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SPECIAL REPORT

Physical Activity: An Underestimated Investment in Human Capital?

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Despite the fact that physical activity is universally acknowledged to be an important part of healthy functioning and well-being, the full scope of its value is rarely appreciated. This article introduces a novel framework for understanding the relationships between physical activity (and specifically sport-related forms of physical activity) and different aspects of human development. It proposes that the outcomes of physical activity can be framed as differential 'capitals' that represent investments in domain-specific assets: Emotional, Financial, Individual, Intellectual, Physical, and Social. These investments, especially when made early in the life course, can yield significant rewards, both at that time and for years to come. The paper presents a new model—the Human Capital Model—that makes sense of these effects, outlines the different capitals, and briefly articulates the conditions necessary for the realization of Human Capital growth through physical activity.

***Keywords*:** public health, sports, policy, evidence-based research

The Human Capital Model (HCM) draws together a comprehensive evidence base of benefits of physical activity. These benefits are not autonomous, independent, or disconnected. They reinforce each other and their true value can only be properly appreciated from a broad holistic perspective. Underlying the HCM is an assertion that personal competencies, knowledge, and other attributes can be acquired through participation in physical activity, and that these activities produce value that is realized in increased quality of life, educational achievement, and, ultimately, economic value.[1]

Despite the mounting evidence for the values of physical activity,[2] there continues to be a general underappreciation of their importance—both to individuals and the wider society.[3,4] Although there is an acknowledgment of the significance of physical activity, it is usually framed in terms of the dangers of its absence, with the corollary that discussions (especially in policy documentation, but also in scientific writing) tend to be focused on a relatively narrow, hierarchically conceptualized range of concerns (primarily obesity and coronary heart disease, in current discourses).[5–7]

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The rationale for this approach is difficult to refute. Globally, the major causes of death and disability are noncommunicable diseases like obesity, heart disease and stroke, cancer, chronic respiratory disease, and diabetes. Cardiovascular disease (CVD) is the leading cause of mortality worldwide.[8] Risk factors for CVD include obesity, high blood pressure, blood lipids, and lipoproteins. Life expectancy may be reduced by several years, as may work productivity, while costs are increasing enormously.[9] Each of these conditions has been found to track from childhood through to adulthood, which strongly suggests that the roots of adult ill health and early death lie in childhood.[10] This suggestion is corroborated by the finding that 1 in 3 to 5 children in the Western world is overweight or obese.[11] It is also supported by reports that one-third of children in the United States have at least 1 risk factor for Metabolic Syndrome, which is the coexistence of multiple risk factors including hyperinsulinaemia, glucose intolerance, hypertension, decreased levels of high-density lipoprotein cholesterol, and elevated triglycerides.[12]

For many, the rise and spread of CVD and obesity represents an epidemic.[13] It has been estimated that, by 2015, there will be 700 million people in the world who are obese.[14] This is mainly due to an environment that promotes excessive food intake and discourages physical activity.[15] Excessive body fat increases the relative risk of several chronic diseases, including cardiovascular disease, type 2 diabetes mellitus, and various musculoskeletal disorders.[16] The estimated annual healthcare cost attributable to obesity in the US alone is estimated to be $147 billion.[17,18] The most alarming trend is the increase in childhood obesity. Studies show the risks of overweight and sedentary behaviors are increasingly

evident in children age 2–5 years, which has considerable implications for all subsequent ages.[19] As obesity and its related risk factors and outcomes usually change little from childhood to adulthood, this is a problem with a long-term effect.[20,21]

Large cohort studies suggest that participation in physical activity is associated with a 20%–40% reduction in all-cause mortality compared with nonparticipation.[22,23] The World Health Organization estimated the annual worldwide tally to be 35 million people per year who are dying of these chronic diseases,[7] which is double the number dying from all combined infectious diseases, such HIV/AIDS and malaria. For the first time in history, children in some Western countries have a shorter lifespan than their parents due to noncommunicable diseases.[24,25] Aside from the human cost, there is a huge, and continuously increasing, financial loss. In 2005 alone, the estimated losses in national income from heart disease, stroke, and diabetes were $18 billion in China, $11 billion in the Russian Federation, $9 billion in India, and $3 billion in Brazil.[26] By one estimate, the U.S. spent $190 billion on obesity-related health care expenses in 2005—double previous estimates.[27]

The importance of physical activity, for most policymakers and politicians, lies in its status as the least expensive and most effective preventive treatment for combating the increasing worldwide problem of obesity, and, with its associated physical fitness, may represent the most effective strategy to prevent chronic disease.[28] The relationship between sedentary behaviors and prevalence of obesity has been well documented. Although it is only one factor in a number of influences, the amount of physical activity people engage in is linked to their status of being overweight or obese.

Sporting forms of activity seem to be particularly valuable in policy terms because they are attractive and motivating forms of exercise. This makes them a highly effective tool for engaging and empowering individuals, communities, and even countries to take action to improve their health. Sports can also be a powerful means of mobilizing health-promoting resources.[29] However, the negative framing of approaches like this tend to result in a narrowing of focus, so that the spotlight on physical health benefits tends to mean that other therapeutic effects (such as potential benefits in terms of cognitive, emotional, and social well-being) are pushed into the shadows.[30]

Increasing participation in physical activity, including engagement with organized sports, forms a core objective across a range of government policies in most developed countries. Of course, there are other aspects of these activities that grab the attention of politicians from time to time (such as the adventures of the European Soccer 'Super Leagues,' the NFL's Super Bowl, or the Olympic and Paralympic Games). In general, though, the broad development of physical activity opportunities has become a policy target because of its significance for health care systems and economies.[31] For instance, the World Health Organization estimates that up to 50% of the world's population does not undertake a sufficient amount of physical activity required to obtain health benefits.[32] Approximately 35% of deaths related to coronary heart disease, 25% of deaths related to stroke and osteoporosis, 20% of deaths related to colon cancer, hypertension, and type 2 diabetes, and 14% of deaths related to breast cancer could be prevented with sufficient physical activity.[33] These modifications could easily translate into considerable health care savings, some of which are likely underestimated.[34]

Discussions of the benefits of physical activity, especially for children and young people, are traditionally framed in the context of the future physical health status of the individual and its consequences for the community. This can be a limited paradigm for a number of reasons. First, it is important to consider physical activity as it relates to the multiple demands of lifelong functioning and development associated with physical growth, biological maturation, and behavioral development. These processes vary considerably among individuals, occur simultaneously and interact, and provide the backdrop against which, for example, youth evaluate their own status among peers, especially during adolescence.[35] This backdrop has implications for many of the decisions that youth make, including those regarding physical activity. Second, outcomes of involvement in physical activity extend far beyond physical health, with an ever-growing literature supporting psychological and social well-being, cognitive and academic performance, and even future career attainment. Third, the view that 'exercise is medicine' leaves little room for the true motivations and significance of exercise in the lives of players.[36]

Based on these premises, the HCM takes a broader and more inclusive view of physical activity—one that takes on the urgent health agenda, but that also locates that agenda within a holistic view of human development. The Model does not deny or minimize the dangers of inactivity, nor does it overlook the great importance of physical health in human functioning and development. Rather, it locates such concerns in a broader, multidimensional context that includes the scope of outcomes of physical activity positive outcomes, and envisages them as interconnected events within the lifespan. In doing so, it acknowledges the World Health Organization's own working definition of health: "a complete state of physical, mental, and social well-being, and not merely the absence of disease or infirmity."[37]

The HCM represents the views that physical activity is a fundamental part of human nature, and that it is essential for healthy human development. The HCM further conceptualizes development in terms of different forms of 'capital,' which are resources that can be built on and drawn upon throughout life. The model suggests not only that physical activity is a key driver of different types of capital formation, but that the capitals in turn influence both physical activity and each other; forming a synergistic feedback network whose whole is greater than the sum of its parts.

