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The Future of Health / Fitness / Sports Performance

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ABSTRACT:

Exercise relative to health/fitness and sports performance has displayed an evolutionary role over time. Large scale, overriding, factors are present which are likely to help us understand the likely future

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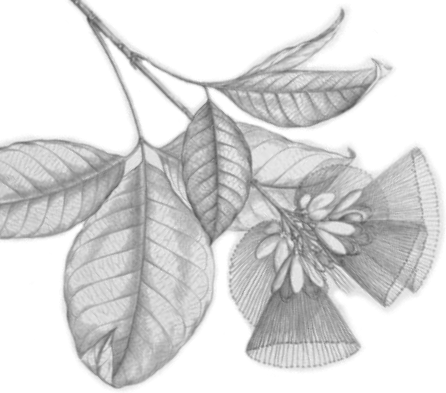


evolutionary path of health/fitness and sports performance. These factors include: 1) the history of exercise, 2) exercise in its' relationship to health, 3) the need for fitness in the military and first responders, 4) the conflicted relationship between top sport (representing the apex of the human genomic capacity for exercise) versus the overly competitive and compensated nature of top sport. Dominantly, the need for exercise as preventive medicine in a progressively more sedentary society, the need to provide social integration and inclusion in a highly mobile society, the risk of undesirable social outcomes related to top sport and the likelihood of human-cyber interactions are likely to drive the evolution of exercise in the future.

Keywords: History Exercise; Wellnes; Preventive Medicine.

In 2010 George Friedman wrote a very engaging book, *The Next 100 Years* (Friedman 2010). In that work he tried to project historical trends to make predictions about the likely course of world history over the next century. From the beginning he pointed out how difficult it is to predict the future. Current events that seem permanent in the news of the day have a way of changing quickly. He cites 20-year periods during the 20th century as examples. In 1900, the world was at peace, with a small number of colonial powers effectively ruling the continents, and the United States (US) was a comparatively minor player on the world stage. By 1920, the Spanish-American war had been fought, the Russian revolution had occurred, WW I had been fought (leaving much of Europe in ruin), and the US had become a global power. By 1940, Germany had recovered, rearmed and had started WW II, Japan was emerging as both an industrial economy and a belligerent force that would draw the US into WW II. By 1960 WW II was over, Japan and China were small-factors in the world economy and the

Soviet Union and the US emerged as the two global superpowers. Lastly, the atomic age, launched at the end of WW II, was the dominant worry of the day. By 1980, the end of the Cold War was in sight, the first stirrings of militant Islam had emerged, and Japan had become a global economic power. By 2000 the Cold War was over, the Soviet Union no longer existed, China was emerging as a world superpower, and the headlines were dominated by conflicts of the Western world with militant Islam. The point of Friedman's example was that major events, even as little as 20 years into the future, could not easily be predicted. At the same time, Friedman developed the theme that the seeds of world events were often sown 20-40 years before a trend emerged from the background into the headlines.

Similarly, in the history of health, fitness and sports performance, despite the evidence of seeds of development, the emergence of current trends is not always easily predictable, even 20 years into the future. There are, however, several dominant trends that make at least a broad prediction of what might occur in the fitness industry and sports performance worthy of consideration.

The dominant trends in the "health-fitness-sports performance" continuum fit into several broad categories: 1) the historical fabric from which current status has emerged, 2) the value of an active lifestyle for health vs the continual growth of possibilities for sedentary life, 3) the need for people (particularly military personnel) to be physically fit, 4) the artistic beauty of the highly skilled elite athlete and possibilities of sports science for contributing to improved performance and safety vs the ugliness of the commercialism of sport, the attendant use of doping for performance enhancement, and the growing problem of match-fixing, and 5) the degree to which the exercise world is conflicted by the high touch vs high tech landscape. Each category arguably exerts a profound influence and drives the situation of the moment in opposite directions.

THE HISTORICAL FABRIC

The concept of the sound mind in a sound body, goes back into the roots of Western culture, to Greek civilization. The writings of Galen and Hippocrates, which fundamentally influenced much of the direction of Western culture, are rich with the concept that there should be a balance between the physical and the mental life, that too little of one or too much of the other predisposes and individual to illness. In the East, the Confucian concept of the need for the balance of opposites, Yin and Yang, supports the ideals of Galen and Hippocrates.

Humans emerged as a distinct species ~150,000 years ago. About 70,000 years ago, humans seemed to make a 'great leap forward', evidenced by the emergence of cave-art, at about the same time

as several waves of emigration had humans leaving Africa and settling much of the planet. By about 10,000 years ago, humans had developed agriculture, and urban life began to supplant hunter-gatherer life. As hunter-gatherers, and later farmers, humans were dominated by the need to move to secure/produce food and to protect themselves from the environment (Cordain et al. 1998). Thus, "exercise" as we know it today was probably not a meaningful term. People learned to be proficient with the skills needed for daily life, and practiced these skills until they died (Cordain et al. 1998, Walker et al. 2000). Current ethnographic evidence suggests that the first 'recreational' forms of physical activity, dancing and early children's games, probably emerged as entertainment after food and security needs were met (Cordain et al. 1998). Just as plausibly, occasional periods of rest, because of their rarity, were likely viewed as the most desirable time of the day, hence the contemporary pleasure of laying down on the couch when one gets home from work (Eaton et al. 1988).

