and female high school students. Methods: A total of 1754 high school students (904 males and 850 females) from Seoul and Kyunggi areas in Korea participated by the completion of the Physical Fitness Knowledge Test (PFKT: Form A), which was developed by Zhu, Safrit, and Cohen (1999) for evaluating a high school student’s cognitive ability. The PFKT contains 50 items which test six domains: concept of fitness, scientific principles of exercise, component of physical fitness, effect of exercise on chronic disease risk factors, exercise prescription, and other factors. BILOG, EQUATE, and IRTDIF were used to examine DIF of the PFKT items between male and female students. Results: It was revealed that: (a) the PFKT’s test was very difficult to Korean high school students (male = 5.66 ± 2.79, female = 5.25 ± 2.11); (b) 22 items of PFKT out of 50 were advantageous to male students, whereas 28 items of PFKT out of 50 were advantageous to female students; (c) a gender difference has been found in Korean high school...
students when a validated, translated Fitness Knowledge test was employed. The cause of DIF, e.g., the translation or culture difference, should be investigated.

**Measurement**

**Validation of the Sensewear Armband Device for Assessing Energy Expenditure**

T. Keylock, M.S., M. Kang, M.S., W. Zhu, Ph.D.;
University of Illinois at Urbana-Champaign, Urbana, IL

**Purpose:** In order to more accurately characterize the relationship of physical activity to health, especially in the area of weight control, better field methods of determining energy expenditure are needed. The SenseWear armband (BodyMedia, Inc., Pittsburgh, PA), a multi-sensor device, was developed to easily quantify physical activity and energy expenditure in conditions outside of the lab environment. This study was to validate the accuracy of the armband device in quantifying energy expenditure during four levels of physical activity by comparing the oxygen consumption measured by the armband to that measured by the metabolic cart, the criterion standard. **Methods:** Twenty-one young (mean age = 24.9 y, SD = 5.0) apparently healthy male (n = 8) and female (n = 13) students volunteered to walk or jog on a treadmill while metabolic measurements were made simultaneously with a metabolic cart (ParvoMedics) and the armband device. In three separate sessions, participant’s resting energy expenditure was taken for 5 min while seated, then in a random order. Participants either walked or jogged on a treadmill at 53.6, 107.2, or 160.8 m/min for 10 min. Data was analyzed by Pearson correlations and paired t-tests. The a-level (0.05) was adjusted by the Bonferroni technique. **Results:** The correlations between measurement tools were moderately high (r = 0.64 at 53.6 m/min, 0.50 at 107.2 m/min, and 0.76 at 160.8 m/min.) However, at all levels of activity, the armband device significantly overestimated the energy expenditures measured by the metabolic cart (t = 11.2, 15.73, 6.22, and 3.09 at rest, 53.6, 107.2, and 160.8 m/min, respectively; p < 0.013). **Conclusions:** While fairly well correlated to the standard of indirect calorimetry, the armband device consistently overestimated the amount of energy expended at all activity levels in this study. However, if statistical adjustments can be made to the device to better reflect energy expenditure as determined by indirect calorimetry, the armband could be a helpful field tool to the assessment of physical activity.

**Measurement**

**Relationship of Diverse Markers of Bone Status: Applications to Aging**

L. Morgan, Ph.D.;
Bowling Green State University, Bowling Green, OH

**Purpose:** Dual energy X-ray absorptiometry (DEXA) is the traditional method of measuring bone status. DEXA is also considered to be the gold standard, however, it is limited in its application because it is not specific enough to measure changes over short time periods (< 3 to 6 months). Thus, a number of biochemical markers have been used to assess bone metabolism more dynamically. The purpose of this study was to describe the relationship between the traditional marker of bone status (DEXA) and several markers of bone metabolism. **Methods:** Thirty-four college-age (mean age = 19.6 ± 1.44 y) females underwent blood sampling at three time points approximately 1 to 3 months apart. Sixteen of the subjects received a DEXA scan at the first and third time point. Serum was separated from the blood samples and stored at -70 °C.
until analysis. Each sample was analyzed in triplicate for markers of bone formation, osteocalcin (OC), and bone-specific alkaline phosphatase (BAP), as well as for cross-linked N-telopeptides (NTx) (a marker of bone resorption). Pearson product moment correlations were determined among the biochemical markers (OC, BAP, NTx) and the DEXA markers (total bone content and bone density at both the spine and hip). The relationship among time points for each marker was also determined. **Results:** Significant correlations were found among the three biochemical markers ($r = 0.248$ to $0.447$, $p \leq 0.013$), among the DEXA markers ($r = 0.466$ to $0.839$, $p \leq 0.002$), and between the biochemical and DEXA markers ($r = 0.356$ to $0.577$, $p \leq 0.022$). Comparisons within each marker were much stronger, ranging from $r = 0.480$ ($p = 0.005$) to $r = 0.860$ ($p = 0.001$). **Conclusions:** This data suggests that biochemical markers of bone metabolism are not strongly correlated to DEXA measures, therefore, caution should be used when making comparisons between these variables. Further, the relationships between biochemical markers are not particularly strong. Considering that variability in physiological data increases as part of the aging process, these results suggest that it may be difficult to demonstrate significant changes in biochemical markers of bone metabolism in the aging population. However, the examination of individual data may prove to be informative for clinical purposes.