The Human Capital Model

The HCM seeks to draw together a comprehensive evidence base of the extensive and varied benefits of physical activity, and represent this base in an inclusive yet parsimonious way. The use of the phrase 'Human Capital' is deliberate, and is motivated in part by a desire to reframe scientific discussion of physical activity by conjecturing an alternative metaphor. The use of metaphorical language in discussions of physical activity and health is, of course, pervasive. Policy documentation and academic literature alike are littered with metaphors, most of which have a martial character: society must 'combat' obesity; it needs to 'fight' and 'defeat' heart disease; and it must battle with the causes of sedentary behavior. Such terminology is understandable in light of the evident threats to health and well-being resulting from inactivity, but they also necessarily frame the discourse in an especially negative manner. Metaphorical thought is unavoidable, ubiquitous, and frequently unconscious, and consequently plays a central role in defining everyday realities and priorities, and this seems to be especially the case with abstract constructs like scientific models and theories.[38]

In everyday language, the word 'capital' refers to wealth. People talk about investing capital, implying that capital is an asset that can be owned and allocated. So, the money that we put under our mattresses for future use is an investment in capital for future consumption and wealth (just as physical activity, good nutrition, and rest are investments in capital for future health); capital, therefore, is a resource that directly or indirectly contributes to future well-being.[39]

Economists used to equate capital investment with investment in physical property, like plants, buildings, and machinery. However, the physicality and tangibility of capital are conceptually unnecessary. For something to be 'capital,' all that is needed is that it is a resource that promises future utility. The 'human capital revolution' in economics happened when it was realized that a host of activities could be considered as an investment in human capital. The literature on human capital has tended to be dominated by education, and has been almost universally defined in terms of skills, qualifications, and schooling.[40] But this is not necessarily the case; just as capital can be obtained from education, so too can a whole host of investments be said to change one's future capacity to derive utility.[41]

> To most people, capital means a bank account, a hundred shares of IBM stock, assembly lines, or steel plants in the Chicago area. These are all forms of capital in the sense that they are assets that yield income and other useful outputs over long periods of time. But such tangible forms of capital are not the only type of capital. Schooling, a computer training course, expenditures on medical care, and lectures on the virtues of punctuality and honesty are also capital. That is because they raise earnings, improve health, or add to a person's good habits over much of his lifetime. Therefore, economists regard expenditures on education, training, medical care, and so on as investments in human capital. They are called *human capital* because people cannot be separated from their knowledge, skills, health, or values in the way they can be separated from their financial and physical assets.[42]

The HCM presented in this paper offers the view that physical activity is an investment capable of delivering valuable returns. Underlying the model is a claim that the stock of competencies, knowledge, and personal attributes are embodied in the ability to participate in physical activity, and that these activities produce values that are realized through increased well-being, educational achievement, economic value, and so on.

The HCM conceptualizes development in terms of different forms of 'capital,' as follows:

1. Physical Capital: The direct benefits to physical health and positive influences on healthy behaviors
2. Emotional Capital: The psychological and mental health benefits associated with physical activity
3. Individual Capital: The elements of a person's character (eg, life skills, interpersonal skills, values) that accrue through participation in physically active play, sports, and other forms of physical activity
4. Social Capital: The outcomes that arise when networks between people, groups, organizations, and civil society are strengthened because of participation in group-based physical activity, play, or competitive sports
5. Intellectual Capital: The cognitive and educational gains that are increasingly linked to participation in physical activity
6. Financial Capital: Gains in terms of earning power, job performance, productivity, and job attainment, alongside reduced costs of health care and absenteeism/presenteeism (ie, lower productivity among those who are "present") linked to physical activity.

The classification of these themes was the result of an extended iterative process of model building, critique, and revision, involving a comprehensive literature search, group workshops, and interviews with a range of authorities on specific aspects of the outcomes of physical activity. The resultant capitals themselves were general themes that imposed order and meaning on 88 distinct benefits that were supported by the peer review process. Figure 1 shows the 6 capitals, and the 88 specific benefits.

According the Model, each of the capitals are resources that can be invested in and drawn on throughout life. The model suggests not only that physical activity is a key driver of different types of capital formation, but that each of the capitals in turn influence both activity and each other, thus forming a synergistic feedback network whose whole is greater than the sum of its parts.

Figure 1 — Human Capital Model and physical activity outcomes.

The HCM is a positive way of framing discussions about the case for physical activity. It builds on existing work in the field, but adds 2 particularly important elements to the debate: first, that physical activity is a wise investment that can deliver valuable returns, both in the present and throughout the future; and second, that the range of these returns is much greater than commonly assumed. The proposal is that significant and wider-ranging benefits can be gained through investing in and developing the human capitals.

Furthermore, the Model reinforces the fact that the outcomes of physical activity are not automatic; participation in these activities is a necessary condition for the growth of the capitals, but it is not sufficient. The qualities of interactions and the relationships that underlie them have pivotal effects on the extent to which benefits are realized, not least because they significantly influence adherence to the activities.[43]

What are these returns? The next section articulates the different 'capitals' that populate the HCM (see Figure 2), and summarizes the evidence base of each.

The Human Capitals

Physical Capital. The relationship between physical activity and physical capital is, not surprisingly, strong. The link between activity and bodily health has now reached the point of consensus: physical activity is an important feature of healthy development, and inactivity is a risk factor for a range of serious conditions that can develop during childhood, adolescence, and adulthood.[44] While the precise extent to which investment in physical capital during childhood tracks into adulthood is a matter of debate, there seems no denying the logic that states that the potency of a cumulative condition or disease will be mitigated by activities that delay and lessen them from early stages.

It is clear that physical activity is a key component of energy balance, and keeping active is an essential part of preventing people from becoming overweight and accumulating body fat.[45,46] Active children and adolescents tend to have less body fat, and physical activities have been shown to be effective in programs for overweight and obese young people.[47] The beneficial effects of physical activity on obesity in young people are lost when interventions stop, which suggests a need for lifestyle change.

Sports are increasingly cited as a potentially important context of physical activity. Children and adolescents involved in sports exhibit higher levels of moderate-to-vigorous physical activity, estimated daily energy expenditure, and energy expenditure in physical activity.[48] However, a great deal depends on the context in which sports takes place: some sports are quite sedentary, and some coaches/teachers are less successful than others at sustaining activity during session.[49] In light of these variables, it is not surprising that some of the most encouraging findings come from school sports and other relatively formal, organized settings.[50]

The mechanisms by which active young people become active adults are still somewhat unclear. However, research suggests that a number of factors contribute to the establishment of physical activity as part of a healthy lifestyle. There is some evidence that health-related behaviors learned in childhood are often maintained into adulthood.[51] An influential European study did not find evidence of continuation of physical activity from 13 and 27 years.[52] However, other studies have found that youth activity carries on into later life.[53–55] Participation in organized physical activity during adolescence tends to track at higher levels than other indicators of activity,[56] while frequency of participation, membership of clubs, and competition during adolescence in Scandinavian countries are significant predictors of physical activity in young adulthood. Sports participation in childhood and adolescence is also a significant predictor of physical activity levels and physical fitness activities in American young adults. It is likely that sports skills transfer readily to other skills that facilitate readiness for an active lifestyle.[57] A review of retrospective and longitudinal studies reported that sports participation in childhood and youth represents a significant predictor of later physical activity. Interestingly, studies also show how strongly inactivity in youth tracks to adulthood,[58] so it does seem the case that physical inactivity during the childhood can leave a legacy of inactivity and associated ill-health in the years to come.

