Sarcopenia, Dynapenia and Sarcobesity: How Do These Conditions Impact Workplace Health?

A White Paper

Written By

Thomas B. Gilliam, Ph.D.

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IPCS, 1696 Georgetown Road, Unit B, Hudson, OH 44236

www.ipcs-inc.com
Sarcopenia, Dynapenia and Sarcobesity: How Do These Conditions Impact Workplace Health?

Executive Summary

The evidence presented in this paper will demonstrate that muscular strength is in fact the new vital sign of workplace health.

The muscular strength of each worker in the workforce should be viewed as a very serious health and safety risk factor that if left alone could result in a significant number of injuries, disabilities and life threatening diseases. But muscle strength is a modifiable risk factor which means that sarcopenia (loss of muscle) and dynapenia (loss of strength) can be slowed during the aging process through well thought out programs to maintain muscle mass and muscular strength. This will also lead to less sarcobesity.

A healthy muscle mass and adequate muscular strength within each worker especially as they age will result in significant savings for the company with fewer injuries, less disability and less disease.

Most employers associate muscle weakness with injuries but do not associate low muscle strength with disease. But low muscle strength is a predictor of Type II diabetes, cardiovascular morbidity and mortality, poor quality of life and other serious costly diseases.

Maintaining a healthy and strong muscle mass will significantly reduce the risk for injury and disease for the entire workforce.

Purpose

The purpose of this paper is to provide industry up to date information on the strength status of the worker and its application to performance and risk for disease and injury. It is also the purpose of this paper to introduce a new health concept called “sarcobesity” which if not fully understood will lead to dramatic increases in healthcare, workers’ compensation and disability costs resulting in significant reductions in performance of the workforce.

Background

Fifty years of research by the American College of Sports Medicine has shown people who are physically active are healthier individuals. But not all physical activity correlates with maintaining a strong and healthy muscle mass so a portion of a person’s activity must include strengthening activities. This is important because all humans lose about 30% of their muscle mass between the ages of 30 and 65 years old and even a more significant loss of their muscular strength. The loss of muscle is known as sarcopenia and the loss of muscular strength is known as dynapenia. Neither sarcopenia nor dynapenia is a disease, but instead part of the aging process. The loss of muscle continues at a quicker rate after the age of 65.
But sarcopenia and dynapenia are wreaking havoc on the workforce today because so many industries have an aging workforce. Unfortunately muscle weakness has been associated with disability, increased risk for disease and mortality (5,9,11,17). Physical inactivity (sedentary lifestyle) and the continued rise in obesity are accelerating both sarcopenia and dynapenia. This has resulted in the loss of muscle more quickly in the aging worker resulting in many workers now the age of 50 with more than 30% muscle loss as shown on the Chart 1 below (16).

The combination of sarcopenia and dynapenia has made it more difficult for many older workers to safely perform the essential functions of the job as they age, especially when the physical demands of the job do not change. This puts the worker more at risk for injury, disability and disease.

<table>
<thead>
<tr>
<th>Chart 1</th>
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<tbody>
<tr>
<td><strong>Is the Loss of Muscle Mass Being Accelerated?</strong></td>
</tr>
<tr>
<td>100%</td>
</tr>
<tr>
<td>Accelerated with weight gain and lack of physical activity</td>
</tr>
<tr>
<td>30</td>
</tr>
</tbody>
</table>

**Why Is Strength the New Vital Sign of Workplace Health?**

Dr. Paul Terpeluk, Chief Medical Officer for Occupational Health, with the Cleveland Clinic has coined the phrase that “strength is the new vital sign of workplace health”. Normally when a person thinks of “vital signs”, one thinks about heart rate, breathing rate and blood pressure. To put strength in the vital sign category demonstrates the importance strength plays today in the health and well-being of the worker and to carry this one step further, the entire workplace. Most employers in the past have made the association between strength and injury. Low strength has been associated with increased risk for injury, however, most employers do not associate low muscular strength with disease. But low muscle strength is a predictor of Type II diabetes, cardiovascular morbidity and mortality and other related diseases (8,9,11,16,17,19). In August, 2014 a study was published in Medicine & Science in Sports and Exercise by Senechal and others, which showed low muscle strength was associated with having an increased risk for metabolic syndrome (16). Metabolic syndrome is associated with a cluster of disease
risk factors created by a combination of low high-density lipoprotein, high triglyceride, hypertension, high glucose and high body mass index along with a high waist circumference.

Muscular strength has become a critical factor to the health and safety in the workplace because the research clearly shows a very strong connection to low strength and increase in disease. Strength is not only critical to safely performing the essential functions of physically demanding jobs but also to disease prevention.

| Low muscle strength is associated with an increase in metabolic syndrome, Type II diabetes, cardiovascular disease and in some instances mortality. |

An analysis of the IPCS database at the end of 2014 consisting of 253,210 male and 46,237 female blue collar new hire applicants clearly shows a reduction in strength with age to two major muscle groups critical in performing physically demanding jobs that involve lifting, carrying, reaching, bending, stooping, climbing and similar kinds of activities. These major muscle groups involve the shoulders and the knees and the details of the outcomes can be found in the Addendum. But a summary is as follows:

- There is a slight increase in absolute strength from ages 20-29 to 30-39 and starting with the 4th decade there is a gradual decrease in shoulder strength up through the 6th decade for both males and females. The percent loss in strength from age 30 to 60 years for males is 20% and for females is 19%.