**Measurement**

**Investigation of Error Sources in Estimating Body Fat Using Bioelectrical Impedance Analysis**


Body composition has been considered the standard index in the health area. Several methods have been developed to measure body composition. The underwater weighing (UWW) method is widely used, regarded as the criterion measure by industry experts; however, it has a limitation in use because it is a time-consuming process requiring expensive equipment. The bioelectrical impedance analysis (BIA) method can be an alternative, which requires relatively little effort and time. **Purpose:** The purposes of this study were (a) to investigate sources of inter-method technical error of measurement between two methods and (b) to compare individual differences of variation. **Methods:** One hundred twenty-two participants (80 males and 42 females), ranging in age from 20 to 40 y, were involved in this study. The oxygen dilution method was used for measuring residual volume in lungs. Both UWW and BIA were used to estimate relative body fat for all participants. Inbody 3.0 (SMITECH, Singapore) was selected as equipment for the BIA. Latent growth model in a Structural Equation Modeling was conducted by EQS software to measure inter-method technical error of measurement of percent body fat between UWW and BIA. The greater inter-method technical error of measurement indicates the greater error between the two methods. **Results:** Overall, the percent body fat in BIA tended to overestimate 0.99% body fat than UWW ($18.69 \pm 7.37$ by BIA, $17.7 \pm 7.71$ by UWW; $p < 0.05$). Ingestion of food and water before measuring UWW and BIA ($p < 0.001$), age ($p < 0.01$), and height ($p < 0.05$) of participants were the main sources of inter-method technical error of measurement between the two methods. **Conclusions:** Great inter-method technical error of measurement was found when the participants took food or water before measuring UWW and BIA, and when the participants are younger and shorter.
**Measurement and Aging**

**Q-Factor Analysis: An Approach for Improving Identification of Elderly Cardiac Rehab Patients: Implications for Treatment**

D. R. Waechter, Ph.D., J. Rosneck, M.S., I. Newman, Ph.D., H. Guthrie, M.S., R. A. Josephson, M.D.;

Summa Health System, Akron, OH

Elderly patients make up a large and growing portion of patients in cardiac rehabilitation (CR) and may require individualized treatment. Patients ≥75 years of age have been found to differ from the general CR population in many aspects. **Purpose:** The purpose of this study is to develop a systematic method of classifying elderly CR patients in order to individualize programming and enhance quality of life. **Method:** A total of 160 patients who were older than 75 y and enrolled in an outpatient cardiac rehabilitation program were given the SF-36, a widely used and highly respected instrument that has shown acceptable reliability and validity estimates in various medical settings. The SF-36 is a self-report Likert-style measure of self-perceived physical and emotional quality of life covering nine specific areas. Two Q-factor analyses, a multivariate technique that systematically classifies individuals into typologies, were conducted using the QUANAL computer program which places squared multiple correlations in the diagonal as communality estimates and conducts a Q-factor analysis appropriate for differentiating between people in terms of the shape of their profiles. The loadings on the rotated factor solutions are interpreted as an individual’s correlation with each of the hypothetical types. **Results:** The first Q-factor analysis, using basic demographic and diagnostic variables, yielded only one typology, which is consistent with past findings. The second analysis used only SF-36 scores and yielded three profiles: Type I was emotionally healthy but experienced problems with daily activities due to physical health, Type II experienced problems with daily activities due to physical health and emotional problems, and Type III were emotionally healthy, with improved physical health and functioning well socially. **Conclusions:** The differing mental and/or physical health needs of elderly CR patients may be addressed by appropriate intervention(s) to improve quality of life. CR professionals and exercise physiologists need a common framework that allows practitioners to maximize the application of available data. A classification system that permits identification of particular types of people with particular types of scoring patterns is the first step in developing intervention strategies.

**Measurement and Aging**

**Measurement Issues in Predicting Participation and Outcomes in Senior Exercise Programs**

B. B. Shadden, Ph.D., R. DiBrezzo, Ph.D.;

University of Arkansas, Fayetteville, AR

**Purpose:** There is consensus that physical exercise is critical for the health and well-being of seniors. Data from the PUSH exercise program (Project Urging Senior Health) provide information about factors that influence/predict program participation and measures associated with individual outcomes. **Methods:** PUSH focuses on strength and balance training three times per week over 10 wk. Of 48 seniors originally screened, 19 (aged 60 to 92) elected to participate in PUSH screening measures which included: height, weight, blood profile, blood pressure, senior fitness test, Mini-Mental State Exam (MMSE) and portions of the RAND measuring perceived health, medical conditions, activity levels, ADL/IADL functioning, and...
mood/emotional state. Exercise program participants were retested on all but the RAND.

