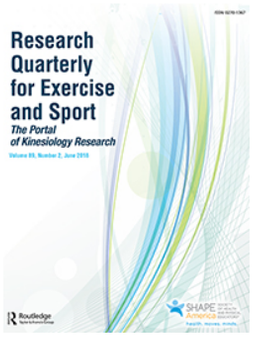

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SPECIAL TOPICS: 2018 *RESEARCH QUARTERLY FOR EXERCISE AND SPORT* LECTURE

The History of Aerobics (50 Years and Still Counting)

Kenneth H. Cooper

Cooper Aerobics

ABSTRACT

Looking back over the 50 years since *Aerobics* was published, I could never have expected for there to have been a major change in physicians' attitudes toward the value of exercise in the practice of medicine. In my lifetime, I never thought I would see a stress test be considered a mandatory component of a complete examination, inactivity classified as importantly as high blood pressure and high cholesterol, and cigarette smoking considered a coronary risk factor. I have tried in this *Research Quarterly for Exercise and Sport* (*RQES*) Lecture presentation to document how this slow but gradual transition took place due to my work and the work of many of my colleagues in this field, along with the important work of The Cooper Institute. In June 1970, I chartered the institute 6 months before I saw my first patient at the Cooper Clinic, but now with the Cooper Center Longitudinal Study being the largest database in the world comparing measured levels of fitness, instead of relying only on questionnaires and correlating fitness and health in our more than 700 published peer-review articles, we have proven and can safely say that "exercise is medicine." In greater detail, I want this lecture to present what we and others have done in this scientific endeavor, and even the harshest critics are now saying that "these results are too impressive to be ignored."

KEYWORDS

Exercise is medicine; fitness; health; youth

During my youth, I successfully participated in competitive sports, particularly basketball and track. As a result, I received a track scholarship to the University of Oklahoma (OU) as a middle-distance runner. During my 3 years at OU (1949–1952), I was able to keep in competitive shape and ran distances up to 2 miles. During that time, my weight held steady at 168 pounds to 170 pounds.

Upon entry into medical school, I soon discovered that the "most common manifestation of stress is obesity." So, during my 4 years of medical school followed by 1 year of internship, sleep deprivation was quite common, and I ate to stay awake. As a result, by the time I had finished those 5 years and married shortly thereafter, I had done nothing physically for approximately 8 years. I went water skiing and attempted to ski a slalom course, which I successfully accomplished 8 years earlier. But in my deconditioned, overweight state, I developed a cardiac arrhythmia while skiing and became nauseous and lightheaded. When I reached shore, I was immediately taken to a nearby emergency center. By that time, my tachycardia (as high as 180) had returned to normal.

A preliminary workup followed by a more extensive cardiovascular workup revealed no heart abnormality, and a diagnosis of "supraventricular tachycardia" was made. Most people refer to this condition, which is much more common in women than in men, as paroxysmal atrial tachycardia. As a result of that frightening experience, I lost the weight within 6 months and ran my first marathon (Boston Marathon) shortly thereafter.

Several things happened to me physically as I lost weight and improved my fitness. My prediabetic condition disappeared, my borderline hypertension dramatically improved, and the one thing I appreciated most was how much better I felt (later we discovered that a person who is physically fit is less depressed, is less of a hypochondriac, has an improved self-image, has a much more positive attitude toward life, and has fewer somatic complaints).

Until that time, my goal had been to go into a residency program preparing for the practice of conventional medicine upon completing my 2-year mandatory military service requirement. But when I discovered what happened to me in response to major lifestyle changing, I realized it was a field of medicine that has been sadly ignored—that is, the importance of "preventive medicine" rather than "primary care medicine," which can be associated with "too much care too late." But I was reminded during my medical school days (1952–1956) we had been taught that preventive medicine is the Cinderella of the medical specialties because there is no profit in health. The profit is only in disease.