In light of the evident dangers of inactivity, it is cause for concern that many children and adolescents are inactive, and that sedentary behavior becomes progressively normal as they get older.[59,60] For example, one study in the United States found that 42% of children age 6–11 years met the recommended 60 minutes of physical activity per day, whereas only 8% of adolescents achieve this goal. Worse, only 5% of adults reached a target of 30 minutes per day.[61] Furthermore, a recent multinational review of movement patterns reported differential declines in metabolic equivalents of task of activity and increases in sedentary time across the globe.[62]

So, it seems fair to say that physical activity is associated with numerous health benefits, and can make substantial contributions to individuals' Physical Capital, both at the time of exercise and into the future. Generally speaking, the more intense and sustained the activity, the greater the benefit, although even modest amounts of physical activity can have health benefits in high-risk youngsters (such as the obese).[18] However, evidence suggests that a considerable number of people, including very young children, are not sufficiently physically active to realize this element of human capital.

One aspect of Physical Capital that reflects the investment metaphor particularly well is motor skill development. That is because childhood (especially up to puberty) represents a sensitive period in the development of movement skills,[63] and that these skills represent the fundamental resources upon which engagement with all later physical activity relies.[64] These are phases when the child finds learning certain skills relatively easy, and during which development is accelerated.[65]

The outcomes listed here capture positive impacts on human capital development. In some cases, these refer to increases or improvements (e.g., income, fitness levels), while in others positive impact is the result of decreases or reductions (e.g., cardiovascular disease, health care costs).

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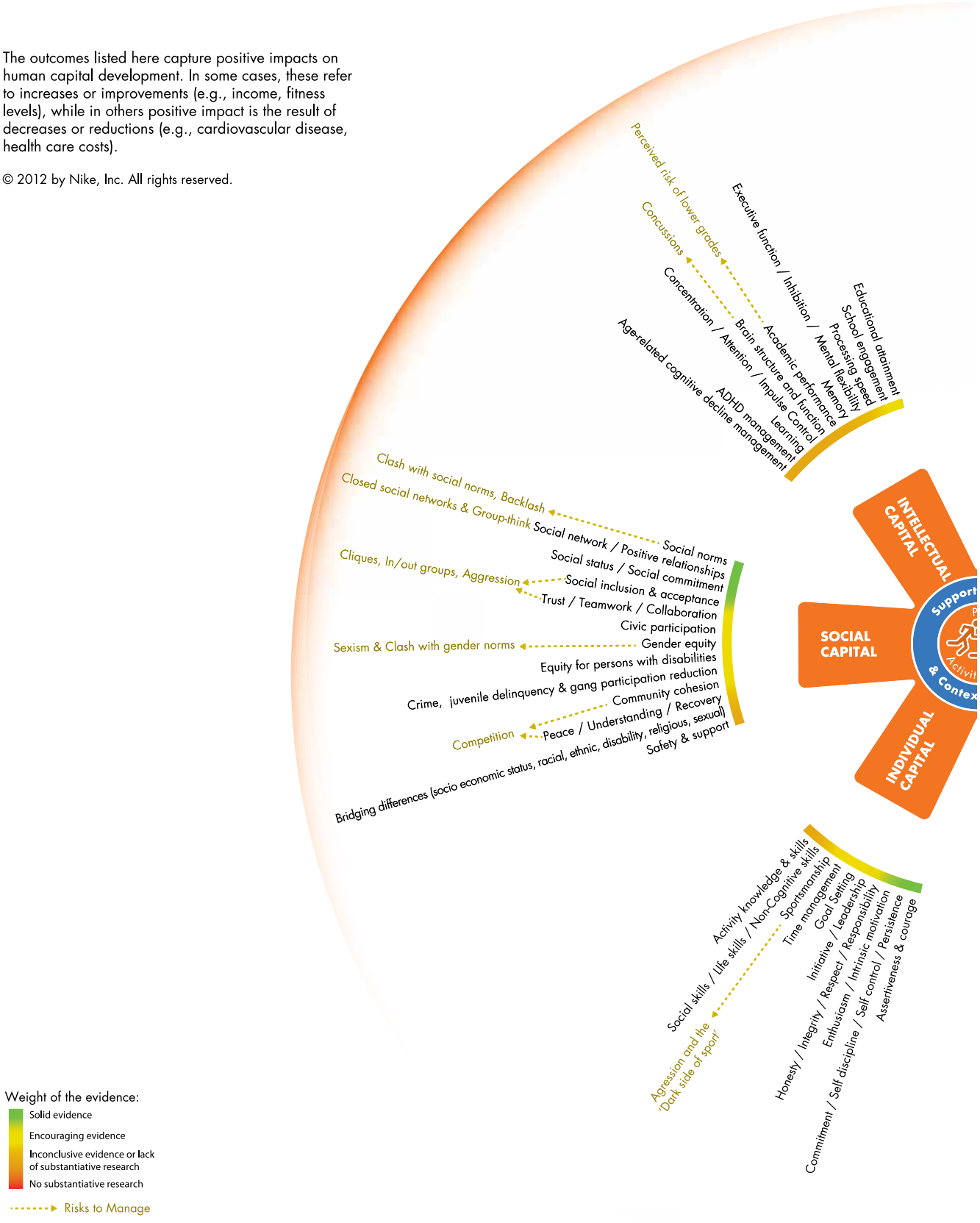
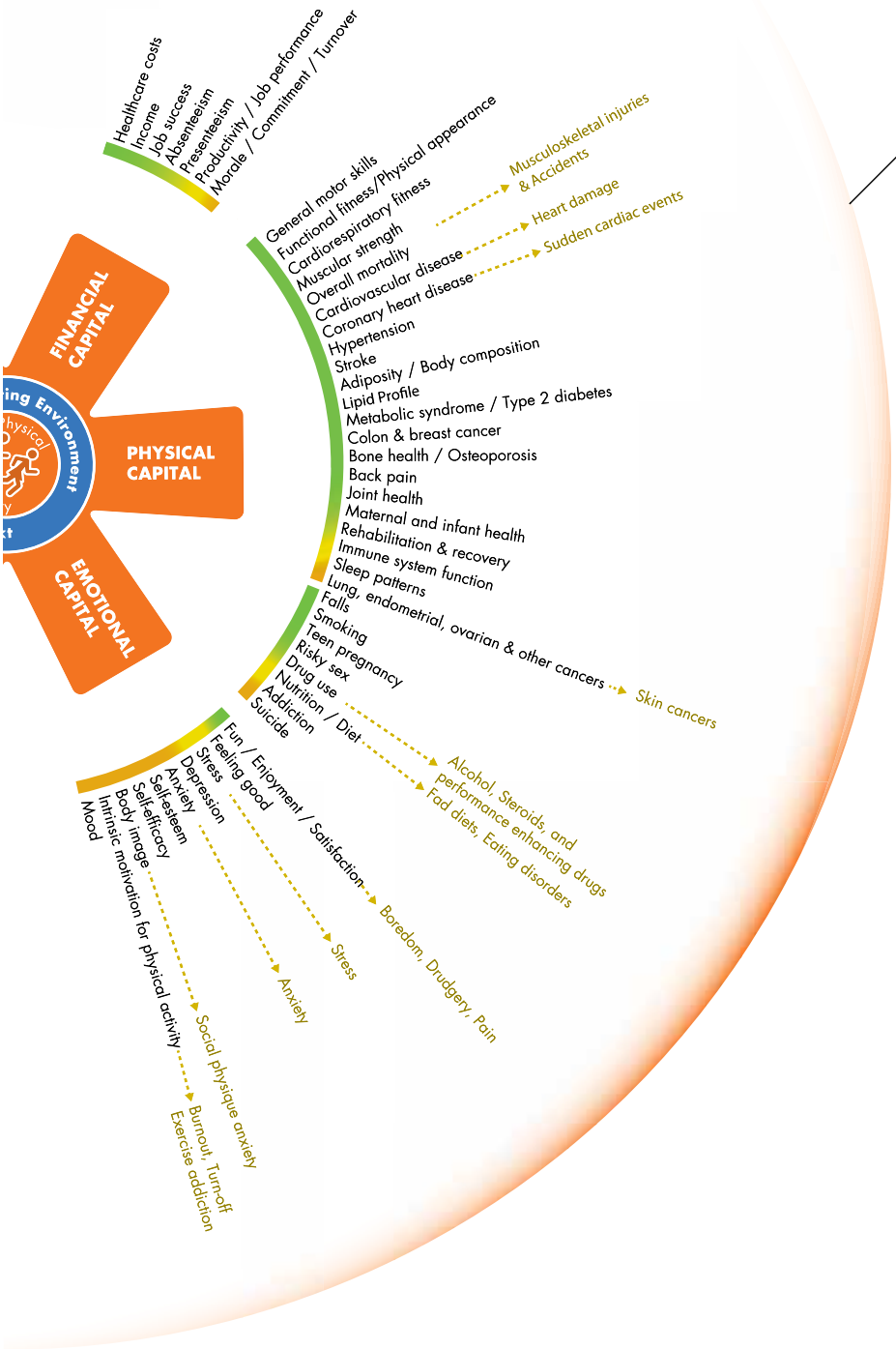