**Results:** Predicting participation: Participant MMSE scores (27.7) were higher than non-participant scores (26), but non-significant. Participants rated themselves as significantly less limited in vigorous activity than non-participants ($t = 2.02$, $p = 0.05$), while reporting an average 2.5 medical problems (heart, blood pressure, diabetes) as compared with 1.9 for non-participants. Perhaps those who see themselves as still vigorous but are threatened by specific medical problems are more likely to take action to improve physical status. Predicting outcomes: Significant improvements were measured in lower and upper body strength ($t = -3.60$, $p = 0.002$ and $t = -2.23$, 0.038), upper body flexibility ($t = -2.84$, $p = 0.011$), dynamic balance/agility ($t = 4.99$, $p < 0.001$), and HDL ($t = -2.49$, $p = 0.026$). Age was significantly correlated only with pre-test physical measures. Participation in the exercise program tended to reduce the effect of age on physical performance. Pre- and post-test measures did not correlate with emotional state. Less initial energy was associated with greater improvement in lower and upper extremity strength ($r = .49$, $p = 0.038$ and $r = 0.48$, $p = 0.043$). Greater initial fatigue correlated with greater improvement in dynamic balance/agility ($r = 0.72$, $p = 0.001$) and lower extremity flexibility ($r = -0.55$, $p = 0.017$). Perceived health deterioration over the past year was significantly correlated with improved lower extremity strength ($r = +0.47$, $p = 0.047$) and dynamic balance ($r = -0.49$, $p = 0.041$). Pre-test MMSE scores were significantly correlated ($p < 0.05$) with better physical performance at pre- and post-testing. **Conclusions:** Post-test MMSE scores only correlated with post-test measures of flexibility, endurance, and balance. Outcome measurement must consider both mental and physical domains, as well as individual needs at outset.

**Measurement and Aging**

**Age and Gender Effects on Physical Activity and Functional Performance of Greek Older Adults**

**M. Michalopoulou, Ph.D.**, S. Exarhopoulou, B.S., N. Ageloussis, Ph.D., V. Zisi, Ph.D., E. Kioumourtzoglou, Ph.D.

Democritus University of Thrace, Komotini, Greece; University of Athens, Athens, Greece

**Purpose:** The purpose of the study was to determine the age and gender effects on physical activity and functional fitness in Greek older adults. Subjects were 489 older adults, 281 males age 73.99 ± 5.9 y and 208 females, age 72.24 ± 5.7 y. **Methods:** Physical activity was evaluated with PASE questionnaire (Washburn R.A., et al., 1993). The evaluation of functional performance included the Physical Performance Test (Reuben & Siu, 1990) and the Tinetti Balance Evaluation (Tinetti, 1986). A $3 \times 2$ (age x gender) analysis of variance model was applied to test the differences between three age groups (A = 61 to 70, B = 71 to 80 and C = 81 to 90), and between men and women in each of the dependent variables, while the Bonferroni test was again used to make post hoc comparisons between the three age groups. **Results:** Men scored significantly lower in PASE [$F(1, 483) = 13.93$, $p < 0.001$] than women did. On the contrary, they had significantly better scores in PPT [$F(1, 481) = 12.61$, $p < 0.001$] than women. However, no statistically significant differences were found between the two genders in the Tinetti test [$F(1, 459) = 2.59$, $p = 0.108$] test. Statistically significant differences existed between the scores of the three age groups in PASE [$F(2, 483) = 5.28$, $p < 0.05$], the PPT test [$F(2, 481) = 28.57$, $p < 0.001$], and the Tinetti test [$F(2, 459) = 15.60$, $p < 0.001$]. Age group A had significantly lower scores than the other two age groups on the PASE questionnaire and in the Tinetti test. In the PPT test, the mean score of each age group was significantly different from
the mean score of the other age groups. **Conclusions:** Increasing age is associated with a decrease in physical activity and functional performance. Men were less physically active than women even though functional fitness was not affected by their inactivity.

**Measurement and Aging**

**Cognitive Function Deficits of Community-Dwelling Elderly in Southwest Michigan**

**S. Paul, Ph.D.**, D. Orchanian, M.A., Y. Liu, Ph.D.; Western Michigan University, Kalamazoo, MI

**Purpose:** The purpose of this study was to identify the most commonly deficient cognitive function areas of community-dwelling elderly adults age 65 and older and to distinguish the differences in cognitive function deficits between male and female elderly. Fifty community-dwelling elderly were randomly selected from a cohort, which was referred to a clinic in southwest Michigan in the past 3 y. **Methods:** The two evaluation tools used were MMSE (Mini Mental State Examination, Crum et al., 1993) and CAM (Cognitive Assessment of Minnesota, Rustad et al., 1993). Health professionals performed these cognitive function evaluations. Cognitive functions assessed included attention span, memory and orientation, visual and auditory memory, temporal awareness, visual memory and sequencing, simple money skills and math skills, foresight and planning, safety and judgment, and concrete problem solving. **Results:** The results showed that out of the 29 cognitive items assessed using the CAM, the elderly showed severe deficits in mental flexibility, complex concrete problem solving, and multiple-digit simple math skills. Moderate deficits were observed in a number of items including forward and backward visual memory and sequencing, forward and backward auditory memory and sequencing, mental manipulation of simple money skills, and single-digit simple math skills, moderate concrete problem solving, and social awareness and safety. No considerable deficits were noted in the rest of the items that included visual neglect, following verbal and written directions, immediate auditory and visual memory, temporal awareness, matching, object identification, and coin recognition of simple money skills. In three items there were substantial differences between males and females, and they included recent memory and orientation, forward memory and sequencing, and multiple-digit simple math skills. In MMSE, 60% of the elderly scored within the acceptable range (80% of the expected score or higher) whereas the remaining 40% performed below the acceptable range (lower than 80% of the expected score). **Conclusion:** In these elderly participants there were specific skill areas that are most commonly affected, but some skill areas remained considerably intact. The most commonly affected areas included mental flexibility, complex concrete problem solving, and multiple-digit simple math skills. In the area of recent memory and orientation, a higher percentage of females showed severe deficits compared to males. However, in the areas of forward visual memory and sequencing and multiple-digit simple math skills, males appear to perform poorly compared to their female counterparts.
Measurement and Aging

