Snowmobiling and Physical Activity – Recent Research

Canadian Council of Snowmobile Organizations

Conseil canadien des organismes de motoneige

Quick Facts

Snowmobiling is a good form of physical activity.

A snowmobile ride can involve different intensities of physical activity depending on the terrain.

Snowmobiling can contribute to every adult's goal of achieving at least 150 minutes of weekly physical activity.

Snowmobiling can be good for your mental health.

This study analyzes Canada's 3 primary forms of recreational snowmobiling.

They are:

- Groomed Trail Riding that occurs on organized trail systems maintained for snowmobiling;
- Backcountry Riding that occurs in snowy areas on uneven terrain away from organized trails;
- Mountain Riding that occurs in deep powder, at higher elevations and/or in steep terrain.

Summary

This document summarizes recent research findings which demonstrate the health benefits of snowmobile riding. The document includes physiological data from field testing in Ontario, British Columbia, and Quebec. It also includes a literature review investigating the potential benefits that snowmobiling could have on mental health. The research summarized in this document was carried out independently by researchers at the University of Guelph.

Snowmobiling Is Moderate Intensity Physical Activity: The researchers found that snowmobiling sufficiently increases metabolic demand (the amount of energy used) for it to be classified as moderate intensity physical activity. The Canadian Physical Activity Guidelines recommend that a person participate in 150 minutes per week of moderate to vigorous intensity physical activity (Tremblay et al., 2011).

Snowmobiling can be categorized within different intensities of physical activity depending on factors such as participant effort, riding location, ride duration, and riding terrain. This means that while the physical demand of a snowmobile ride can vary substantially, all can be effective for accumulating the recommended 150 minutes of physical activity and accompanying health benefits.
(Read more: pages 3 - 14)

Snowmobiling Activity Benefits Mental Health: Regular physical activity is beneficial for improving both physical and mental health. Recently, awareness of mental health disorders such as depression and anxiety has revealed that the prevalence and severity of these diseases is more severe than previously thought. Although these conditions are typically treated with medications, snowmobiling involves a variety of factors known to complement medications to improve mental health. Snowmobiling is a physical activity and there is plenty of research suggesting that physical activity, alone or in combination with medication, is an effective treatment for depression and anxiety. (Read more: pages 15 - 17)

Snowmobiling Environment & Camaraderie Benefit Mental Health: In addition to being a physical activity, snowmobiling is also performed outdoors, in natural environments, and often with family and friends. Getting outdoors, seeing nature, and socializing are all well-known methods of combating mental health issues. Although the mental health benefits of snowmobiling have not been directly tested in the field, strong evidence suggests that snowmobiling could positively influence mental health. (Read more: pages 16 & 17)

Snowmobiling Can Benefit Overall Health: By summarizing recent field work and related research, this document aims to highlight the potential benefits of snowmobiling on physical and mental health. These benefits can be accrued because snowmobiling involves physical activity, outdoor time, exposure to nature, and socialization. All are aspects of our lives often neglected during the winter. These factors position snowmobiling as an excellent activity for people of all ages as part of a healthy lifestyle. (Read more on pages 13 &14 about how snowmobiling compares with other activities.)

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Recent Research

ON SNOWMOBILING AND PHYSICAL ACTIVITY

Snowmobile riding is different from traditional forms of physical activity because a snowmobile is a machine that uses an engine to propel itself forward. However, during a snowmobile ride, the rider frequently uses arm, leg, and whole-body movements that require muscular endurance and strength to complete. These movements are even more common during technical or hilly terrain. Researchers from the University of Guelph have investigated the physical demands of snowmobiling in a variety of terrains and determined that a significant portion of a snowmobile ride is sufficiently demanding to be classified as moderate intensity physical activity, with small portions of time pushing up towards more vigorous intensities.

The Canadian Physical Activity Guidelines recommend that adults accumulate at least 150 minutes of moderate to vigorous physical activity a week in order to obtain a variety of health benefits (Tremblay et al., 2011). Physical activity can lead to a reduced risk of heart attack, stroke, cancer, type 2 diabetes, and osteoporosis. It can also improve fitness, body composition, and mental health. These health benefits can occur regardless of age, ethnic background, or gender. Snowmobiling could, therefore, be a way to meet these guidelines, either alone or in combination with other physical activities.

SUMMARY OF THE PHYSICAL DEMAND RESEARCH DESIGN

First, researchers collected information from more than 4,000 people who rode at least once per week. From this data it was apparent that there were differing demands according to the terrain, and thus the physical demand was categorized into flatland and mountain riding categories. The data survey was used to create courses in Revelstoke, BC (mountain riding) and Haliburton, ON (groomed trail riding) that represented a typical snowmobile ride. A third course was created in Maniwaki, QC to represent a technical, single-track, backcountry ride. Here, 65 local recreational snowmobile riders rode this course while researchers collected data on oxygen use, heart rate, fatigue, body position, and perceived effort. They also collected data during tasks that are related to riding, such as digging out a sled.

FINDINGS OF THE RESEARCH

Oxygen Use

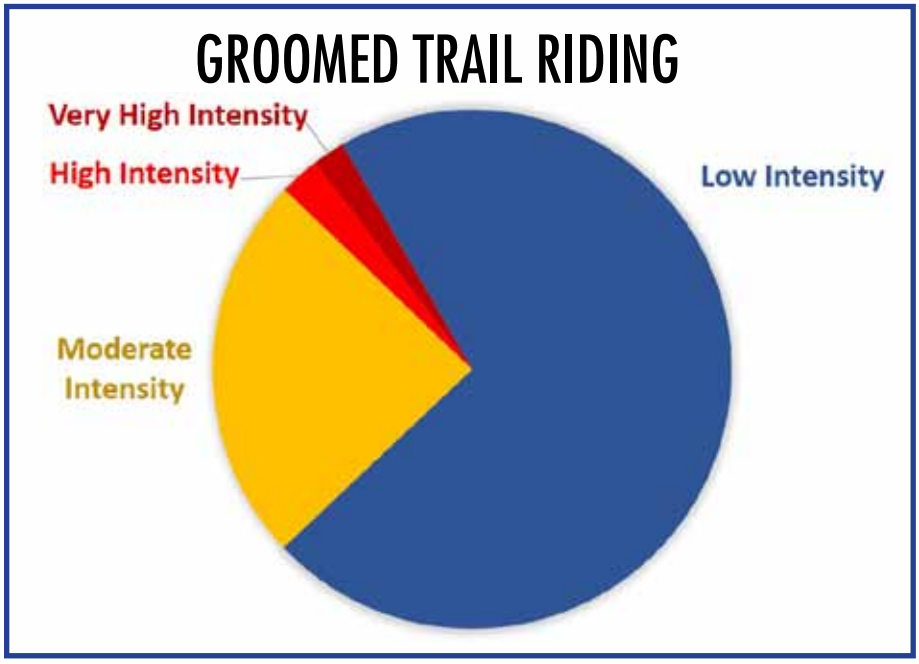
During exercise, your body needs to create energy by breathing in and using oxygen from the air. By measuring the amount of oxygen your body takes in and uses during exercise, researchers can tell how many calories (i.e. energy) are being burned. The MET (Metabolic Equivalent of Task) is a commonly used way of expressing the energy used during physical activity versus the amount of energy used at rest, with rest being equal to a MET value of one. For example, walking slowly might have a value of 3 METs, meaning that walking uses three times as much energy as sitting and resting.

