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July 22 / volume 14 / number 7

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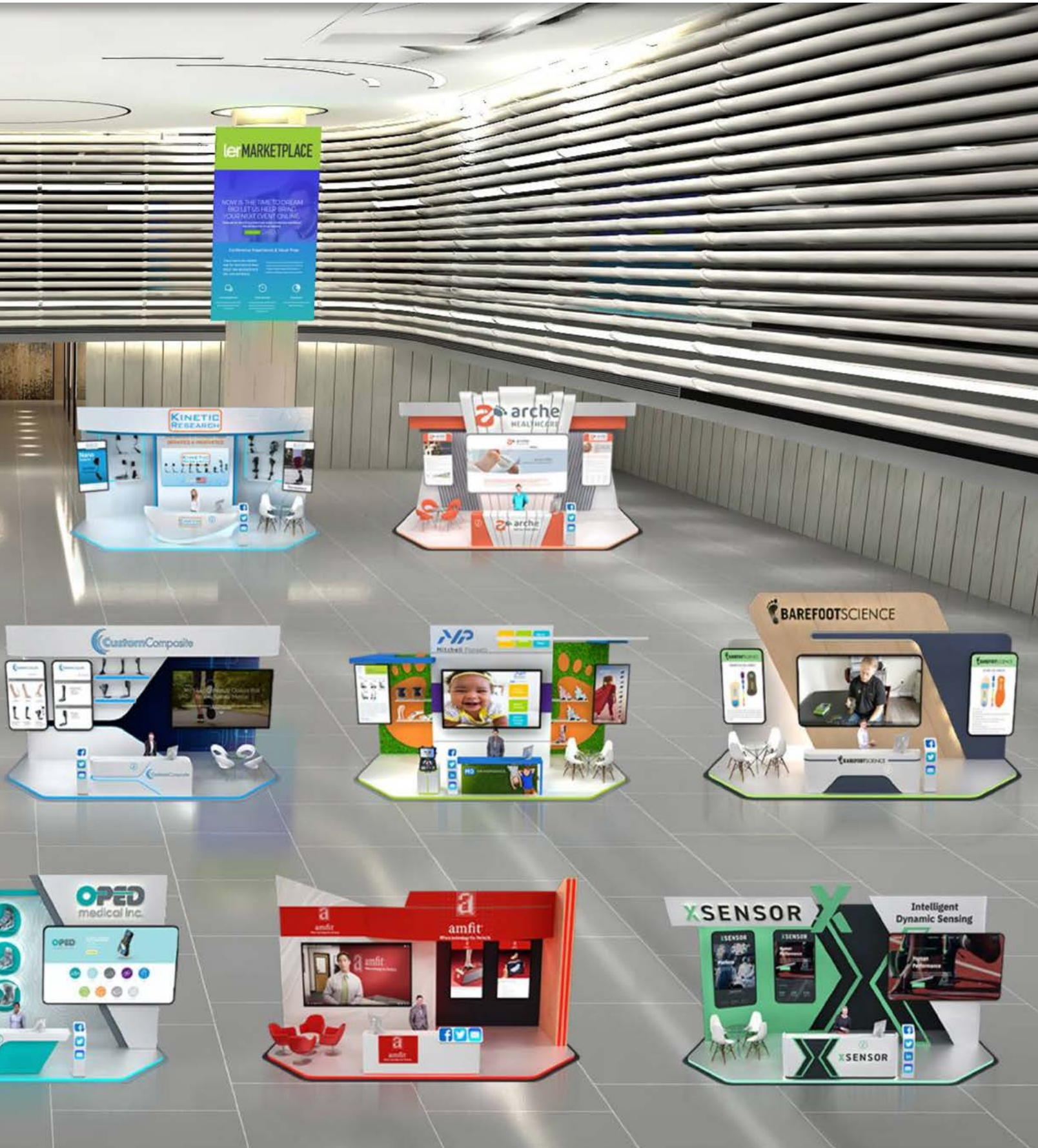

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Lower Extremity Review

Lower Extremity Review informs healthcare practitioners on current developments in the diagnosis, treatment, and prevention of lower extremity injuries. LER encourages a collaborative multidisciplinary clinical approach with an emphasis on functional outcomes and evidence-based medicine. LER is published monthly, except for a combined November/December issue and an additional special issue in December, by Lower Extremity Review, LLC.

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Lower Extremity Review Mission

Showcasing evidence and expertise across multiple medical disciplines to build, preserve, and restore function of the lower extremity from pediatrics to geriatrics.

EDITORIAL PILLARS

- Biomechanics matter
- Movement is essential
- Injury prevention is possible
- Diabetic foot ulcers can be prevented
- Collaborative care leads to better outcomes

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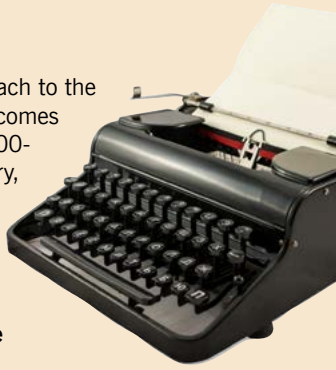
LER encourages a collaborative multidisciplinary clinical approach to the care of the lower extremity with an emphasis on functional outcomes using evidence-based medicine. We welcome manuscripts (1000-2000 words) that cross the clinical spectrum, including podiatry, orthopedics and sports medicine, physical medicine and rehabilitation, biomechanics, obesity, wound management, physical and occupational therapy, athletic training, orthotics and prosthetics, and pedorthics.