Measuring Stage of Change Behavior in Older Adults: Challenge and Solution of Instrument Development

K. J. Bawel, Ph.D.1, J. F. Keck, Ph.D.2, E. E. Morrison, Ed.D.1;
1University of Southern Indiana, Evansville, IN, 2Indiana University-Purdue University, Indianapolis, IN

Purpose: This presentation reports the findings of a study measuring the stages of exercise behavior in older adults and encountered challenges in measurement. The Transtheoretical Model of Behavioral Change was used as the framework. A review of the literature failed to detect a suitable instrument for assessing strength stage of change behavior. Methods: The initial step used existing concepts from documented instruments to create an author-developed questionnaire. A 6-item instrument with 5-point Likert scales was developed to represent the 6 stages of behavioral change. Strength stage of change behavior was measured 0, 6, and 12 wk. A convenience sample of 86 healthy community-dwelling adults age 60 to 92 y volunteered. Inclusion criteria included cognitively intact older adults. Older adults found the question design confusing. For example, questions with two concepts instead of one were difficult to answer with the Likert scale. Another challenge became evident when a priori was conducted on the initial data. The Likert scale format was not useful in differentiating between older adults’ stage of change behavior. As a result, the subjects were placed into one of the 6 stages according to their highest degree of agreement on the individual questions. These challenges created a potential reliability and validity problem. The solution to the two encountered challenges included developing clear and precise definitions of each stage of strength training behavior, and having the subjects identify their individual stage of change behavior according to these definitions. Another possible solution to this challenge could have been to modify each question so that it measures only one concept. Results: Confusion was decreased with the addition of the new format. Findings at 6 wk suggested a significant relationship (T² = 37.57, p = 0.05) between the researcher’s categories and the older adults’ perception of their stage. At 12 wk findings continued to support the relationship (T² = 46.38, p = 0.006) between the category placements. Therefore, the findings supported the solution. Conclusions: When working with the older adult population and measuring change in behavior, clarity, brevity, and use of a single concept are beneficial for the older adult. Structure and design can enhance the reliability and validity potential when assessing behavior in the older adult population.

Measurement and Aging

Age and Gender as Factors in the Reliability of Simple Reaction Time

H. H. Morris, M. C. Schutten, P.Ed., H. Guan, M.S.; Indiana University, Bloomington, IN

Purpose: The purpose of this study was to determine the reliability of measurement schedules designed to assess reaction time and its components, pre-motor and motor time, and to compare the intraclass reliability coefficients (ICC) of males and females with ages between 60 and 70 y with those of males and females with ages between 20 and 30 y. Methods: Five male and five female volunteer subjects within each of the 2 × 2 age/gender classifications who met the requirements of the study were tested on four consecutive days within which each subject completed 80 simple reaction time trials. Preliminary analyses were conducted to detect outliers that were determined via comparison with the individual subjects’ responses for a given day and,
when warranted, replacement values were determined. A test of the day-to-day trends was then completed with the findings that responses on days 1 and 2 were significantly slower than those of days 3 and 4; responses on days 3 and 4 were not significantly different. In view of these results, responses on days 3 and 4 were included for further analyses (Kroll, 1967). Results: ICC reliability estimates were determined for each of the four age/gender classifications based on the 160 trials completed on days 3 and 4. ICC values ranged between 0.94 and 0.99. Tests of significance of the difference among the ICC values were completed using the procedures outlined by Alsawalmeh and Feldt (1992). In general, the reliability of the responses was similar for subjects in the older as compared with the younger age classifications, although some were significantly different (p < 0.05) and the differences in reliabilities were similar for males and females. These results can be contrasted with Schutten (1994) who found lower reliabilities for subjects using the same apparatus, but were engaged in the more difficult psychological refractory period task that required sequential responses to the pairs of stimuli. Conclusions: The Alsawalmeh and Feldt (1992) procedure is recommended as a preliminary analysis when comparing subpopulations on motor responses, as the difficulty of the task may be confounded with age, gender, or other classification variables. Differences in reliability among the groups on specific tasks may complicate the power of tests of statistical inference, leading to concerns of internal validity as well as generalizability.

**Measurement and Aging**

**Culture and ADL Measure of Chinese Older Adults: A Rasch Analysis**

M. Lee, M.S., W. Zhu, Ph.D., Y. Gao, M.S., B. G. Ragan, M.S.; University of Illinois at Urbana-Champaign, Urbana, IL

The numbers of older adults have been rapidly increasing around the world. In China, for example, the older population was more than 90 million in 2001, which was one-fifth of the older in the world (Global Action on Aging, 2002). Cross-cultural study of the aging population has also been an increased interest. To reach accurate and scientific conclusions on the comparison, the measurement tools should be free of cultural bias which, unfortunately, is often not the case. **Purpose**: Using the Rasch analysis, the purpose of the study was to examine psychometric characteristics of activities of daily living (ADL), a widely used subjective measure of physical function in western aging research, when it was applied to Chinese older adults. **Methods**: The data from “The Chinese Longitudinal Healthy Longevity in China” was used, which included 4651 males and 6548 females ranged from 78 to 124 years old. The ADL included items of bathing, dressing, toilet, transfer, continence, and eating. Descriptive analysis and correlation were first employed. The data was then analyzed by the Rasch Rating Scale Model and model-data fit was determined by in-fit and out-fit statistics (< 0.7 or > 1.3). **Results**: Overall, the model fit the data of ADL well, except for the continence item (in-fit = 1.4, outfit = 4.6), which was removed from the final calibration. It was found that eating was the easiest item (logit = -1.73), followed by transferring (logit = -0.97), toileting (logit = -0.43), and dressing (logit = 0.25), respectively. Bathing was the most difficult item (logit = 2.88). This confirms that ADL is an ordinal scale. Overall, both genders needed more assistance when they got old, but women needed more. **Conclusions**: Most ADL items except continence fit the Rasch model well. Because of the ordinal nature of the ADL, total raw score should not be used. There seems to be a culture impact on the difficulty of ADL and Asian older adults may be shyer when talking about their own body conditions, such as bathing, toileting, and continence.