- A similar pattern for knee strength exists only there is not much change between the 2nd and 3rd decade of life but then a rapid decrease in absolute strength occurs after age 40 for both males and females. The percent loss in strength from age 30 to 60 years for males is 24% and for females is 27%.

- The results support the acceleration of the loss of muscle mass and strength as previously discussed. In fact, the results show a rapid decrease in absolute strength beginning as early as age 40 for the knee and a more gradual decrease beginning at age 40 for the shoulder for both genders.

| This finding in itself does not bode well for physically demanding jobs especially with an aging workforce. The loss of strength does place the worker at a greater risk of injury and poorer performance. |

**Strength to Body Weight Ratio (SBW)**

Strength to body weight has for years been an important measure of performance in athletes. Strength should be proportionate to body weight to maximize performance and efficiency of movement and to minimize the potential for injury. SBW should be an important measure in industry mainly because of the rapid increase in obesity since 2000 and now the loss of muscle and strength (6,12,16,18). Senechal showed that strength scaled to body weight was associated with having metabolic syndrome especially in men under the age of 50 (16).

If in weight gain, the gain is mostly attributable to fat weight and not muscle, the strength to body weight ratio is changed in such a way that it puts the worker at greater risk for injury and disease. The first study to show the impact of increase in obesity on workers’ compensation claims was Ostbye’s Duke University Hospital research that showed a severely obese worker (body mass index 35 or more) was injured twice as often with workers’ compensation claim cost 7 times the cost and 13 times more
lost work days compared to a normal weight worker (12). Van Nuys showed that medical, sick days, short term disability and workers’ compensation combined costs for a morbidly obese worker was $8,067 per year versus $3,830 for a normal weight worker (18).

What happens to the strength to body weight ratio when body mass index (BMI) and body weight increase is shown on Chart 2. The distance between the blue line (strength) and the red line (body weight) is essentially the SBW. This chart supports the research by Ostebye as to why a person with a BMI of 35 or more is at greater risk for injury. Chart 2 shows with a BMI of 35 or more, the SBW rapidly diminishes. This means the worker’s strength is no longer proportionate to the body weight which is why the worker is at greater risk for injury.

Chart 2

The Relationship Between Body Weight vs Strength

<table>
<thead>
<tr>
<th>Foot Pounds</th>
<th>Pounds</th>
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<tbody>
<tr>
<td>250</td>
<td>100</td>
</tr>
<tr>
<td>300</td>
<td>150</td>
</tr>
<tr>
<td>350</td>
<td>200</td>
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<td>400</td>
<td>250</td>
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<tr>
<td>450</td>
<td>300</td>
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<td>500</td>
<td>350</td>
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Body Mass Index
- Normal
- Overweight
- Obese
- Severe
- Morbid
- Extreme Morbid

Torgue (Ft.Pds.)
- Body Weight (Pds.)
When SBW is expressed relative to age by gender, Chart 3 shows a rapid decrease in SBW from age 20 to 60 and older. In fact, the decrease for both genders is about 27%. The data from Chart 2 and 3 was derived from the IPCS database.

Chart 3

The results on Chart 3 are not good for the worker. These outcomes continue to place the worker at greater risk for injury and disease because it will be much more difficult for them to safely perform the essential functions of the job as they age. Contributing factors to this rapid decrease is a combination of two things – loss of muscle mass/strength and increase in body fatness.

Implications for the Health of the Workforce

What does all of this mean for the worker? When muscle is lost, fat will infiltrate the muscle in its place (4). This leads to sarcobesity (1,13,14,15,19,20). Chart 4 graphically shows as muscle mass is lost (orange line), fat weight increases (green line) as it replaces the space muscle once occupied. As muscle is lost due to sarcopenia, strength is lost at a greater rate (grey line). Chart 4 shows that the increase in fat weight could happen to the worker without the worker gaining weight (blue line) due to the loss of muscle weight. This entire process would be further complicated if the worker also gained weight (as normally occurs with aging) which is more than likely to be in the form of fat weight.

This scenario becomes even more complicated as many of the physically demanding jobs have been lost because of automation. Church reported that the prevalence of moderate physically active occupations has decreased by 28% since 1960 (3). According to Brownson, the number of low activity jobs has doubled compared to high-activity jobs since 1950 (2). As a result, the probability today of the blue-collar worker experiencing daily physical activity intense enough to maintain strength and muscle mass has greatly diminished.
The scenario shown on Chart 4 points out a critical weakness of using body mass index (BMI) as a measure of obesity. Consider the following hypothetical scenario based on the research stated in the preceding paragraphs. It is possible for a worker to go through life and not gain weight but increase body fatness. Chart 5 assumes the worker at age 25 and 65 has a BMI of 32 because the worker gained no weight in those 40 years. (Height and weight are the two measures used in calculating BMI). But during this time frame, the worker became less physically active and did not work to maintain muscle mass and strength which resulted in loss of muscle weight but an increase in fat weight. This increase in fatness and decrease in muscle mass neutralized each other resulting in no weight gain. But with the increase in body fatness, the worker’s BMI would not have remained the same, it would have increased from 32 at age 25 to a BMI of 42 at age 65.
How Does Sarcobesity Impact the Risk and Safety of the Worker?