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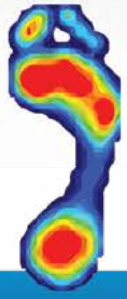

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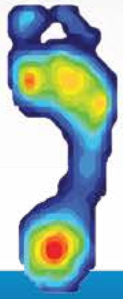

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13 Years of Making Things Happen!

Anything in life is possible, if you make it happen.
Jack LaLanne

BY RICH DUBIN, PUBLISHER

It is hard to believe that we are celebrating 13 years…that's right, *Lower Extremity Review* turns 13 this month and I am so grateful for everyone who has participated in our success. This publication was born out of a belief that this market deserves a unique voice, one that speaks to all corners of it – from podiatrists to sports medicine specialists, from physical therapists to orthotists, from prosthetists to biomechanists, from wound care experts to athletic trainers. And we strive everyday to collaborate with authors and content creators from every corner because we really do believe that collaborative care leads to better outcomes.

When I see how far we have come, and what all lies ahead, I am very excited and deeply appreciative of all those who have generously shared anecdotes, criticisms (mostly constructive), stories, and 'advice,' and have referred us to authors and new partners. We believe in continuous improvement here and we need your input to keep the innovations coming.

We also believe in making things happen. Despite the pandemic, heck maybe because the pandemic, we were able to launch lerEXPO, our online events platform where we host the most fun educational events on the planet! It's true, read our reviews! I'd been working with this idea on and off for more than 5 years and was this close – then BAM! – the pandemic strikes and I figured, leap of faith, go for it. And launch we did – in June 2020. Since then, we've been promoting and hosting a progressively larger number of monthly educational events on a range of topics with a range of experts. Visit lerEXPO.com to sign up for upcoming events and to have access to past events as well. Everything is recorded so if you can't make the main event, you can at least hear it later. Get CEs in your own home, on your own screen, in your own time – and you get to set the dress code! We've had great response, with over 7000 attendees online for all our events averaging over 400 for a single event - that's the size of an in-person meeting plenary session; so, you get to meet new people, address professional requirements while learning something new, and all with no travel expenses.

Hosting and moderating the sessions on **lerEXPO** has been a real growth experience for me, but one I am enjoying embracing. Caring for the lower extremity requires a village and I never ceased to be amazed how when I'm dealing with one expert on a topic, they generously tell me who else's opinion I should seek out and why. Every lerEXPO session proves that relationships matter. And I am grateful to acknowledge all those who have participated in lerEXPO events and hope we get to work with you again. It's been a blast on my end, and from the reviews, we're pretty certain that the audience is thrilled with the educational platform as well.

And then we were able to launch **lerMARKETPLACE**, an online trade show like no other because there truly isn't anything like it out there that we are aware of. It's an opportunity for online-users to get information about a product straight from the manufacturer via an online interface – it's more than a webpage, it's your personal channel for getting

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answers to critical product-related questions in a timely manner.

For the long-term, we're developing **lerEDUCATE** which will continue to provide online CEs in a learning management system and **lerAUDIO** which will be the next level of digital conversation with authors and product specialists. I say this to show you how committed we are to helping you grow.

lerEXPERT continues to help practice owners hone their business and marketing game to stay relevant in the today's fast-paced market.

All of this growth is made possible by the continued support from readers and advertisers of our flagship magazine, *Lower Extremity Review*. As you'll read in the *Editorial Observations* piece (page 13) by our editor, Janice Radak, we will be adding a 5th pillar to our editorial coverage, 'Movement is essential.' As our understanding of the role of physical activity and movement in general grows, the need to encourage your clients to move physically gets more real every day. *LER's* goal will be to provide the most recent evidence supporting that guidance so you can feel confident in the recommendations that you make. Janice works with authors from around the world and is happy to talk to you if have a story idea – reach out to her at janice@lermagazine.com for a chat.

If this was a birthday party, now would be time for the big wish and blowing out the candles on the cake. But I'll just take this moment to thank all of the authors who have provided content, all of the manufacturers who have provided support and sponsorships, and all of the readers and online users who have shown support of this little magazine for all these years.

I am truly humbled and forever grateful to be surrounded by such great people who all share the same goal: to make things happen to keep the lower extremity functional and safe.

Happy birthday to us!

CALL FOR MANUSCRIPTS

The Editors of *Lower Extremity Review* want to highlight the work of thoughtful, innovative practitioners who have solved their patients' vexing problems. We are seeking reports of your most intriguing cases in the following areas:

- Biomechanics
- Falls and other injury prevention
- Benefit of movement
- Prevention of diabetic foot ulcers
- Collaborative care

Before you begin to write, query the Editors about your proposed topic (email is fine). Doing so ensures that your manuscript will conform to the mission of the publication and that the topic does not duplicate an article already accepted for publication. Furthermore, a query often allows the Editors and the publication's advisors to make recommendations for improving the utility of the manuscript for readers.

Case reports should be no more than 1500 words (not including references, legends, and author biographies). Photos (≤4) are encouraged. Case reports can include a literature review as is appropriate for the topic. (Please note that for HIPPA compliance, photos should be de-identified before sending.)

Manuscripts must be original and not under consideration for publication elsewhere. Any prior publication of material must be explained in a cover letter.

All authors must be medical professionals in good standing. Students will be considered as first author only when the byline includes a fully licensed professional.

Manuscripts are submitted with the understanding that they will be reviewed; that revisions of content might be requested; and that the editorial staff will undertake editing, as necessary, aimed at improving clarity and conciseness and applying conformity to style. Authors will have the opportunity to review and approve the edited version of their work before publication.

The Editors reserve the right to reject any unsolicited or solicited article that does not meet with editorial approval, including approval denied following requested revision.