(We appreciate “The Chinese Longitudinal Healthy Longevity in China” for allowing us to use its data.)

**Measurement and Aging**

**Determinants of ADL of the Oldest-Old Chinese**

University of Illinois at Urbana-Champaign, Urbana, IL

Due to the rapidly increasing older population in the world, the index of activities of daily living (ADL) has become one of the most important and commonly used measures in identifying physical function of older adults. Little, however, is known about the determinants of ADL. **Purpose**: The purpose of this study was to investigate the relationship between ADL and a set of physical activity and health- and economy-related variables in Chinese older adults. **Method**: The data of the 2000 wave of the “Chinese Longitudinal Healthy Longevity Survey” was used for the study, which included samples from 22 out of 31 provinces in China and included 11,199 older adult participants (aged from 78 to 124 y; 41.5% were males and 58.5% were females). Using five ADL items (i.e., bathing, dressing, toilet, transfer, and eating), participants’ ADL ability scores were estimated using the Rasch Rating Scale Model. A stepwise regression analysis was then run with the dependent variable of ADL ability, and 30 independent variables from various dimensions of physical activities, self-rated health, self-evaluation on life.
satisfaction, psychological characteristics, economic resources, and medical care. **Results**: Out of 30 independent variables, 17 were significant predictors due to large sample size ($R^2$ equal to 0.322, $p < 0.05$). However, most of them only accounted for little of the total variance. According to the criterion for significant $R^2$ change, which was set to 0.02 for this study, four predictors were identified. They were: “Do you grow vegetables & do other field work at present?”, “Do you do house work at present?”, “Self-reported health” and “Age.” $R^2$ for these four predictors equaled 0.296, $p < 0.001$. **Conclusion**: Physical activity participation and age might play critical roles in determining the physical function of the oldest-old Chinese and “self-reported health” is a good indicator of the ADL status for them. (We appreciate “The Chinese Longitudinal Healthy Longevity in China” for allowing us to use its data.)

**Measurement and Aging**

**The Coordination of Respiration and Deglutition in the Healthy Elderly**

T. Zhou, A. L. Perlman, X. He; University of Illinois at Urbana-Champaign, Urbana, IL

With aging, the ability to swallow safely can be altered by neuromuscular, anatomical, or cognitive impairment. **Purpose**: To understand the effects of these alterations, the coordination between respiration and deglutition in healthy adults must be examined. **Methods**: A total of 52 normal healthy subjects (22 males, 30 females) age 70 to 85 y participated in this study. Subjects were presented with 5 and 10 mL of water and 5 and 10 mL of pudding. Two conditions, self-fed and examiner-fed, were included in the study with about 28 swallows for each condition. Subjects were connected to a respirodeglutometer. Output from each channel was input to a DATAQ DI220 and then to a desktop PC. Data collection was performed with CODAS (Dataq, Akron, OH); signals were analyzed with MATLAB (MathWorks, Novi, MI). A total of 2873 swallows were analyzed. Multi-factor ANOVA models were used to detect the significant factors for the difference in apnea duration and the direction of airflow before and after apnea. A total of four factors were considered: gender, volume, viscosity, and feeding type. Apnea duration was modeled on the log scale. A generalized linear mixed model with a logit link was used to analyze the direction of airflow before and after apnea. **Results**: Significant differences in apnea duration were found for feeding condition, for the interaction between viscosity and volume, and for the interaction between gender and volume. The larger volume had a longer duration with liquid. Females demonstrated a longer apnea duration with liquid than with pudding, and with liquids, females demonstrated a longer duration than males. Both males and females demonstrated a longer apnea when examiner-fed than when self-fed. Regarding the airflow direction, feeding condition, viscosity, and volume were each significant for inspiration before apnea. The interactions between gender and viscosity and between feeding condition and viscosity were also significant. More subjects inspired before apnea when swallowing pudding than when swallowing liquid. The self-fed condition resulted in more inspiration than did the examiner-fed condition. Before the swallow, females inspired more frequently with liquid swallows and males inspired more frequently with pudding. Following the swallow, viscosity and volume were significant and their interaction was significant for inspiration. For liquid swallows, the smaller volume resulted in more inspiration than did the larger volume, but for pudding the opposite was observed to occur. In addition, liquids presented with fewer inspirations after the swallow than did pudding. **Conclusions**: These findings show that the elderly differ from the data we have
obtained from children and young adults. Special attention needs to be paid to this subpopulation as a result.

