A fitness screening model for increasing fitness assessment and research experiences in undergraduate exercise science students

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Brown GA, Lynott F, Heelan KA. A fitness screening model for increasing fitness assessment and research experiences in undergraduate exercise science students. Adv Physiol Educ 32: 212–218, 2008; doi:10.1152/advan.00025.2007.—When students analyze and present original data they have collected, and hence have a cultivated sense of curiosity about the data, student learning is enhanced. It is often difficult to provide students an opportunity to practice their skills, use their knowledge, and gain research experiences during a typical course laboratory. This article describes a model of an out-of-classroom experience during which undergraduate exercise science students provide a free health and fitness screening to the campus community. Although some evidence of the effectiveness of this experience is presented, this is not a detailed evaluation of either the service or learning benefits of the fitness screening. Working in small learning groups in the classroom, students develop hypotheses about the health and fitness of the population to be screened. Then, as part of the health and fitness screening, participants are evaluated for muscular strength, aerobic fitness, body composition, blood pressure, physical activity, and blood cholesterol levels. Students then analyze the data collected during the screening, accept or reject their hypotheses based on statistical analyses of the data, and make in-class presentations of their findings. This learning experience has been used successfully to illustrate the levels of obesity, hypercholesterolemia, and lack of physical fitness in the campus community as well as provide an opportunity for students to use statistical procedures to analyze data. It has also provided students with an opportunity to practice fitness assessment and interpersonal skills that will enhance their future careers.

WE HAVE OBSERVED that many students are complacent in the laboratory setting regarding the accuracy of their measurements when performing fitness evaluations on their classmates. To thwart the complacency of students' measurements of health and fitness, provide students an increased opportunity to further develop their fitness assessment skills, and provide a service to the larger university community, we developed an experience in which exercise science students provide a free health and fitness screening to the campus community. This learning exercise is based on a service-learning model and is designed for students who have had previous coursework in Health and Wellness, Introductory Nutrition, Wellness Interventions, Statistics, Human Anatomy and Physiology, Anatomical Kinesiology, Exercise Physiology, and Fitness Assessment and Exercise Prescription.

Service learning is a pedagogical technique in which learning is enhanced through the use of skills learned in the classroom and laboratory in an appropriate setting outside of the classroom, such as in a community clinic. Service learning has been used successfully in nursing (29), dentistry (20), and dietetics (26) education, among other fields. It appears that service learning increases students' sense of ownership for performing the desired skills correctly and enhances students' feelings of preparedness for the use of their skills, and students feel that their learning and skills benefit society (22). Service learning also provides structured time for students to reflect on their experiences and broaden learning beyond the classroom (15). Furthermore, service learning may provide an opportunity for those students who are less successful at taking tests to demonstrate competence in their professional skills (6).

To the best of our knowledge, there are no reports describing the use of a health and fitness screening to enhance students’ learning experience in the exercise science curriculum. However, students in exercise science can use their skills to provide many useful services to the public. For instance, a blood pressure screening may be effective at detecting hypertension and stimulating a person to seek treatment (19). An accurate measurement of body mass and height may more effectively identify individuals who are overweight or obese than does the use of self-reported data (18). Furthermore, many people are unaware of their physical fitness (or lack thereof) even if they have lifestyles or careers that require above-average fitness (23). Finally, the health and fitness screening described herein provides information for participants about modifiable risk factors for lifestyle-related diseases, and this information may stimulate lifestyle changes (24, 25).

Students have increased interest in data analysis and presentation when the data are derived from their own experimental data rather than from a prepared data set, particularly when the data may result in a novel finding (17, 27). Krathwohl (13) demonstrated that the highest level of learning occurs when students generate a hypothesis, prepare an investigation to test the hypothesis, and then produce novel data relating to their hypothesis. Hence, we require the students to approach the health and fitness screening as a research experience that not only increases their skill development but also enhances their educational experience.

The purpose of this article is to describe a model of a free health and fitness screening as an opportunity for undergraduate exercise science students to gain more experience with fitness assessment skills beyond the opportunities provided by a typical laboratory and to also provide an opportunity for students to analyze original data. This article primarily details a model learning experience that can be used by others and is

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not a detailed evaluation of either the service or learning benefits of the health and fitness screening.