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EDITORIAL OBSERVATIONS

Movement Is Essential

Every avalanche begins with the movement of a single snowflake, and my hope is to move a snowflake.
Thomas Fey

By Janice T. Radak, Editor

Happy 13th birthday *Lower Extremity Review*! Like any growing teenager, we've been through some changes, but there are plenty more still to come!

Just before the pandemic started, we began to identify and understand what *LER*'s users wanted to learn more about so we could better focus our coverage. Mobility and all that keeps us moving topped that list. And key to mobility, you guessed it, is the lower extremity! Our findings led to the development of the 4 pillars of editorial coverage which were introduced in June 2020:

- Biomechanics matter
- Injury prevention is possible
- Diabetic foot ulcers can be prevented
- Collaborative care leads to better outcomes.

While these 4 pillars identify critical areas, when you look at the literature overall, a far bigger picture emerges in 2022: bodies that are physically active have better health and quality of life outcomes.

And so, as we enter our 13th year, we are adding a new pillar of coverage: Movement is essential. We use movement to mean physical activity (PA), where PA is defined as any voluntary bodily movement produced by skeletal muscles that requires energy expenditure. Indeed, the evidence is pretty clear that movement does a body good. In its 2018 report,[1] the Physical Activity Guidelines Advisory Committee (PAGAC) found robust evidence to show that:

- There is a dose-response relationship between sedentary behavior (SB) and all-cause and cardiovascular disease (CVD) mortality risk, as well as a direct relationship with CVD, type 2 diabetes (T2D), and certain cancers. However, the risk associated with SB can be attenuated with greater amounts of moderate-to-vigorous physical activity (MVPA).
- PA lowers weight and fat gain and is associated with better bone health, even in children as young as 3 years.
- In older adults, multicomponent PA reduces risk of fall-related injuries; aerobic and multicomponent PA and balance activities improve physical function in the general population, as well as in those with frailty or other chronic conditions.
- Regular PA helps reduce the incidence of hypertension.
- Both the risk of T2D and the risk of its progression can be reduced with MVPA, aerobic, and dynamic resistance exercise—independent of weight status.
- PA prevents weight gain and helps maintain healthy body weight in both adults and children and is strongest for those who spend >150 min/week in moderate-intensity activity.
- PA improves cognitive function across the lifespan, quality of life, symptoms of anxiety and depression, and sleep.

This issue is dedicated to all of the benefits provided by movement in all its forms—physical activity, exercise, resistance, whatever you want to call it. We pulled together articles that examine ways to reduce sedentary behavior and the myriad benefits that accrue when patients are encouraged to move—from improved glucose metabolism to the prevention of loss of muscle mass.

We also include the Physical Activity Guidelines for Americans as well as a discussion of resistance and high intensity interval training in older adults. The data is clear: Movement is safe for most people. Starting small and gaining confidence is key to getting patients engaged enough to do more.

And we also address what physical activity can do for two common and critically important conditions: plantar fasciitis and diabetic peripheral neuropathy—yes, exercise can be a logical part of a therapeutic regimen for both of these conditions. And we also introduce you to an innovation that could transform how you think about walker assist devices.

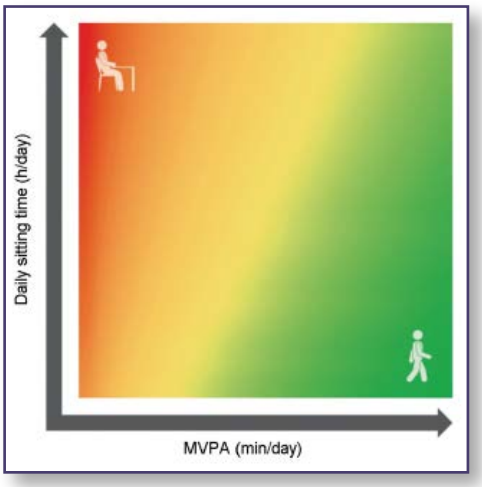

Figure. Relationship among moderate-to-vigorous physical activity (MVPA), sitting time, and risk of all-cause mortality. The red zone illustrates greater mortality risk with higher amounts of sitting time combined with low levels of MVPA (top left corner). The green zone illustrates how higher amounts of MVPA can mitigate the risk of even moderate-to-high levels of sitting time (top right area). Reprinted with permission from reference 1. All rights reserved.

Just as we do for the other 4 pillars, we will be covering 'Movement is essential' in every issue. As the Baby Boomers age and more need guidance on how to stay or start becoming physically active, the message of this pillar will only grow in importance.

We welcome your thoughts on the topic… please feel free to email me at janice@lermagazine.com.

Here's to making movement essential everyday.

Reference

1. DiPietro L, Buchner DM, Marquez DX, Pate RR, Pescatello LS, Whitt-Glover MC. New scientific basis for the 2018 U.S. Physical Activity Guidelines. J Sport Health Sci. 2019;8:197-200.

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GUEST PERSPECTIVE

I Agree! Movement Is Essential!

Better to wear out than rust out.
Jack LaLanne

By Robert Weil, DPM

Happy 13th Anniversary *LER*!! So happy to see the new editorial pillar and can't wait to see the growing body of evidence that supports the idea behind Movement Is Essential.

Humans are made to move – it's essential, it's healthy, it's fun! Restrictions and problems with movement, like pain and discomfort from injuries and certain medical conditions, have always been challenging. This new pillar of editorial coverage joins *LER*'s other forever goals in striving to educate and inform its readers in all health fields about the importance of movement in our own, our patient's, and our client's lives. It's critical for so many reasons. Whether for overall health, physical activity, sports, joint health, weight management, stress control, or whatever, movement is KEY. So key, in fact, I include Keep Moving as part of "The New Medicine" that I talk about with my multidisciplinary radio guests. Keep Moving goes right along with eating smarter and reducing stress!

