ARTICLE

Sustainability of natural movement activity

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In recent years, there has been a focus on reducing energy consumption in commercial buildings as a means of increasing their sustainability. As part of this trend, various health clubs and fitness centers have been designed to lower consumption of resources such as electricity and water. However, energy consumption is just one part of sustainability, with human health and economic health also paramount. When all components of sustainability are analyzed, other forms of physical activity may possess higher levels of sustainability than traditional gym exercise. Natural movement activity consists of outdoor activity that replicates movements performed by ancient humans during the Paleolithic era. A full analysis of sustainability shows that natural movement activity consumes fewer resources and provides unique psychological and physical benefits compared with traditional indoor exercise.

KEYWORDS: physical activity, fitness, environmental impact, economic factors, quality of life, health

Introduction

In efforts to increase sustainability, various commercial gyms and fitness centers have been redesigned or constructed to lower energy consumption. Such improvements include increased natural light, low-flow toilets, and more efficient lighting (Bogar, 2008; Bloyd, 2010). In the United States, a growing number of fitness centers have also in recent years achieved certification under the program of Leadership in Energy and Environmental Design (LEED). To further reduce energy consumption, studies have proposed, for instance, harnessing the power of treadmills or other exercise machines used by patrons to generate power for the building itself (Haji et al. 2010). In the future, it may be possible for gyms to become “net-zero” facilities or actually become net positive generators of energy.

While such efforts are to be commended, energy consumption is only one aspect of sustainability. The United States Department of Health and Human Services (USDHHS) refers to sustainability in terms of the “triple bottom line—human health, environmental health and economic health” (USDHHS, 2011). Commercial gyms, fitness centers, and other physical activity facilities should be analyzed with regard to all components of sustainability. In general, different models of physical activity have different impacts on human and environmental health.

The sustainability of different exercise models becomes more important as public health organizations continue to encourage more physical activity within populations. For example, the World Health Organization (WHO) calls for certain levels of activity based on age, but also emphasizes how additional physical movement can further reduce health risks (WHO, 2010). Curiously, there is no mention of where this activity should occur, nor is there any specific discussion of outdoor or indoor exercise, even though engaging in physical movement is influenced by accessibility of facilities, opportunities to participate, weather, safety, and aesthetic attributes (Humpel et al. 2002). Both outdoor and indoor facilities promote physical activity, as the number of gyms and parks per capita is associated with greater exercise participation (McInnes & Shinogle, 2009). Subjects perceive different benefits and costs to outdoor and indoor exercise, which lead to individual preferences for exercise settings (Huber et al. 2009).

This article seeks to reframe the sustainability of exercise by looking at physical activity from a natural perspective. By focusing on all aspects of sustainability, the possibilities for how and where to engage in bodily exercise can be widened beyond traditional ideas. Other models of physical activity besides traditional gym exercise may both reduce energy consumption and increase health outcomes.

Natural Movement Activity

The last few decades have seen strong growth in fitness center memberships in the United States (Stern, 2011). In particular, commercial gyms have become highly competitive and are popular places for recreational exercise. In 2010, there were approximately 50.2 million gym memberships in the United States (IHRSA, 2011). These facilities offer an in-
Humans evolved as hunter-gatherers during the Paleolithic era between 2.6 million and 100,000 years ago. During this time, a variety of physical movements were performed on a regular basis, such as walking, running, jumping, climbing, and lifting natural objects (O’Keefe et al. 2011). Early humans did not “exercise,” but rather engaged in daily activity to secure food and shelter. As such, humans are genetically programmed to expect physical activity, and healthy gene expression depends upon it (Booth et al. 2000; Eaton et al. 1988; Carrera-Bastos et al. 2011). Proponents of evolutionary health promotion argue that these hunter-gatherer activity patterns are optimal given our genetic heritage (Eaton et al. 2002).

The human genome is primarily the same as it was during the Paleolithic era, yet the pattern of activity in modern life is remarkably different (Cordain et al. 1998). Studies of existing hunter-gatherers show them to be largely free of degenerative disease (Eaton et al. 1988; Carrera-Bastos et al. 2011). Proponents of evolutionary health promotion argue that these hunter-gatherer activity patterns are optimal given our genetic heritage (Eaton et al. 2002).

The modern challenge, some exercise physiologists argue, is, then, to recreate these ancestral movement patterns (Booth et al. 2000; O’Keefe et al. 2011). However, in contrast to modern gym exercise, hunter-gatherer activity had one universal characteristic: it took place entirely outdoors. Outdoor versus indoor exercise requires different environmental resources and may have different impacts on health. For example, a person could engage in running on a treadmill indoors compared to running on an outdoor trail. These two activities require different levels of physical resources and may affect health in different ways. Therefore, the overall human, environmental, and economic sustainability of these two modes of exercise may not be the same.