Researchers found that on average, riding a snowmobile used 5.6 METs. This means that a snowmobile rider is using 5.6 times as much energy while riding than if they were sitting at home watching TV. The 5.6 METS used during a typical ride is similar to the amount of energy used during downhill skiing or snow shoveling and categorizes snowmobiling as moderate intensity physical activity. It is recommended that people do 150 minutes of moderate to vigorous intense physical activity (at least 3 METs) per week to maximize health benefits and to prevent a variety of health risks (Tremblay et al., 2011). Therefore, a snowmobile ride can contribute to this weekly recommendation, which will reduce the risk of developing a variety of diseases.

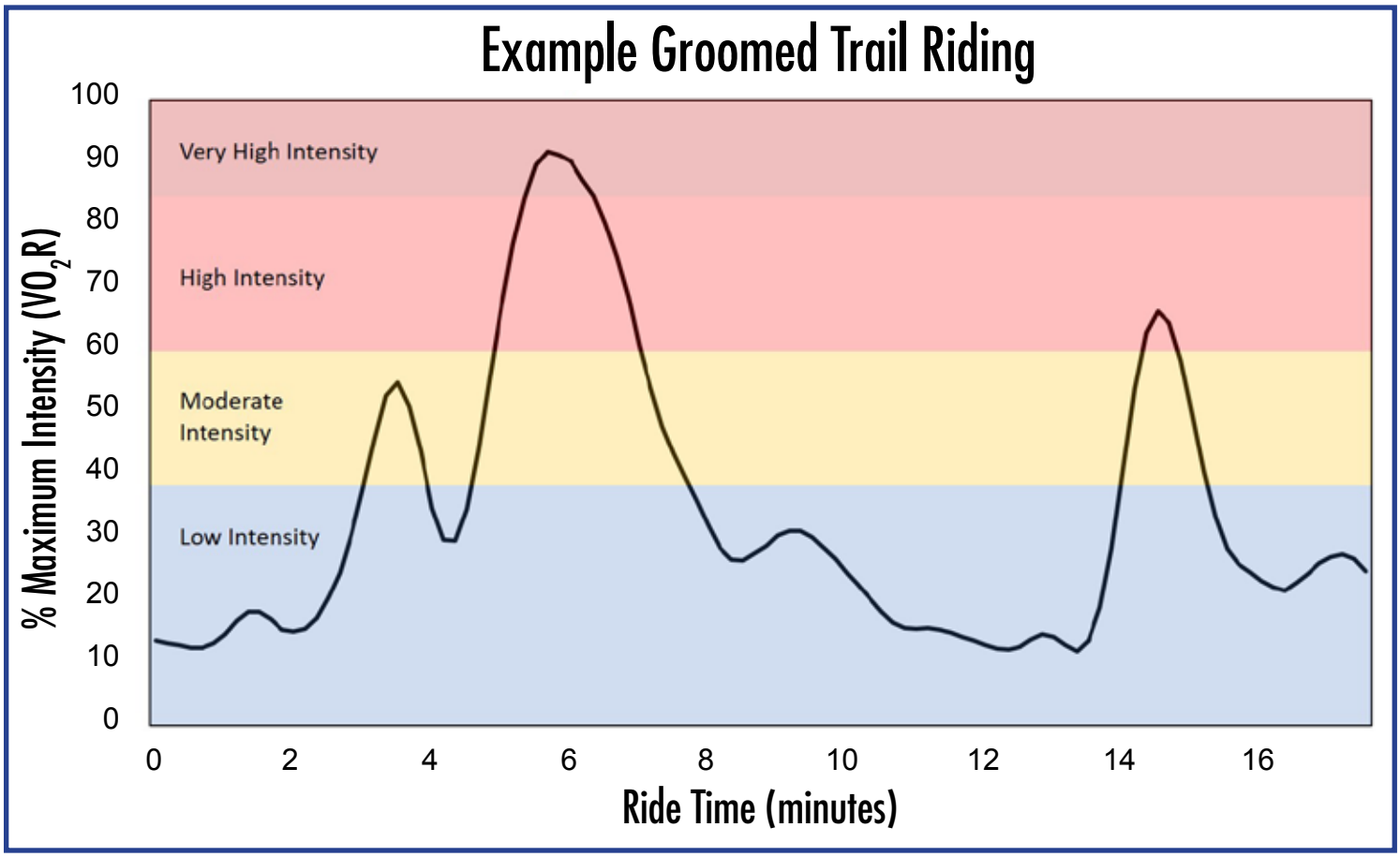
The rate that a snowmobiler uses energy varies quite a bit depending on the type of terrain being ridden. For example, mountain riding requires riders to spend a large portion of their time standing and shifting their weight as they lean to turn the snowmobile in deep snow, and to maintain balance on hills. Alternatively, when riding on groomed trails, shifting of weight is less frequent, and riders can be less active for greater periods of time. Because of these differences, riders in mountainous locations spent 76% of their rides at moderate or vigorous intensities, while groomed trail riders spent 31% of their rides at these intensities. Backcountry riding also involves plenty of turning and weight shifting, but less hill climbing, so riders in these conditions spent an average of 63% of the ride working at moderate or vigorous intensities.