Let's explore some of these key areas in the essential world of movement.

Our overall health relies on our ability to move – to walk, sit, turn, play – and to do it comfortably. Movement also can have an aerobic, peace-of-mind component, breathing and thinking as we move. At its highest levels with all sports, movement can be fast, slow, explosive, graceful, powerful, even artful. At its most basic, it involves everything we all do at whatever level, like writing these words and turning the page.

Any activity that is physical, like sitting down, getting up, using stairs, standing, and walking, requires multi-joint and muscle movement. So does throwing a ball, swinging a golf club and going for a jog. So does all the finger action with our cell phones or brushing our teeth! Some is just more intense and gets your heart rate moving faster – and that's a very good thing.

Of course, another of *LER*'s forever goals is to consistently educate its readers in all the ways to facilitate important components like identifying, evaluating, and strengthening all the biomechanics that contribute to healthy movement like range of motion, flexibility, balance, and stability of joints. Starting, stopping, turning with control are other examples. When these actions are lacking, problems can follow. Lack of coordinated movement of all these components leads to trouble like soreness, stiffness, pain, and too often, arthritic concerns. The importance of proper posture and alignment are also key parts of comfortable pain-free movement always stressed by *LER*.

Sports movement can be electric: running, jumping, throwing, swinging, dancing, skating, all come to mind. So much of sports medicine is about helping patients of all ages do these activities and movements safely and preventing injuries in adults and kids. Overuse and repetitive motion injuries are constant challenges in youth sports as well as in the older ages. Yes, movement is great, but too much, too aggressive, and injury-causing ain't so great!

Lack of consistent, comfortable, efficient movement causes and contributes to all sorts of unhealthy effects. Muscles can atrophy and weaken due to disuse from pain and discomfort. Joints can become stiff, painful, and arthritic. Movement is essential to keep these at bay.

So encourage your patients of all ages to exercise, to at least keep moving! One of our best strategies for both keeping a healthy weight and reducing stress is movement – it can be as simple as a daily walk. Walking is one of the safest, heart-effective weight-control methods we have and it's a great way to control and reduce stress. Just be in the right shoes! ler

Robert A. Weil is a sports podiatrist in private practice in Aurora, Illinois. He hosts The Sports Doctor, a live weekly radio show on bbsradio.com. His book, #HeySportsParents, written with Sharkie Zartman, is available on Amazon.com. Dr. Weil was inducted into the prestigious National Fitness Hall of Fame in April 2019.

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GUEST PERSPECTIVE

"Small Ball" Can Prevent Falls

Change starts with awareness.
Chris Prentiss

By Ben Pearl, DPM

Many of us do not have to look far when it comes to the devastation that falls can have, particularly as we age. We all know the stats: The increase in morbidity and mortality after a hip fracture from an errant step. It is no coincidence that the US has the highest incidence of hip fractures. This has only been made worse, no doubt, by the change in habits that has occurred during the pandemic. When my mother was young, she was a graceful equestrian and diver. She skied by the time I came along but slowly succumbed to the steady decline that many Americans suffer. I would implore her to take a walk and get moving. Over the years, I noticed that her walking became more unsteady. She did not take me up on my "prescription," but I did get her to walk occasionally when I came over. I got a call one evening that my mom had fallen, broken her neck, and suffered a massive stroke. Many times, these tragic events happen with the cardiac or clot event preceding the fall, but here's the thing: John, her significant other, saw her hook her ankle on the low-profile coffee table as she was carrying a tray of plates from the living room back to the kitchen. Perhaps if she had done some modest exercises at home, her fall may have been prevented. If nothing else, walking more regularly to try to control her weight and help her heart health may have helped.

Recently I had an interesting conversation with Rich Dubin, the publisher of this magazine, regarding the benefits of making small things happen in people's lives. Why the rush to the "big surgery"? What's wrong with a simple splint or a set of exercises to help someone be more steady and walk better? Does an intervention always have to be a homerun? What's wrong with a base hit or a double?

Rich happened to have played basketball that morning at 5:30 am before I caught him on the phone and he commented, just keep playing "Small Ball"! Rich made a decision to play at 5:30 to knockout his workout for the day. That may be a big step for some of us. But the evidence is clear that a series of many "small" decisions to be active and healthy will pay dividends over the long haul.

Fall prevention and balance is currently a hot topic. During the pandemic, there have been more falls around the home. I had one patient who fell after stepping on glass barefoot and changed her foot position taking trash outside down her steps. The information on the cognitive and proprioceptive piece of falling has exploded. It turns out we do fall more when we are task-overloaded, but we can also train to challenge ourselves with cognitive tasks. "Barefoot science" (the evidence delineating the benefits of going barefoot) has also exploded, but we need to do these intrinsic exercises along with the bigger levers, i.e., glute and trunk strengthening to make a more impactful difference.

> The evidence is clear that a series of many "small" decisions to be active and healthy will pay dividends over the long haul.

Health education is a big deal for patient outcomes. But patients need help finding appropriate exercise information. If you make or refer to patient information videos on exercises, etc., patients can then refer to those when they are at home and they need repetition and reinforcement. Check out this 5-minute FitFootU video I did with former pro goalkeeper for Manchester United and current strength and conditioning coach, Andrew Dystra--our focus is on balance drills that help not only soccer players, but can help everyday people stay healthy and upright and in their own homes: https://youtu.be/iT-sH2dfKQJw

This issue of *Lower Extremity Review* is full of evidence-based information to help tweak

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Continued from page 17

some of your current approaches with patients. The critical thing about physical activity interventions is that guided physical therapy is great, but at the end of the day patients need to be more consistent with small little exercises—bite-size moments of physical activity that they can do waiting for a subway or in line at a grocery store because it is difficult to sustain longer therapy sessions at home.