Beginning about 4000 BC and continuing until the fall of the Roman Empire, the ancient city-states dominated much of human history. Since this domination depended on the ability to wage war, physical activities not linked to food production began in a systematic way, e.g. training for combat (at least among the male population) became more important (Whipp et al. 1998). This training, since it involved fundamental human activities such as running, throwing, wrestling, led to recognition that some individuals were more adept than others, and to the first structured competitive contests, which were also considered as religious festivals. In a similar way, skiing (an essential form of transport amongst Nordic lumberjacks) led to local competitions and to the development of Nordic skiing as we know it (Sandbakk 2017). The observation of relative excellence in physical activities also led to the growth of art reflecting the perfection of bodies in motion. The history of the evolution of physical activity has recently been well reviewed (Le Corre 2014).

With the fall of the Roman Empire, and the coming of the Dark Ages, the cultural latitude for 'artistic activity' lost impetus. Farming or preparing for wars continued as the meaningful physical activity. Although tournaments, jousts, and contests were organized, certainly they were not what we would call exercise or sport today. This trend away from 'artistic activity' was furthered by the body-denying belief structure of early Christianity. Life was probably strenuous enough that most people were quite fit based on the needs of farming or having to walk most places they wanted to go. But, other than the ceremonial training for combat performed by nobles, the concept of "exercising" and "sport" essentially died.

The Renaissance changed the view of the body, and broadened the concept of exercise as part of farm work or war preparation. In 1420 the Italian humanist/educator Vittorino de Feltre opened a school that emphasized both academic and physical education. Only a little more than a century later, in 1553, Spaniard Cristobal Mendez wrote "*El Libro del Ejercicio Corporal y Sus Provenchos*", exclusively addressing the methods and benefits of physical exercise. Rather than being solely dedicated to young adult males who might become soldiers, "*El Libro*" had chapters regarding women, children and the elderly. By 1569 the Italian physician, Mercurialis, has published "*De Arte Gymnastica*", which recovered much of the ancient Greek wisdom about hygiene, diet, exercise and treatments for disease. "*De Arte Gymnastica*" laid out the general principles of physical therapy and led to the growth of physical education in Europe in the 18th century.

Much of the need for structured exercise in contemporary life can be attributed to the emergence of the Industrial Revolution after the mid-18th century. Not only the movement away from the demands of agrarian life, but also the development of a sedentary "owner class' dictated that if one was going to be physically active, they had to do it in an intentional way. This approach was reinforced by the need, at least amongst young men, to stay fit for military service, as Europe entered a period of frequent warfare.

By 1774, Johann Basedow, who was strongly influenced by Rousseau's concept of the "Natural Human" opened the *Philanthropinum* in Germany, arguably the first health and exercise club in the world. Focused on gymnastic exercises, and using for the first-time clothing specially designed to allow freedom of movement (although art work from the Piazza Armerina in Sicily suggests special clothing for sport as early as 4th Century), Basedow's facility led, more or less directly, to a book on artistic gymnastics by Guts Muths, "*Gymnastik for de Jugend*", published in 1800 which ultimately became the reference for the physical education community in the English-speaking world. With the essential motivation of keeping young men fit for military service, Muths' successor, Fiedrich Jahn became the 'father of gymnastics'. By 1811, he had opened the Turnplatz (open air gymnasium) in Berlin, which led to the world-wide Turnverein movement that spread throughout not only Germany, but to places, such as the US, where there were substantial numbers of German immigrants. An outgrowth of this thinking was the physical culture movement that emerged in the 19th century in both Europe and Russia, most notably as the 'light Gymnastics' invented by Ling in Sweden, the military gymnastics invented by Francisco Amoros in Spain, the physical culturist Hippolyte Triat in France, the emergence of the Higland Games in Scotland, and MacLaren's Royal Military Academy at Oxford.

While many of these 'fitness' movements were primarily associated with preparing young men of the elite class for military service, there was enough carry over from the Turnverein movement in Germany, and similar schools within Europe, to cross over to the general population, and to the Americas which had deep cultural roots in Europe. The idea that citizens of the civilized world could further perfect themselves by the application of weight training or gymnastics, to further improve on the apparently favorable Darwinian selection, represented in the concept of social Darwinism, is a logical extension of the ideologically challenging concept of the "health of the people" emerging in Europe (Haas 2008).

In the mid-19th century, in response to growing evidence of degenerative diseases amongst affluent Europeans, the Spa movement emerged (Frosch 2007, Pierach et al. 1993). Here, patients (mostly affluent) could visit the mountains, drink clean spring water, eat a better diet and participate in the "kur". Considering that city life for the affluent in the 19th century was marked by higher meat than vegetable consumption (secondary to food preservation practices) and that many people pointedly did not exercise to prove that they were wealthy, it's reasonable that constipation was a frequent medical condition. Further, with early plumbing and clothing dyes, there was a large exposure to heavy metals, with a variety of associated toxicities. Lastly, given that coal was the dominant source of fuel in this period of time, and that smoking was becoming popular (e.g. the early US was viewed largely as a source of tobacco for Europe), the prevalence of respiratory illnesses had increased. A visit to the mountains with clear air must have done much for chronic pulmonary disorders, clean spring water must have improved heavy metal toxicity, more exercise and more vegetables must have improved digestive health. No wonder that famous people, including Charles Darwin, were frequent and enthusiastic guests at these Spas. Many of the he fundamental tenants of the Spa movement from the 19th century are remarkably similar to the concepts of preventive medicine today.

For much of history, during the period when humans were either hunter-gatherers or farmers, life was so strenuous that it's easy to suggest that individuals found leisure time, time with no physical requirements, to be the height of pleasure. Thus, the roots of the pleasure that one feels laying down on the couch to watch TV, may indeed go back to the very beginnings of our existence as humans. Even the pleasure of the early 20th century farmer (Bassett et al. 2004), resting on his porch at the end of a hard day, may be evidence of a fundamental programming to find pleasure in sedentary behavior. Achieving the balance between mental and physical, in particular making sure there was enough of the

physical in our lives, is a comparatively recent problem, emerging only during the industrial revolution in the 19th century, and only becoming really well established in the last 50 years.