The research is clear that increased muscular strength results in an increase in functionality and performance and a decrease in disability, disease and mortality. It also means that workers reduce their risk for injury, disability and disease in that they will be able to more safely perform the essential functions of the physical demands of their jobs. According to Manini and others, sarcobesity leads to diminished functional capacity, increased susceptibility to disease and a declining physical quality of life 5,7,8,10,15,19,20). Since signs of sarcobesity can be found in the aging worker as early as age 50, employers will experience greater employee costs and reduced performance. Chart 6 shows the importance of increased strength for the worker on functionality leading to less disease, injury and mortality.

Chart 6

The opposite would be true for low strength leading to less functionality with an increase in disease, injury and mortality.
Summary

Clearly, the evidence presented in this paper shows that muscular strength is in fact the new vital sign of workplace health.

The muscular strength of each worker in the workforce should be viewed as a very serious health and safety risk factor that, if left alone, could result in significant numbers of injuries, disabilities and life threatening diseases. But muscle strength is a modifiable risk factor which means that sarcopenia and dynapenia can be slowed during the aging process through well thought out programs to maintain muscle mass and muscular strength. This will also lead to less sarcobesity.

A healthy muscle mass and adequate muscular strength within each worker, especially as they age, will result in significant savings for the company with fewer injuries, less disability and less disease.
Addendum

Obesity Update in Industry
It is important to understand what is happening to obesity in the workplace. Chart 7 shows that obesity as measured by Body Mass Index (BMI) of 30 or more did not change much in that 40.3% of the nearly 25,000 workers assessed in 2005 were obese compared to 41.3% in 2014 for nearly 40,000 workers. However within the obese group, the big change occurred with the BMI category of 35-39 and greater than 39 between 2005 and 2014. These two categories of severe obesity (BMI 35-39) and morbid obesity (BMI >39) are the categories that cost industry the most in terms of workers’ compensation costs and healthcare costs. Chart 7 below shows the severe obesity increased from 2005 to 2014 by 2.1% which is a 23% increase and morbid obesity increased by 2.1% which is a 45% increase. Even though the overall increase in obesity rose just 1%, the increase in the severe and morbid obesity was made possible by a decrease from 26.6% to 23.6% in the first level of obesity and the slight increase in overall obesity.

Chart 7

<table>
<thead>
<tr>
<th>10-Year Comparison for Obese, Severe and Morbid Obesity</th>
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<tbody>
<tr>
<td>2005</td>
</tr>
<tr>
<td>Body Mass Index 30-34</td>
</tr>
<tr>
<td>Body Mass Index 35-39</td>
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<tr>
<td>Body Mass Index &gt;39</td>
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Obesity by Age Group

When focusing just on the severe obesity and greater, the results become even more disturbing as shown in Chart 8. With this chart, morbid obesity was further divided into morbid (BMI 40-49) and Extreme Morbid (>49). The middle age groups (ages 30-39 and 40-49) have the highest percentage of workers in the severe, morbid and extreme morbid obesity categories.

Chart 8

It is interesting to note the decrease in these high obesity categories in the 50-59 and greater than 60 age groups and as to why the decrease has occurred. Here are a few possible reasons as to why the two older age groups experienced a decrease in the severe, morbid and extreme morbid obesity categories:

- Perhaps the middle age worker opted out of the physically demanding job and into a job less physically demanding.
- Perhaps the middle age morbidly obese worker could no longer work.
- Perhaps the older worker is more in tune with taking care of themselves and took the appropriate action to reduce their obesity.
Muscular Strength Update

An analysis of the IPCS database at the end of 2014 consisting of 253,210 male and 46,237 female blue collar workers clearly shows a reduction in strength with age to two major muscle groups critical in performing physically demanding jobs that involve lifting, carrying, reaching, bending, stooping, climbing and similar kinds of activities. These major muscle groups involve the shoulders and the knees.

Chart 9 above shows after a slight increase in absolute strength from ages 20-29 to 30-39 and starting with the 4th decade there is a gradual decrease in shoulder strength up through the 6th decade for both males and females. The percent loss in strength from age 30 to 60 years for males is 20% and for females is 19%.

Chart 10 below shows a similar pattern for knee strength only there is not much change between the 2nd and 3rd decade of life but then a rapid decrease in absolute strength occurs after age 40 for both males and females. The percent loss in strength from age 30 to 60 years for males is 24% and for females is 27%.
The results shown on Chart 9 and Chart 10 support the acceleration of the loss of muscle mass and strength as previously discussed. In fact, the results show a rapid decrease in absolute strength beginning as early as age 40 for the knee and a more gradual decrease beginning at age 40 for the shoulder for both genders.
References