Prescriptions have recently been offered on how to recreate the physical activity patterns of hunter-gatherers (O’Keefe et al. 2010). For purposes of this article, natural movement activity is based on a relatively strict definition of recreating ancestral movement patterns. This entails that all the major elements of hunter-gatherer activity—taking place outdoors on natural surfaces, going barefoot or in minimal shoes, using natural objects—are needed to classify activity as natural movement activity. In reality, a continuum exists between natural movement activity and gym exercise. However, this article treats them as separate entities for clearer conceptual analysis. For example, could natural movement be simulated indoors?

Yes, but then the participant would miss out on sunlight exposure, psychological benefits from interacting with nature, and other benefits of outdoor activity. Therefore, the two models of activity are kept distinct for this analysis.

Given their potential differences, it is of interest to compare the sustainability of traditional gym exercise to natural movement activity. To show tangible differences, components of sustainability are compared for a traditional fitness center and an area for natural movement activity. This comparison is not site-specific; it contrasts the general features of a traditional gym to a natural movement area. A customary fitness center is assumed to be housed in a typical building with aerobic and resistance machines, along with other manufactured equipment. A natural movement area would be entirely outdoors. A likely scenario would be a park or nature area that possessed dirt trails for walking and running. Another scenario would be if a private property had a large yard, or if a property were located in a rural area with adjacent open space. The area might also possess other natural objects, such as stones or logs for resistance training.

This article compares the two models of physical activity in regard to the three broad categories of sustainability: environmental health, human health, and economic health. Selected subcategories, where there are significant differences between the two modes of activity, are assessed.

Environmental Health

Energy Consumption

Traditional gyms or fitness centers, similar to any modern building, consume resources such as water and electricity. Efforts have been made to reduce consumption through improvements in construction and design, such as the use of low-flow toilets and energy-efficient lighting. However, modern facilities still consume substantial amounts of electricity, natural gas, and water. For example, in 2003 the average healthcare building used 22.9 kilowatt-hours (kWh) of electricity and 92.5 cubic feet (cf) of natural gas per square foot (USEIA, 2006). In 2000, the average healthcare/medical building used 1,236 gallons of water per day (USDOE, 2010).

In contrast, natural movement takes place outdoors, eliminating the need for the construction of a physical structure and its associated energy consumption. The energy savings can obviously be significant. Outdoor areas avoid these energy costs in both the present and in perpetuity. There may be minimal energy costs for some outdoor areas, such as...
electric lighting, mowing, and parking, depending on the specific set up.

Additional energy consumption may be involved in motorized transportation to an exercise site. For this item, it is difficult to determine whether there are significant differences in distances to commercial gyms or to nature areas/parks. This depends on specific geographical areas, and as such, the potential net difference in transport time would require further study.

**Construction Materials**

Commercial gyms require various raw materials for construction. As mentioned earlier, there have been improvements in construction efficiency with the rising influence of “green” construction certification, such as LEED in the United States and the Building Research Establishment Environmental Assessment Method (BREEAM) in the UK. Research shows that for a typical LEED academic building, new construction will range anywhere between US$200 and US$400 per square foot (Matthiessen & Morris, 2004). Based on a previous estimate that an average fitness center is 32,402 square feet, this would result in construction for a new building costing from US$6.8 to US$12.9 million (IHRSA, 2001).

A natural movement area may require some construction materials initially in regard to the trails. Drainage systems may be needed to keep the trails open for use. It is estimated that each mile of trail construction will cost approximately US$50,000 to US$70,000 to create a natural surface trail (Flink et al. 2001). Therefore, to create a typical three-mile native trail, construction costs would range from US$150,000 to US$210,000. Costs may increase with maintenance and upkeep, but may be close to zero for exercise in undeveloped or wilderness areas.

**Human Health**

**Cognitive Benefits**

In general, acute exercise improves mood (Bartholomew et al. 2005; Tsang 2011; Hopkins et al. 2012). Even traditional indoor exercise, such as aerobic or resistance training, has been shown to enhance one’s frame of mind (Hoffman & Hoffman, 2008; Herring & O’Connor, 2009). Over the long term, regular exercise improves mood as well (Puetz et al. 2006).