The Fitness Screening Learning Exercise

Overview. Undergraduate exercise science students in their capstone class develop a series of hypotheses relating to the academic major, academic rank, gender, or other factors that may influence physical activity and health. Then, a free health and fitness screening is offered to the campus community by the undergraduate exercise science students. After completing a physical activity readiness questionnaire (PAR-Q) and signing a document of informed consent, participants are questioned for their age, gender, year in school, and academic major. Participants then have their blood pressure, body height, body mass, body composition (via 7 site skinfolds), muscular strength (via submaximal strength testing of the upper body using a bench press and lower body using a leg press), and aerobic fitness (via a 1.5-mile run/walk with postexercise heart rate measurements) assessed. Participants then wear a pedometer for 24 h of normal activity to obtain a daily step count and undergo a fasting cholesterol screening from a fingerstick blood sample. All processes of the health screening are conducted by students under the supervision of faculty and staff members, and data for all of the variables measured are entered into a spreadsheet for analyses by students. Students then analyze the data and present their findings in class.

Student preparation. The fitness screening learning exercise has been used as part of a capstone experience in PE 468 (Public Health Aspects of Physical Activity), in which a focus of the class is to educate students about the health benefits of physical activity and how to enhance physical activity in the community. The goal of this learning exercise is not to teach students the assessment skills that should have previously been learned but to allow students an opportunity to practice and develop their professional skills as well as learn data collection, analysis, and presentation skills. Before enrolling in PE 468, students have taken coursework in Statistics, Human Anatomy and Physiology, Anatomical Kinesiology, Health and Wellness, Exercise Physiology, Introductory Nutrition, and Fitness Assessment and Exercise Prescription.

Before offering the health and fitness screening to the campus community, students practice the screening on their classmates during several laboratory sessions for PE 468 to understand the procedures and for a final practice of their skills before using them on the public. At this time, the instructor monitors the students, and the students are encouraged to monitor one another to make sure that correct techniques are followed. Students must demonstrate competence in the health and fitness assessment skills to the instructor at this time, and students who struggle with the fitness assessment skills are provided one-on-one instruction until their skills are acceptable.

Hypotheses development. During class, students in PE 468 are divided into groups of three to four students. Each group is then assigned one aspect of the health and fitness screening to use for their hypothesis development so that there are groups for body composition, aerobic fitness, muscular strength, blood pressure, physical activity, and blood cholesterol. Each group of students is then instructed to develop a hypothesis that could be tested during the health and fitness screening and to present their hypothesis to the instructor for approval. These hypotheses may be based on solidly supported ideas, such as a lack of physical activity is generally associated with a higher incidence of hypertension or hypercholesterolemia (5). Students may also develop hypotheses based on their own experiences or perceptions. One such popular hypothesis is that students who are enrolled in a health or physical education major will be more physically active and have better muscular strength, aerobic fitness, and body composition than other students (8, 9). Part of the course material before the development of the hypotheses is a discussion of the numerous lifestyle-related diseases that can be prevented through proper diet and physical activity, such as type 2 diabetes mellitus and heart disease. This discussion builds on and summarizes information that students have studied in their preparatory coursework.

Statistical challenges. The t-test and simple linear regression are the basic statistical tests that we think students should understand. However, we have observed that even after taking a class in statistics, having the importance of statistics in scientific data explained in other classes, and using t-tests and linear regression in their laboratory assignments in exercise physiology, the majority of our students do not understand the application of a correlation coefficient or P value. The data analyses performed in this learning exercise are not intended to involve the use of advanced statistics or the derivation of equations but to help illustrate how relationships or differences between measured variables are assessed. Students are therefore instructed to develop hypotheses that can be easily analyzed using either a t-test or simple linear regression using data that fit within the parameters of the health and fitness screening. While developing their hypothesis in class, students discuss with the instructor when a t-test would be appropriate, such a comparison of two groups, and when a correlation would be appropriate, such as the relationship between two variables.