With that experience, I decided not to leave the military as planned in September 1959 but to transfer from the U.S. Army to the U.S. Air Force (USAF). I had been a flight surgeon during my 2-year Army career, became

CONTACT Kenneth H. Cooper Cooper Aerobics, 12200 Preston Road, Dallas, TX 75230.

enthralled with flying, and decided to consider becoming an astronaut. At that time, the USAF had a Manned Orbiting Laboratory program and needed medical assistance. But before I could qualify for that position, I needed to obtain my boards in preventive/aerospace medicine, which required a year to obtain a master's in public health followed by another year of training in the USAF. So, I selected Harvard School of Public Health and started in September 1961, which is when I ran the Boston Marathon twice, once in April 1962 and again in April 1963. And I am proud to say in my first Boston Marathon, I placed 101st with a time of 3 hr and 54 min. One reason I placed so well is only 150 people ran the marathon that year. The next year, I trained harder and dropped my time down some 30 min but placed only slightly better at 98th. That was the year before the Olympics in Tokyo in 1964, and 450 people ran that year.

After that 1st year at Harvard School of Public Health, I earned the master's of public health degree but petitioned the USAF to let me stay an extra year and work on a doctorate of science (DSc) in exercise physiology. That request was approved and that is where I gained my knowledge in exercise physiology and completed all the requirements including reading proficiency of medical literature in German and Russian. I passed the oral qualifying exam but did not have enough time to complete the required thesis before I had to go back full-time into the USAF. I never received my DSc degree; however, Harvard School of Public Health said if I would defend my *Aerobics* book, published in March 1968, it would easily qualify as the required thesis but had to be done before 1970. However, with the interest in *Aerobics* exploding, I had little time to finalize a thesis to qualify for this DSc degree. That is one thing in my career I wish in retrospect I would have been able to complete.

I moved from Boston back to San Antonio, TX, in September 1963 and completed the 1-year residency training to qualify for my boards in preventive/aerospace medicine. I was then assigned to the Aerospace Medical Laboratory Clinic at Wilford Hall Hospital at Lackland Air Force Base in San Antonio.

I still had great interest in possibly becoming a scientist astronaut and worked extensively in the field of developing ideal conditioning programs for astronauts prior to going into the weightlessness of space and also an in-flight conditioning program that would enable astronauts to retain their aerobic capacity, which is lost rapidly in the weightlessness of space. My colleague during that time was Dr. Bill Thornton, who later became a National Aeronautics and Space Administration astronaut.

The requirement for preflight training resulted in a 2-year program working with all 27,000 men and women at five USAF bases to determine the best way to measure aerobic capacities in large groups of people and develop a training program.

First, we had to decide what type of conditioning program was best for the astronauts. The different types of exercise were aerobic, anaerobic, isometric, isophasic, and isokinetic. We soon learned that all these types of exercise have merit, but the only one with the potential to prolong one's life and provide clear aerobic benefit was aerobic exercise. Once we had settled on that type of exercise, there were other questions we had to answer such as, "How can you compare exercises and how much is necessary?"

To determine the best way to test large groups in the field, we looked at the 600-yard run, the timed 1-mile run, a 20-min run, a 15-min run, and finally the 12-min run. The 600-yard run and 1-mile run were "too anaerobic"—that is, you could perform at fairly high levels with minimal training—and the 15-min to 20-min time requirements were too long. So, we settled on the 12-min time, which correlated with maximal oxygen consumption as determined in the laboratory, and these results were published on January 15, 1968, in the *Journal of the American Medical Association* in an article entitled "A Means of Assessing Maximal Oxygen Intake" (Cooper, 1968).

In this article, we found a correlation coefficient of .897 between the distance covered in 12 min and

To calculate the maximal oxygen consumption ($\dot{V}O_2max$) from the Cooper 12:00-minute test, the following formulas were used:

Miles: $\dot{V}O_2max = (35.97 \times d_{12}) - 11.29$
(d_{12} = miles in 12:00 minutes)

Meters: $\dot{V}O_2max = \frac{d_{12} - 504.9}{44.73}$
(d_{12} = meters in 12:00 minutes)

Then levels of cardiovascular fitness were determined as follows (men younger than 30 years):

$\dot{V}O_2max$	Cardiovascular Fitness Level	Percentile
> 52.0	Superior	5%
52.0	Excellent	15%
42.0	Good	20%
34.0	Fair	20%
28.0	Poor	20%
< 28.0	Very Poor	20%

maximal oxygen consumption as determined in laboratory treadmill stress testing.