The following graphics summarize the differences between the types of riding and how much of a typical ride is spent at certain exercise intensities. To create these graphics, the riders' oxygen consumption (oxygen used to create the energy needed to ride) during the ride was measured continuously. This oxygen consumption was compared to the maximal amount of oxygen that each rider was able to use (measured during a separate laboratory test). Low intensity exercise and sedentary time does not count towards weekly physical activity times.

OXYGEN USE



Average proportion of a ride at each exercise intensity for all riders on the groomed trail course.



Representative data from one rider during a groomed trail ride.

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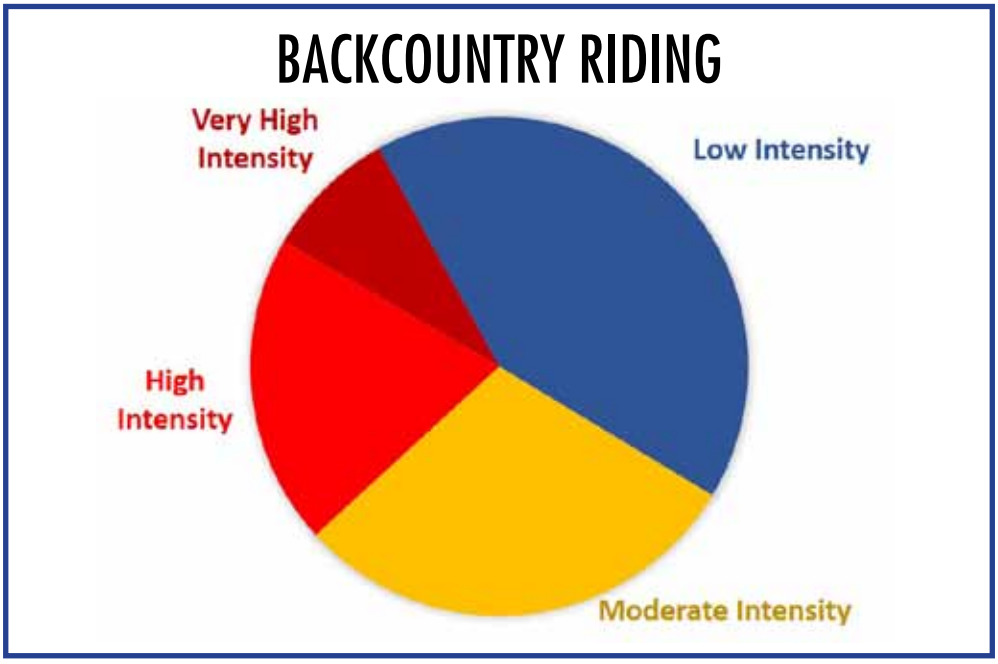
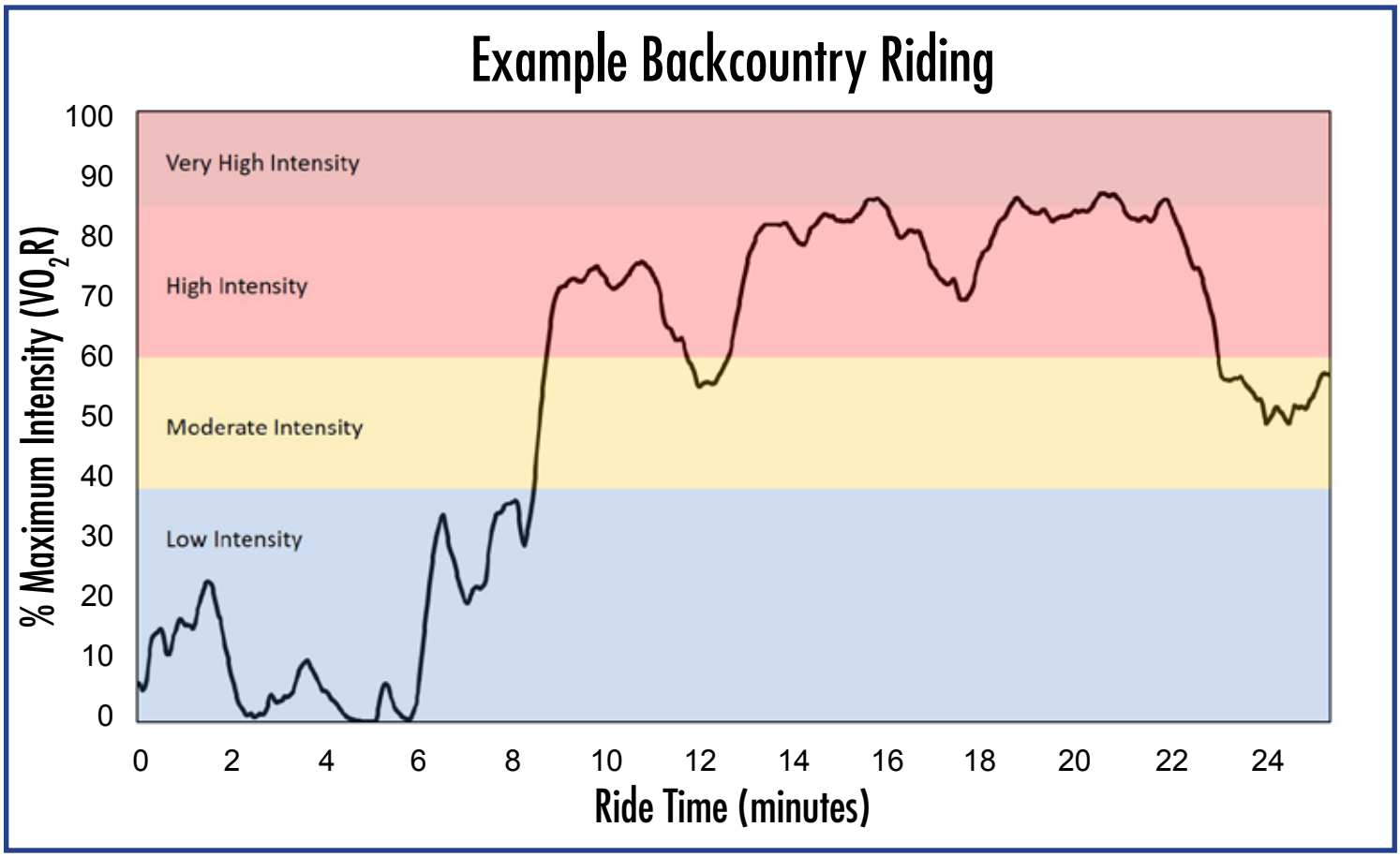


Backcountry riding trail values are estimates based on heart rate, typical heart rate inflation, and predicted using actual participant VO_2 values from an incremental exercise test.