With the growth of affluence that began with the Industrial revolution, humans found increased evidence of the perils of largely sedentary existence. As Boyd Eaton, M.D. wrote in his most engaging article "*Stone Agers in the Fast Lane*" (Eaton 1988) humans evolved as a species where those who were the best at moving around were the most successful at leaving children (Cordain et al. 1998). But, then humans moved to a place (contemporary industrial or post-industrial life) which is fundamentally discordant with our genetic heritage. This discordance leads to what US researcher Frank Booth has identified as the abnormal expression of genes that would ordinarily be beneficial in a hunter-gatherer-agriculturalist environment, but which lead to pathology in the sedentary environment in which most of us live today (Booth & Roberts 2008, Booth et al. 2000, 2002, Chakravarthy & Booth 2004). For example, our physiology is exquisitely designed to deal with dietary carbohydrate and fat, so long as the normal storage sites for carbohydrate and fat have been depleted by previous exercise or dietary restriction. However, in the presence of full fuel reserves, our livers deal with the extra glucose and fat that is circulating after meals in fundamentally different, and less healthy ways, what Booth calls 'metabolic stalling' (Booth et al. 2000).

Even the medical community, which should support the fundamental ideas of Galen and Hippocrates, has gone through cycles were exercise was viewed as more dangerous than beneficial. At the time of the American Revolution, the Scottish physician, William Heberden, identified the concept of exertional angina pectoris. He also identified a patient who was 'nearly cured' (e.g his exertional angina pectoris was improved) after" setting himself the task of sawing wood for a half hour per day", laying the historical foundations for contemporary cardiac rehabilitation programs. However, only a century later, in the late 19th century, physicians were describing the early Oxford-Cambridge boat races as 'cruelty to animals' and claiming that anyone who competed in athletic events for 10 years would be 'damaged for life' (Foster et al. 2008). As recently as the mid 1930's, when fitness pioneer Jack La Lane opened his first gymnasium in the US, local physicians were actively campaigning for their patients NOT to follow La Lane's ideas of exercise and diet, claiming that doing so would render them "muscle bound" and would "destroy their sex drive". It wasn't until the mid 1950's, in the midst of the post WW II epidemic of coronary heart disease and in the wake of U.S. President Dwight Eisenhower having a heart attack while in office, that Paul Dudley White, M.D. was able to find traction for his long-espoused ideas that lifestyle, including diet and exercise, was intimately related to health. Despite

Dr White's influence and mounting scientific evidence of the benefits of exercise on health, it wasn't until the publication of *Aerobics* by Kenneth Cooper, M.D. in 1968 (Cooper 1968) that the contemporary exercise movement really began. This rapid increase in public levels of exercise was followed, however, within 5 years by reports of sudden death and heart attacks while jogging (Foster et al. 2008). Furthermore, quite an extensive medical literature on the concept of female frailty made women's involvement in sport a challenge (Mewett 2003, Pfister 1990). Within the last decade consistent public health guidelines regarding the appropriate quantity and quality of exercise needed to improve health have emerged (Garber et al. 2011, Haskell et al. 2007), culminating in the Exercise is Medicine™ program by the American College of Sports Medicine. Despite evidence demonstrating that an appropriately prescribed health and lifestyle program could produce superior clinical outcomes, even compared to standard procedures such as coronary angioplasty (Hambrecht et al. 2004), exercise has generally been ignored by the medical community. Lastly, despite the mounting evidence and acceptance of the benefit of exercise by the medical community, statistics on the level of exercise undertaken by adults shows little change in terms of the proportion of youth and adults undertaking adequate levels of physical activity (Carlson et al. 2010). This paradox could be attributed to the dose-response approach to physical activity, which does not consider the multi-faceted determinants of active lifestyles (Biddle et al. 2004, Condello et al. 2016).

Thus, despite a clear progression of the recognition of the health benefit of physical activity in the post-industrial revolution world, the reality is that implementation of this knowledge has largely been for military preparedness and health recovery amongst the socially elite. Only in the last 50 years has there been general recognition of the value of a more active lifestyle, which is still not well subscribed to by the population at large.

FITNESS FOR PUBLIC SERVICE

In addition to the historical growth of physical preparedness for potential military activity in European society, the same theme has been adopted in North America. Early in American history, thought leaders such as Thomas Jefferson and Ben Franklin were recommending not only regular, but in the case of Jefferson, prodigious amounts (2 hours daily) of exercise (Foster et al. 2008). Until the emergence of the Industrial Revolution in the early 18th century, the demands of agrarian life were sufficient that all but the wealthiest individuals had occupational demands sufficient to develop high levels of fitness, and the chronic diseases of today (e.g., heart disease, diabetes, cancer) were comparatively unimportant as causes of death and disability. This trend is reflected in contemporary

studies of the Amish, who still live and work much as American farmers did in the 19th century, and who have very low rates of heart disease, diabetes and cancer (Bassett et al. 2004).

Many of the cycles of increased interest in health-related fitness have followed the needs of the military. General concern about the fitness of soldiers for military service led to increases in school physical education programs in the US following both WW I and WW II. However, despite the interest spurred by the military needs of WW II, the affluence following the war dictated that, by the early 1950's, 60% of children failed to pass the Kraus-Hirschland "minimal Muscular Fitness Tests in Children". This outcome led, in the US, to establishing the President's Council on Youth Fitness in 1956 by President Eisenhower. This initiative was followed by the *Sports Illustrated* article "*The Soft American*" by newly elected President John F. Kennedy, who was encouraging Americans to participate in 'the vigorous life' (including encouragement to take 50-mile hikes).