The 12-min standard was recommended as the best field test for fitness, but the problem was determining exactly how far participants were running in 12 min (there was no GPS at that time). We soon discovered that the time it took to run 1.5 miles correlated almost exactly with the 12-min run and verified not only the ease with which that test could be performed in large groups, but also a way of documenting improvement. I went to all five USAF bases on several occasions to supervise and participate in the 1.5-mile runs, which included a total of 15,000 exercising participants and 12,000 control participants.

We would set up a 1.5-mile course on unused runways, and participants would run three quarters of a mile, turn around, and run three quarters of a mile back. This way, we could easily monitor thousands of runners in a day. I recall trying to set a 1.5-mile pace to show these airmen how to pace themselves because most of them were not experienced runners, and on several occasions, I would participate in six 1.5-mile runs in 1 day.

So, after getting our baseline results for the 1.5-mile run, the next question that had to be answered was, "How can you compare aerobic-type activities?"

By testing in the laboratory running, walking, and cycling in the field and then comparing results with the scientific literature available on other types of exercise, we soon developed a points system based on the intensity and duration of the activity. Forty-one exercises were classified as aerobic, and the top five were as follows: (a) cross-country skiing, (b) swimming, (c) jogging or running, (d) cycling, and (e) walking.

Those exercises were so classified because nearly anyone regardless of age or sex can easily perform them and earn aerobic points.

Points were awarded based on the amount of oxygen used during exercise, which is a multiple of 7 mL/kg/min (7 mL of oxygen used in 1 min per kilogram of body weight). This is the amount of oxygen used over and above resting oxygen consumption. For example, if you walked 1 mile in 18 min, you earned 1 point because the average energy cost during that time over and above resting was 7 mL/kg/min. But if you ran 1 mile in less than 8 min, you were awarded 5 points because the average oxygen utilization during the 8 min was 35 mL/kg/min. So, as mentioned, we actually did the laboratory and field testing on walking and running and then outdoor cycling to develop a basis for the aerobic points system, and then from studying the scientific literature, we awarded points for a total of 41 aerobic activities.

The final objective was to determine how many points were necessary to achieve a certain level of maximal oxygen consumption. Because the average age of the USAF population we tested was 28 years, we determined the goal should be 42 mL/kg body weight/min which was being used by military forces in Sweden (the Scandinavians had been using a scientific method to determine fitness in their military many years before we started). As a result of these studies, we determined that 30 points per week should enable airmen younger than 30 years of age to reach a maximal oxygen consumption of 42 mL/kg/min if they could cover 1.5 miles in 12 min.

So, during the next 2 years, we did follow-up testing at all five USAF bases and we found that more than 80% of the personnel who went through at least a 30 point-per-week training program could easily achieve the goal of 1.5 miles in 12 min.

But going back to 1966, I was involved in working with bed rest studies and using bicycle ergometers attached to the end of a bed while the airmen were supine for 2 weeks. Bed rest was an effort to simulate the weightlessness of space. We soon discovered in both experimental and controlled groups that among those who exercised for 20 min twice a day on the bicycle ergometers attached to the end of the bed, if they exercised at a heart rate of at least 65% of maximal heart rate, it would have a significant effect on decreasing the adverse problems associated with weightlessness.

While I was involved in those studies at the Wilford Hall USAF Hospital, a reporter from *Popular Mechanics* by the name of Kevin Brown interviewed me. He was so excited about what we were doing in the field testing of fitness and aerobic conditioning programs coupled with bedrest studies that he prepared an article for *Family Weekly*, a Sunday supplement, entitled "Exercise the Astronaut Way." This article was the first time that the word aerobics was used. Once the article was published, at least five publishers contacted me and wanted a book on this topic as soon as possible. After working with Mr. Kevin Brown for 2 years and finally getting approval from the chief of staff of the USAF, General McConnell, to publish the book, it was released in April 1968.

The publisher, M. Evans and Company in New York then selected the title of the book, *Aerobics*. In the manuscript, when I got to the chapters dealing with various types of exercise, I needed an exercise that required large amounts of oxygen. I knew that aerobic meant "living in air or living in oxygen," which was the goal of conditioning, so I took the adjective "aerobic,"

added an "s" to it, and made it a noun and titled a chapter in the book "Aerobics." During that time, the book *Isometrics* had become popular, and because "aerobics" was a unique word, the publisher thought it should be the book title. I disagreed and said, "People can't pronounce it, can't spell it, and can't remember it," but contrary to my expectation, the book did become very popular.