Average proportion of a ride at each exercise intensity for all riders on the backcountry riding course.



Representative data from one rider during a backcountry ride.

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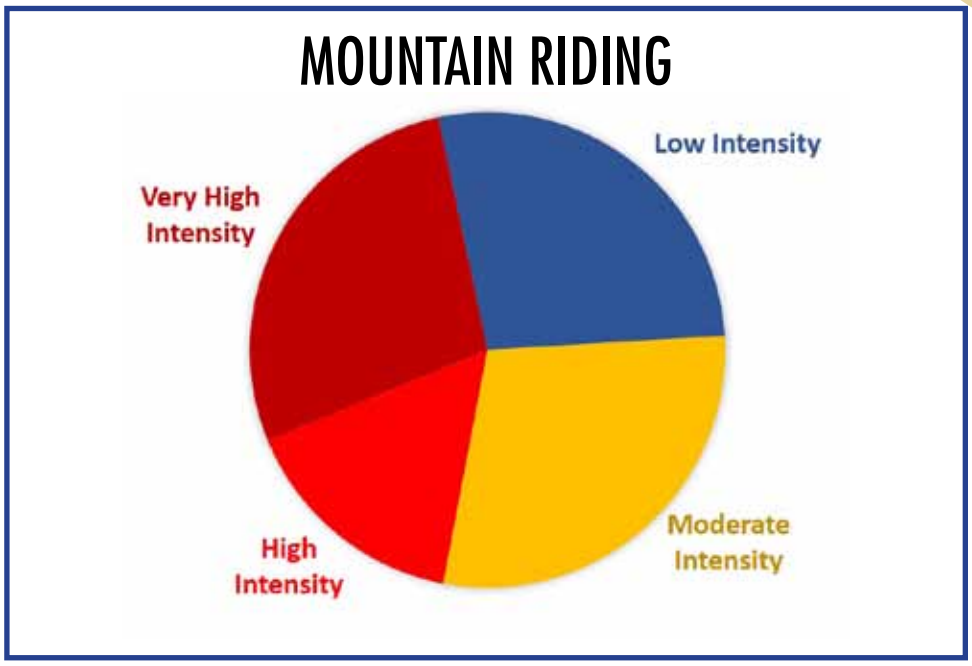
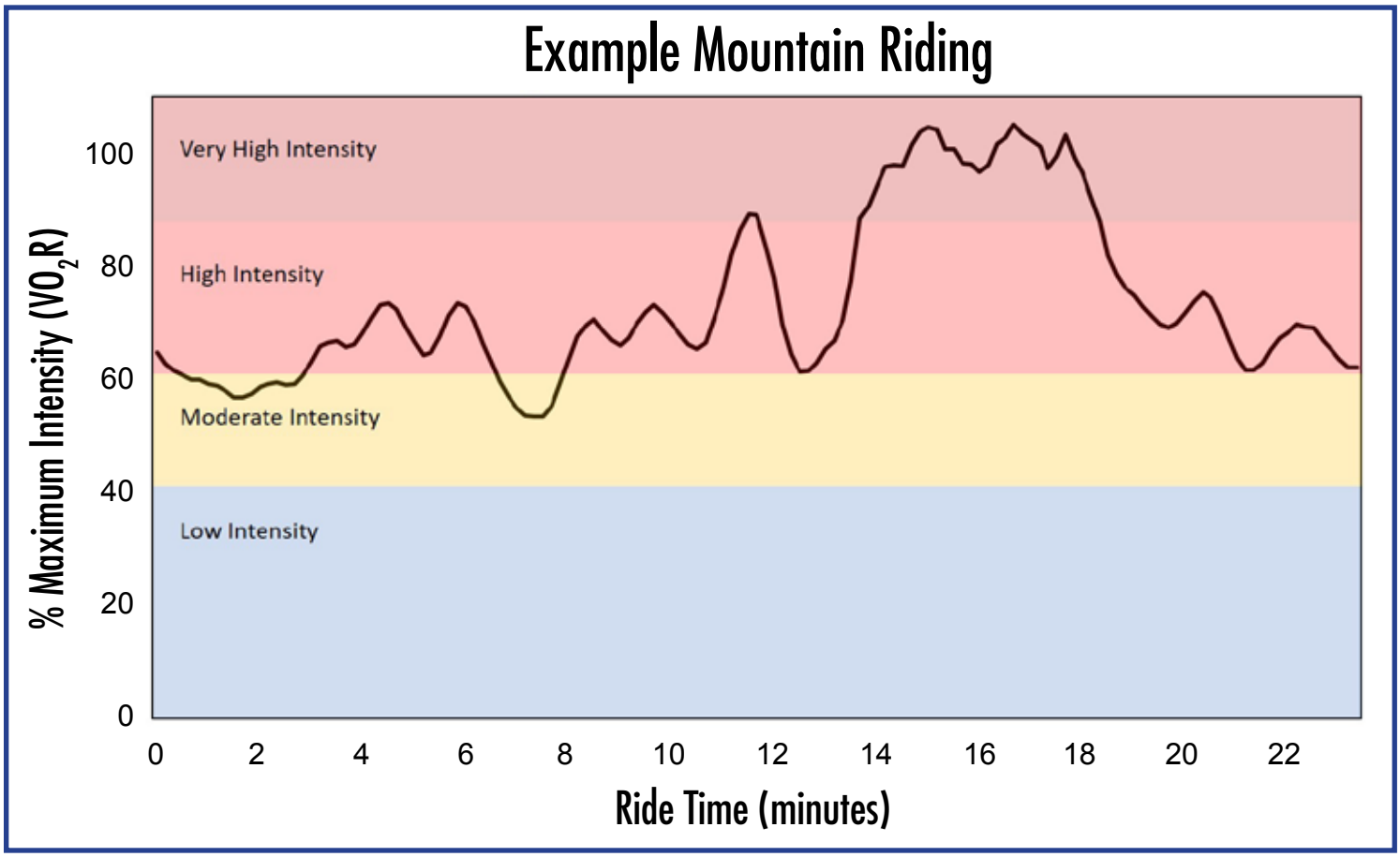


Average proportion of a ride at each exercise intensity for all riders on the mountain course.