Recruiting participants. Participants for the health and fitness screening are recruited via e-mail, through in-class announcements, and through advertisements posted in campus buildings, all of which advertise a free student-operated health and fitness screening. The announcement indicates when the fitness testing will occur and where to register for the health and fitness screening. Participants register for specific screening times on a sign-up sheet posted near the testing location. At the location where participants register for the health screening, instructions are posted informing participants of the assessments to be performed, to come dressed for exercise and body composition analysis (e.g., wear shorts, a T-shirt, comfortable walking or running shoes, and for women to wear a sports bra), to be well hydrated, to abstain from caffeine for 6 h before the screening, and to avoid eating for 3 h before the screening (2). In the past, we have focused on recruiting students, but this process could be expanded to include faculty or staff members or anyone who wants to be in the participant population. The number of participants in the screening is largely determined by the number of students in the PE 468 class and time available for conducting the screening. Recently, in a 4-wk period, by having two 3-h evening screening times per week, 305 participants underwent the health and fitness screenings, which were conducted by 40 students.
eight subjects and paired with two student technicians. Student technicians then proceed with their cohort through all stages of the health and fitness screening. As participants and student technicians continue through the various stations, the student technician explains the purposes of each measurement and helps participants to understand their results.

PREPARTICIPATION SCREENING. The first task for all cohorts is to complete the PAR-Q (2), to ensure that they can safely participate in the fitness testing, and sign a document of informed consent approved by the institutional review board. Participants are then given a paper listing all of the screening stations with spaces provided for recording the appropriate results. The process of obtaining consent and completing the PAR-Q usually takes 2–3 min/person. Before initiating this project, appropriate approval from the Institutional Review Board for the Protection of Human Subjects should be obtained. Fortunately, all procedures are fairly common submaximal or educational procedures, and, in the experience of the authors, IRB approval is easily obtained.

BLOOD PRESSURE. Participants are allowed to sit for 2–3 min, while completing the paperwork, before blood pressure measurement. Blood pressure is measured via the auscultatory method (2) on seated participants using mercury sphygmomanometers, and two measurements are taken with 1 min allowed to pass between readings. Data for blood pressure are recorded to the nearest even number as systolic and diastolic blood pressure. This process usually takes 2 min/participant.

BODY COMPOSITION. Participants are measured for body height to the nearest 0.5 cm via a stadiometer and body mass to the nearest 0.1 kg using a balance scale, having removed their shoes for both measurements. Body composition is assessed via 7 site skinfolds using the techniques of the American College of Sports Medicine (ACSM) (2). The use of the 7-site skinfold assessment was chosen to maximize the skinfold testing experience of the students providing the health and fitness screening. All sites are measured in duplicate by a single technician, and duplicate measurements not within 2 mm of one another are then remeasured. Data obtained from body composition testing are used to calculate body mass index (in kg/m²) and percent body fat using generalized ACSM prediction equations (2). This process usually takes 5 min/participant.

MUSCULAR STRENGTH. Muscular strength is assessed via a submaximal 2–20 repetition to fatigue bench press and leg press using resistance exercise machines. These tests require participants to complete the exercise throughout the entire range of motion at least 2 times but not >20 times, with fatigue occurring at the last repetition. The weight lifted and number of repetitions completed are then used to predict maximal muscular strength from Eq. 4.1 of Adams (1) as follows:

\[
1 \text{ RM (in kg)} = \frac{\text{kg lifted}}{1 - (\# \text{ repetitions} \times 0.02)}
\]

where 1 RM is the one repetition maximum and \# repetitions is the number of times the participant was able to complete the prescribed exercise. If the participant is able to complete the exercise >20 times, the participant should be given several minutes to recover and then try again with a heavier resistance. Usually, participants are able to complete the muscular strength assessment in 5 min/person. As having controlled motion is essential to prevent injury during resistance training (particularly among persons of unknown resistance training experience) and to expedite the testing process, it is suggested that the strength assessment be conducted using a machine rather than free weights.