One prediction that I made that was correct was that if the book was successful, translating the book into foreign languages would be difficult. The book was ultimately in one form or another translated into 41 languages worldwide, and there were problems with the translation. For example, in Germany, it came out as *Bewegens Training*, which means motion training. In Russian, it was translated as *Аэробика or Aerobika* and *New Aerobics* was translated as *Новый Аэробика* or "Aerobika Novvy." In Brazil, they were unable to translate the word, so they called it *Doing the Cooper*. The French version came out as *Oxygen a la Carte*.

The official definition of "aerobics" was published in *The Oxford English Dictionary* in 1986 as: aer·o·bics (ə ˈrōbiks), *noun*. "A method of physical exercise for producing beneficial changes in the respiratory and circulatory systems by activities which require meeting a modest increase in oxygen intake and so can be maintained."

So, the worldwide acceptance of *Aerobics* far exceeded anyone's expectations, but the Cooper 12-Minute Run or 1.5-Mile Run Test soon became an international standard due to the work that I did with the Brazilian World Cup team in 1968 to 1970, which allegedly enabled them to win the World Cup Championship in Mexico City in 1970 (but that is another story).

The enthusiasm in the United States was not that great, and to the contrary, criticisms far exceeded compliments. In fact, I would see in medical newspaper articles headlines like, "The Streets Are Going to Be Full of Dead Joggers as Americans Follow Cooper's Recommendations and the Incidence of Heart Disease Will Rapidly Increase." According to the Gallup Polls in 1968, less than 24% of the adult population was involved in any type of regular physical activity, and there were less than 100,000 joggers. But by 1984, those same polls indicated the number of exercisers had increased to 59% and joggers increased to 34 million. As predicted by the critics, though, was there an increase in deaths from heart disease? To answer that question, let me quote from the famous "medical journal" *The Wall Street Journal* in 1984: "Deaths from coronary heart disease in America started rising in the 1940s and reached a peak in 1968, and then it mysteriously began dropping."

By 1990, at least 45% of the total population was exercising and more than 24 million people were joggers. And during that time, heart disease death rates dropped by 48%—the first time in history.

This decline, which also resulted in a 6-year increase in longevity, was attributed to the 76 million baby boomers born during 1946 to 1964. That generation seemed to take their health into their own hands: They stopped smoking in great numbers; they started monitoring their blood pressure and got better control; they changed their diets, and their blood cholesterol levels began to drop; they started to learn the harmful effects of stress and how to control it; and they exercised in great numbers.

Unfortunately, after 1990, this trend did not continue and that became the beginning of the obesity epidemic in America. The Centers for Disease Control and Prevention data indicate that during 1976 to 1980, 15% of adults were obese (greater than 30 on the Body Mass Index [BMI] scale) and 5.5% of children aged 2 to 19 years old were obese (BMI ≥ to the age/sex-specific 95th percentile). But by 1999 to 2000, adult obesity had increased to 35.5%, and children's obesity increased to 13.9%. And by 2015 to 2016, 39.8% of adults were obese and 18.5% of children were obese (Hales, Carroll, Fryar, & Ogden, 2017; Healy, 2017).

To estimate the number of adults and children who are overweight or obese (e.g., greater than 25 on the BMI Scale for adults), you double those figures. That means that in 2015 to 2016, up to 80% of American adults and 37% of children were classified as being overweight or obese.

The reason for this obesity epidemic has been primarily due to changes in eating habits as well as inactivity. Increased serving sizes of foods was a contributor as was the type of food consumed—that is, the "fast food generation." And sugar-containing beverages also seemed to be one of the culprits.

Regardless of the cause, the obesity epidemic is having a major impact on the health of Americans of all ages, but my interest for the past 10 years has been more with the problem of obesity in children. Historically, weight-loss programs are not that successful for adults, and that is why the adult obesity problem continues to grow. So, as I have said many times, there is a small window of opportunity to do something for the children before they become obese adults.

An article published November 29, 2017, in *The New England Journal of Medicine* by Dr. Zachary Ward, a researcher of the Harvard T. H. Chan School of Public Health, predicted that 57% of kids will be obese by age 35 years if this obesity epidemic is allowed to continue! And a major problem that commonly occurs with obesity is diabetes. Whereas adult-

onset diabetes in children in the past was quite rare, it has now become very common even in children aged 5, 6, or 7 years old.