Representative data from one rider during a mountain ride.

Heart Rate

As a person begins to exercise harder, their heart pumps faster so that it can deliver more blood to the exercising muscles. This means that we can use heart rate as a method of estimating how hard a person is exercising. The data collected in the study showed that riders on groomed trails had a heart rate that was on average 68% of their maximum, backcountry riders averaged a heart rate to 71% of maximum, and riders in the mountains had heart rates that were 82% of their maximum.

Heart rate is relatively easy to measure; there are a variety of wearable devices that can inexpensively determine your heart rate throughout an exercise bout and categorize these values into heart rate zones. However, one of the downsides of using heart rate is that exercises that rely on constant gripping (such as snowmobiling, car racing, rock climbing, bicycling) can result in inflated heart rate values and, therefore, inaccurate estimation of exercise intensity.

Another factor to consider is a person's state of excitedness or anxiety, both of which can cause an artificially elevated heart rate. These confounding factors are present during most snowmobile rides, and, therefore, heart rate data collected during any ride must be interpreted with caution. As such, the study that is currently being described, using the gold standard measure of metabolism (measuring oxygen consumption to determine physical demand), is a substantial improvement upon the accuracy of previous work.

Exertion

The measurement 'rating of perceived exertion' is a method for researchers to quantify how hard a person feels that they are working during an activity. To take this measurement, participants are asked to rate how hard they feel like their body is working on a scale from 6 (representing no exertion at all) to 20 (representing maximal exertion). In this study, riders were asked for their rating of perceived exertion during the easiest portion of the ride, the hardest portion of the ride, and considering the average level of exertion on the ride as a whole.

On average, the riders rated their exertion as a 12 (between 'light' and 'somewhat hard'). However, when rating the hardest portions of the ride, the riders rated the exertion as 15 ('hard'). The rating of perceived exertion was about the same for all 3 courses, and riding experience did not affect this rating either. These results indicate that more experienced riders might self-select a faster pace, or more difficult route, and this keeps the perceived difficulty of a ride similar across riders with different levels of experience.

Fatigue

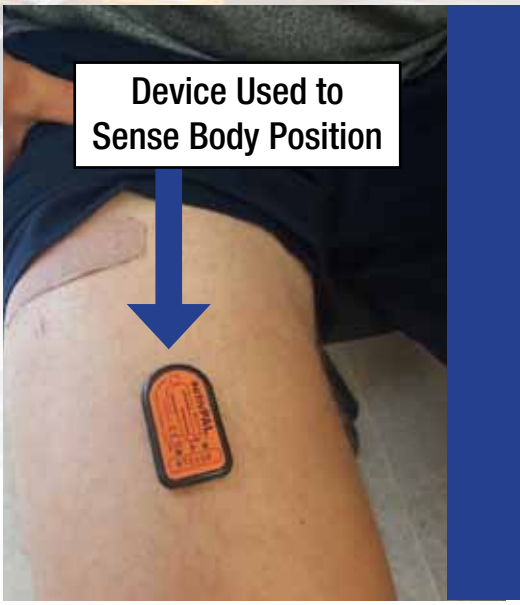
During exercise, particularly strength-based exercise, muscles undergo a certain amount of fatigue as the exercise continues. Muscle fatigue can be measured by investigating how much your muscles lose strength and power following an exercise. These losses in strength are temporary and are a normal part of the adaptation that leads to muscles getting stronger. Measuring how much grip strength decreases is a good indicator of upper body muscle fatigue. Meanwhile, measuring reductions in maximal jump height is a measure of lower body fatigue.

Following a short ride (about 20 minutes), a snowmobile rider's grip strength decreases by about 6 %, indicating upper body fatigue. Lower body fatigue was not observed following the short test rides. However, there was an association where those that stood more during their ride were more likely to exhibit lower body fatigue following the ride. Since snowmobiling is largely endurance-based in the lower body, it is perhaps not surprising that most people did not exhibit lower body fatigue. However, a typical ride usually lasts about 5 or 6 hours. This is a fair bit longer than the test rides, which had to be scaled down to allow measurement over a reasonable time. If the ride were to be longer, fatigue may continue to build up, and you might expect an even larger decrease in grip strength, and maybe a decrease in jump height.

Testing Grip Strength

Body Position

Riders wore a special sensor during their rides to detect movement of their upper thigh, including whether it was vertical or horizontal, and thus body position. These devices reported that mountain riders spend 2.5 times more time standing during a ride than flatland backcountry riders, and almost 4 times more time standing than on-trail riders. Standing, stabilizing, and changing position all require more energy than sitting. These findings may help explain why mountain riding is more often of a higher intensity and would be classified as physical activity for a larger portion of the representative ride.



Device Used to Sense Body Position

WHICH ASPECTS OF SNOWMOBILING INCREASE ENERGY EXPENDITURE?

A single snowmobile ride can take a rider over diverse trail and terrain types. Therefore, every ride may involve a variety of different movements. Some of these movements may require more energy than others, and just like other forms of physical activity, a rider can often tailor their ride to their preference. Here is a non-exhaustive list of some components of a snowmobile ride that require increased energy expenditure.

Standing and Shifting Weight

- The following actions require a rider to move their body around, or stabilize in a specific position, requiring the use of energy:
  - Shifting weight forward when going up a hill, or into a hill when going across the hill;
  - Shifting weight into a turn;
  - Standing/posting position;
  - Kneeling.

- **Mountain riding** requires a rider to spend a greater portion of their ride in the standing position because it is necessary to shift their weight on hills. Mountain sleds are also less stable so that riders can lean to make sharp turns, especially in deep snow.
- During **groomed trail riding,** shifting of weight is important, but less critical. As a result, a great portion of steering can be done using only the musculature of the upper body. The difference in riding styles means that mountain riding generally uses more muscle mass, and requires more energy during a given ride, than a groomed trail ride.
- **Backcountry riding** requires frequent turns and may involve more shifting on weight than on-trail flatland riding. Because of this, backcountry riding expends more energy than groomed trail riding.

Riding on Uneven Terrain

- A majority of a snowmobile ride occurs on uneven terrain. This means that a rider is constantly responding to dips and bumps by attempting to maintain posture and balance.
- Maintaining body posture requires core and back muscle activity.
- The minor physical demands placed on the core and back may go unnoticed, but can contribute to the amount of energy a snowmobile ride requires.

