

Running: An Overview of General and Cardiovascular Health Benefits

Abstract

This paper provides a brief overview of the current health situation in the United States in regards to obesity and provides the physical and mental health benefits of exercise and why running is possibly the most beneficial form of exercise, as it has a closer relationship between metabolic equivalent tasks (METs) and adiposity, and has a higher reduced risk (RR) for many diseases compared to other forms of vigorous exercises, especially with cardiovascular disease (CVD) and coronary heart disease (CHD) (Williams, 2012; Williams, 1997; Tanasescu, et al. 2002). The risk of injury from running is less than other physical activities such as contact sports (AGAC, 2008, G10-4). Most injuries from running are overuse injuries (Hespanhol, Costa, Carvalho & Lopes, 2011; Tenforde et al., 2009; Fields, Sykes, Walker & Jackson, 2010; Knobloch, Yoon & Vogt, 2008). The risk of overuse injuries can be reduced by decreasing mileage to a level appropriate to the level of physical fitness (Tenforde et al., 2009; Garber et al., 2011; Lysholm & Wiklander, 1987; Fields, et al., 2010). Certain warm-up programs have been also shown to reduce injuries (Mandelbaum, et al., 2005; Soligard, et al., 2008; LaBella, 2011; Mayo, M., Seijas, R. & Álvarez, 2014). The risk of death from long distance running by heart attack does occur, but has been found relatively rare (Kim et al., 2012; Roberts & Maron, 2005; Running USA, 2016).

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Introduction

The U.S. Department of Health and Human Services reports that rates of obesity among adults have increased from 30.5% in 1999 to 37.7% in 2014 (National Center for health Statistics, 2015). While levels of obesity have leveled out in recent years, obesity is still a major issue in the United States (NCHS, 2015). In obese youth, when compared to normal weight youth, television viewing times were higher and level of physical activity were lower (Janssen et al., 2005). It has been agreed upon that obesity is majorly caused by overconsumption of calories and lack of, or lack of the opportunity of, physical activity (National Heart, Lung, and Blood Institute, 1998, 12). It has also been found that higher Body mass index (BMI) starting from above 20Kg/m² is associated with higher risks of many diseases including but not limited to: coronary heart disease (CHD), stroke, osteoarthritis, hypertension, and depression (NHLBI, 1998, 12). In treatment for obesity, regular exercise plays an important role in first losing weight during the first six months, and then keeping off weight (NHLBI, xix). The most recommended exercise is walking, and later on running (NHLBI, xx). Running not only helps keeps off weight but also can provide a plethora of additional health benefits, especially benefiting cardiovascular health and the increased health risks found with obesity, which may not be as prevalent in other forms of vigorous exercise.

Exercising

Regular exercise has been shown to decrease risk of many diseases in adults that being obese can increase including, hypertension, colon cancer, breast cancer, coronary heart disease, cardiovascular disease (CVD), type-2 diabetes, and all-cause mortality (Physical Activity Guidelines Ad-

visory Committee, 2008, E-22).

It has been found that more physically active men and women are leaner, lead healthier lives (consumed less amounts of fats, consumed more amounts of fiber, and a lower prevalence of smoking) and have lower levels of hypertension (Williams, 2012; Tanasescu et al., 2002; Williams, 1997). It also appears that there has been a relation between optimism, exercise, and health. Optimistic people tend to have healthier lifestyles, thus also have better overall physical and mental health, and healthier people tend to be more optimistic, thus having better mental health (Conversano et al., 2010; Galper, Trivedi, Barlow, Dunn & Kampert, J. B., 2006). Furthermore, higher levels of physical activity presents higher reduced risk of CVD and all-cause mortality even in men with type-2 diabetes (Tanasescu, 2003).

Risk of Injuries in Exercising

The risk of injuries caused by exercise can be a major concern. While injury is a possibility, there are different risks of injury for different types of exercise or physical activities. For example, football has a higher risk of injury than running, running has a higher risk of injury than walking (U.S. Department of Health and Human Services, 2008, G10-4). The risk of injury is also greatly dependant on level of physical fitness (PAGAC, G10-14). In a study covering injuries in Army trainees it was found that there is a higher incidence of injuries among those with a lower level fitness compared to those with the highest level of fitness (Jones, Bovee, Harris & Cowan, 1993). If the level of physical activity higher than the level of physical fitness, or usual level of physical activity, risk of injury is significantly higher. The difference between usual physical activity and a new increased level of physical activity is considered overload (PAGAC 2008, D-3). Thus, when creating an exercise plan or routine, in order to reduce risk of injury, it's

important to have a small amount of overload, letting the body adapt to the new higher level of physical activity by gradually increasing the first length, and then intensity of exercise to again have a small amount of overload (PAGAC, 2008, D-3).