I have been involved in various types of activities in China since my first visit to Beijing in 1988. On April 21, 2017, I had the privilege of opening the first Cooper Aerobics Health & Wellness Center in Nanjing, China. It was established as a training center, and seminars are provided for a variety of occupations from schoolteachers (particularly physical education teachers) to physicians. Encouraged by their President Xi, we have been challenged to work with the children since "the rate of excessively fat children in Chinese cities has reached that of developed countries, and obesity has become the most fearful enemy to their health" (Zhongyun, 2002). In one way, we are attempting to achieve that goal as a result of my multiple contacts with Brazilian coaches and trainers. We are utilizing these men and women to help bring more sophisticated soccer programs into schools in China beginning in the early grades. Even though it has been a short period of time since we started these training programs, I have been very pleased with the success.

It has been said for years that "data drives decisions." So, an effort was made in 2007 to not only bring physical education back as a core subject in schools, but to use the FitnessGram® as a test to monitor progress.

In early 2007, I started working with the Texas state legislators in Austin, TX, to accomplish these two goals. There was only minimal interest in this project because the feelings of parents were, "The health and fitness of my child is not the government's responsibility; it is the parents' responsibility." My response to that statement was, "I agree with you entirely. But, face the facts, you have failed miserably. And that is why the American children are now classified as the most overweight children in the world!"

So, in response to multiple visits and presentations to the members of the legislature in early 2007, I was able to achieve the goal of at least bringing physical education back into the school for kindergarten through 12th grade, but more importantly, we started FitnessGram® testing. As that session was terminating by late June 2007, I had approval but no funding to start this statewide project.

We needed $3 million to equip all 9,000 schools in Texas with equipment to facilitate FitnessGram® testing and train 25,000 teachers in how to perform the test. So, when the legislature passed the approval as a "mandate without funding," my "back was up against the wall!" I told the members of the legislature, "If you can't find public funding to support this very important project, I will raise the funds privately." By a coordinated effort, a lot of hard work, and—I am convinced—divine intervention, we were able to raise $3.3 million for the FitnessGram® project and start our testing in January 2008. This was all a part of Senate Bill 530, which was signed into law by Governor Rick Perry in June 2007.

Grades K–5	30 min five times per week	45 min three times per week (or 225 min for 2 weeks) 45 min three times the 1st week and 45 min the 2nd week
Grades 6–8	Same as above	But only four of six semesters required
Grades 9–12	No physical education requirement	Testing requirements using the FitnessGram® beginning in the 2007–2008 school year, all students in Grades 3 to 12 are required to be tested annually at some time during the school year.

So, the first test began in January 2008, and by the end of the schoolyear, 2,658,665 students through the 12th grade were tested.

FitnessGram® testing has its component parts. They include aerobic capacity (i.e., estimated maximal oxygen consumption) with a 1-mile walk/run for middle school and high school and the 20-m Progressive Cardiovascular Endurance Run fitness test for grade school, abdominal curl-ups, trunk extension (trunk lift), upper-body push-ups, flexibility (back-saver) sit and reach, and BMI or percent body fat. Testing results were divided into Healthy Fitness Zone (top 80%) or Needs Improvement. All that was required was whether students' age- and sex-adjusted scores were in the Healthy Fitness Zone. But even though the majority of students should have easily accomplished this goal, it did not happen. We noticed that only 33.25% of 3rd-grade girls and 28.6% of 3rd-grade boys could pass all six FitnessGram® test requirements. And then there was a straight-line decline until 12th grade, when only 8.18% of girls could pass the test and 8.96% of boys could pass the test.

This was a shock to both the educational community and the public to see how poorly conditioned and obese our children were. But after that discovery, the education community asked if we could show the relationship between FitnessGram® testing and such things as academics in school.

Our next research took the original database and tried to determine the correlation of the various FitnessGram® tests with academic achievement, absenteeism from school, and school incidence problems. This information was published in a supplement of *Research Quarterly for Exercise and Sport* (Cooper, 2010). Academic scores correlated positively with aerobic capacity and inversely with BMI or percent body fat. Absenteeism and discipline problems were inversely related to aerobic capacity.