Steering and Gripping the Handlebars

- Following even a short snowmobile ride there is fatigue in the upper body. This is because gripping the handlebars, working the accelerator/brakes, and steering requires a fair amount of energy and strength.
- Frequent snowmobiling could train a rider's forearms and upper body, leading to an increase in upper body and handgrip strength. Improving muscular strength is an important part of a balanced exercise routine.
- Exercise training via handgrip exercise can help lower blood pressure (Millar, Levy, Mcgowan, Mccartney, & Macdonald, 2013) and improve the health of arteries (Tinken et al., 2010).

Peripheral Tasks

There are a variety of tasks related to snowmobiling, while not actually riding, that could also be considered physical activity. These may include:

- Digging a sled out when stuck in deep snow;
- Dragging a sled on pavement at a gas station;
- Loading up a sled on a truck or trailer;
- Lifting the back end of a sled to loosen ice/snow;
- Tipping the sled to do a repair or adjustment;
- Changing the drive belt or spark plugs;
- Clearing the way ahead of obstacles such as fallen branches or drifted snow.

Of these tasks, digging out a sled is the most physically demanding. Digging out a sled in deep snow can require the use of 8.3 times more energy than at rest. However, not every ride involves digging out your sled. Only 40 % of groomed trail riders report normally having to dig out their sled, but 81 % of mountain riders dig out at least once per ride. Digging out is also more frequent for backcountry riders. When you do find yourself digging out a sled, it's an energetic task, and most riders report that it takes between 5 and 15 minutes to complete.

The difficulty and frequency of other tasks related to snowmobiling vary by location. Mountain riders who were surveyed thought that tipping a sled to do repair or adjustments, and clearing the way ahead are the most difficult common tasks. Groomed trail riders thought that loading and unloading sleds and lifting the back end of a sled to loosen snow and ice from the track are most difficult. Differences in sled design, trail design, and riding style likely result in variations in the frequency and difficulty of these peripheral tasks.

SNOWMOBILING VERSUS OTHER FORMS OF PHYSICAL ACTIVITY

As described earlier, a MET (Metabolic Equivalent of Task) is a way of expressing the energy used during physical activity versus the amount of energy used at rest. By using METs, we can compare different types of physical activity based on how much oxygen you use when doing each activity. For example, walking slowly might have a value of 3 METs, meaning that walking uses three times as much energy as sitting and resting.

Below, snowmobiling and related tasks are categorized by the METs required to perform. Activities that require a similar amount of energy are also provided for comparison.

Snowmobiling and related tasks	How much energy it uses	Activities that use a similar amount of energy
Groomed Trail Riding (Haliburton, ON)	3.8 ± 1.5 METs	Bicycling for leisure at 8.9 kph (3.5 METs) Calisthenics (push-ups, sit-ups, pull-ups, jumping jacks, moderate effort) (3.8 METs) Volleyball (4 METs) Walking at a brisk pace (4.3 METs)
Backcountry Riding (Maniwaki, QC)	5.5 ± 2.8 METs	Softball or baseball (5.0 METs) Golf, pulling clubs (5.3 METs) Downhill skiing/snowboarding (5.3 METs) Shoveling snow, moderate effort (5.3 METs) Badminton, social (5.5 METs) Jog/walk combination (6.0 METs)
Mountain Riding (Revelstoke, BC)	7.3 ± 1.9 METs	Cross-country skiing (light) (6.8 METs) Jogging (7 METs) Soccer (casual) (7.0 METs) Climbing hills carrying 4.5 - 9 kgs (7.3 METs) Bicycling at a moderate pace (7.5 METs)
Digging out your sled	8.3 ± 3.0 METs	Wheelchair basketball (7.8 METs) Hockey (non-competitive) (8.0 METs) Football, competitive (8.0 METs) Running 8 kph (8.3 METs) Mountain biking (8.5 METs)

Energy expenditure of 'similar activities' collected from: Ainsworth BE, Haskell WL, Herrmann SD, Meckes N, Bassett Jr DR, Tudor-Locke C, Greer JL, Vezina J, Whitt-Glover MC, Leon AS. The Compendium of Physical Activities Tracking Guide. Healthy Lifestyles Research Center, College of Nursing & Health Innovation, Arizona State University. Retrieved June 26, 2018 from https://sites.google.com/site/compendiumofphysicalactivities/AVERAGES

HOW MUCH PHYSICAL ACTIVITY DO YOU GET DURING A REGULAR DAY OF SNOWMOBILING?

In addition to the snowmobile ride itself, a day of snowmobiling involves a lot of different activities that could require you to get your body moving. These might include loading/unloading from a trailer, filling up with gas, performing repairs, digging out your sled, removing snow from the tracks, and clearing the way ahead, among other activities. Because of this, the amount of activity involved in a day of snowmobiling might be considerably higher than the values listed above. And, the amount of energy listed above are average values; during particularly difficult portions of a ride, snowmobiling requires more energy than the 'average'. Working at moderate and vigorous intensities maximizes the benefits of physical activity and uses energy faster. For example, a 1-hour snowmobile ride at a vigorous intensity might burn 600 calories, but a 1 hour ride at a low to moderate intensity would only burn 250 calories**.

The research on snowmobiling and physical activity was performed on short test rides that were designed to represent a typical snowmobile ride in a variety of locations (mountain riding, groomed trail riding, and backcountry riding). However, most people ride for several hours at a time and may cover a few hundred kilometres. In fact, the average snowmobile ride on groomed trails is 6 hours, and on mountain terrain is 5 hours. Therefore, a single snowmobile trip might help you accumulate a fairly large amount of physical activity.