**Measurement and Aging**

**Identifying Healthy Arteries in Older Men**

**N. Jordan, M.S., T. S. Church, M.D., S. N. Blair, Ph.D.;**
The Cooper Institute, Dallas, TX

Electron beam tomography (EBT) is useful in assessing coronary artery calcium (CAC). Research has shown that CAC scores and incidence of coronary heart disease (CHD) increase exponentially with age. Yet there are older individuals that have low or no CAC scores. It is important to identify the cardiovascular risk factor profiles in these older individuals. **Purpose:** Describe the risk factor profile of older men who have no CAC. **Methods:** Five hundred eighty-three older men (age 60 to 70 y) reported to the Cooper Clinic (Dallas, TX) for a routine physical examination and EBT scan. CAC scores were split into 0 and non-zero CAC groups. We compared heart disease risk factors (resting systolic and diastolic blood pressure, LDL, HDL, and total cholesterol, triglycerides, fasting plasma glucose, incidence of diabetes, body mass index, and waist circumference) of the no CAC (n = 90) group and the group of men with CAC scores within the 25th and 75th percentiles (CAC = 21 to 713 and n = 301). **Results:** Paired t-tests showed there were no statistically significant differences for any of the heart disease risk factors. Linear regression analyses showed a non-statistically significant but inverse relationship between higher cardiorespiratory fitness levels and CAC scores, whereas parental history of premature CHD also had a non-statistically significant but positive linear relationship with CAC scores. **Conclusion:** There appears to be no one risk factor associated with CAC-free arteries in elderly men. Exercise, diet, and genetics are areas that deserve further attention in regards to CAC.

**Measurement**

**Smartmat Area Monitoring and Analysis System for Measuring Ambulatory Motion in a Control Space**

**K. W. Brendley, M.S., J. Marti, Ph.D.;**
Artis, LLC, Reston, VA

The Smartmat Area Monitoring and Analysis System, a new device for measuring ambulatory motion in a control space, is described and evaluated in this study. The system counts subjects and other objects passing across it and computes their location, direction, time, speed, and stride length. Applications in the field of aging research include activity monitoring of home or institutional environments, physical activity monitoring of pedestrian walkways, and monitoring of caregiver visitation frequency and activity. A typical Smartmat resembles an industrial carpet in appearance and has four layers: (a) a top vinyl layer typically of commercial flooring material, (b) an active layer of sensors and electronics, (c) a sealing layer of vinyl or other appropriate material, and (d) a flexible layer of rubber or neoprene. In laboratory tests, single human subjects, groups of human subjects, and a dog walked across the Smartmat. Subjects were counted by an observer, verified with video recording, and then counted by automated Smartmat software with no human intervention. For single subjects (n = 39), the False Alarm Rate (FAR—a measure of false positives) was 5.13%, and the Probability of Acquisition (PA—the probability of
sensing a subject) was 100%. For multiple subjects crossing the Smartmat at a given time ($n = 108$), FAR was 0.00% and PA was 91.74%, indicating that the Smartmat had a tendency to over-count single subjects and undercount multiple subjects. When no subjects were using the mat (e.g., it was turned on but no one was permitted to pass over it), it correctly reported zero counts. Finally, Smartmat rejected the non-human subject, i.e., a dog. The cumulative error rate was 5.44%. This data indicates that Smartmat holds potential for further development into an accurate monitoring system. The goal of ongoing efforts is to limit FAR to 1% or less for a PA greater than 99%. This will be attained through a combination of increased sensor density, different mat design (surface shape, elasticity, and sensor surface friction), improved electronics systems (temperature compensation, better sensor quality control, and signal conditioning), better software systems (improved noise rejection, continuous calibration, footfall prediction/correction and incorporation of footfall pressure–weight–differentiation).

(This work is sponsored by the National Center for Chronic Disease Prevention and Health Promotion, Centers for Disease Control and Prevention.)

Measurement and Aging
Effect of Gymnastics on Body Composition and Mood of Older Adults
S. Kim, Ph.D.;
University of Seoul, Seoul, Republic of Korea

Purpose: The purpose of this study was to examine the effects of gymnastics on the body composition and mood of older adults, and to develop the program (which included several conditions focusing on the characteristics of the older adults). Methods: The participants of this study were 20 older adults, who did not exercise regularly and had access to the welfare facilities. Those participants were asked to do the gymnastic exercise designed by the researcher three times a week for 24 wk. Data for body composition were obtained by In-Body 3.0, and BDI was operated for mood status. Results: Overall, weight reduced from $M = 67.6$ kg ($SD = 5.21$) to $M = 66.2$ kg ($SD = 4.83$) in males and from $M = 62.4$ kg ($SD = 6.46$) to $M = 60.9$ kg ($SD = 6.57$) in females. Body fat weight was reduced from $M = 16.5$ kg ($SD = 3.32$) to $M = 15.4$ kg ($SD = 3.05$) in males and from $M = 21.7$ kg ($SD = 3.07$) to $M = 20.8$ kg ($SD = 2.36$) in females. Body fat percent was reduced from $M = 24.4$% ($SD = 3.77$) to $M = 23.2$% ($SD = 3.66$) in males and from $M = 34.8$% ($SD = 3.12$) to $M = 33.5$% ($SD = 2.52$) in females. Lean body mass was reduced from $M = 51.0$ kg ($SD = 3.41$) to $M = 50.5$ kg ($SD = 3.49$) in males and from $M = 40.7$ kg ($SD = 4.42$) to $M = 40.5$ kg ($SD = 4.33$) in females. There was a statistically significant difference in mood status before and after the program intervention ($p < 0.01$). Conclusions: Because depression score was significantly decreased after the intervention, it is believed that the gymnastics program has a positive effect on the mood status for the older adults.

