Abstract

Skill related health concepts are an important part of an adolescent’s development. Not only are they important for the overall health of the future adult, they also serve as key determinants in athletic success. However, as a physical educator or coach it is important to determine whether any teaching or coaching imparted is improving these skill related health concepts. Typically, this is accomplished through pre and posttests whereby some intervention or training occurs in-between. Average scores are calculated, and a conclusion is made using these averages. Unfortunately, averages are not the best method for determining improvement, and more complex statistical analysis provides better evidence whether interventions are successful. In the present article, an overview of the importance of developing skill related concepts in adolescents is provided in addition to a step-by-step guide on how to statistically test whether interventions are successful. Using statistical analysis will provide the educator or coach with more robust arguments to support or change training or teaching methods.
Why Assess Skill Related Health Concepts

Athletics has become one of the biggest financial markets in our culture today. From little league to professional levels there is an increasing interest in sports, competition, and athletics. The number children participating of youth sport programs have increased significantly. According to Hilgers (2006), “there are an estimated 41 million American kids playing competitive youth sports” (paragraph 4). In nearly every sport there has been a significant increase in the past 10 to 20 years. For example, soccer participation has increased by 2.5 million in 15 years and in those same 15 years the number of children who signed up for youth football has nearly doubled from approximately 130,000 to 260,000 participants. Non-traditional and extreme sports participation such as skateboarding, mountain biking, and snowboarding have also seen an increase in participation during recent years (Hilgers, 2006).

With this particular increase in sport and athletic competition many parents are interested in helping their child become an elite athlete and experience success in a specific sport. However, although a focus on one sport is common, this may not be the best method for developing an elite athlete. Instead, research suggests that the elite development is acquired through participation in a variety of sports during early adolescence where an emphasis is on enjoyment as a key component (Côté, 1999). In fact, Balyi and Hamilton (2004) report that “scientific research has concluded that it takes 8 to 12 years of training for a talented player/athlete to reach elite levels. This is called the 10-year or 10,000 hour rule and translates to more than three hours of practice every day for 10 years” (p.1). It is possible that parents familiar with these findings attempt to begin deliberately practicing as early as possible believing that practicing sooner will equal an earlier, elite level ability. Unfortunately, such actions fail to consider factors such as motivation, burnout, or other personal interests.
Instead of focusing on developing an elite level athlete, physical educators need to direct their efforts toward enjoyment of lifetime physical activity. According to the National Association for Sport and Physical Education (NASPE), physical educators should be trying to instill behaviors in their students that will promote life-long physical activity which will help fight the obesity epidemic. One way that NASPE suggests that physical educators do this is by assessing their students’ skills-related physical fitness levels and working to improve those skill levels. If students can become more skilled at specific sports then they will be more inclined to participate in physical activity outside of class time (Mason, 2009). Balyi and Hamilton (2004) suggest certain “windows of opportunity” that children possess at certain age levels. The first window is one of “accelerated adaptation to speed” which occurs in girls and boys between the ages of 6-8 and 7-9 respectively. This is the optimal time for them to develop agility, quickness, and change of direction which is applicable to many sports and activities. A second window of opportunity occurs during the preadolescent years that highlight speed and explosive strength, or power (Lloyd, 2012). These windows of opportunities are very crucial times for children to develop these physical skills. Lloyd and Oliver (2012) point out that not utilizing these critical opportunities may limit the development of the athlete and may lead to a decreased full potential.

What Skills are Included?

In order to address the goals of NASPE and develop specific skills that will ultimately reduce obesity, the long-term athlete development (LTAD) model should be encouraged (Mason, 2009). Long-term athlete development breaks down a person’s life-span into six categories and specifies how, what, and when to train/develop in those particular stages. The present article focuses on the early levels of development and training, such that could be found in an elementary physical education class setting. Balyi and Hamilton (2004) call the first category of
the “FUNdamental” stage which ranges from ages 6-9 and the “Learning to Train” stage which ranges from 9-12. These stages of development should span grades one through six and focus on skill-related concepts.

Skill-related health concepts are the underlying skills which are needed in sport competition and include speed, agility, power, coordination, and reaction time. Skills such as these are not only important for use in sports, but they are also very beneficial in everyday life. Helping students feel more confident at playing a variety of recreational sports will in turn make them more likely to be physically active (Mason, 2009). Many adults are approached with the opportunity to participate in recreational activities, and if they had already developed these skills they would be much more likely to participate and enjoy the activity (Balyi, 2004). These skill-related components provide a foundation of basic movement principles.

The LTAD model suggests that these early stage children should be given a very good overall development of fundamental movement skills where these concepts should be developed through fun games, activities, and lessons (Balyi, 2004). Therefore, the purpose of this assessment is to determine skill-related fitness levels of elementary students. By determining such levels the physical education teacher will become more knowledgeable about what areas of skill-related fitness each student needs to better develop.