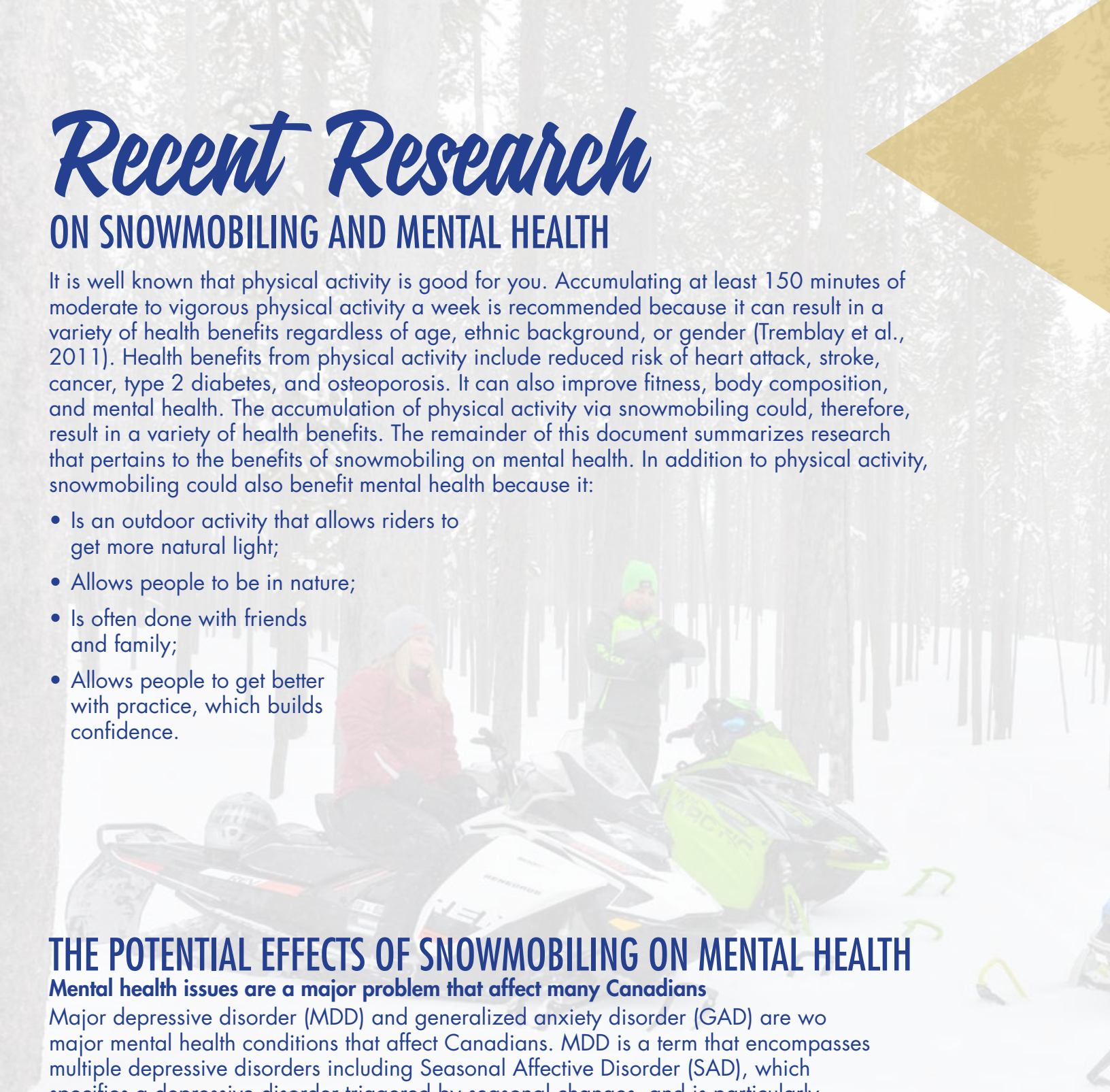
** Calorie values are estimated and would vary based on body weight, riding style, and intensity

Recent Research

ON SNOWMOBILING AND MENTAL HEALTH

It is well known that physical activity is good for you. Accumulating at least 150 minutes of moderate to vigorous physical activity a week is recommended because it can result in a variety of health benefits regardless of age, ethnic background, or gender (Tremblay et al., 2011). Health benefits from physical activity include reduced risk of heart attack, stroke, cancer, type 2 diabetes, and osteoporosis. It can also improve fitness, body composition, and mental health. The accumulation of physical activity via snowmobiling could, therefore, result in a variety of health benefits. The remainder of this document summarizes research that pertains to the benefits of snowmobiling on mental health. In addition to physical activity, snowmobiling could also benefit mental health because it:

- Is an outdoor activity that allows riders to get more natural light;
- Allows people to be in nature;
- Is often done with friends and family;
- Allows people to get better with practice, which builds confidence.



THE POTENTIAL EFFECTS OF SNOWMOBILING ON MENTAL HEALTH

Mental health issues are a major problem that affect many Canadians

Major depressive disorder (MDD) and generalized anxiety disorder (GAD) are wo major mental health conditions that affect Canadians. MDD is a term that encompasses multiple depressive disorders including Seasonal Affective Disorder (SAD), which specifies a depressive disorder triggered by seasonal changes, and is particularly prevalent during the winter months (American Psychiatric Association, 2013).
By the age of 45 (average age of a snowmobiler (The International Snowmobile Manufacturers Association ISMA, 2018), about half of Canadians have experienced or will experience some form of mental illness or disorder (Mental Health Commission of Canada, 2013). MDD is the second leading cause of global disability (Ferrari et al., 2013) and MDD-linked suicide is the third leading cause of death for individuals aged 10 - 24 years old (McArdle, Katch, & Katch, 2006). GAD is also quite prevalent, as 4.9 % of individuals older than 14 years display at least two of the disorder's three diagnostic criteria (Gilmour, 2016).

Physical activity that occurs during snowmobiling can positively affect mental health

Regularly performing physical activity is beneficial for both physical health and mental health. Physical activity can combat changes in the brain that occur during depression and anxiety (Mikkelsen, Stojanovska, Polenakovic, Bosevski, & Apostolopoulos, 2017). For example, it can improve sleep, enhance brain blood flow, and alter brain structure. Physical activity can also have positive effects on brain structure, stress hormones, inflammation, and the production of neurotransmitters. Similar to other OHV activities, snowmobiling has a large aerobic component (Burr, Jamnik, Shaw, & Gledhill, 2010), and could, therefore, assist in the prevention and treatment of GAD and MDD symptoms.

Snowmobiling could help treat symptoms of depression and anxiety

MDD is typically treated by antidepressant medications, and GAD treatment usually involves medications and/or cognitive behavioral therapies. These treatments are often effective, but can have high reoccurrence rates (Bockting et al., 2008), and various side effects (Fava et al., 2006). Physical activity is as effective or more effective than medications at reducing MDD and GAD (Blumenthal et al., 2007), and can often be effective for patients who don't respond to traditional treatments. Importantly, physical activity in combination with medication can be more beneficial than either treatment alone (Schuch, Vasconcelos-Moreno, Borowsky, & Fleck, 2011). Adding snowmobiling to regular treatment therapy could, therefore, help alleviate symptoms.