Measurement and Aging
Survey of Physical Activity Participation and Health Correlates of Individuals with Spinal Cord Injury/Disease
University of Illinois at Urbana-Champaign, Urbana, IL

The number of Americans with spinal cord injury or disease (SCID) has been estimated to be as high as 230,000. Unfortunately, little is known about physical activity (PA) participation levels
of persons with disabilities, and there is little compelling evidence of the extent to which participation in PA fosters such beneficial health consequences among persons with severe physical disabilities. **Purpose:** The purpose of this study was to investigate PA participation of individuals with SCID and assess the relationship between PA participation and a range of health and demographic variables. **Methods:** A comprehensive survey called “Human Factors and Employment Issues Related to the Use of Assistive Technologies,” with six sections and 60 items, was developed for the study. The survey was administered to 195 SCID participants, ranging in age from 18 to 64 y. The participants were recruited from two groups: one college-educated group comprised of alumni from a Midwestern university (n = 94) and another mixed-educated group comprised of US veterans (n = 101). Their participation in PA was assessed by self-reporting. They were asked if they participated in any moderate physical activity or exercise specifically to maintain or improve their health and fitness during the past 12 months. If they did, they were asked how many times per week, on average, they participated in such activities. Group differences in both PA participation and their correlates were examined. **Results:** Overall, a rather high PA participation rate was reported by both groups: 44.1% of the alumni group reported that they had participated in PA three or more times per week during the previous 12 months and 51.5% of the veteran group stated that they had participated in moderate PA at that frequency. However, PA participation was found to have no or very low correlations with the health and demographic variables examined, e.g., age (r = -0.098), the number of days hospitalized (r = -0.070), the number of co-morbidities (r = -0.058), disability severity (r = -0.006), functional status (r = -0.117), participation in community volunteer activities (r = 0.078) and participation in educational activities (r = 0.072). **Conclusion:** A relatively large percentage of persons with SCID reported that they participated in PA three or more times per week specifically to enhance their health and wellness. There is a need to provide better guidance as to the frequency, duration, and intensity of exercise that would be necessary to produce significant and beneficial health outcomes of this population.

**Measurement and Aging**

**BMI Standards in Midlife and Older Postmenopausal Women**

E. M. Evans, Ph.D.1, K. M. Ross, B.S1, S. B. Racette, Ph.D.2;

1University of Illinois at Urbana-Champaign, Urbana, IL, 2Washington University School of Medicine, St. Louis, MO

The National Institutes of Health (NIH) has adopted guidelines for determining overweight and obesity as a body mass index (BMI) of 25 and 30 kg/m², respectively. Alarmingly, the percentage of early postmenopausal women considered obese (BMI = ≥30 kg/m²) increased 43% in the past decade. Due to increases in adiposity and decreases in fat-free mass with age, the relation between percentage body fat (percent fat) and BMI may differ in older women. **Purpose:** The aim of this study was to examine the relation between percent fat and BMI in the sixth through the eighth decade of life in women. **Methods:** Height, weight, BMI and percent fat, assessed by dual energy X-ray absorptiometry (DXA), were determined for 275 healthy women ranging in age from 50 to 80 y (M ± SD; 64.4 ± 7.8 y). **Results:** Per NIH BMI guidelines, 36% were classified as normal weight, 42% as overweight, and only 22% as obese (M ± SD; 26.7 ± 3.6 kg/m², range = 18 to 35 kg/m²). In contrast, using the percent fat criterion of 38% advocated by Lohman to diagnose obesity, 47% of our sample was classified as obese (M ± SD; 37.4 ± 5.6 percent fat, range = 18 to 50 percent fat). A moderately high relation existed...
between BMI and percent fat \( (r = 0.70, \text{percent fat} = 1.11x + 7.62, \text{SEE} = 4.2 \text{ percent fat}, p < 0.001) \). Estimated percent fat associated with NIH classifications were: 25 kg/m\(^2\) = 35.5 percent fat and 30 kg/m\(^2\) = 41.0 percent fat. The relation between percent fat and BMI changed slightly in the oldest cohort (50 to 59 y; \( y = 1.17x + 6.70, \text{SEE} = 4.6 \text{ percent fat}, n = 68 \); 60 to 69 y; \( y = 1.17x + 6.02, \text{SEE} = 4.2 \text{ percent fat}, n = 133 \); however, the resulting percent fat estimation for a given BMI was similar (e.g., 25 kg/m\(^2\) = 35.9 percent fat, 35.3 percent fat, and 35.5 percent fat for the sixth, seventh, and eighth decade, respectively). **Conclusions:** We conclude that there is a strong relation between percent fat and BMI in postmenopausal women and the percent fat prediction ability of BMI remains constant from the sixth through the eighth decade of life. No percent fat classifications for obesity have been established at this time; however, based on percent fat standards established by experts in the field, current NIH BMI classifications for obesity may be misleading in older women. Further studies are needed utilizing larger sample sizes to investigate the stability of BMI to predict percent fat across the lifespan in women.