**What Tests to Include and Why**

Physical Education teachers must utilize these so called “windows of opportunity” if their students are to develop these skills-related fitness components that can be used throughout their lives to help them enjoy different types of physical activity through competitive and recreational sports. In this article, an example assessment is provided that measures speed, agility, power,
reaction time, and coordination. A rationale for each component is provided along with a specific “real-life” example.

Speed is defined as the ability to perform a movement in a short period of time (Matte, 2011). It is critical for fast paced sport positions such as a point guard in basketball or a running back in football. In this assessment the 20m + 20m test will be used, as it removes the variability of different acceleration and anticipation rates among the elementary students who will be tested. The students should run 40 total meters; 20 meters untimed and 20 meters timed. They should be at a relatively constant acceleration rate when they hit the beginning of the final 20 meters (timed) and should continue to run as fast as they can until the finish. This test will give a good idea of true speed since any acceleration will be removed from the test (Makaruk, 2009).

Agility is defined as being able to change directions and body positions very quickly and accurately (Matte, 2011). This skill is very important in sports like tennis, racquetball, football, and basketball where changing directions is a crucial part of the sport. The Illinois agility test can be used to assess this skill. It is used in numerous agility research studies including sports such as rugby, field hockey, and other basic youth tests (e.g., Gabbett, 2002; Keogh, 2003; Whitehead, 1989).

The next component that will be tested is power, or also known as muscular explosiveness. The most common definition of this component is the ability to produce maximum force in a quick explosive burst; therefore, it is a combination of strength and speed (Matte, 2011). Some applications of power could include a football lineman exploding out of his three point stance or a swimmer bursting off of the starting platform. In the present example, two tests will be used for measuring power to include both upper and lower body measures. The students will be completing the squat jump to test their lower body power and a medicine ball
put to test their upper body power (Miller, 2012). According to Markovic, Dizdar, Jukic, and Carinale (2004), from their research on the reliability of jump tests, the squat jump is one of the most reliable and valid tests of lower body muscular power. The seated medicine ball put has been one of the most commonly used tests of upper body power. Miller (2012) states that “the widespread popularity of this test is due not only to the ease of administration, but also to the direct specificity of this movement to a functional task” (p. 316). In addition these tests will be simple to conduct with elementary school students in a gym setting.

Hand-eye and foot-eye coordination will also be tested to determine if a child is fully coordinated from top to bottom. The hand-eye coordination test will be conducted using the popular activity of Speed Stacking. According to Mayer and Murray (2004) coordination is “the integration of the nervous and muscular system to produce correct, graceful, and harmonious body movements” (p. 413). In their research study they concluded that speed stacking is a very good measure of hand-eye coordination. To measure foot-eye coordination a test will be formed using a hacky sack during which the students will be using their eyes to track the hacky sack and only one foot to try and catch it on. This test is being formed, as there is no validated and reliable measure of foot-eye coordination of adolescents available.

The last skill-related component that could be included is reaction time. However, because reaction time is an inherent ability that cannot be improved, it will not be included in this assessment (Mackenzie, 1998).

How to Conduct the Assessment

In this example the assessment will be done all in one week during the student’s scheduled physical education classes. Since the equipment is being borrowed, it is important to have it used and returned during the same day to reduce the possibility of losing the equipment.
Students will have their own fitness sheet on which the volunteers will record all of their results. As they approach a station they will give the volunteer the sheet, perform the test, and must take their sheet with them to the next station. There will be four stations (jump squat, medicine ball put, speed stacking, and hacky sack) set up inside the gymnasium and two stations (Illinois agility test and 20+20 run) set up on a grassy field. The stations are split up because there isn’t enough room in a typical gymnasium to conduct all of the tests; also the agility and speed tests require at least 50 meters of space.

The Illinois Agility Test (Whitehead, 1989) will be set up in a grass field and will require eight cones and one stop watch (see Figure 1). The stop watch should be started as the participant crosses the start and stopped as soon as any part of their body crosses the finish line. Before the participant begins they will be shown a picture of the path they are supposed to take and a volunteer will run through the course to show them the correct way to weave through the cones. To use time effectively it would be beneficial to let a group of participants be shown the course all at once to limit the wait time between trials.

The 20+20 meter run to test speed will also be set up on the grassy field. This test will require three cones and one stop watch. The three cones will be set up in a line 20 meters from each other. The end cones will be the start and finish line and the middle cone will be the speed test start line. The first 20 meters is the acceleration phase and the participants will have this distance to try and get to their top speed before the stop watch is started. They will continue to run to the last cone/finish line where the time will be stopped and recorded (see Figure 2).

Upper body power will be tested using the medicine ball put. Each participant will sit back on the 45° incline bench with a four pound medicine ball held at chest height. There should be a tape measure taped to the floor beginning at the front of the bench and extending across the
gymnasium floor in a straight line. The participants will be asked to put or push the ball into the air while keeping their back in contact with the bench. This motion should mimic a chest pass in basketball but should be putted at a 45° angle, which is the same angle that they will be laid back on the bench. The distance that the ball travels from where it is released to where it lands on the floor is to be recorded.