A single bout of physical activity can have positive effects on mental health that last up to a week

Many snowmobilers ride on weekends but find it difficult to ride every day. However, because of the prolonged effects of physical activity on mental health (LeBouthillier & Asmundson, 2015), a weekend ride can continue to confer mental health benefits for the rest of the week.

Outdoor physical activity is more beneficial to mental health than indoor physical activity, particularly when performed in the wilderness

During the winter it may be difficult for individuals to be get outdoors, leading to a 15 - 20% reduction in average physical activity time (Pivarnik, Reeves, & Raferty, 2003). Individuals often experience more anxiety and depressive symptoms during the winter because of the long nights, cold weather, and lack of outdoor activity. Snowmobiling provides an opportunity for people to get outdoors and experience nature during the winter months. Interacting with nature can improve cognition (Berman et al., 2012), decrease stress, and improve self-esteem in adults with depression (Bratman, Hamilton, Hahn, Daily, & Gross, 2015), and exposure to natural light can also positively change depressive symptoms (Pinchasov, Shurgaja, Grischin, & Putilov, 2000).

Physical activity with friends or family can improve mental health by increasing feelings of support and distracting from worrying

Snowmobiling is a group activity that can strengthen social networks, which may combat the feelings of social isolation often encountered by those with depression (Pels & Kleinert, 2016). Furthermore, when people are enjoying physical activity, they are distracted from negative self-thoughts (Mikkelsen et al., 2017). Snowmobiling offers a range of natural scenery and varying/technical terrain that act to distract a rider from negative self-thought, particularly if the person enjoys snowmobiling. Activities that challenge a person mentally and physically at the same time have a larger ability to alleviate depressive symptoms (Nolen-hoeksema & Morrow, 1993). While snowmobiling, a rider is physically active while they are also challenged cognitively by choosing their snowmobiling path or route on the trail, adjusting their speed, following directions, and being aware of other riders/potential dangers. The social connections that are strengthened during snowmobiling, while performing physical and mental work, make snowmobiling an excellent way to alleviate the symptoms of GAD and MDD.

Physical activity can build confidence and reduce feelings of anxiety

Physical activity can build confidence and reduce feelings of anxiety. Particularly when learning to ride a snowmobile, the confidence that is gained by mastering the activity can help reduce feelings of anxiety (Bodin & Martinsen, 2004). For example, a beginner snowmobiler can be exposed to riding terrain which requires techniques that they may not be able to perform at first. However, as the rider learns and practices, they will master those techniques and improve their self-confidence, which could reduce symptoms of GAD. A barrier to exercise among people with GAD is that some of the outcomes of exercise are similar to anxiety symptoms or attacks (increased heart rate, breathing, etc.), and thus they avoid exercise (McWilliams & Asmundson, 2001). However, by gradually increasing exposure to these sensations via snowmobiling, a person could become habituated to these sensations and become comfortable with the idea of exercise as an anxiety treatment (Anderson & Shivakumar, 2013).

Seasonal affective disorder (SAD) most frequently occurs in winter. Performing physical activity via snowmobiling could be an effective way to combat the symptoms of SAD

Snowmobiling increases exposure to natural light, outdoor time, and physical activity, which are all typically reduced during the winter. All of these factors are effective for the treatment of depressive symptoms. Snowmobiling, as a winter activity, is accessible during the time of year that the effects of SAD are most prevalent and could, therefore, be a convenient way for individuals with SAD to reduce their symptoms.

Glossary of Terms

Physical Activity – Body movement that requires energy expenditure. Physical activity can be divided into low, moderate, high, and very high intensity. To accrue health benefits, physical activity should be at least moderate intensity.

VO_2 – The rate of oxygen consumption that a body is using to convert energy from the food you eat to energy molecules called adenosine triphosphate. When you exercise harder, you use more oxygen. VO_2max (the maximum amount of oxygen that your body can use) is a measure of fitness. VO_2 is often expressed relative to body weight and uses the units '$ml \cdot kg^{-1} \cdot min^{-1}$'.

VO_2Reserve (VO_2R) – The difference between your resting VO_2 and maximal VO_2. Exercising at 40 to 60 % of your VO_2R represents moderate intensity exercise, 60 – 85% VO_2R represents high intensity, and 85 % or more represents very high intensity exercise.

Metabolic Equivalent of Task (MET) – a way of expressing the energy cost of a physical activity in relation to the energy that you use during seated rest. The average resting metabolic rate is 3.5 $ml \cdot kg^{-1} \cdot min^{-1}$, or about 1 $kcal \cdot kg^{-1} \cdot h^{-1}$. The METs used during a specific exercise can be determined by taking the VO_2 used during that exercise and dividing by 3.5 $ml \cdot kg^{-1} \cdot min^{-1}$. For example, walking slowly requires 10.5 $ml \cdot kg^{-1} \cdot min^{-1}$, therefore, if we divide 10.5 $ml \cdot kg^{-1} \cdot min^{-1}$ by 3.5 $ml \cdot kg^{-1} \cdot min^{-1}$, we get 3. Walking slowly requires 3 times more energy than sitting quietly and is represented as 3 METs.

Major Depressive Disorder (MDD) – also known as depression, is a group of mental disorders characterized by at least two weeks of low mood that is present across most situations. It is often accompanied by low self-esteem, loss of interest in normally enjoyable activities, low energy, and pain without a clear cause.

Generalized Anxiety Disorder (GAD) – a psychological disorder characterized by excessive or disproportionate anxiety about several aspects of life, such as work, social relationships, or financial matters.

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Did You Know?

Snowmobiling is physical activity.

Physical activity can positively affect mental health.

Physical activity can help treat symptoms of depression and anxiety. Major depressive disorder is the second leading cause of global disability, and generalized anxiety disorder affects about 5% of Canadians.

A single bout of exercise can have positive effects on mental health that last up to a week.

Outdoor physical activity is more beneficial to mental health than indoor physical activity, particularly when performed in the wilderness.

Physical activity with friends or family can improve mental health by increasing feelings of support and distracting from worrying.

Physical activity can build confidence and reduce feelings of anxiety.

Seasonal affective disorder (SAD) most frequently occurs in winter. Performing physical activity via snowmobiling could be an effective way to combat the symptoms of SAD.

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