**Measurement and Aging**

**Effects of Water Exercise on Psychological Well-Being of Old Women**

H. Lim

Hanyang Women’s College, Seoul, Republic of Korea

**Purpose:** The purpose of this study was to investigate the effects of water exercise on the psychological well-being of old women. **Methods:** A total of 39 old women participated in this study. The participants were divided into two groups: 21 in the water exercise participation group and 18 in the control group. After 8 wk of intervention, 10 variables including confluence, optimism, self-esteem, self-efficacy, social support, social interest, freedom, energy, cheerfulness, and clarity were measured using Affectometer 2. Independent t-tests were used to identify the difference in psychological well-being between the water exercise and control groups. **Results:** There were statistically significant differences in all 10 variables between the two groups. Statistically significant changes; confluence \( (t = 4.33, p < 0.001) \), optimism \( (t = 4.15, p < 0.001) \), self-esteem \( (t = 6.82, p < 0.001) \), self-efficacy \( (t = 4.28, p < 0.001) \), social support \( (t = 5.92, p < 0.001) \), social interest \( (t = 5.90, p < 0.001) \), freedom \( (t = 8.21, p < 0.001) \), energy \( (t = 7.93, p < 0.001) \), cheerfulness \( (t = 6.76, p < 0.001) \), and clarity \( (t = 6.78, p < 0.001) \). The results showed that differences existed in the psychological well-being between old women who participated in water exercise and those who did not participate. **Conclusions:** Based on the findings, participation in water exercise may have a crucial impact on the psychological well-being of old women.

**Measurement**

**Errors in Measurement of Body Composition using Generalizability Theory**

S. Oh, Ph.D, M. Cho, Ph.D.;

Inha University, Incheon, Republic of Korea

As the number of students who are overweight is increasing, there is a growing need to examine Korean adolescents’ body composition, one of the health-related fitness components. It is very difficult for physical educators to implement the rigid measurement procedures of body composition due to limitations of instruments and budget. For this reason, it is not surprising to
have errors in measuring body composition. **Purpose:** The purpose of this study is to identify the error sources of skinfold measurement in order to develop the standards for measuring body composition for middle-school male students. **Methods:** A generalizability theory has been often used to provide the sources of variation during the measuring process. Two hundred and six male students from a middle school were involved in this study. The skinfold measurement is conducted using three composite models by three of the examiners (an expert, a semi-expert, and a non-expert) over three trials. Three calipers including a Harpenden caliper, a Lange skinfold caliper, and a Skindex were used. **Results:** This study found that about 61% of variation came from participants themselves, and 38% of variation from complex interactions among examiners, participants, instruments, and trials. The measurement results are significantly different over the examiners (between the expert and the semi-expert; between the expert and the non-expert). It seems that the results of non-expert examiners are not appropriate to measure body composition. The errors of intra-examiners are very small, whereas the errors of inter-examiners are relatively large. The results from the Lange skinfold caliper are more consistent than the ones of other calipers. **Conclusions:** It is suggested that the knowledge, skills, and training of skinfold measurements (especially landmarking techniques) are needed when accessing body composition of middle school students.

**Measurement and Aging**

**Kinematical Evaluation of Gait Variables in Developmental Gait Studies**

**K.Yi, Ph.D., M. Kim, Ph.D.;**
Ewha Womans University, Seoul, Republic of Korea

**Purpose:** The purpose of this study is to evaluate how kinematics gait variables explain the developmental process, change, and transition of gait in girls between the ages of one and five. **Methods:** The participants of this study were 24 girls, from one to five years of age. The control group consisted of 21 adult females who did not have an experience of pregnancy (these factors may alter the shape of the pelvis, and consequently change gait). The Vicon 370 by Oxford Metrics was used in this study. Joint angles and joint angle velocity throughout the gait cycle were recorded. This study focused on the following variables: (a) the mean angle during the entire gait cycle, (b) the mean angle for each of the four phases of the gait cycle, (c) the mean angle for each event (e.g., heel down or toe-off), (d) the maximum mean angle value for the entire gait cycle, (e) the maximum mean angle value for each phase of the gait cycle, (f) dynamic range of motion, (g) angle graphs according to each age, (h) angle graphs according to each joint, (i) angular velocity according to each age, and (j) angular velocity according to each joint. **Results:** The mean angles and the maximum mean angles significantly differed from age in the entire gait cycle, phases, and events. The results for each phase and each event provided more detailed and accurate information about gait development than the results for only the mean angles and the maximum mean angle for the entire gait cycle. While analysis of mean angles for the entire gait cycle, phase, and event can provide detailed information, these results are limited. This is because the movement is the ratio of angle change to time, while angle analysis provides information about joints only at a static point. **Conclusions:** Both angular velocity graphs can be included in analysis to counterbalance this deficiency.
Worries of Low Achievement Athletes at High School: A Qualitative Study

M. Cho, M. Kim; Inha University, Incheon, Republic of Korea

Purpose: A case study was employed to understand the worries of low achievement athletes at high school. Methods: Three student baseball players of a high school in the northern area of Korea were selected. Video recording, in-depth interviews, and records of critical incidents were used to collect the data. Data analysis was completed by an inductive analysis. In order to increase interpretative accuracy and to provide evidence of credibility, the techniques of peer debriefing (discussion with colleagues) and member checking (research participants’ review) were employed. Results: The results showed that student athletes with low marks had several worries: in school life, within the sports team, and inferiority. Poor sports and learning ability were the causes for the worry in their school life, such as confusion about their ego-identity and isolation from the classroom. All three students thought themselves as victims of the system. Conclusion: The worries in the sports team were conflicts with and distrust in the leaders and absence of alternative plans for their future. The inferiority resulted from the above two and had close relationship with the worries that the participants had.