There was not much development of the exercise industry associated with the Korean or Vietnam Wars, but in contemporary times a number of simple bodyweight exercise programs, P90X, CrossFit, Insanity and similar programs, has emerged in close association with groups catering to the needs of military personnel and first responders. Nevertheless, one of the more widely publicized techniques for improving the performance of soldier (and presumably a whole range of public servants and first responders) performance has been development of exoskeletons that allow soldiers to carry much heavier loads (Yu et al. 2014). However, these exoskeletons, which can also facilitate ambulation by patients with spinal cord injuries (Fleischer & Hommel 2008), may remove the impetus for high levels of physical performance in soldiers.

HIGH LEVEL SPORTS PERFORMANCE

The concept of high level performance athletes, the best of the best, goes back to the ancient Olympic-Games in Greece and other sporting/religious festivals of the ancient world. Even our basic concept of the principle of progression of exercise training, dates from Milo of Croton, the legendary farm boy who lifted a growing bullock daily until he became the strongest man in the world, as well as a 6-time Olympic champion and great military leader. So, the concept of exercise to the level where humans approach their genetic potential is not new (Berthelot et al. 2015, Lucia et al. 2016). However, the idea of a systematically trained athlete, who did more than play the occasional recreational game, was largely forgotten until the emergence of more leisure time following the industrial revolution. At that time, children's games expanded into contests amongst young men, often relatively untrained young men (as in the Oxford-Cambridge boat races), who viewed systematic training for sport as a

violation of the 'amateur code' of late Victorian England. This quandary was very well depicted in the classic movie "*Chariots of Fire*" in early 1980's.

Today, high level professional and amateur sports provide a major focus for recreational time, and have become a major part of the entertainment industry. Indeed, one major television network in the US, ESPN=Entertainment and Sports Programming Network, takes its very name from the recognition that high level sports performance is centered in the entertainment industry. This development has led to remarkable economic investment, and reward, in sports and sports performers. The US is hardly unique in terms of the linkage between sports and entertainment. Travel to any country in the developed world reveals that sports programming is a centerpiece of home entertainment. New stadiums, which are really massive entertainment complexes, can easily cost over $1 billion to build. Major sports championships (such as the Super Bowl, the World Cup, the World Series and the Olympic Games) are major features in terms of market share in the television industry. Professional player salaries in a number of different sports frequently exceed $20 million per year. If one adds endorsements to salaries, it is possible to suggest that occasional top sports performers will receive more than $50 million in a year. With these kinds of excesses of competition, compensation and culture there are inevitable behavior problems. Social behavior (drug use, spousal abuse) that would send most citizens to jail is more than frequently winked at amongst high level athletes and their fans. Even collegiate sports, where nominally the 'student-athlete' is the focus, are major revenue producers for many US universities, and the career of many 'student-athletes' is devoted to preparing them for later professional play. This pattern has led to concern, particularly within the European Union (EU), regarding the short professional careers of many professional athletes, and concerns that preparation for professional careers that fail to be realized may be creating a crisis for many promising athletes by preventing the normal maturation and professional preparation that most people undertake at this stage of life (Aquilina & Henry 2010, Capranica et al. 2015, Capranica & Guidotti 2016). Similarly, the salaries of top coaches in revenue producing sports at major American universities far exceed the compensation of the top faculty, and even senior administrators, often by several fold.

The substantial compensation of professional athletes is not a new thing. The life of the Olympians in classical Greece was reputed to be much more luxurious compared to the life of a normal Greek farmer or merchant of the time. Baseball players in the early 20th century (at the time that baseball was 'the American pastime') reputedly had salaries often 10x those of ordinary workers. This evolution of compensation has grown, to the point where the total compensation of top team sport

athletes is 300-400x that of the authors of this article. The point of this is, of course, that the beauty of performance demonstrated by extraordinarily talented and well-prepared athletes, may be overshadowed by the cultural and social excesses related to top sport.

Beginning around the turn of the 20th century, the re-emergence of the Olympic games and popular development of collegiate and later professional sports (particularly football) in the US, has driven sport in the direction of greater levels of performance, although often at the expense of the long-term health of the competitors (Maffulli et al. 2010, Guskiewicz et al. 2004) and purportedly widespread use of doping procedures (Noakes et al. 2004). In many respects, sports have followed a path to what has been described as "neo-gladitorialism" (Renson et al. 2001). Just as the comparative purity of high level sports in Greek civilization deteriorated into the gladiatorial circus in ancient Rome, high level contemporary sports have deteriorated into an often unattractive circus. In effect, high level sports are following the path of excess and showmanship presaged by professional Wrestling.