AEROBIC FITNESS. Aerobic fitness is assessed with a 1.5-mile run/jog/walk using postexercise heart rate to enhance accuracy (14). This test requires participants to complete 1.5 miles at a comfortable, consistent pace. Heart rate is then measured immediately postexercise, and the time to complete 1.5 miles (in min) and postexercise heart rate are then used to estimate aerobic fitness. This station is operated as a group testing station with participants running on an indoor track or other location with a circular known distance, and each participant has a number pinned to their shirt to help the technicians count laps (and hence measure distance completed). Participants are also fitted with a chest strap for a heart rate monitor (e.g., Polar A1). Before beginning the testing, the technicians verify that the chest strap is correctly placed on the participants and is transmitting to the receiver. Participants are instructed to complete the 1.5-mile run at a consistent moderate pace with minimal variation in speed (e.g., do not sprint and then walk). Participants then start the aerobic fitness test, and, as they pass the technicians, the technicians count their laps and remind the participants to maintain a steady pace. Upon finishing the aerobic fitness test, the technician measures heart rate with the receiver, and aerobic fitness [maximal oxygen consumption (V\text{O}2\text{max})] is calculated using the equation of Larsen et al. (14).

The chest straps are cleansed between each group of participants. This station takes anywhere from 9 to 25 min/person, depending on how quickly the participant finishes the 1.5-mile distance.

DATA EXPLANATION. At this station, the results of the participant’s screening that have been recorded on the data sheet are entered into a computer spreadsheet (e.g., MS Excel), which performs all calculations for the determination of 1 RM, 1 RM relative to body mass, aerobic fitness, body mass index, and body composition. The spreadsheet is designed by student technicians and verified for accuracy by the instructor. These results are then printed off for the participants, and the meaningfulness of the results relevant to established normative data (2) are explained to the participants. The data are also transposed to a spreadsheet for later data analysis. This process usually takes 1 min/participant to enter and print the data, and then the student technicians answer questions for their participants as they explain how to understand the results.

CHECKOUT. After completing all of the preceding stations and during the checkout process, participants are provided with a step counter (e.g., Digiwalker SW-701, Yamax, Tokyo, Japan) that is numbered, and the number is recorded on the data sheet. Participants are shown how to wear the step counter (on the waistband of the pants directly above the knee) and how to reset the step counter to zero. Participants are then instructed to, on the morning of physical activity monitoring, reset the step counter to zero and wear the step counter for 1 full day of their normal lifestyle. At the end of the measurement day, participants are to write down their number of steps on an adhesive label that is attached to the step counter and return the step counter with the label to a designated location. Participants are also asked to sign up for a time to come back for a fasting cholesterol screening.
When the step counters are returned, the participant-reported numbers are matched with the step counter number on the spreadsheet, and the numbers of steps are entered into the master data spreadsheet by a student.

**BLOOD CHOLESTEROL.** For the measurement of blood cholesterol, participants report to a designated location after an 8- to 10-h fast for the measurement of blood cholesterol concentrations. Total and HDL blood cholesterol concentrations are measured via a fingerstick using an enzymatic system (LDX Lipid Monitoring System, Cholestech, Hayward, CA). This process usually takes 10 min/participant, and two technicians are assigned to this station. In our experience, the student technicians have not previously had blood-borne pathogen exposure control or fingerstick blood sample collection training. So, as part of the preparatory laboratory experiences, we provide student technicians with training on blood-borne pathogen exposure control and fingerstick blood-sampling techniques, which require the use of cleaning and disinfecting the site of blood sample collection, disposable gloves, new lancets for each blood sample, and disposal of waste in a biohazardous waste container. As the results of the blood cholesterol screening are completed, the technicians assist the participants in understanding the results, and the participants are given a brief information sheet indicating the health implications of blood cholesterol (21). The blood cholesterol data are entered into the data spreadsheet for later analysis.