The pandemic has irreversibly opened our eyes to the platform of telemedicine which is a great way to provide continuity for our patients with follow up and in some cases entry screening. Finally, the new virtual platforms–like lerEXPO and FitFootU–have offered us alternatives to in-person medical meetings that offer no travel cost, more time because of no travel, and a lower carbon footprint on our planet at a time when gas prices are constantly changing. In-person networking is still essential to our professional growth, but we now have robust alternatives—small steps in keeping our networks alive.

"Small Ball" may not be as financially rewarding for you the practitioner in the short term, and may not be as sexy as the latest, greatest surgical procedure, but a satisfied patient will bring you more patients, and more importantly, you will be helping your patients one small step at a time. ler

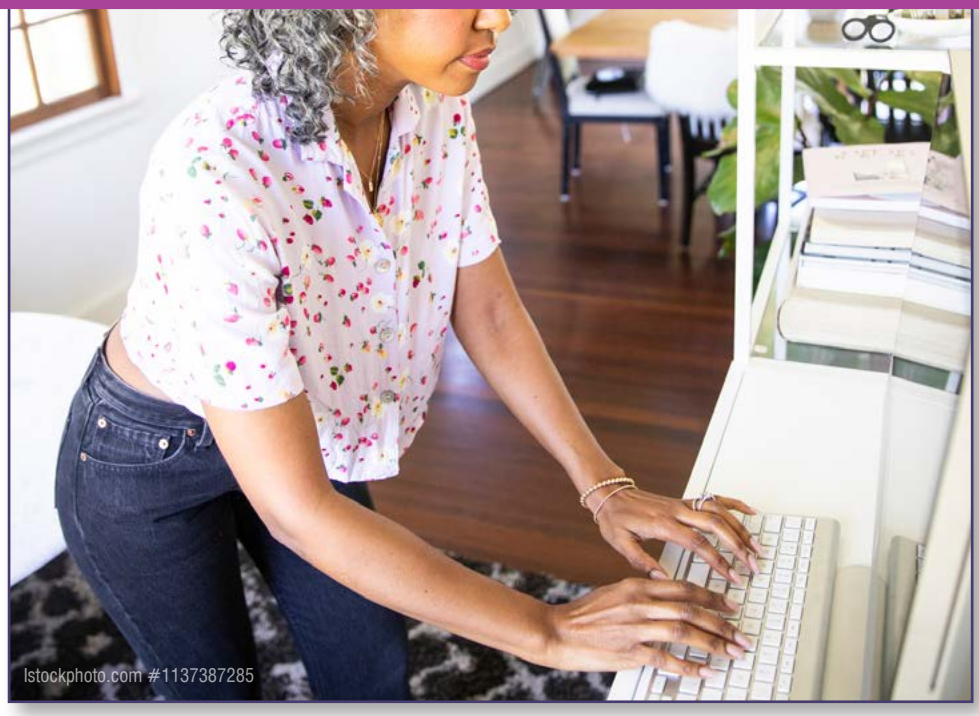
Ben Pearl, DPM, is a practicing sports medicine podiatrist in Northern Virginia. He is a consultant with the National Institutes of Health and serves on an advisory board of the US Food and Drug Administration. A fellow of the American Academy of Podiatric Sports Medicine, Dr. Pearl is the team podiatrist for the District Track Club, an elite Olympic development track team in Washington DC. He's also been honored by Washingtonian Magazine as a top sports doctor.

Cardiometabolic Benefits of Replacing Sedentary Time with Light Physical Activity

The man who moves a mountain begins by carrying away small stones.
Confucious

By Taru Garthwaite, Tanja Sjöros, Saara Laine, Henri Vähä-Ypyä, Eliisa Löyttyniemi, Harri Sievänen, Noora Houttu, Kirsi Laitinen, Kari Kalliokoski, Tommi Vasankari, Juhani Knuuti, and Ilkka Heinonen

Reduced sedentary time and increased light- and moderate- to vigorous-intensity physical activity had beneficial effects on several cardiometabolic risk markers in adults with metabolic syndrome.



The modern lifestyle has reduced daily physical activity (PA) demands in the recent decades, and now the majority of waking time (~8–9 h/day) is spent sitting. Physical inactivity and sedentary behavior (SB) increase the risk of chronic diseases and mortality, and SB has been adversely associated with cardiometabolic outcomes (eg, waist circumference [WC], HDL-cholesterol, triglycerides and insulin). Due to the accumulating observational evidence of the detrimental effects of sitting, an increasing number of interventions are targeting reductions in SB and investigating whether sitting less can improve health. As a major proportion of adults globally are insufficiently physically active, reducing SB instead of increasing PA may be a more feasible method for achieving health benefits.

Recent meta-analyses have shown that SB interventions can reduce sedentary time by 24–82 min/day and produce beneficial effects on common cardiometabolic outcomes (eg, weight, WC, blood pressure [BP], fasting insulin, HDL). However, previous interventions have mainly targeted healthy populations and occupational sitting, and the majority have lasted for less than 3 months or reported attenuations in SB reductions with longer follow-ups. Additionally, accelerometers are typically used only for ≤7 days at the beginning and end of interventions, which may not accurately reflect actual changes during the intervention or habitual behaviors. Thus, the current evidence of cardiometabolic benefits of reduced SB is limited, particularly in populations at increased cardiometabolic disease risk.