Though any type of physical activity typically enhances dispositional status, the outdoor aspect of natural movement activity may have unique impacts on the affective state. This is effectively predicted by the biophilia hypothesis that suggests humans gain more satisfaction by viewing natural landscapes (Wilson, 1984). For example, a recent study comparing brief walks in an outdoor versus an indoor environment finds that the former leads to greater enjoyment and also a stronger intention to engage in future activity (Focht, 2009). A recent systematic review highlights that outdoor exercise produced greater increases in relaxation and revitalization along with greater decreases in anger and depression when compared to indoor exercise (Thompson et al. 2011). Another analysis finds that the unique benefits of outdoor exercise appear within as few as five minutes spent outdoors (Barton & Pretty, 2010). The outdoor setting for natural movement activity lends itself to other unique mental benefits. In addition to mood enhancement, studies have shown how interacting with nature leads to increases in cognitive functioning (Kaplan, 1995; Bratman et al. 2012). Experiments have demonstrated that walking in nature or viewing nature scenes reduces stimulation and restores attention-focusing abilities (Berman et al. 2008). An intervention study found that environmental interaction can lead to a quicker recovery of cognitive skills in women treated for breast cancer (Cimprich & Ronis, 2003). Further, a parental survey demonstrated that for children with Attention Deficit Disorder (ADD), time spent in “green” spaces decreases symptoms (Kuo & Taylor, 2004).

**Exercise Adherence**

Activity must be adhered to over the long term to continue to produce health benefits. One of the primary positive outcomes of indoor exercise is potentially greater comfort due to protection from the elements. Personal safety issues perhaps play a part, as may be surmised from a recent study of African-American women showing that indoor walking facilities lead to greater exercise adherence than exercise in neighborhoods or outdoor spaces, though the relationship is unclear (Zenk et al. 2009; see also Kerr et al. 2008). However, another investigation compares the restorative effects of outdoor versus indoor exercise (Hug et al. 2009). Outdoor exercise was found to lead to greater restoration of attention, and restoration predicts the frequency of exercise during the prior thirty days.

A meta-analysis shows that accessibility and opportunities are important determinants of adults’ participation in physical activity, but weather has surprisingly been shown to be a weaker factor of exercise participation (Humpel et al. 2002). Along the same lines, a recent survey shows perceived benefits and disadvantages to both outdoor and indoor exercise, demonstrating that either model can be attractive depending on the individual (Huber et al. 2009).
Foot Musculature

Indoor exercise typically takes place on flat, human-made surfaces such as tile or hardwood floors. In modern gyms, participants often exercise on treadmills, which consist of a hard, flat rubberized surface. These arrangements represent a departure from the outdoor surfaces on which ancient humans traveled. Hunter-gatherers walked on natural, uneven terrain through tropical grasslands (Marean, 1997). Natural surfaces may be superior to typical modern surfaces in terms of physical health in two ways. First, surfaces such as grass or dirt are softer than indoor surfaces, and reduce loading of the joints (O’Keefe et al. 2011). Second, natural surfaces have undulation, and walking on uneven surfaces improves balance and physical function in adults (Li et al. 2005). Through these two mechanisms, performing exercise on natural surfaces can lead to improved health outcomes.

A related aspect to the surface issue is footwear. Indoor fitness centers often require athletic footwear, while there is no such mandated requirement at parks or in outdoor environments. Hunter-gatherers generally went barefoot or perhaps wore minimal shoes (O’Keefe et al. 2011). This situation is in contrast to the heavily cushioned shoes often used during indoor athletic activity. Recent research has shown that barefoot locomotion is more efficient, both on a treadmill and overground, than shod locomotion (Hanson et al. 2011). Use of heavily cushioned shoes lessens the sensory feedback to the feet and may contribute to higher injury rates due to improper body positioning (Robbins & Hanna, 1987). Other investigations have shown that predominantly barefoot populations have very few of the orthopedic problems prevalent in Western society (Engle & Morton, 1931; Schulman 1949; D’Aout et al. 2009).

Nonetheless, the overall benefits of barefoot locomotion are still controversial. Recent studies show that shod running generally increases impact forces to the body, but Western adults who have grown up shod have different barefoot running mechanics than those who grew up barefoot (Lieberman et al. 2010). An overall review of the literature shows barefoot running as a viable source of activity, though one that may require additional training (Jenkins & Cauthon, 2011).

Vitamin D Levels and Sunlight Exposure

Traditional gym exercise usually takes place indoors, limiting access to sunlight. The outdoor aspect of natural movement activity leads to a unique potential benefit via sunlight: increased vitamin D levels. Currently, 41.6% of the American adult population is considered vitamin D deficient due to indoor living and reduced sunlight availability at higher latitudes (Forrest & Stuhldreher, 2011). Low vitamin D levels are associated with a large number of adverse health conditions, such as cancer, cardiovascular disease, and type-2 diabetes (Garland et al. 2011; Holick, 2011). Short amounts of time spent in the sunlight, depending on season and latitude, can improve vitamin D status (Webb et al. 2011). While vitamin D levels can be increased through both food and supplementation, they can also be increased at no cost by spending sufficient time outdoors. A recent study showed that outdoor exercise reduced the risk of hypovitaminosis D in the obese (Florez et al. 2007).