**Analyzing the data.** Hypotheses regarding the data obtained from the health and fitness screening that have been previously tested are (1) that students majoring in health or physical education will have better muscular strength, aerobic fitness, and body composition than their nonmajor peers, (2) that upper-division undergraduates (juniors and seniors) will be less fit than the lower-division undergraduates (freshman and sophomores), and (3) that persons who accumulate more steps per day are more physically fit. *Hypotheses 1 and 2* are analyzed by using a *t*-test to compare the respective groups for a given parameter of fitness, such as V̇O₂max or muscular strength, whereas *hypothesis 3* is analyzed with linear regression. During the classroom meetings when the health and fitness screening is offered, students are instructed on how to calculate means and SDs and how to conduct and analyze *t*-tests and linear regression using the spreadsheet software (e.g., MS Excel). Students are also instructed on how to prepare graphs of the data. Once the data collection is complete, students analyze the various components of the data based on their assigned groups, accept or reject their hypotheses (e.g., muscular strength of Health and Physical Education majors vs. nonmajors, aerobic fitness of majors vs. nonmajors), and prepare a 5-min presentation of their data, including background, methods, results, and discussion.

**Participant perceptions of the health and fitness screening.** One hundred and twenty participants (~1/3 of the participants) in the health and fitness screening were asked to complete a brief, anonymous questionnaire (Table 1) regarding their perceptions of the health and fitness screening. These participants were drawn from students in introductory and general education classes in the Department of Health, Physical Education, Recreation, and Leisure Studies (HPERLS) at the University of Nebraska (Kearney, NE). Participants were asked to complete and return the survey in class and assured that their responses would be confidential and would not influence their course grade. Responses were entered by an assistant who would not recognize handwriting or otherwise connect the responses on the questionnaire with class grades, and data were analyzed for both mean scores and the frequency of each response.

**Student technician perceptions of the health and fitness screening.** The students who conducted the health and fitness screening were allowed to discuss what they had learned and what should be changed about the health and fitness screening on several opportunities in class. Students were also required to comment on their perceptions of the positive or negative aspects of conducting the health and fitness screening and to include any constructive criticism in their course journals. Students were assured that their comments, either positive or negative, would not influence their course grades, but that it was required to comment.

**What We Have Learned**

In February and March of 2006, the health and fitness screening was offered for 4 wk at 2 nights/wk for 3 h/night with 4 accompanying sessions/wk for cholesterol assessment. In this screening, 305 participants [186 HPERLS majors (90 women and 96 men) and 119 non-HPERLS majors (61 women and 58 men)] completed the health and fitness screening.

**Participant perceptions of the health and fitness screening.** Based on the participant surveys, 85% of the participants indicated either a 3 or 4 (3.25 ± 0.18, means ± SE), agreeing that the health and fitness screening increased their awareness of their own physical fitness. Fewer participants (50%) indicated that the health and fitness screening increased their knowledge of lifestyle-related diseases (2.52 ± 0.26). Participants in the health and fitness screening were favorably impressed with the knowledge of the student technicians (3.71 ± 0.10) and with the skill level of the student technicians (3.30 ± 0.15).

### Table 1. Questionnaire regarding participants’ perceptions of a student-operated health and fitness screening

<table>
<thead>
<tr>
<th>Hypothesis</th>
<th>Strongly Disagree</th>
<th>Disagree</th>
<th>Agree</th>
<th>Strongly Agree</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. I felt that the health and fitness screening increased my awareness of my level of physical fitness.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>2. I felt that the health and fitness screening increased my knowledge about my risk factors for lifestyle-related diseases.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>3. The students conducting the health and fitness screening were knowledgeable about health and fitness.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>4. The students conducting the health and fitness screening were skilled in fitness assessment techniques.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>5. Please indicate what you thought was the most informative aspect of the health and fitness screening.</td>
<td>Blood pressure</td>
<td>Body composition</td>
<td>Muscular Strength</td>
<td>Laboratory techniques</td>
</tr>
<tr>
<td>6. Please indicate anything that could be done to improve the health and fitness screening.</td>
<td>Blood pressure</td>
<td>Body composition</td>
<td>Muscular Strength</td>
<td>Laboratory techniques</td>
</tr>
<tr>
<td>7. Are there any additional comments that you would like to share regarding the health and fitness screening?</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
fitness screening, followed by aerobic fitness (23%), body composition (19%), muscular strength (15%), physical activity (5%), and blood pressure (2%). The vast majority of participant comments were very positive, with comments such as “I knew I was out of shape, but this really helped me understand how out of shape I was”, “I have never had my cholesterol measured, and it’s nice to know I am not in trouble”, and “I think this is a great experience.” Overall, participants described how they enjoyed learning about their own levels of health in regard to strength and aerobic fitness, body composition, and blood cholesterol concentrations. Participants remarked that the students conducting the health screening were friendly and competent and seemed very knowledgeable about what they were doing.

