

Montana State University professor, students conduct research on the slopes

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For people who would like to be better skiers and enjoy the sport more, Montana State University professor John Seifert has some tips.

Seifert, a health and human development professor, and a handful of MSU students regularly conduct a variety of skiing-related research, often at Bridger Bowl, the local ski hill just north of town. Together, they search for the answers to many questions, such as "Do sports and [energy drinks](#) help people perform better?" "What gear performs the best in various conditions?" "What is the ideal placement for snowboard bindings to maximize comfort when riding?" And, "How does hydration affect people's performance and level of comfort when skiing?"

Seifert, an internationally recognized expert on alpine skiing research, categorizes his current work into four different areas: muscle function and fatigue; physiological studies, such as the effects of dehydration; the effects of sports drinks and other nutritional supplements; and how equipment - such as powder skis - affect the bodies of people who are using them.

"The studies are really interesting, and they're a lot of fun," said Jen Portmann, an MSU graduate student in exercise physiology who has been performing research with Seifert. "The people we work with are great, and we get to be up on the hill a lot. Occasionally we get to go skiing, too!"

Portmann is one of about half a dozen students -- some graduate

students, others undergraduate -- with whom Seifert currently works. In the nearly 20 years that Seifert has been conducting skiing-related research, he and dozens of students have completed many different projects. And, Seifert has many more studies on the horizon. He focuses primarily on downhill skiing, although he has done some work related to snowboarding and cross-country skiing, too.

One of Seifert's current projects examines the [energy expenditure](#) of ski patrollers. Seifert said it's important to know how hard patrollers are working when trying to understand their skiing-related injuries, because patrollers have a particularly high injury rate.

"Approximately 30 percent of ski patrollers are injured each season, with eight to 12 injuries at Bridger Bowl," Seifert said. Some of these injuries are recurring, such as chronic back or neck pain, while others are one-time only injuries.

To measure energy expenditure, Seifert has each patroller wear a mask, as well as a backpack with two analyzers attached to it, as he or she transports skiers off the mountain via toboggans. Small tubes connect the mask -- which makes participants look remarkably similar to the storm troopers characters in the Star Wars movies -- to the two analyzers. When patrollers breathe into the mask as they ski, the analyzers measure three things: the volume of air, the oxygen concentration the patrollers expire, and the carbon dioxide concentration they expire.

Using these measurements, Seifert can calculate a patroller's oxygen uptake, which shows how hard they're working -- a critical piece of information that allows Seifert to calculate their energy expenditure. Seifert and the students also tracked the patrollers' heart rates and monitored their hydration levels.

What they found is that when patrollers are performing avalanche

control, they are exceeding their functional expenditure threshold and approaching maximum heart rates for sustained periods of time, to the point where it can be dangerous.

"There is a tremendous energy cost to patrollers performing their jobs," Seifert said.

"The take-away is that patrollers' fitness levels are extremely important," Seifert said. "They don't have to be marathoners, but they should be in fairly good shape if they want to maximize enjoyment and minimize risk."

The bottom line, he added, is that fit skiers are less likely to be injured on the slopes. And while most ski patrollers are fit, Seifert added, a more focused training program could benefit them. To that end, Seifert would like to put together a training program for patrollers.

"These findings are important because they can benefit everyone from ski patrollers to recreational skiers," Seifert said. "More knowledge and understanding can help all of them stay safe."

Seifert and MSU graduate student Sarah Williams are working on another study to determine the best kind of material with which to make climbing skins. Funded by a company that manufactures climbing skins, the study will examine the effectiveness of a variety of different materials, including mohair and synthetic.

Williams and Seifert will measure the time it takes their participants to ski a course, as well as the participants' heart rates. These measurements will be taken as the skiers use a variety of different types of skins in controlled conditions.

"If you're slipping more, you'll have to change your body mechanics,"

Williams said. "For example, if you have to bend your knees more to prevent slipping, it pumps up your heart rate. This probably means the skin you're using isn't as good."

The findings will enable the researchers to rate the skins.

Williams thinks the results of the study will be of interest to people in Bozeman, Mont., and other skiing communities.

"People are curious about how small factors affect their performance," she said. "People want to ski better and improve. They're interested in what kind of products to use and how their bodies respond to different conditions.

"This study will help people make informed decisions about the gear to use," she added.

Another two-part study examines how powder skis behave in deep powder versus groomed runs and also determines the energy expenditure of skiers on groomed runs versus deep powder. The study relies on the use of accelerometers, tiny instruments the researchers mount above a ski binding that measure tilt and acceleration of the ski.

Seifert has found that skiers' heart rates are from five to 10 percent greater when they ski groomed runs on powder skis instead of on skis of normal width. Meanwhile, acceleration when using powder skis on groomed runs is, on average, about 50 percent greater.

"Large stresses are incurred by a skier using powder skis on groomed runs," Seifert said. "It's a lot harder to make turns, and the skiers have to do something to deal with increased acceleration. They either have to ski faster or produce more force to slow the skis down."

His conclusion is that powder skis should be used on powder runs, not on groomed runs.

"Using powder skis on groomers beats your body up a lot," he said.

It's not only people on the slopes - who sometimes ski up with questions or shout queries from the lift - who are interested in Seifert's work. It has also distinguished him in academic circles. Seifert has published numerous scientific articles in journals ranging from the "International Journal of Sport Nutrition and Exercise Metabolism" to "The Science Journal of the American Association for Respiratory Care." He is an active participant in the International Congress on Science and Skiing and regularly collaborates on studies with researchers in Europe. He also has been quoted in several newspaper articles, including a recent Wall Street Journal story about cold-weather masks, or devices designed to warm and humidify the air people breathe to protect lungs from cold weather.

Much of Seifert's motivation for his work comes simply from having developed a curiosity about the mechanics of skiing.

"Skiing really is challenging, with its physical, mental and mechanical aspects," Seifert said. "I'm the type of person who wants to know how and why things work."

Seifert's background in ski racing and desire to make himself a better skier also contributed to his decision to pursue research related to skiing, he said.

Seifert grew up alpine skiing in southern Minnesota and raced throughout college. He continued skiing while pursuing a master's degree and doctoral degree at Boise State University and then the University of Utah. He also worked with the U.S. Ski Team's testing and training

program.

"I wanted to perform as well as possible," he said. "I wanted to be faster and also improve my training off the snow. All of these things motivated me to do research."

Most of all, Seifert loves being outdoors, even in the cold and sometimes inclement weather. "You just put on more clothes when it's cold out," he said.

And, doing research on skiing doesn't make skiing itself any less fun for Seifert.

"Let me put it this way," Seifert said. "I've never been happy to see the ski season over."

The students who work with Seifert are equally enthusiastic about their research. Next winter, Portmann, now 22, and Williams will present their research findings at the International Congress on Science and Skiing, which will be held in St. Christoph, Austria. Portmann's topic is energy expenditure of avalanche crew members who transport patients.

She's interested in pursuing a career in cardiac rehabilitation and says her experiences at MSU have been valuable preparation in conducting research - as well as fun.

"It's great to get to be up on the hill so much," she said. "How many other students get to say that skiing is part of their studies?"

Provided by Montana State University

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