Therefore, we investigated the effects of a 3-month free-living intervention aiming at 1 h/day SB reduction on cardiometabolic outcomes in inactive sedentary adults with metabolic syndrome (MetS). In contrast to previous studies, accelerometers were used continuously throughout the intervention. In addition to the traditional cardiometabolic biomarkers, we investigated the effects on liver enzymes alanine aminotransferase (ALT), aspartate aminotransferase (AST) and γ-glutamyltransferase (GGT), which have not been studied in the context of SB reduction previously. These enzymes are markers of liver health, and they can thus provide novel and valuable information to further understand the effects of SB on metabolic health. We hypothesized that reduced SB, without intentionally adding exercise and moderate-to-vigorous PA (MVPA), has beneficial effects on cardiometabolic outcomes.

This article has been excepted from "Effects of reduced sedentary time on cardiometabolic health in adults with metabolic syndrome: A 3-month randomized controlled trial," by the authors noted above, which was published online on April 7, 2022, in *Journal of Science and Medicine in Sport*; 2022;25(7):579-585. doi: 10.1016/j.jsams.2022.04.002. Editing has occurred, including the renumbering of tables, and references have been removed for brevity. Use is per CC BY 4.0.

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Methods

Sixty-four sedentary middle-aged adults with metabolic syndrome were randomized into intervention (INT; n=33) and control (CON; n=31) groups. INT participants were guided by a researcher in 1-hour tailored personal counseling sessions to sit less by increasing standing and light intensity PA (LPA), without intentionally adding exercise or MVPA. Ways to increase standing and LPA were discussed individually according to participants' preferences, and could include eg, use of sit-stand desks, standing during phone calls and taking stairs instead of elevators. CON was instructed to maintain usual habits. Sedentary behavior, breaks in sedentary behavior, standing, and physical activity were measured for 3 months with hip-worn accelerometers connected via a cloud system to an interactive smartphone application. Fasting blood sampling and measurements of anthropometrics, body composition, and blood pressure were performed at baseline and at 3 months. Linear mixed models were used for statistical analyses. (Full details are available in the online article.)

Results

Sixty-three participants completed the 3-month intervention period (mean duration 3.2 [0.6] months). Only one participant dropped out (personal reasons). The mean age was 58 (SD 7) years, and 37 participants (58%) were women; 41% of the participants were overweight and 59% obese. At baseline, the participants spent 10.04 (SD 1.01) h/day sedentary, 1.79 (0.59) h/day standing, 1.74 (0.44) h/day in LPA, and 0.97 (0.32) h/day in MVPA and took 5149 (1825) steps and 29 (8) breaks in SB daily.

Valid accelerometer data from the intervention period is available for 50 participants (78%; n = 25 in both groups); missing data is due to data transfer issues between the accelerometers and the cloud system. The median of valid accelerometer days was 61 (Q1 37, Q3 73, range 7–99), and the accelerometers were worn for 15.11 (SD 0.75) h/day during the intervention. Wear time was ~35min/day longer during the intervention compared to the screening in both groups. In SB, LPA, MVPA, standing time and steps/day the mean changes from baseline to 3 months were significantly different between groups (Fig. 1). In more detail, INT reduced SB by ~50 min/day (95 % CI: 24, 73; 8% of daily baseline SB) primarily by increasing LPA (19 [8, 30] min/day) and MVPA (24 [14, 34] min/day). CON did not significantly change SB, LPA, or MVPA. Standing time increased slightly and not statistically significantly in INT (6 [−11, 23] min/day) and decreased in CON (−13 [−30, 5] min/day). Both groups increased steps/day, but the increase was greater in INT compared to CON: 3800 (2685, 4195) vs. 1918 (801, 3036) steps/day. Breaks in SB did not significantly change in either group.

Significant intervention effects favoring INT occurred in fasting insulin (INT: 83.4 [68.7, 101.2] vs. CON: 102.0 [83.3, 125.0] pmol/l at 3 months), insulin resistance (HOMA-IR; 3.2 [2.6, 3.9] vs. 4.0 [3.2, 4.9]), HbA1c (37 [36, 38]