This deterioration is not new. In the US, it began with the restructuring of university physical education programs at the turn of the 20th, along the lines of "sports are educational", designed to find a niche for football coaches on university faculties. This development was followed by rampant recruiting excesses, where the parents of top athletes often were offered attractive jobs, just so their son could play high-school football (or some other sport) in a certain city. With the understanding of how doping might work, and probable use by soldiers during WW II, came the systematic (and very effective) use of doping practices by East Germany and other Communist bloc countries beginning in the middle of the 20th century, such that the nature (and purity) of sport has eroded. If perhaps less systematically applied, anabolic steroids become the 'breakfast of champions' in the US and Western Europe during the same period of time. The problem of doping, with ever more sophisticated methods, and ever more sophisticated strategies (medical, technical and legal) to defeat doping, continues today. Professional athletes are regularly being investigated by the US Congress, in an interesting, if fruitless, morality, play. One Tour de France champion has recently been stripped of his title, another lost his title (perhaps for inadvertent doping from contaminated meat), and a 7-time winner of the Tour, who has taken and passed >100 doping control tests, has been found guilty of systematic, long term doping, but only through the use of investigative procedures similar to those used by the law-enforcement community (United States Anti-Doping Agency 2012). More recently, at the time of the 2016 Olympics in Rio, there was a large scale banning of athletes from Russia, based on evidence that the Russian anti-doping organization had systematically assisted its athletes with doping.

Another emerging international phenomenon presenting a major threat to the integrity of sporting events is match fixing, which is often linked to criminal networks exploiting unregulated gambling markets. Several international bodies are currently involved in combatting match fixing to secure the reputation of competitive sports (Carpenter 2012).

It is a paradox, that in the same period of history where professional sports are growing rapidly, and where the performance of athletes (whether from better preparation or doping) improved markedly, that sedentary behavior amongst the public is growing (Carlson et al. 2010) and the frequency and quality of school physical education classes is declining markedly (Hardman & Marshall 2005).

Remarkably, in the context of all that is wrong with high level competitive sports, a robust sports science community has emerged, which has developed a better understanding of why certain athletes are more successful (Garrett & Kirkendall 2000, Milvy 1977, Saltin & Astrand 1967), how the training response really works (Fitz-Clarke et al. 1991, Foster et al. 1996, Morton et al. 1990, Seiler 2010, Sylta et al. 2016), how to evaluate performance in athletes (Maud & Foster 2006, Tanner & Gore 2012) and how to monitor (e.g. give feedback to the coach) the training and performance of athletes (Cardinale & Varley 2017, Foster et al. 2017, Robertson et al. 2017, Sands et al. 2017). This emerging body of knowledge is anchored by professional societies (American College of Sports Medicine, European College of Sports Science, British Association for Sports and Exercise Science, Exercise and Sports Science Australia) that provide a convenient format for the free exchange of ideas amongst scientists, researchers, clinicians and other practitioners, all designed to improve the health and performance of athletes.

A curious outgrowth of the high-performance culture and doping culture has been the development of exercise and sports as vehicles for improving personal appearance. The concept of 'physical culture' goes back, into the 19th century, where strongmen and body builders were admired, if from afar. In the early 20th century, thanks to pioneers such as Bonnie Pruden and Jack La Lane, the concept of adults using exercise to improve, not only their health, but also their appearance, found a willing audience in the American public. La Lane was amongst the first to use the new medium of television to take his version of improved health and appearance out of the gymnasium and bring it into the home. However, the real watershed moment in the exercise for appearance movement was the release, in 1977, of the movie "*Pumping Iron*", a nominal documentary about the quest of the Austrian body builder (subsequently movie star and Governor of California) Arnold Schwarzenegger to win the 1975 Mr. Olympia bodybuilding contest. Although nominally a cult film, *Pumping Iron* had a broad

public outreach, and captured the interest of the public at a very deep level. This movie, set against the background messages of La Lane and Pruden about exercising to improve appearance, created a major industry devoted to self-improvement through exercise. Health club memberships increased, television shows, later videotapes and then CD's devoted to exercise were produced in large numbers, and new and innovative exercise equipment emerged rapidly on to the commercial market. In the midst of this same trend, performance enhancing drugs, which formerly had been used exclusively by elite athletes for maximizing performance, were broadly adopted by the "keep fit-look good-stay young" exercise community, particularly the aging baby-boomers. This same concept has morphed into the 'anti-aging' focus within certain elements of the medical community, which itself had its' historical roots in the Spa movement of Europe in the 19th century. While it is hard to argue with keeping oneself fit and healtghy, the risks of using these pharmacologic and nutritional strategies is simply unknown.

HIGH TOUCH VS HIGH TECH

Following the American Civil War, the success of the Industrial Revolution allowed the development of more and more sedentary individuals, who began to develop heart disease and diabetes. Following the fundamental concepts developed in Europe, American pioneers such as Dioclesian Lewis, Edward Hitchcock, William Anderson, and Dudley Seargent planted the seeds for the entire health related fitness movement in the US. Catherine Beecher pioneered the development of gymnastic exercise programs targeted at women, set to phonographic music, a remarkable precursor of the musically choreographed exercise that is so much part of the mainstream of contemporary exercise programming.

During much of the last 25 years, the fitness movement has focused on more high-tech delivery of fitness products. One defining event in this generation, developed around 1990, was the development by Life Fitness of resistance machines that required the exerciser to make a preliminary maximal contraction, and then accommodated the resistance to allow training sets of 12 repetitions. For the first time the exerciser didn't have to know how to set resistance, the machine could accommodate to their abilities. This has led to the evolution of a generation of "smart" exercise machines that could (in theory) help the exerciser to define, and monitor, optimal exercise strategies.