Figure 2 — The Human Capital Model overview.


Human Capital
Human Potential
Resilience
Wellbeing
Quality of Life
Competitive Advantage
FINANCIAL CAPITAL
PHYSICAL CAPITAL
EMOTIONAL CAPITAL
Healthcare costs
Income
Job success
Absenteeism
Presenteeism
Productivity / Job performance
Morale / Commitment / Turnover
General motor skills
Functional fitness/Physical appearance
Cardiorespiratory fitness
Muscular strength
Overall mortality
Cardiovascular disease
Coronary heart disease
Hypertension
Stroke
Adiposity / Body composition
Lipid Profile
Metabolic syndrome / Type 2 diabetes
Colon & breast cancer
Bone health / Osteoporosis
Back pain
Joint health
Maternal and infant health
Rehabilitation & recovery
Immune system function
Sleep patterns
Lung, endometrial, ovarian & other cancers
Falls
Smoking
Teen pregnancy
Risky sex
Drug use
Nutrition / Diet
Addiction
Suicide
Fun / Enjoyment / Satisfaction
Feeling good
Stress
Depression
Anxiety
Selfesteem
Selfefficacy
Body image
Intrinsic motivation for physical activity
Mood
Musculoskeletal injuries & Accidents
Heart damage
Sudden cardiac events
Skin cancers
Alcohol, Steroids, and performance enhancing drugs
Fad diets, Eating disorders
Boredom, Drudgery, Pain
Stress
Anxiety
Social physique anxiety
Burnout, Turn-off
Exercise addiction

Some theorists go further, arguing that the period of childhood is so critical for movement skill learning that if children do not develop a broad foundation of skills during this period, they never will.[66] It does seem to be the case that failure to master movement skills at one stage of development will hinder the development of skills at the next, and create a "proficiency barrier" to participation as children will not have the necessary skills to be active or play sport.[67,68] There is evidence that the development of these skills can have a long-lasting effect on physical fitness and participation, both during childhood and adulthood. This is because learning a broad base of movement skills in childhood creates opportunities to take part in a vast range of activities; equally important is the fact that the absence of these skills means that the individual has an impoverished range of options to be active because he or she lacks the necessary physical competence. This goes some way in explaining why participation in structured physical activity programs during childhood can track to participation in adulthood, which in turn results in improved physical health for life.[69,70] Consequently, there is no doubt that childhood is the pivotal period in Physical Capital development. Investment in physical activity at any point in the life course is likely to result in enhanced quality and quantity of life.[71] However, investment of time and other resources at earliest stages will deliver significant returns in the future.[72]

Emotional Capital. There is compelling evidence that regular physical activity can have a positive effect on emotional well-being, especially the well-being of children and young people.[73] Physical activity has been linked to a variety of mental health outcomes, including

- increased levels of self esteem[74]
- antidepressant and anxiety-reducing effects[75]
- reduced social isolation[76]
- general social benefits such as making new friends, enhancing social skills, and gaining confidence in relating to peers[77]
- learning about positive and negative emotions and strategies for regulating them.[78]

The evidence is particularly strong with regards to self-esteem,[79]or the degree to which individuals feel positive about themselves.[80] These findings offer some explanation why participation in structured activities at school has been associated with increased life satisfaction: the more structured activities young people participate in, the greater is their life satisfaction.[81] Positive physical activity experiences are also positively related with the associated concepts of global and physical self-concept, and to a lesser extent with social, emotional, and academic self-concepts. However, there is a caution: organized sports are often socially significant for young people, and so have potential for a negative influence that is dependent on the outcome (winning or losing) and quality of adult involvement.[82]

The relationship between physical activity and stress has received particular attention in the scientific literature in recent years.[83] Chronically high levels of stress have been found to disrupt hormonal regulation and are associated with CVD, insulin resistance, hypertension, cancer, reproductive dysfunction, dyslipidemia, and obesity.[84] In fact, chronic stress may have an impact on CVD that is comparable to smoking, obesity, and sedentary behavior,[85] with at least 1 study suggesting that psychological stress may account for as much as one-third of total CVD risk.[86]

Physical activity itself is a stressor, yet has been found to have positive impacts on the stress response, emotional and mood disorders, and outcomes related to obesity and CVD risk.[87,88] There is evidence that exercise may produce antidepressant effects equivalent to pharmacological treatment.[89] Additionally, exercise has been found to reduce inflammatory cytokines, which are also associated with stress-related disorders as well as obesity.[90] It may be that optimal, controlled stimulation of the stress response is one mechanism through which exercise exerts its affective and physiological benefits. The protective effects that physical activity appears to exert on the hippocampus may even provide additional emotional benefit.[91] A review of studies conducted over 15 years supports the benefits of physical activity as a coping strategy for stress.[92] Results from all studies, regardless of their design and methodology, were positive, demonstrating psychological improvement. Significant associations linking fitness with decreases in life stress were also reported.