The comments for areas of the health and fitness screening that needed improvement were minimal. A few participants indicated that they “wish that we could conduct more specific tests of health and fitness” or that “the time for the screening was too long.” Some participants also commented that they “did not understand the reason for measuring the number of steps” taken in the 24-h period.

Student technician perceptions of the health and fitness screening. The students conducting the health and fitness screening remarked that the experience “helped me to develop fitness testing skills” and “will make me a better professional.” Many of the student technicians (95%) commented that the health and fitness screening provided an opportunity for them to understand and answer questions about health and fitness from nonexercise science students and that this experience “. . . opened their eyes to how confused people can be about health and fitness.” Overall, the students conducting the health and fitness screening found this to be an enjoyable, meaningful learning experience. A few students complained about the evening or morning time they had to give up to complete the assignment, but this was a very small minority of the students.

When the students analyze the data from the health and fitness screening, some groups do a very good job understanding and analyzing the data, whereas others do not. One of the most common mistakes is that students confuse the meaning and analyzing the data, whereas others do not. One of the student technicians (95%) commented that the health and fitness screening provided an opportunity for them to understand and answer questions about health and fitness from nonexercise science students and that this experience “. . . opened their eyes to how confused people can be about health and fitness.” Overall, the students conducting the health and fitness screening found this to be an enjoyable, meaningful learning experience. A few students complained about the evening or morning time they had to give up to complete the assignment, but this was a very small minority of the students.

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Thought-provoking data. The data largely seem to refute incorrect assumptions made by students. For instance, in the most recent use of the fitness screening, we observed that there were no differences in body composition, aerobic fitness, muscular strength, physical activity, or blood cholesterol levels between HPERLS majors and their nonmajor peers (Table 2).

Table 2. Sample of the data collected during a health and fitness screening offered by undergraduate exercise students as a service-learning experience comparing non-HPERLS and HPERLS majors

<table>
<thead>
<tr>
<th>Measure</th>
<th>Non-HPERLS Majors</th>
<th>HPERLS Majors</th>
</tr>
</thead>
<tbody>
<tr>
<td>Body mass index, kg/m²</td>
<td>25.5 ± 5.0</td>
<td>24.6 ± 4.0</td>
</tr>
<tr>
<td>Body fat, %</td>
<td>20.2 ± 8.0</td>
<td>18.6 ± 7.6</td>
</tr>
<tr>
<td>Bench press 1 RM, kg</td>
<td>54.2 ± 25.9</td>
<td>57.3 ± 28.5</td>
</tr>
<tr>
<td>Leg press 1 RM, kg</td>
<td>198.7 ± 71.4</td>
<td>203.0 ± 71.9</td>
</tr>
<tr>
<td>Maximal oxygen uptake, ml·kg⁻¹·min⁻¹</td>
<td>44.1 ± 8.3</td>
<td>46.0 ± 7.9</td>
</tr>
<tr>
<td>Systolic blood pressure, mmHg</td>
<td>125.6 ± 11.2</td>
<td>124.9 ± 10.6</td>
</tr>
<tr>
<td>Diastolic blood pressure, mmHg</td>
<td>77.7 ± 8.1</td>
<td>77.7 ± 8.8</td>
</tr>
<tr>
<td>Total blood cholesterol, mg/dl</td>
<td>218.7 ± 50.2</td>
<td>211.1 ± 51.4</td>
</tr>
<tr>
<td>HDL-cholesterol, mg/dl</td>
<td>55.7 ± 19.3</td>
<td>56.7 ± 19.2</td>
</tr>
<tr>
<td>Steps taken in 24 h</td>
<td>10,109.2 ± 4,109.3</td>
<td>10,819.7 ± 3,646.1</td>
</tr>
</tbody>
</table>

Data are means ± SD; n = 119 non-Health, Physical Education, Recreation, and Leisure Studies (HPERLS) majors and 186 HPERLS majors. 1 RM, one repetition maximum.

mean and how it is applicable to educating others about health and fitness. Students were able to intellectually conceptualize the outcomes much better than textbook teaching of statistical analysis and application.