The emergence and wide distribution of the personal computer by the 1980's was, at the same time, the best thing and the worst thing that ever happened to fitness. This development led, paradoxically, to the 'perfect storm' of video games-supersizing 24-hour news cycles (that made us too frightened to let our kids play outside) that has contributed so much to the youth obesity epidemic. The

development of the computer also led to the development of "exergaming" which appears to be developing into a major trend in the exercise industry. In fact, it is possible to predict that evolution of exergaming, with further development of both computer and HD/3D projection technology, may develop into the "Holodeck", envisioned in the 1970's in the television show *Star Trek*. In this scenario, fully customizable individual exercise programs, which combine elements of games, health, fitness, appearance improvement and even athletic competition, can be seen as one logical future of the exercise business. Thus, just as Edmond Desbonnet in Europe and Bernarr Macfadden in the US made the fitness industry fashionable in the early 20th century by publishing fitness journals, creating specialized exercise equipment and opening chains of health clubs, and just as Jack La Lane pioneered the use of television as a delivery vehicle for exercise, the industry may well evolve using the cyber capabilities of the 21st century. Add this to the possibility of connecting personal trainers to clients via web-based technology, or even having remote individuals play or compete with each other, and you have the substrate for the genesis for one possible future of the exercise industry. This, of course, is contrasted by the (human) Personal Trainer, one's own personal 'workout buddy', who is the exact opposite of the high-tech approach. However, given that it is possible that Personal Trainers are already able to interface with clients via on-line connections and apps on cell phones, it seems more reasonable that development toward the "Holodeck" is already well under way. In this regard, ACSM has been publishing fitness trends on an annual basis (American College of Sports Medicine 2016b). As an example, wearable technology is predicted to be the top fitness trend for 2017, personal trainers are the #6 trend and exercise apps are the #17 trend. The future may already be arriving.

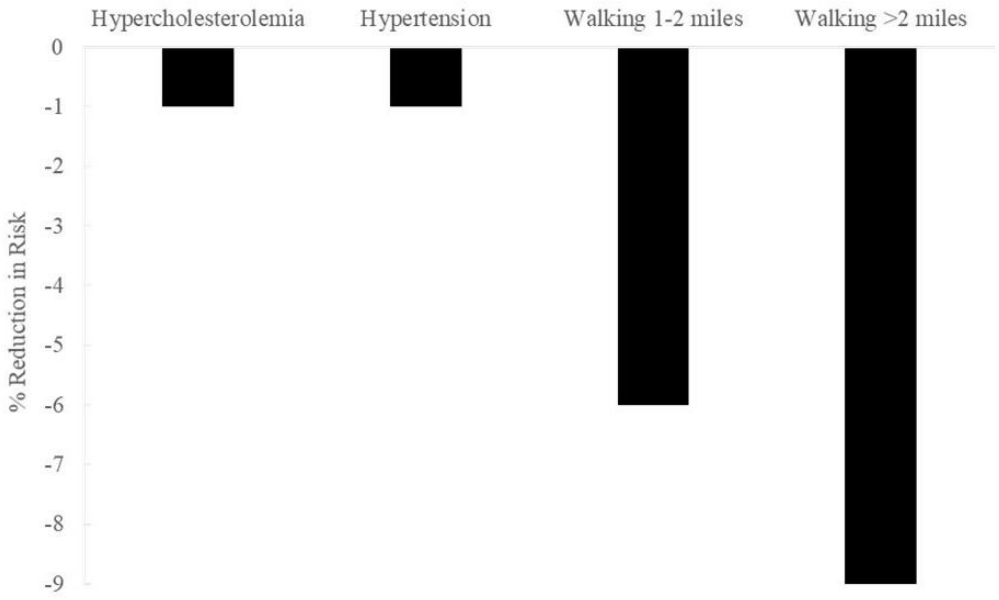
At the other end of the continuum, despite the wide popularity and economic success of high level competitive sports, the excessive economic factors, behavior problems (which border on criminality) and doping of high level athletes may be spelling the end of serious competitive sports. Indeed, as frightening as it seems, the caricature-gladiators of today's professional Wrestling, where true competition is likely non-existent and matches are carefully scripted, may be the future of high level competitive sports. Already referred to as 'the show' by professional athletes, the development of rivalries by the media, the advent of 'trash talking' aided by media such as Twitter, and the ability of using media to put the fan 'inside the game' present a bias where competition may easily be scripted to maximize the entertainment value. Not that professional athletes (including professional Wrestlers) aren't extraordinary manifestations of the human genome, with remarkable abilities to exercise, but they may be sowing the seeds of their own demise via the social excesses of high level sport. When contrasted with the ability of exergaming to allow virtually everyone to compete in their own Olympics,

in their own Super Bowl, it makes sense that there will be major changes in the future for the exercise and fitness community.

EXERCISE IS MEDICINE™

An interesting development in the linkage of exercise and health has been the development of the Exercise is Medicine™ program by the American College of Sports Medicine in 2008 (American College of Sports Medicine 2016a). Under the leadership of Robert Sallis, M.D. the leadership of ACSM began to point out that the simple act of a physician asking their patient about their exercise habits at every routine office visit was a powerful tool relative to encouraging patients to exercise. This program has received the endorsement of the American Medical Association, giving the concept of an 'exercise sign' wide acceptance. The second step of the EIM program is having physicians advise their patients who do not currently exercise to follow the broad public health recommendations of ACSM and the American Heart Association (Garber et al. 2011, Haskell et al. 2007), namely to accumulate at least 30 min of moderate intensity exercise on most, if not all, days of the week.

Figure 1. Reduction in 5-year mortality compared to control in hypercolesterolemic men treated with statins (Ford et al. 2007), in hypertensive men treated for hypertension (Herbert et al. 1993), and in healthy non-smoking men who either walked 1-2 miles per day, or more than 2 miles per day (Hakim et al. 1998).