Besides acting as a coping strategy, physical activity may help to prevent anxiety and distress in the first place.[93] Nevertheless, analyses of a variety of markers support the claim that physical activity is associated with reductions in anxiety, regardless of participants' age and health status. This effect seems to be due to activity's ability to cause a combination of psychological state, such as relaxation, distraction; mood enhancement; improvement to self-esteem and self-efficacy; and providing a context for reflection.[94]

Some interesting data have emerged from studies of the physical activity experiences of normally socially marginalized groups, such as at-risk youth, women, minority ethnic groups, and persons with disabilities. It has been suggested that activity can contribute to a more generalized feeling of empowerment in women.[95] This is particularly important in environments where adolescents may be encouraged to view their bodies as sexual and reproductive resources, rather than sources of strength for themselves.[96] Physical activities may help young women develop a sense of ownership of their bodies. This may be because participation augments young people's self-esteem[97] or because being an athlete carries with it a strong public identity.[98] Alternatively, it may be associated with the hypothesis that by promoting physical fitness, increased physical performance, lessening body mass, and promoting a more favorable body shape and structure, physical activity will provide

more positive social feedback and recognition from peer groups, which will subsequently lead to improvement in an individual's self-image.[99] Some female athletes report having a stronger sense of identity and self-direction as a result of their engagement in structured activities—what has been called 'being herself through sport.'[100]

Drawing on the evidence reported in this and the earlier section, it seems to be the case that positive movement experiences can form part of a 'virtuous cycle' by which physical, psychological, and social skills interact and reinforce each other through a positive feedback loop (see Figure 3). The key variable is, of course, the positive experience. If such experiences were replaced with negative ones, the cycle is transformed into a 'vicious cycle,' through which the young person becomes progressively disaffected from physical activities. This highlights a recurring finding from the empirical base: physical activity's contribution to well-being is conditional on certain types of contexts and settings.[39] Positive development does not automatically occur by simply registering a child in a sports club. Outcomes are mediated by a host of factors; without doubt, the most significant of these is the social climate generated by teachers, coaches, and other adults.[101]

Social Capital. Social Capital is essentially the resources generated when people come together. The potential relevance of physical activity should be self-evident, as the vast majority of physical activity forms involve social groups, whether by the team-based nature of the activities or wider organizational factors.[102] Consequently, there has been a long-running discussion regarding the extent to which such activities *naturally* bring people together,[103] and whether such coming together necessarily translates to changes in practices in the outside world.[104]

The research literature on the relationship between participation in physical activity and social development is equivocal.[105] It does not seem to be the case that prosocial behavior necessarily improves as a result of playing organized activities, and there is evidence that in some circumstances behavior actually worsens as a result of badly planned participation.[106] However, numerous studies have demonstrated that appropriately structured and presented activities can make a contribution to the development of prosocial behavior, and can even combat antisocial and criminal behaviors in youth.[107] In light of the profound and long-lasting negative effects of such behavior on life chances, these findings are of enormous significance.[108]

The most encouraging findings come from institution-based studies, such as those focusing on physical education programs.[109] While a wide range of physical activity forms seem able to offer valuable environments for social development, school-based programs have a number of advantages, such as access to nearly all children, fewer external pressures to emphasize outcome and competition, and the ability to integrate social education with similar teaching across the school curriculum.[110] Intervention studies have produced generally positive results, including improvements in moral reasoning,[111] fair play and 'sportspersonship,'[112] and personal responsibility.[113] It also seems the case that teachers and coaches are most effective in developing social skills and values when they focus on situations that arise naturally through activities, by asking questions of students and by modeling appropriate responses though their own behavior.[26]

Running alongside the literature on prosocial development is another focusing on the contributions physical activity can make to the development of social networks.[114] This is in response to a growing theoretical

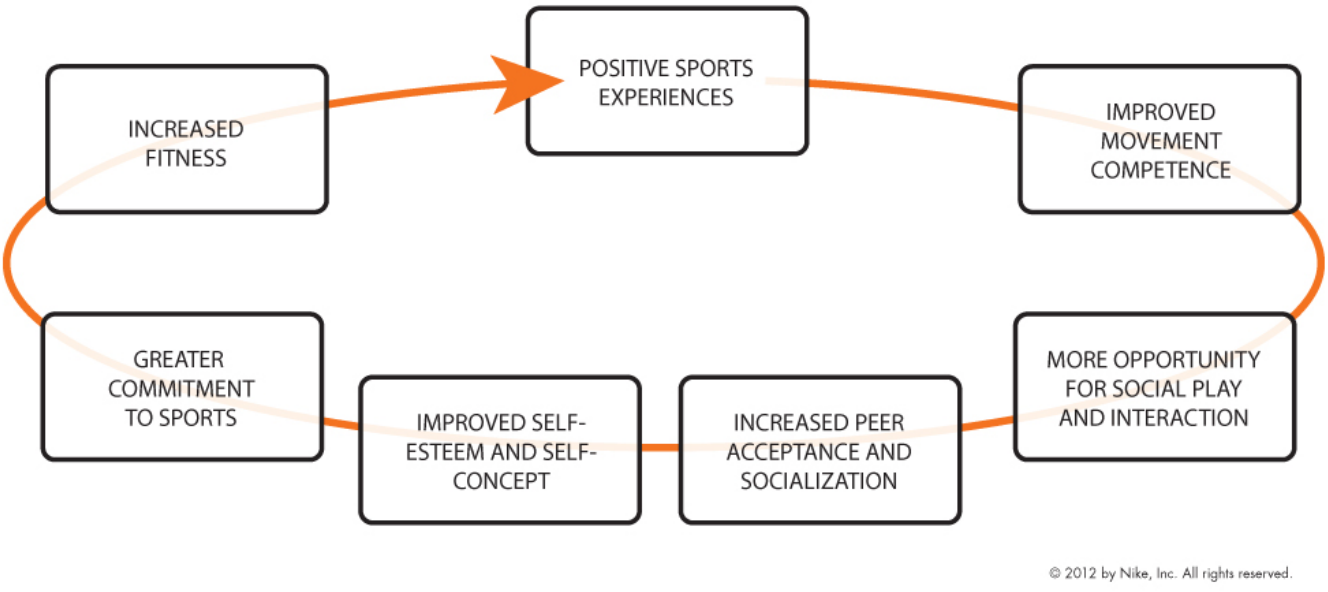


Figure 3 — A 'virtuous cycle' of the interaction between Physical and Emotional Capitals.

and empirical concern with the harmful effects of 'social exclusion,' or "a situation in which certain members of a society are, or become, separated from much that comprises the normal round of living and working in the society."[115] The consequences of social exclusion include mental health problems, poverty, and crime behavior.[116] Significantly, the most severe difficulties in adulthood are typically the end result of a history of problems that started much earlier in life. So policymakers are increasingly turning to interventions that seek to prevent exclusion from developing in the first place.[117,118]

Since participation in physical activity provides a focus for positive social activity, an opportunity to make friends, develop networks, and reduce social isolation, it is well placed to combat social exclusion.[119] First, these activities provide opportunities for the development of valued capabilities and competencies, and the anecdotal evidence in favor of socially orientated physical activity's contribution to interpersonal and intrapersonal skills is persuasive. Second, organized activities can offer young people a sense of belonging—to a team, a club, or community.[120] Many types of physical activity can act as a point of shared interest bringing families together and encouraging people to interact in the broader community and beyond, often with people from different social backgrounds.[121] Even young people who identify themselves explicitly as 'nonjoiners' seem able to join like-minded peers in informal or 'lifestyle' activities, and through this find a bridge between social and personal identities.[122] Third, there are frequent claims that formalized physical activity brings individuals from a variety of social and economic backgrounds together in a shared interest in activities that are seen to be inherently valuable.[123] For example, physical activity's nonverbal format can help overcome linguistic and cultural barriers more easily than other areas of social life. And the valued and socially prestigious character of many activities, especially sports, could mean that people who might not otherwise meet come together for the sake of a shared passion. Finally, physical activity increases individuals' sense of control over their lives by extending social networks, increased community cohesion, and civic pride.[124] This is especially important for at-risk youth, for whom social and organized settings can be sources of anxiety or disaffection.[125]