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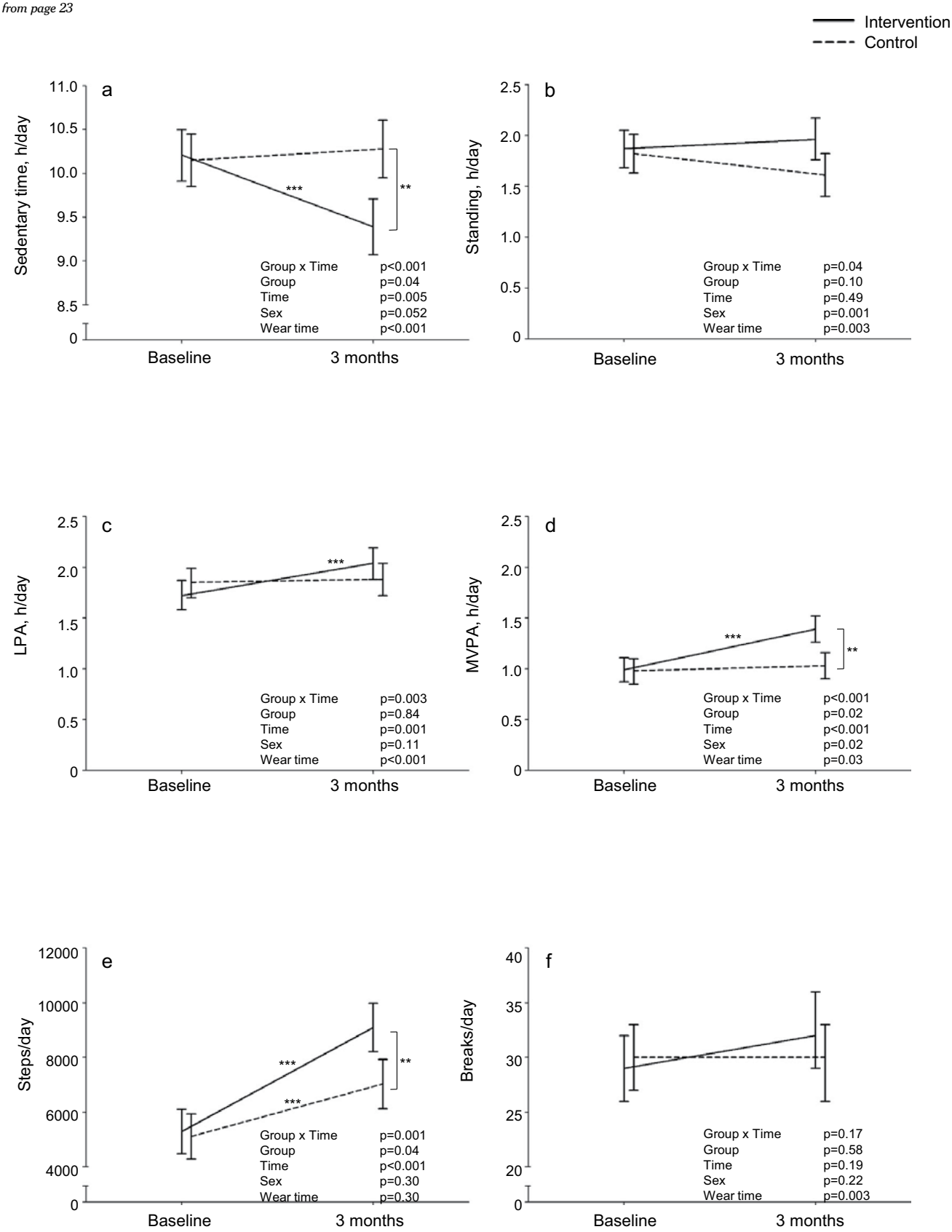

Figure 1. The intervention effects on activity outcomes. a) Sedentary time (h/day), b) standing (h/day), c) light-intensity physical activity (h/day), d)moderate-to-vigorous physical activity (h/day), e) steps/day, and f) breaks in sedentary time/day at baseline and throughout the 3-month intervention in sedentary, inactive adults with metabolic syndrome. Baseline indicates daily mean (95 % CI) of a continuous 1-month screening accelerometer measurement, and value at 3 months indicates daily mean (95 % CI) of continuous accelerometer measurement throughout the 3-month intervention. Solid line represents the intervention group and dashed line the control group. ** = Tukey's $P < 0.01$; *** = Tukey's $P < 0.001$.

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vs. 38 [37, 39]mmol/mol), and liver enzyme alanine aminotransferase (ALT; 28 [24, 33] vs. 33 [28, 38] U/l). The effects mainly occurred due to increases from baseline to 3 months in CON that exceeded any changes in INT. In triglycerides and heart rate, within-group changes were non-significant despite significant overall intervention effects.

Waist circumference (WC), body fat %, fat mass, systolic blood pressure, and diastolic blood pressure decreased slightly during the intervention with no difference between groups. Fasting glucose; fat free mass (FFM); total, LDL- and HDL-cholesterol; aspartate aminotransferase (AST); and γ-glutamyltransferase (GGT) increased similarly in both groups. Weight or BMI did not change in either group.

Changes in standing time were inversely correlated with weight and BMI changes, and changes in the number of steps/day correlated inversely with WC changes. Changes in MVPA correlated positively with HDL changes. Changes in weight and BMI correlated positively with changes in triglycerides and BP, and changes in WC also correlated positively with changes in BP. Changes in FFM correlated inversely with changes in fasting glucose.

Discussion

Our results indicate benefits in several cardiometabolic outcomes with reduced SB in sedentary adults with MetS. A 50min/day reduction in SB and subsequent increases in LPA and MVPA (consisting mainly of moderate-intensity PA) had beneficial effects on fasting insulin, HOMA-IR, HbA1c and ALT, but it was not able to prevent worsening in all biomarkers. Reducing daily SB may be helpful in cardiometabolic disease prevention in risk populations, but a more substantial SB reduction and/or higher volume and intensity of PA is likely needed for sedentary individuals to achieve greater health benefits. To our knowledge, this is the first study to measure SB and PA with accelerometers continuously throughout the 3-month intervention, and to investigate the health effects of SB reduction in sedentary and inactive, middle-aged adults with MetS. Compared to a population-based sample of Finnish adults of similar age, our participants spent 1.5 h more sedentary and had ~1 h less LPA and ~30 min less MVPA daily.

The effects of free-living SB interventions on cardiometabolic health have been recently synthesized in two meta-analyses. Hadgraft et al (2021) reported improvements in anthropometrics, BP, insulin, and lipids in healthy populations, but SB changes were not analyzed. In clinical populations (overweight/obesity; type 2 diabetes; cardiovascular, neurological/cognitive and musculoskeletal diseases) ~1-hour SB reduction improved HbA1c, body fat % and WC. Similar to our findings, others have also reported benefits in HbA1c, fasting insulin and HOMA-IR following SB interventions. SB reduction may also improve fasting glucose, total cholesterol, body fat %, WC, and clustered cardiometabolic risk score. On the other hand, not all interventions have been effective in reducing SB, or improving cardiometabolic outcomes despite SB reductions.