So, these results caught the attention of professional and lay people alike, and annual FitnessGram® testing since 2008 has shown some slow improvement, particularly in the areas of aerobic capacity and body weight.

Also, the FitnessGram® test has been used as a replacement for the President's Challenge, the youth fitness test used by the President's Council on Fitness, Sports, and Nutrition. The advantage of FitnessGram® is that it is a test of health-related fitness, not natural athletic ability, which limits the effectiveness of the President's Challenge.

Other countries are now using FitnessGram® for testing in schools, and at least one pilot study conducted in China showed that the performance of children in 3rd through 12th grade was much better in aerobic capacity and BMI (even though their children are now getting fatter), but the children had weaker upper-body musculature and could not perform as well on the test of upper-body strength.

My hope is that FitnessGram® testing will be used in all Chinese schools and will be implemented and supervised by our Cooper Health & Wellness Center in Nanjing, China. If so and if the results are good, perhaps it will motivate the American people to do something in this country to improve the health and fitness of our children. If not, I question what will happen because there are more than 3 times as many people living in China as there are in the United States of America.

In conclusion, instead of the aerobics concept of conditioning and testing people of all ages "fading away," interest has at least remained steady and in many places has grown. For example, since 1994, the Federation of International Football Association (FIFA) has had mandatory requirements that to be an official referee for FIFA, you must be able to run 2,400 meters (1.5 miles) in 12 min whereas a lineman must able to run 2,000 meters (1.25 miles) in 12 min.

And now modern technology allows the opportunity to measure individual fitness levels through field tests adapted to a smartphone. In fact, my son, Tyler Cooper, MD, MPH, is currently working on a project to use this technology in conjunction with the Cooper Clinic's stratification of measured fitness to provide an individual with a reliable, consistent, and predictive fitness result. Not only does this app provide the user with their measured level of fitness and the subsequent health benefits, but preliminary internal studies have shown potential significant medical cost variances as based on a person's level of fitness. An evaluation that Tyler conducted with our own employees suggested that those in the bottom two categories of fitness as defined by our data cost 3 to 5 times more in annual health insurance expenses than those in the top four categories.

And with the escalation of the cost of health care estimated to be at least $2.7 trillion in 2016—which means we spend more than twice as much money on health care as any other country in the world, but we still rank only 43 in longevity and on top of that, there was a slight decrease in longevity during the past 2 years—we need to wake up and make a major effort to keep these problems from accelerating in the future. If not, the health of our people beginning with our children, the cost of health care, the rising economies throughout the world, but particularly in China, may all combine to paint a very poor picture of America in the next 40 to 50 years. Of course, at my age of 87 years, I will not be around. But I am deeply concerned about the health and welfare of my children and particularly my grandchildren, who will be around, unless we do something dramatic to change this poor prognosis for disaster in the future.

Until my dying days, I will continue to promote the fact that 76% of the diseases we have in America are the result of our lifestyle and up to 45% of cancers can be prevented. So, my goal is to greatly emphasize the importance of preventive medicine because we have been able to prove without question that it is cheaper and much less expensive to maintain good health than it is to regain it once it is lost!

References

Cooper, K. H. (1968). A means of assessing maximal oxygen intake. *Journal of the American Medical Association*, *203*, 201–204. doi:10.1001/jama.1968.03140030033008

Cooper, K. H. (2010). Preface: Texas statewide assessment of youth fitness. *Research Quarterly for Exercise and Sport, 81* (Suppl. 3), ii–iv. doi:10.1080/02701367.2010.10599687

Hales, C. M., Carroll, M. D., Fryar, C. D., & Ogden, C. L. (2017). Prevalence of obesity among adults and youth: United States, 2015–2016. *NCHS Data Brief*, *288*, 1–8.

Healy, M. (2017, October 14). Americans keep piling on the pounds. *The Dallas Morning News*, p. 7A.

Ward, Z. (2017). Simulation of growth trajectories of childhood obesity into adulthood. *New England Journal of Medicine*, *377*, 2145–2153. doi:10.1056/NEJMoa1703860

Zhongyun, L. (2002). Obesity: A warning to Chinese children. *Beijing Review*, *45*(26), 14–16.