Individual Capital. Discussions of physical activity's contribution to the development of life skills, social skills, values, and the like have focused primarily on the interactive character of organized sports.[126] The idea that collaborative physical play and activity offers learning contexts that facilitate the development of attitudes and skills like trust, perseverance, empathy, leadership, and cooperation has become something of a truism in advocacy and policy discourse.[127] However, the empirical base for such claims is currently somewhat unclear, mainly due to the relative nascence of the field.[128,129]

Nevertheless, the conjecture that physical activity provides appropriate settings for the promotion of young people's social development is gaining empirical support. Social physical activity offers contexts in which young people can experience genuine moral challenges in highly emotional and interactive settings.[130] They can also experiment with their responses to these challenges in a relatively safe space that has many social and moral requirements that parallel those of participating in a law-bound community, but where the consequences of error are usually less severe than in the outside world.[131] Because the results of players' efforts to address these challenges are immediate and visible, those who break the rules are likely to be seen. In addition, the capacity of physical activity to contribute in this way is enhanced by its social significance and popularity.[132]

This has led to the formation of a number of programs aimed at using various physical activity forms as vehicles for the development of valuable skills and capabilities.[133] It has also led to the development of a number of theory-based programs, designed to teach young people personal and social skills, such as the Sport Education approach,[134] the Social Responsibility model,[135] and the Sport for Peace curriculum.[136] Many of these programs and models have been evaluated, and their findings might be summarized as cautiously optimistic, with some of the most promising evidence coming from school-based initiatives.

There is a growing body of research that focuses on adolescence as a life phase during which individuals develop a greater ability to empathize with others and assume responsibility for their own behavior. As such, positive physical activity experiences that provide latency-aged children with a sense of industry and mastery can provide a launching pad for psychosocial development in their adolescent years. While there remains a need for further research, attractive insights are starting to emerge, such as physical activity's potential to promote a broad spectrum of life skills and values, including team-work,[137] communication skills,[138] decision-making skills,[139] problem-solving skills,[140] personal responsibility,[141] empathy,[142] and resiliency.[143]

In one of the few international reviews that examined the relationship between life skills developed through participation in physical activities, specifically organized sports, and skills valued by employers, researchers found that, in addition to many of the skills outlined above, well-designed programs also nurtured moral values and practices that tend to be highly appreciated in the labor market. Of particular value were socially orientated attributes like volunteering, commitment to teamwork and team building, acceptance of rules, and adoption of a peaceful and tolerant attitude toward cultural diversity.[144]

Part of the difficulty in generalizing more confidently about the relationship between physical activity and life skills is the folklore of sports. It certainly seems to be the case that both coaches and players believe that engagement in physical activity necessarily develops life skills.[145–147] In fact, what evidence there is suggests that the pedagogy of the coach or teacher and the social

environment in which sessions take place are more important than the activities themselves.[148]

Life skills that are acquired through physical activity do not automatically transfer to school, home, or other settings unless coaches discuss and promote these connections intentionally.[126,149,150] Coaches in physical activity-based youth development programs, who assist participants in identifying their transferable skills, who create opportunities for participants to use these skills in different settings, and who provide the support and encouragement needed for participants to gain confidence in their abilities to use these skills in various situations, have a strong track record of success.[151,152]

A synthesis of the youth development literature identified 3 conditions necessary for optimal psychosocial outcomes through physical activity: 1) a *context* in which activities are challenging and intrinsically interesting, players feel psychologically safe and accepted by peers, and personal mastery and group cooperation are emphasized; 2) *external resources*, such as close relationships with caring adult mentors, parental monitoring, positive peer interactions, and community involvement; and 3) *internal assets* consisting of actively learning skills that youth can use and transfer to domains outside the activity context.[39] Programs that have demonstrated these benefits have consistently shown positive outcomes. For example, programs like Sports United to Promote Education and Recreation (SUPER)[153] and The First Tee's Life Skills Experience[154] provide evidence that under the right conditions participation can facilitate acquisition and transfer of life skills to school and other settings.

Despite divergent views, there is a general consensus among researchers that physical activity has the potential to act as a powerful vehicle for the development and reinforcement of life skills.[155,156] By providing opportunities for young people to develop qualities of leadership, perseverance, and organizational ability, physical activity can help participants to gain and enhance a range of skills that are transferable to important parts of life. So what is true elsewhere in this article is especially the case here: physical activity, if presented and managed in certain ways, can provide effective and popular contexts for the development of capitals that can have a significant impact on one's life experiences and life-course. Investments made in providing opportunities for involvement in physical activity, coach education, and life skills curriculum development are likely to result in significant benefits to future generations.

Intellectual Capital. There is no doubt that education is an important resource, and the rewards on investment in high quality schooling and intellectual development provide the paradigm case for studies of human capital.[157,158] In this regard, there is a wide-scale presumption, especially in the Western world, that physical activity is either an irrelevance or sometimes interference to academic concerns,[159] and this may account for the total omission of physical activity from the human capital literature. However, research suggests that such assumptions are misguided.

Empirical research into the cognitive outcomes of engagement in physical activity tend to fall into 2 categories:[160] 1) studies of associations between physical activity and academic performance, such as in assessments;[161–164] and 2) studies of association of physical activity and brain cognitive functioning.[165,166] Academic performance is maintained or enhanced by an increase in a student's level of physical activity, despite a reduction in the time for the study of academic material. A classic study of the relationship between physical activity and general school performance was carried out in France between 1951 and 1961.[167] Researchers reduced 'academic' curriculum time by 26%, replacing it with physical activity; yet academic results did not worsen and there were fewer discipline problems, greater attentiveness, and less absenteeism. Similarly, the Hindmarsh Project in Australia assessed the effects of a 14-week daily physical activity program on a range of measures, including academic performance.[168] Despite the loss of 45–60 minutes of classroom teaching time each day, there were no signs of an adverse effect on numeracy and literacy.

A review of 3 large-scale studies found that academic performance is maintained and occasionally enhanced by an increase in a student's levels of physical activity, despite a reduction in the time for the study of academic material.[169] It has also been found in some studies that physical activity levels are greater in relatively high-performing rather than low-performing schools.[170] Other studies have found improvements for children in academic performance when time for physical activity was increased in their school day.[171] In one case, a reduction of 240 minutes per week of academic class time, replaced with increased time for physical education, led to higher scores on standardized mathematics examinations. In another, teacher-reported estimates of the time students spent in physical education correlated with higher academic performance among girls but not among boys.[172] A further study found that increasing the number of physical education lessons from 2 per week to daily was associated with improved mathematics, reading, and writing scores, despite the fact that none of these domains were addressed in the extra lessons.[173]

The literature on incorporating physical activity into the classroom lesson is somewhat limited, although findings are encouraging. Overall, those studies that have examined this area suggest that classroom-based physical activity can have favorable associations with indicators of cognitive functioning, academic behaviors, and/or academic achievement.[174–176] For example, investigators have found mathematics achievement was enhanced by brief bouts of physical activity as part of the mainstream academic curriculum.[177] Others found beneficial effects on reading (but not mathematics).[178] Others reported positive, nonsignificant associations.[179,180] No negative associations have been found. These and similar studies indicate that the cognitive benefits accrued from physical activity more than compensate time spent away from other academic subjects.[181] Similarly, another

recent review asserts that, at the very least, time spent in physical education does not interfere with academic performance and may lead to improvement.[182] To be more explicit on this, studies provide one of two results regarding the relationship between physical activity and educational achievement: some report that activity is positively related to achievement; others that activity is unrelated to achievement. To the best of our knowledge, there is no published work to suggest that time spent being physically active detracts from educational goals. This is significant as increases in physical activity are usually associated with reductions to time for other curricular subjects, yet these subjects suffer no detrimental effects.[183] From the perspective of the HCM, these data mean that Physical Capital can be increased in schools with no necessary cost to Intellectual Capital.