In contrast, overexposure to sunlight has a well-known link to skin cancer, especially for children (Armstrong, 2004; Moehrle, 2008; Green et al. 2011). The depletion of the stratospheric ozone layer, along with climate change, may also increase the risk of certain cancers (Norval et al. 2011). Indoor exercise provides a clear protective measure against excessive ultraviolet (UV) radiation and is beneficial in this regard. The challenge for exercise models is to provide the benefits of moderate sunlight exposure while protecting against the harmful effects of excessive UV radiation (Holick, 2008).

Economic Health

The role of economic health in sustainability usually relates to employment and economic diversification. Commercial gyms are a source of jobs and can add to an area’s economic diversity. Natural movement activity taking place in parks or nature areas would typically be funded by government agencies or nonprofit groups. These agencies may also create employment (through, for example, park maintenance) that could contribute to economic diversity. Whether one model of physical activity produces more economic benefits is unclear.

However, there is a significant literature linking health and work productivity (see, e.g., Schultz et al. 2009; Van den Heuvel et al. 2010; Zhang et al. 2010). If one form of activity can produce more health benefits, this may lead to additional economic health via higher productivity. Employers face economic loss for direct healthcare costs, but even greater costs due to the associated loss in productivity (Loeppke et al. 2009). Therefore, the health effects of different physical activity models should be included in the discussion of economic health.

Open space such as parks may also produce additional economic benefits. Homes near parks generally have relatively higher property values, which can lead to increased tax revenue for local governments (Bolitzer & Netusil, 2000; Lutzenhiser & Noelwahr, 2001). Open space, as compared to residential devel-
The applicability of natural movement exercise to all age groups merits further investigation.

Conclusion

This article analyzes the sustainability of different models of physical activity. Compared to traditional gym environments, natural movement activity consumes fewer resources such as water and electricity. Natural movement activity also produces increases in psychological health greater than traditional gym exercise. However, traditional gym exercise provides protection from the elements that may improve adherence.

Taken in sum, natural movement activity exhibits a high overall degree of sustainability and should be undertaken by responsible organizations. By engaging in more sustainable patterns of physical activity, society can reduce resource consumption and improve health outcomes.

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Barton, J., Griffin, M., & Pretty, J. 2012. Exercise, nature and social support in terms of exercise adherence, and the combination of the two may be superior (Barton et al. 2012). Therefore, group-based programs for natural movement activity may be more successful in facilitating change than merely encouraging individual exploration.

Another issue is social support, one of the keys to behavior change, particularly since people generally prefer exercising in a social setting (Nies & Motyka, 2006; Greaves et al. 2011). Recent research indicates that outdoor exercise is as effective as social support in terms of exercise adherence, and the combination of the two may be superior (Barton et al. 2012). Therefore, group-based programs for natural movement activity may be more successful in facilitating change than merely encouraging individual exploration.

Changing activity preferences throughout the lifecycle is also an important consideration. There is evidence that the level of formal gym exercise, such as aerobics, may decrease with age (Bélanger et al. 2011). Whether general preferences for outdoor versus indoor exercise change with age is a question that to date has not received adequate research attention.

The evidence presented here shows that natural movement activity is likely to have, on balance, positive effects on human health combined with relatively low consumption of environmental resources. In terms of economic, environmental, and human health, natural movement activity appears to be a highly sustainable form of physical activity. Shifting the proportion of exercise time toward natural movement activity could increase overall sustainability. Directing participants who are new or returning to exercise toward natural movement could also increase overall sustainability. Such a shift would require awareness, leadership, and education about the benefits of this type of physical activity.

The possibility of this shift toward natural movement raises several questions. The first concerns sufficient access to natural environments, which, in urban settings, may be limited to parks. A study of Canadian children demonstrated that those with greater access to parks reported greater physical activity (Veugelers et al. 2008). A second question concerns climate. It has been previously shown that season/time of year affects levels of recreational physical activity (Burton et al. 2003). Therefore, natural movement activity may be less appealing in certain climates or seasons. Third is the issue of inclement weather, such as rain or snow, and how that may hinder motivation to engage in natural movement outdoors (Nies & Motyka, 2006). Finally, there is the potential for overexposure to sunlight and its associated risks, although these could be lessened through simple measures such as sunscreen and education.

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