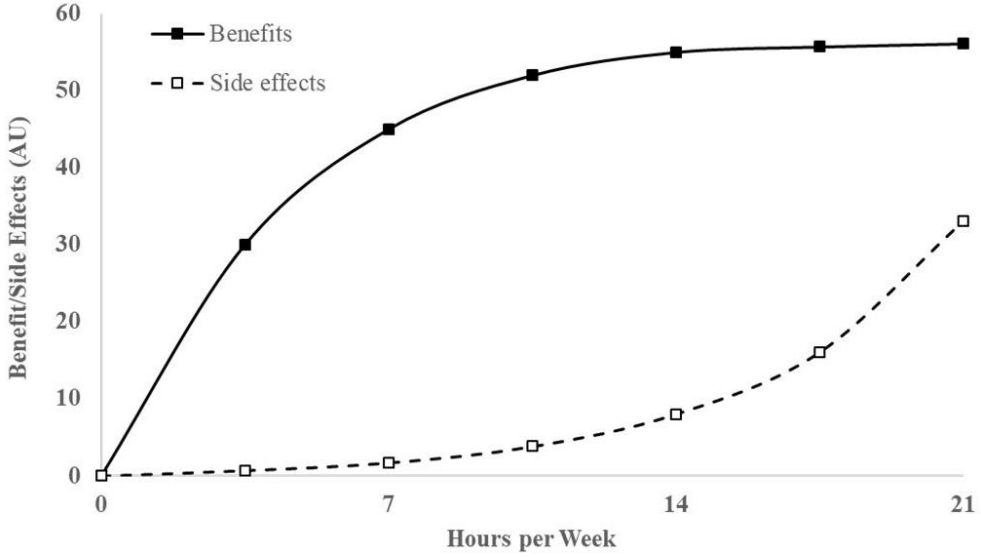


Source: The Authors.

The magnitude of health outcomes related to exercise can be estimated by combining a series of studies of normal medical interventions with the effect of exercise vs not exercising. In patients with

either high cholesterol or high blood pressure, both established risk factors for developing cardiovascular disease, the reduction in mortality over a 5-year period is about 1% in patients who are adequately treated vs inadequately treated (Hakim 1998). In middle aged and older men, the reduction in mortality is about 6% for men walking 1-2 miles per day, and 9% in men walking more than 2 miles per day (Figure 1). These data indicate that the effect of exercise on health is large, perhaps even significantly larger than standard medical therapies, and that it is graduated, with larger benefits from more exercise. These outcomes support epidemiologic findings (Arem et al. 2015, O'Keefe et al. 2012, Paffenbarger et al. 1978) that the risk of mortality and/or heart attack decreases progressively with higher levels of physical activity.

Figure 2. Schematic concept of the likely health benefit of increasing the volume of moderate intensity exercise, adapted from evidence in traditionally living humans (Cordain et al. 1998, Eaton et al. 1988), from Amish farmers living a 19th century lifestyle (Bassett et al. 2004), from professional society consensus statements (Garber et al. 2011, Haskell et al. 2007) and from epidemiologic studies (Paffenbarger et al. 1978). Also included is an estimate of the likelihood of side effects (primarily orthopedic) in relation to the volume of moderate intensity exercise (e.g. walking).



Source: The Authors.

This raises the question of how much exercise is enough, or what the dose-response curve looks like. It is almost impossible to do a controlled study over a long enough period of time to measure appropriate health outcomes. Almost certainly there is a rapidly accelerated curve, such that a dose of exercise as little as 30 min per day (3.0-3.5 hours per week) has significant positive effects on health (Arem et al. 2015, O'Keefe et al. 2012). However, extrapolating from epidemiologic data, as well as evidence from ethnographic studies of populations who still live as hunter-gatherers (Cordain et

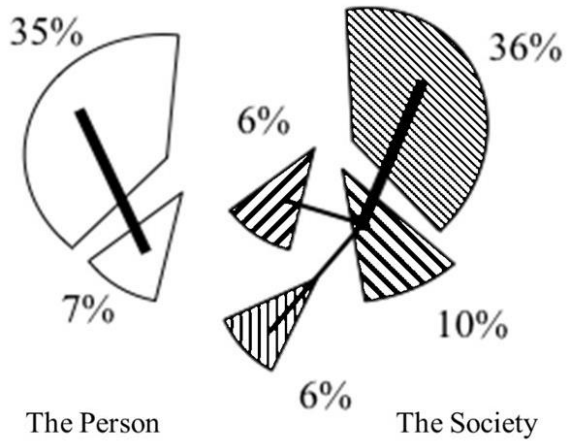
al.1998), it is probably safe to suggest that health benefits continue to accrue as the amount of exercise climbs to as much as 3 hours per day (~20 hour per week) (Figure 2). However, beyond about an hour of walking per day (less with more demanding activities like running), there is an increased risk of orthopedic problems. Accordingly, using the premise of keeping side effects minimal, a case can be made that an hour of walking daily is likely to deliver nearly maximal health benefits with minimal side effects. To borrow (and modify) an old saying "an apple a day, and an hour walking a day, keeps the doctor away".