DISCUSSION

The purposes of the learning experience described herein are to (1) provide an opportunity for undergraduate exercise science students to gain experience conducting health and fitness assessments on a larger population than is possible within a single laboratory meeting, (2) provide students with an opportunity to develop and test hypotheses related to health and fitness, and (3) provide a service to the campus community that can help participants to learn about their health and fitness. We have successfully used this student-operated health and fitness screening to achieve all of the aforementioned purposes and have found that, similar to other service-learning exercises (6, 22, 26, 29), both students and participants find it to be a useful and enriching experience. Inquiry-based learning is an integral part of undergraduate science education (3). To the best of our knowledge, this is the first article to connect a service-learning-style experience with inquiry-based learning, which should help students to achieve the highest cognitive level in Bloom’s Taxonomy of Educational Objectives (13).

For the student technicians, the opportunity to practice their skills before performing an internship or obtaining employment is very useful. For instance, it is essential to use correct techniques for the measurement of blood pressure (7), and it has been observed that lack of practice with blood pressure measurement contributes to inaccuracy (4). In the exercise science curriculum at the University of Nebraska (Kearney, NE), which seems similar to many schools, students learn and practice the techniques for measuring blood pressure in three classes (Anatomy and Physiology, Exercise Physiology, and Fitness Assessment and Exercise Prescription), but this process only provides for practice measuring blood pressure on ~10 different people. Using the health and fitness screening de-
Table 3. Sample of data collected during a health and fitness screening offered by undergraduate exercise science students as a service-learning experience comparing lower- and upper-division undergraduates

<table>
<thead>
<tr>
<th></th>
<th>Lower-Division</th>
<th>Upper-Division</th>
</tr>
</thead>
<tbody>
<tr>
<td>Body mass index, kg/m²</td>
<td>24.2 ± 4.7</td>
<td>26.5 ± 5.2*</td>
</tr>
<tr>
<td>Body fat, %</td>
<td>17.7 ± 8.0</td>
<td>22.2 ± 7.7*</td>
</tr>
<tr>
<td>Bench press 1 RM, kg</td>
<td>49.8 ± 23.0</td>
<td>57.9 ± 27.6</td>
</tr>
<tr>
<td>Leg press 1 RM, kg</td>
<td>186.6 ± 68.24</td>
<td>208.8 ± 83.0</td>
</tr>
<tr>
<td>Maximal oxygen uptake, ml·kg⁻¹·min⁻¹</td>
<td>44.8 ± 9.0</td>
<td>43.4 ± 8.0</td>
</tr>
<tr>
<td>Systolic blood pressure, mmHg</td>
<td>123.8 ± 10.4</td>
<td>126.8 ± 11.6</td>
</tr>
<tr>
<td>Diastolic blood pressure, mmHg</td>
<td>75.9 ± 6.7</td>
<td>79.0 ± 9.0</td>
</tr>
<tr>
<td>Total blood cholesterol, mg/dl</td>
<td>217.1 ± 41.7</td>
<td>217.2 ± 56.3</td>
</tr>
<tr>
<td>HDL-cholesterol, mg/dl</td>
<td>58.4 ± 19.1</td>
<td>54.2 ± 19.8</td>
</tr>
<tr>
<td>Steps taken in 24 h</td>
<td>10,232.4 ± 4,431.3</td>
<td>9,833.7 ± 3,925.6</td>
</tr>
</tbody>
</table>

Data are means ± SD; n = 108 lower-division undergraduates (freshmen and sophomores) and 197 upper-division undergraduates (juniors and seniors).