The lower body portion of the power test will be done using a squat jump. To test the force produced during the squat jump a force mat will be used. Each participant will be shown how to execute a proper squat jump before doing a practice trial followed by the true test standing on the force mat. To perform a proper squat jump the participants will start with their hands on their head and their knees at a 90° angle. From that position the participant will jump as high as they can, leaving their hands on their head. The hands must remain on their head to keep them from creating momentum from swinging their arms. The force mat is not a readily available piece of equipment, but might be borrowed from a university kinesiology program. The volunteer working this station will need to become familiar with the instrument before administering the tests. This station will need a table to place the computer on and the attendant to sit at to view the data. The data from the jump squat is fed into a computer and the results should be recorded on the student’s fitness sheet.

The hand-eye coordination test will be executed using Speed Stacking. The week before the test the students will need to watch the Speed Stacking video that will be supplied. The students need to be familiar with how the Speed Stacking activity works to be able to perform it correctly. There will need to be a table at this station so that the participants will have something to stack the cups on top of. Each participant will get two trial runs to familiarize themselves with the process. The third trial will be the actual test and will be timed. The participants will have to
take six cups which are stacked inside of each other and stack them into a pyramid, as shown in the video. The time it takes them to stack the cups will be recorded by a volunteer on the student’s fitness sheet.

The final station will test foot-eye coordination using a simple hacky sack. A volunteer will drop the hacky sack from six feet above the ground and three feet in front of the participant. The participant will then attempt to see how many consecutive times they can kick the hacky sack, using any part of their foot, into the air without it touching the ground. The number of times the hacky sack is kicked will be recorded on the fitness sheet. There should be two practice trials given for students to familiarize themselves with the process. Once all of the stations are completed the participants should sign the bottom of their fitness sheets and hand them to the supervisor.

**Example Data**

In order to determine whether students have improved from one test to another (e.g. September to April) it is important to determine whether statistical improvement has occurred. Statistically measuring the changes allows a teacher or coach to determine whether improvements observed are due to chance or something else (e.g., interventions that deliberately develop health-related sport skills) have helped to cause the improvements. Included is a typical set of data that will be used to provide a guide through the data entry, analysis and interpretation of the outcome. In the following hypothetical situation, 29 boys and 26 girls completed the assessments.

**Example Analysis**

In order to statistically analyze this data, SPSS was used. Once the program has been opened, new data should be entered as in Figure 3. Each row in the window represents an
individual participant in which their pretest score/time and posttest score/time are in the same row as the corresponding participant’s number. In this example Participant One had a pretest time of 18 seconds and a posttest time of 19.3 seconds. The data should be entered the same for every participant. Once all data is entered, the “Analyze” tab should be selected. From the drop down list of options, “Compare Means” should be selected, giving more additional options. Of the compare means options, “Paired Samples T-Test…” should be selected. Once selected the window, shown in Figure 4, will appear to determine what variable should be compared. Using the mouse, click “Pre Test (Pre)” from the list and drag it under “Variable 1” in the “Paired Variables” table. Proceed to do the same with “Post Test” (Post), dragging it under the “Variable 2” space. Once this is completed, the option to click “OK” at the bottom of this window will be available (Figure 5). After clicking “OK” another window should appear which displays the analysis of the data that had been entered at the beginning (Figure 6). Adjust the window size to view all three boxes of statistical information.

**Analyzing the Output**

The following is an example of how to interpret the above hypothetical statistical information that was generated using SPSS and was conducted on the Illinois Agility Run shown in Figure 6. For the purposes of this example, the paired samples test is what is most important and in particular the number under Sig. (2-tailed). If this number (which in this case is .000) is less than .05, then there is a significant difference between pretest and posttest. The box labeled Paired Samples Statistics provides the mean/average scores of the pretest and posttest. Thus, based on these scores, participants significantly decreased their time in the test.
Conclusion and Additional Application

In conclusion, instead of only assessing a student’s fitness based on health related components, the skills related components can also be assessed to provide an overall understanding of a student’s physical fitness. This assessment can also be used beyond the physical education classroom. Coaches, personal trainers, and fitness specialists can use this assessment as part of their program to monitor progress in speed, agility, power, and hand-eye/foot-eye coordination. Furthermore, the more adventurous could include a control group in this assessment to see if the students or participants are making positive gains because of the fitness program or because of other factors such as normal growth/development or free play in sports at home. In sum, this assessment should provide a basis or starting point for anyone looking to improve their student’s or athlete’s fitness in a different way than focusing on health related fitness components, and statistically demonstrate that improvement is occurring.
References


Figure 1: Illinois Agility Test

Figure 2: 20 + 20 Run
Figure 3

Figure 4
Figure 5

![SPSS T-Test Output]  

Figure 6

![SPSS T-Test Output]