PLAYING AS A TEAM

Active lifestyles are not only crucial for the health of the individuals but represent an important opportunity for personal development and achievement, social inclusion, integration, and equality. At micro level, the individual is responsible for regularly engaging in exercise and sports, and it is crucial that the activity is considered fun and enjoyable regardless of age (Diamond & Ling 2015, Pesce et al. 2016b). It is also well recognized that several stakeholders at meso (e.g., relatives, peers, teachers/employers, coaches, sport managers), macro (e.g., sport organizations, educational institutions, and labor market), and policy (e.g., national and international governing bodies) levels have specific responsibilities for supporting active lifestyles. Indeed, this multi-faceted phenomenon requires coordinated efforts to counteract the secular trends towards inactivity in the life course. Recently, 12 European countries (e.g., Austria, Belgium, Finland, France, Germany, Italy, Ireland, Norway, Poland, Spain, The Netherlands and United Kingdom) addressed this societal challenge by providing financial resources to a large-scale research project on Determinants of Diet and Physical ACtivity Knowledge Hub (DEDIPAC-KH) developed within the European Joint Programming Initiative Healthy Diet for a Healthy Life (2010). Thus, almost 300 researchers of different disciplines from 68 research institutes reviewed main measurements methods, correlates and determinants, and benchmarking of interventions and policies of diet and physical activity behaviors (Lakerveld et al. 2014). For determinants of physical activity behaviors, umbrella systematic reviews of the current state-of-the art (Carlin et al. 2017, Condello et al. 2017, Cortis et al. 2017, Puggina et al. 2017), the development of dynamic and evolving framework for guiding research (Condello et al. 2016), and secondary data analyses of European studies were performed. In particular, by involving experts of different disciplines in a concept mapping procedure, the EUropean-Physical Activity Determinants (EU-PAD) framework identified six distinct clusters (Figure 3) organized in two areas (i.e, the 'Person', including the clusters 'Intra-Personal Context and Wellbeing' and 'Family and Social Economic Status'; and 2) the 'Society',

including the remaining four clusters 'Policy and Provision', 'Cultural Context and Media', 'Social Support and Modelling', and 'Supportive Environment') and the most modifiable and impactful factors to be further investigated with a trans-disciplinary approach (Condello et al. 2016). The DEDIPAC-KH could be considered a good practice for preliminary trans-disciplinary cooperation aiming at new and coordinated initiatives to subsume the actual strategies and policies and to envisage new directions for more effective active lifestyle programmes.

Figure 3. Graphic Representation of the EU-PAD framework. Areas without texture: The Person (e.g., Intra-Personal Context and Wellbeing=35%; and Family and Social Economic Status=7%). Areas with texture: The Society (e.g., Policy and Provision=36%; Cultural Context and Media=10%; Social Support and Modelling=6%; and Supportive Environment=6%). Straight lines represent the origin of the clusters. (Modified from Condello et al. BMC Public Health, 2016, 16:1145).



Source: The Authors.

In the last decade, the European Parliament and the European Commission have deeply supported sports (and dedicated programmes and initiatives to establish partnerships between different stakeholders for tackling several aspects related to a healthy society, an active citizenship, and social inclusion of minorities and migrants (European Commission 2007, 2014, 2016, European Parliament 2016). In considering that migration is an emergent phenomenon challenging western societies with the need to be inclusive of a growing number of refugees and migrants, sport participation could be considered as a potential socializing agent for facilitating the integration of people from different cultures, ethnicities and social classes (Gasparini & Cometti 2010). Because athletes could "act as a symbol of hope for refugees worldwide and bring global attention to the magnitude of the refugee crisis" (International Olympic Committee [IOC] 2016). Indeed, for the first time, the 2016 Games in Rio de Janeiro encompassed a Refugee Olympic Team to show that sports present no barriers for participation regardless of circumstance (IOC 2017).

CONCLUSION

As we come to a conclusion, it is fair to summarize what we know. We know that exercise is good for wellness, we know that sports, for all their beauty, may be sowing the seeds of their own destruction. We know that any form of exercise probably has substantial health and social benefits, although there is a continuing quest to define a 'best' way to exercise (Zeni et al. 1996). Given that we have suggested that exergaming may well morph into the 'Holodeck", is it fair to speculate that exercise married to technology may replace the gymnasium? Similarly, wearable monitors (Stackpool et al. 2014, Tudor-Lock et al. 2004) can translate the careful evaluation of athletes into practical strategies for guiding the exercise programs of less athletically gifted individuals. At the same time, for many humans our jobs will become more automated, and we may have relatively more leisure time, thus the 'need' to exercise for our daily life will only decrease. However, to maintain our physical health from the discordance between lifestyle and our genetic heritage, the 'need' to exercise to maintain our wellness will only increase. Further, if one assumes the validity of the *Homo Ludens* concept of Johann Hauzinga (1949), our need to 'play' will remain present, and we will need to find avenues of expression (Pesce et al. 2016a). The answer is unknown, but given the tremendous societal push toward technological solutions, even to the point where many of our friends are cyber friends, with very little physical 'face time', it seems hard to argue against the idea that the trend toward technological solutions will have a bigger and bigger role in the future of exercise.

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O Futuro da Saúde / Aptidão Física / Desempenho Esportivo

RESUMO:

O exercício relativo à saúde / aptidão física e desempenho esportivo tem mostrado um papel evolutivo ao longo do tempo. São apresentados fatores primários de grande escala, que provavelmente nos ajudarão a entender o caminho evolutivo futuro da saúde / aptidão física e desempenho esportivo. Esses fatores incluem: 1) a história do exercício, 2) o exercício em sua relação com a saúde, 3) a necessidade de aptidão física entre os militares e os socorristas, 4) a relação conflitante entre o esporte (representando o ápice da capacidade genômica humana para o exercício) versus a natureza excessivamente competitiva e compensada do esporte. Predominantemente, a necessidade de exercício como medicina preventiva em uma sociedade progressivamente mais sedentária, a necessidade de proporcionar a integração social e inclusão em uma sociedade altamente móvel, o risco de resultados sociais indesejáveis relacionados ao esporte e a probabilidade de interações humano-tecnológicas são suscetíveis de impulsionar a evolução do exercício no futuro.

Palavras-Chave: História do Exercício; Bem Estar; Medicina Preventiva.

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