*P < 0.05.

scribed in this article, students are provided an opportunity to measure blood pressure in a nonclassroom setting on many people in a short period of time, which seems to enhance feelings of responsibility for accurate measurement among student technicians. Unfortunately, the majority of participants do not perceive the blood pressure screening as important and do not understand the importance of maintaining healthy blood pressure and having regular blood pressure testing (28). So, in addition to providing students with more opportunities to practice blood pressure measurement and enhancing a sense of responsibility for accurate measurement, students are also allowed to practice explaining the importance of measuring blood pressure and controlling hypertension.

Students in exercise science need to be able to accurately assess muscular strength, aerobic fitness, and body composition, and they must also be able to explain the results, the norms for age and gender, and be able to speak in a clear, concise manner using layman’s terms. For instance, following standardized procedures (16) and having lots of practice enhances the accuracy of skinfold measurement for body composition assessment (12). The students enhance their skills at applying fitness testing data as they explain to the participants the difference between lean mass and fat mass and how a person may be overweight but still be healthy if the mass if muscle or, conversely, how a person may be overweight and at risk due to excessive adiposity.

Most of the participants’ data result in healthy values for blood pressure, cholesterol, and fitness. The overall good health of the participants is partly due to selection bias, which apparently primarily attracts those persons who are healthy. The overall good health of the participants may also be due to the population being measured, which consists primarily of college-aged adults who have not yet begun to experience most lifestyle-related diseases. We have tried to increase the variation in fitness levels of participants by encouraging some introductory university classes to participate in this exercise, yet we have found that this still has not added too many older participants or participants who are obese.

One aspect of the screening that we have found to be challenging is the aerobic fitness assessment. Despite instructions to complete the 1.5 miles at a steady, moderate pace (14), some subjects still do not comply and either walk very slowly or sprint and walk alternately during the test. As this is a free screening, there are no repercussions for noncompliance. All that can be done is for the technicians to remind the participants of the need for a consistent moderate pace to have accurate results. Despite these difficulties, the aerobic fitness assessment was rated as the second most informative aspect of the health and fitness screening. This may be due to an overall lack of knowledge regarding how to classify and measure aerobic fitness (23).

Once the heart rate monitors, skinfold calipers, stop watches, scale, and other instruments have been purchased, the only cost for this project is for the disposable items used for cholesterol assessment and some cleaning supplies (e.g., rubbing alcohol). Most exercise science programs probably already have all of these items except for perhaps the Cholestech unit. We have previously funded the costs for the disposable items for this project through course development funding from the University of Nebraska (Kearney, NE). Unfortunately, the cost for the cholesterol screening can be ~$7.00–8.00 per subject, which may make this aspect of the project cost prohibitive. We have found that if the cholesterol screening is offered as an optional service that must be paid for, some participants are still willing to pay for cholesterol screening. Unfortunately, this number is usually too small to make for effective hypothesis testing for the students. So, while the results from a cholesterol screening may still be enlightening to the student technicians, the costs may make it untenable for future endeavors without funding beyond that the participants are willing to provide.

The undergraduate statistics course taken by our students is a general statistics class for all majors that focuses primarily on calculations and is essentially a math class. The examples and problems used in the statistics class are not specific to exercise science; hence, it is not surprising that our students have difficulty applying statistical analyses to our data (10). Also, many students take the statistics class early in their academic career as a general education requirement and have very limited exposure to the use of statistical techniques afterward. We think that by increasing the use and application of statistics by students in all laboratory classes, such as occur in human physiology or exercise physiology, students will have increased exposure to and understanding of statistics. In the fitness screening exercise, we have attempted to further increase students learning of statistics by using small-group cooperative activities (11) and consider this experience to be beneficial to the students.

We have attempted to describe the application of a service-learning project for exercise science students. Although we did not evaluate the conceptual learning of students in the traditional fashion, both student technicians and participants found the health and fitness screening to be enlightening and educational. By increasing the variation in the age and health of the participants, the educational value of the experience of the students will likely be enhanced.
REFERENCES