Recent advances in brain imaging techniques have shown that physical activity leads to changes in brain structure and function. These changes include increased blood flow in the brain, increased levels of arousal, and stimulated brain development.[184] Cognitive function may also indirectly benefit from increased activation, as well as breaks from sedentary, classroom-based work.[185] One meta-analysis determined a positive relation between physical activity and cognitive performance in school-age children (age 4–18 years) in such things as perceptual skills, IQ, achievement, verbal ability, mathematics, and developmental level/academic readiness. These beneficial relationships were found for all age groups. These findings suggest that, although physical activity might be beneficial at all stages of life, early intervention might be important for the improvement and/or maintenance of cognitive health and function throughout the adult lifespan.[139]

Examination of baseline spectral frequency distributions of electroencephalograms (EEGs) suggest that physical activity influences baseline electrocortical function and, therefore, might affect cognitive operations.[186] Other studies indicate that greater amounts of physical activity or aerobic fitness are beneficial to cognitive processes that are related to the allocation of attentional resources and faster cognitive processing during stimulus encoding. These findings are supported by functional MRI (fMRI) and behavioral data showing an activity-related modulation that is disproportionately larger for task components that require greater amounts of executive control.[187,188] Higher levels of fitness and fitness improvements are also related to larger volumes of prefrontal and temporal gray matter, as well as anterior white matter.[189] Such increases in brain volume have been shown to be predictive of performance in older adults.[190]

A positive relationship between increased physical activity and concentration has also been found.[191–193] While most studies have tested the effects of short-term interventions, it has been suggested that effects are more likely to be sustained when physical activity is maintained over a long period of time.[194,195] A well-planned and delivered activity program will likely positively contribute to academic performance.

There is now sufficient evidence to support the claim that a well-planned and delivered physical activity program, offering opportunities for intensive and sustained physical activity, will positively contribute to academic performance. Recent neuroscientific research suggests that physical activity, and aerobic fitness training in particular, can have a positive effect on many aspects of brain function and cognition. Although the number of studies on physical activity is larger for older adults than for other age groups, the data suggest that physical activity can have beneficial effects throughout the lifespan.

Financial Capital. While almost all countries in the world implicitly equate career success with academic achievement, there is compelling evidence that this narrow focus is mistaken and that noncognitive factors are important determinants of success in life. Moreover, unlike many cognitive skills, noncognitive factors can be acquired over a long period, and consequently can have a more sustained impact. Skills and attitudes like determination, self-discipline, time management, goal-setting, emotional control, and decision-making have a powerful effect on success at every point in life,[196] despite the fact that they are almost universally ignored by educational assessments.

A number of studies have demonstrated that students who regularly engage in physical activity are more successful than nonparticipants, and benefits include earning higher wages.[197] One robust study found that engaging in regular exercise yields a 6%–10% wage increase, and that while even moderate exercise yields a positive earnings effect, frequent exercise generates an even larger impact. This effect seems to apply to both genders. Commentators tend to attribute the career advantage offered by physical activity, and especially organized sports, in terms of a confluence of physical health and 'soft skills,' such as communication and collaborative skills.[198] Sports players are, therefore, generally more productive. Using the terminology of Human Capital, physical activity helps make people more successful due to the contribution of the other Capitals, as is illustrated by Figure 4.

Two types of explanations have been offered to explain why 'sporty' students are more successful than others: 1) objective advantage offered by participation and 2) subjective judgments by employers of the value of physical activity. An example of the former comes from German economists who analyzed cohort data and hypothesized that physical activity students were more productive at school due to improved physical health and the acquisition of skills and attributes like self-esteem, competitive spirit, tenacity, motivation, discipline, and responsibility learned by playing games.[199] The latter has been explained in terms 'job-market signaling,'[200] where participation in physical activity represents a signal to potential employers about ability. That employers assume physical activity is positively correlated with having greater ability has been clearly demonstrated by a number of studies, including the finding from Scandinavia that being 'sporty' is equivalent to 1.5 additional years

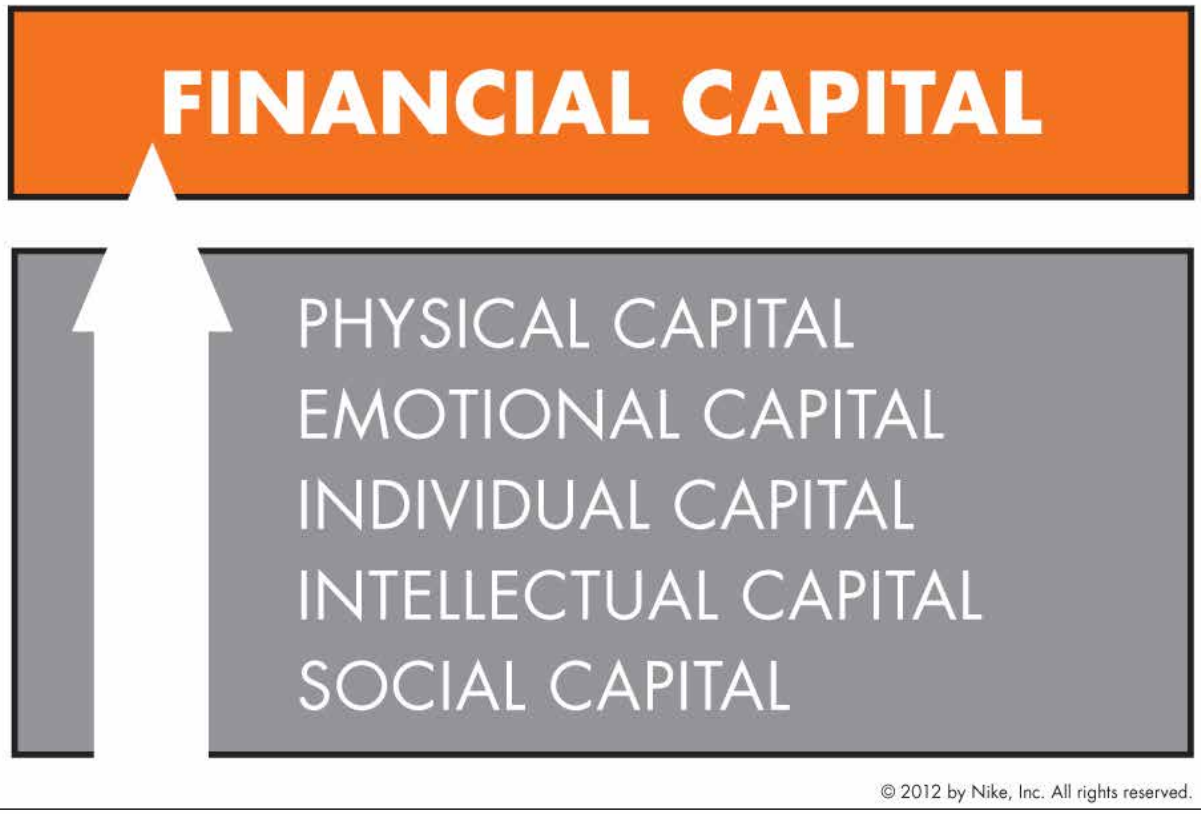


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Figure 4 — Financial Capital: reliant on the other Capitals.

of work experience,[201] and a study from Germany that calculated the benefit of participation in physical activities on market long-term outcomes as equivalent to an additional year of schooling.[202]

There is now strong evidence that the career advantage of the physically active is not just attributable to signaling. In fact, it seems to be the case that physically active people behave differently, and usually in a way valued by employers.[203] They are more likely to hold responsible and leadership positions during their youth; they also tend to be more competitive and productive.[204] So, these findings highlight the ways in which engagement in physical activity can act as an asset that enhances career and financial success.