Running

Running compared to other exercises

In order to compare different physical activities or exercises, they are usually grouped based on relative intensity (usually, light, moderate, or vigorous) which is determined by their metabolic equivalent of tasks (METs). One MET is equal to the energy exerted while resting, the energy expended while resting is then compared to energy expended while exercising (Hughes, 2012). METs can also be expressed in MET-minutes, MET-hours, and MET hours per day (MET hr/d) and are simply the time engaged in the exercise multiplied by the amount of METs (Hughes, 2012). This comparison gives an idea to the intensity of the exercise, and calories burned during the exercise.

BMI and adiposity of running and other exercises. It is well known that there is an inverse relationship between adiposity, BMI, and METhr/d (Williams, 2012; Williams, 1997). However, it has been found that this inverse relationship between METhr/d and adiposity is stronger when METhr/d was calculated from time and intensity of running than with METhr/d of other vigorous exercises. METhr/d calculated from distance run showed an even stronger relationship, suggesting that the current recommended minimums for exercise, because they are based off of time are possibly aggrandized (Williams 2012; PAGAC, 2008). In a study of over 8,000 runners, found that leaner men ran further, in which the leanness was most likely a result of running (Williams 1997). From the relationship between METhr/d from distance ran and adiposity, it can be pro-

posed that running has a greater effect on METhr/d and therefore possibly stronger health benefits.

Cardiovascular health associated with running

The lower BMI of the more lean long-distance runners, also had lower levels of hypertension and better cholesterol levels (Tanasescu et al., 2002; Williams 1997). It was also found that runners who once had a higher BMI, had higher levels of high density lipoproteins (HDL) cholesterol (Williams, 1997). The high levels of HDL cholesterol, lower levels of low density lipoproteins (LDL) cholesterol, lower blood pressure, and lower incidence of hypertension of lean long-distance runners, leads to a significant decrease in the risk of coronary heart disease (Williams 1997; Tanasescu et al. 2002). In fact, Tanasescu (2002) found that runners who ran for an hour or more per week had a higher reduction in risk than other vigorous exercises with a 42% decrease in risk of CHD (compared to the next highest: 18% risk reduction (RR) rowing, 23% RR weight training), Williams (1997) found that runners who ran 64km/wk (39 miles) or more had a 30% decrease in risk of CHD compared to those who ran less than 16km/wk (9 miles).

Similar decreases in risk was found with cardiovascular (CVD) related mortality and all-cause mortality, even in runners who ran below the recommended minimum of 75 minutes per week of vigorous aerobic activity (Blair, et al., 2014; PAGAC, 2008, G4-3; Lavie, et al., 2015; Lee, et al., 2014). Runners who regularly ran over a long period of time had 50% lower risk of CVD related mortality, and 29% lower risk of all-cause mortality (Blair, et al., 2014).

Risk of injuries and cardiac arrest from running

Running, being a non-contact sport or activity, has a considerable lower rate of injury than other activities (i.e. limited-contact and contact sports) (PAGAC, 2008, G10-4). However, injuries are

still possible and concern over the connection between long-distance runners and cardiac arrest has grown (Maraham, 2011).

Running Injuries and Prevention. The most common injuries in long distance runners seem to be patellofemoral syndrome and achilles tendinopathy, and the most common cause of injuries is overuse through training error (Hespanhol , Costa, Carvalho & Lopes, 2011; Tenforde et al., 2009; Fields, Sykes, Walker & Jackson, 2010; Knobloch, Yoon & Vogt, 2008). As most injuries are caused by overuse, it has been found that as distance run increases, risk of musculoskeletal injury also increases, therefore, it is recommended that decreasing mileage by a small amount, or only participating in moderate amount of running, can help decrease risk of musculoskeletal injury. (Carvalho, Costa, Hespanhol & Lopes, 2011; Tenforde et al., 2009; Garber et al., 2011; Lysholm & Wiklander, 1987; Fields, et al., 2010). From the research that has been done, reducing mileage and/or intensity to levels appropriate for the individual, is the only prevention method that has been confidently recommended (Fields et al. 2010; Garber et al., 2011).