Stimulating or Inhibiting Human Capital

There is not the space to review the substantial literature on the factors that influence the development of Human Capital through physical activity.[205–208] However, it is clear that the value of physical activity as a resource is mediated by a range of elements that *incline* individuals toward activity or not. Some of these elements have the status of determinants, since their presence is necessary criteria for participation. Accessible and safe facilities, equipment, and coaching might be considered determinants, depending on the specific activity and the context. Many other factors have a less direct influence, but nonetheless can prove extremely potent, especially when they occur together. For example, a player who is introduced to an activity in a social environment that is inclusive and welcoming, led by a coach or teacher who is authoritative yet friendly, taking place in a safe and functional space, and accompanied by family and friends is much more likely to stick with it than an unfortunate player who has none or few of these conditions. However, truly necessary conditions for engagement in physical activity are rare because it is possible that highly motivated people will adhere to an activity *despite* extremely poor opportunities.[209]

It might be worthwhile to borrow a phrase from Behavioral Economics to capture the nature of this effect, and say that the majority of variables "nudge" people toward or away from participation;[210] they dispose them in one direction or another. Moreover, different mediating factors affect people in different ways at different times. For example, parental support has its greatest potency during the first 10 or so years of life, whereas peer socialization becomes a key social influence during adolescence.[211] Some influences have an objective character, such as access to a place to be active; others are subjective, such as perceived competence or social acceptance.[212]

Sallis and Owen usefully classified the correlates of physical activity in terms of Intrapersonal, Social, and Environmental Variables.[213] According to the HCM, these determinants, correlates, causal variables, mediators, moderators, and confounders stimulate or inhibit the value of the different capitals, as is illustrated in Figure 5.

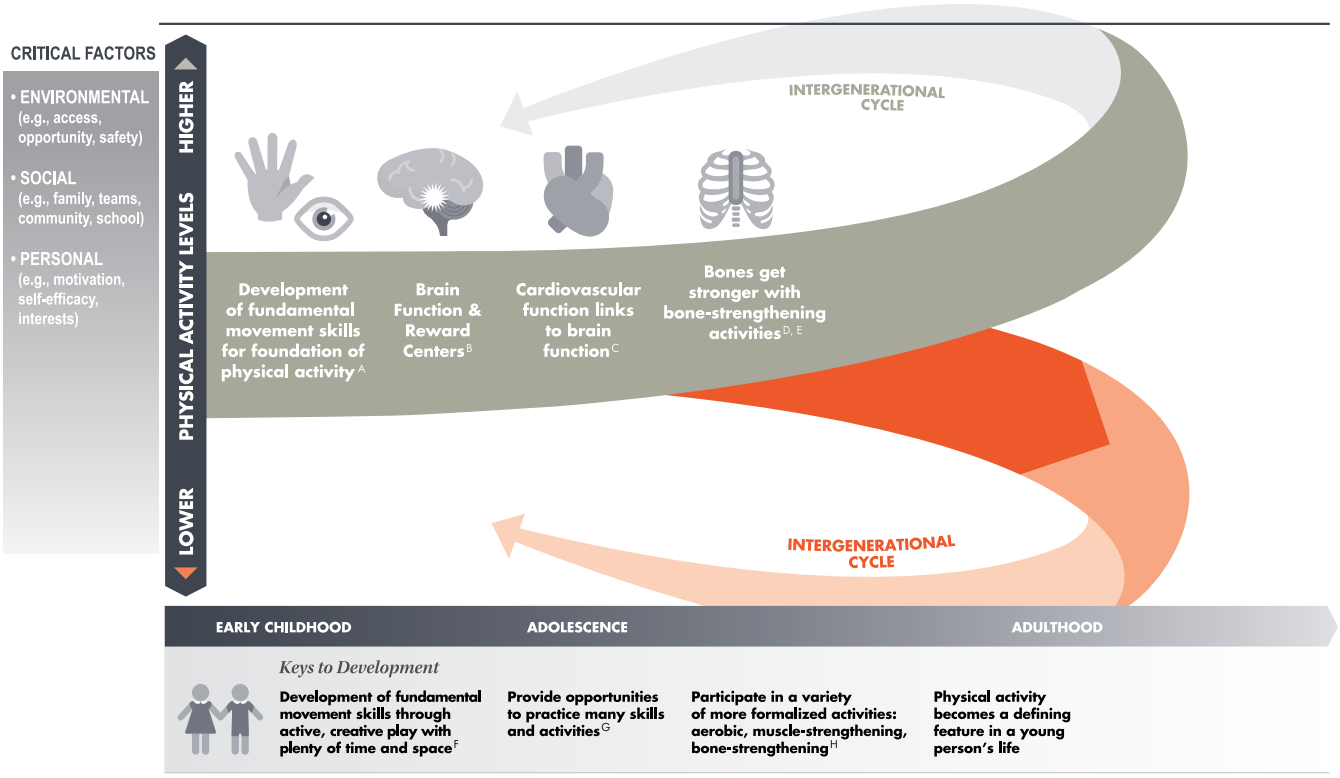

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Figure 5 — Developmental markers linked to physical activity levels. References: **A.** Okely AD, Booth ML, Patterson JW. Relationship of physical activity to fundamental movement skills among adolescents. *Medicine and Science in Sports and Exercise.* 2001;33(11): 1899–1904. **B.** Brookens H. Adolescent brain development. *Mental Health Matters.* 2008; 5(4): unpaged. **C.** Aberg M, Pedersen N, Toren K, et al. Cardiovascular fitness is associated with cognition in young adulthood. *Proceedings of the National Academy of Sciences of the United States of America.* http://www.pnas.org/content/106/49/20906.full, Date accessed 2012 March 27], 2009. **D.** U.S. Department of Health and Human Services. *Physical Activity Guidelines Advisory Committee Report, 2008.* Washington, D.C.: USDHHS; 2008. **E.** U.S. Department of Health and Human Services. Physical Activity Guidelines for Americans. *United States Department of Health and Human Services,* http://www.health.gov/paguidelines/default/aspx. [Date accessed 2009 Aug 10], 2008. **F.** Institute of Medicine. *Early childhood obesity prevention policies*. Washington, D.C.: The National Academies Press; 2011. **G & H.** U.S. Department of Health and Human Services. Physical Activity Guidelines Advisory Committee Report, 2008. Washington, D.C.: USDHHS; 2008.

Conclusion

Physical activity is an important contributor to human health and well-being, and the full extent of its benefit is only now becoming realized. However, the physical health outcomes of regular exercise that generate Physical Capital are so compelling and urgent that they are in danger of excluding other outcomes by dominance. This would be unfortunate, as the cases for each of the forms of Human Capital—Emotional, Individual, Intellectual, Financial, and Social—seem to be moving toward a point where their place in public policy discourse will soon become unarguable.

The HCM is certainly not intended to be a replacement to more established paradigms. On the contrary, it seeks to augment those paradigms by reframing the terms of the discussion. The great psychologist Abraham Maslow is credited with saying, "if you only have a hammer, you treat all problems as nails." Physical activity research, like all inquiry, needs new conceptual tools and a variety of ways of articulating the state-of-the-science. The HCM offers a new metaphor for helping with this task.

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