While static stretching as warm-up before running or exercise has been traditionally believed to help reduce the risk of injuries, there has been growing evidence evidence against stretching in the prevention of injuries (Safran et al., 1988; Laursen, Bertelsen & Anderson, 2014; Leppänen, Aaltonen, Parkkari, Heinonen & Kujala, 2013; Zakaria, Kinningham & Sen, 2015). As Pope et al. (2000) found there was no significant difference in the amount of injuries in army recruits who did or did not stretch. However, the evidence against stretching does not mean that other specific types of training or warm-up activity is not effective against preventing injuries. A neuromuscular warm up program that included stretching of the trunk and lower body, strength training, plyometric exercises, and sport-specific agility drills was successful in reducing anterior cruciate

ligament injuries in female athletes (Mandelbaum, et al., 2005). In warm-up programs featuring the same basic routine as previously mentioned, along with running, carried out by football (soccer) players, found reduced rates of lower extremity injuries including overuse injuries (Soligard, et al., 2008; LaBella, 2011; Mayo, M., Seijas, R. & Álvarez, 2014).

While overuse is the most common type of injuries, foot strike patterns can also be the cause of injuries. Thus, altering foot strike patterns and running form could decrease risk of certain types of musculoskeletal injuries. A rear foot strike pattern (RFS), where the heel makes contact with the ground first, is found to be most common in runners and puts stress on the hip and knee, as a result, rates of patellofemoral pain and repetitive stress injuries (RSI) are higher compared to front foot strike (FFS) (Rogers, 2017; Hatala, Dingwall, Wunderlich, & Richmond, 2013; Daoud, et al., 2012). As the ball of the foot makes contact with the ground first in a FFS pattern, there is a large range of ankle plantarflexion, which puts stress on the achilles tendon, possibly leading to more occurrences of achilles tendinopathy (Almonroeder, Willson & Kernozek, 2013; Mann et al., 2014).

Cardiovascular risks of running. It has been recorded that in recent years rates of cardiac arrest occurring during or shortly after long-distance runs have increased and due to this, increased concerns of cardiac arrest surrounding long-distance running have grown, however, this can be explained by increased participation in long-distance running events such as marathons and half-marathons (Kim et al., 2012; Roberts & Maron, 2005; Running USA, 2016). Furthermore, it has been found that the risk of experiencing cardiac arrest during or shortly after a marathon or half-marathon is extremely low. It has been found men have a higher risk at around 1 per 184,000 participants, and out of 10.9 million long-distance runners participating in marathons or half-

marathons over 10 years, only $5.54 \times 10^{-6}\%$ of runners experienced cardiac arrest during or shortly after finishing a full or half marathon (Kim et al., 2012; Maharam, 2011). Incidences of sudden death from cardiac arrest are even lower, possibly lower than that of vigorous exercise, about 1 in 260,000 participants (Kim et al., 2012; Maharam, 2011). Furthermore, Albert C. M. Et al. (2000) suggested those who habitually perform vigorous activities have a decreased risk of sudden death during vigorous activities. Out of the cases that do occur, it has been found that there is a 72% case mortality rate, this is still lower than the 92% case mortality rate of out-of hospital cardiac arrests (Kim et al., 2012; Callaway et al., 2008).

Conclusion

Exercise plays a major role in leading a healthier lifestyle both physically and mentally (PAGAC, 2008; Conversano et al., 2010; Galper, et al., 2006). Running is possibly the most beneficial form of moderate to vigorous exercise, as it has a stronger relationship between METhr/d and adiposity (Williams, 2012; Williams, 1997). Furthermore, it has been suggested that running provides more of a beneficial effect in reducing risk of CVD and CHD than other vigorous exercises (Williams 1997; Tanasescu et al. 2002).

Any physical activity or exercise has a risk for injury, some more than others. If physical activity or exercise is of the same level as physical fitness the risk for injury decreases dramatically (PAGAC, 2008, D-3). Running does not have as much risk for injury as some other exercises or physical activities (PAGAC, 2008, G10-4). The most common injuries in runners are overuse injuries or repetitive stress injuries (RSIs) such as achilles tendinopathy and patellofemoral syndrome, decreasing mileage or intensity can help reduce the risk of overuse injuries or RSIs (Hespanhol, et al. 2011; Tenforde et al., 2009; Fields, et al. 2010; Knobloch, et al. 2008). Warm-

up techniques that include stretching, running, agility, plyometric and strength training have been shown to reduce risk of injuries (Soligard, et al., 2008; LaBella, 2011; Mandelbaum, et al., 2005). Foot strike patterns can also influence the risk of certain types of injuries (Rogers, 2017; Hatala et al., 2013; Daoud, et al., 2012; Almonroeder, Willson & Kernozek, 2013; Mann et al., 2014). While death relating to cardiovascular health during a long distance run can happen, it is relatively rare (Kim et al., 2012; Roberts & Maron, 2005; Maharam, 2011).

While this research may not be able to point out definitively what is the best kind of exercise, it does point towards running being effective form of exercise in terms of recommended time running and energy expenditure. In concert with a prescribed diet or other lifestyle changes recommended by a doctor, the most of the beneficial health effects of running can be achieved.

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