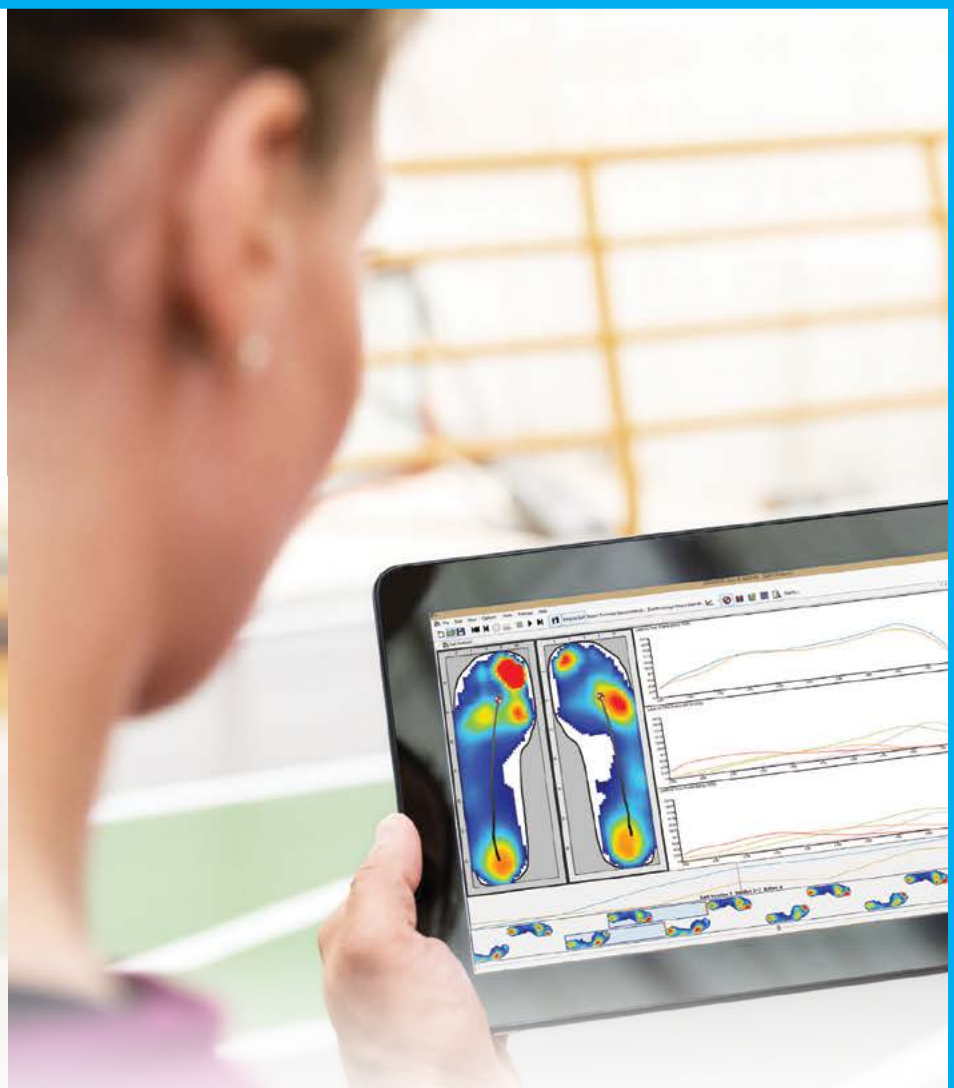
Our study complements and extends this limited and inconsistent

evidence. It seems that sitting less may be beneficial particularly from type 2 diabetes prevention perspective, as we found benefits in markers of glucose metabolism and diabetes risk (i.e., fasting insulin, HOMA-IR, HbA1c), in line with previous findings. In addition to the traditional cardiometabolic biomarkers, the intervention effect favoring INT on liver enzyme ALT is a novel finding that, to our knowledge, has not been reported previously. The intervention effects on liver enzymes AST and GGT also were near-significant (group × time $P = 0.057$ and $P = 0.071$, respectively). These enzymes are markers of liver dysfunction or injury, and are most often elevated due to non-alcoholic fatty liver disease, which is considered the hepatic expression of MetS. SB has been associated with fatty liver, but SB interventions have not studied effects on liver health markers. Elevated ALT and AST are associated with obesity and dyslipidemia, and they independently predict type 2 diabetes. It may have an important impact on public health and disease prevention in risk populations if benefits in several diabetes risk markers can be achieved with SB reductions.

Although the intervention aimed to reduce SB primarily by increasing standing and LPA, both LPA and MVPA increased. Standing time also increased slightly (6 min/day), but non-significantly. A recent meta-analysis of free-living interventions in clinical populations by Nieste et al (2021) reported a comparable ~60 min/day SB reduction, but in contrast to our study SB was mainly replaced by standing and low-intensity walking, with no change in MVPA. It is noteworthy, however, that the MVPA amount is dependent on analysis methods. In our study, the total MVPA amount also includes short and sporadic MVPA bouts as we analyzed the accelerometer data in only 6-second epochs. Steps increased in our study as well, and the increase correlated with the MVPA increase, suggesting that the participants may have found it easier to reduce SB by walking at a moderate pace than by standing and incorporating LPA into daily activities. Reallocating SB to different behaviors, and the composition of behaviors across the 24-h day, affects health outcomes differently. Replacing SB with standing has been shown to improve glycemic outcomes and fat mass, while reallocating SB to LPA or MVPA appears beneficial for glycemic outcomes, lipids and WC. Although replacing SB with any intensity PA is beneficial, the greatest benefits are achieved with the reallocation of SB to MVPA.

Conclusion

Reducing daily SB by 50 min and increasing LPA and MVPA resulted in beneficial effects in several cardiometabolic risk markers in adults with MetS in 3 months, but it was not enough to prevent increases in all biomarkers. More substantial reduction in SB and/or structured exercise may be needed for sedentary individuals to achieve greater health benefits. However, sitting less may provide an additional approach to aid in chronic disease prevention in high-risk populations.



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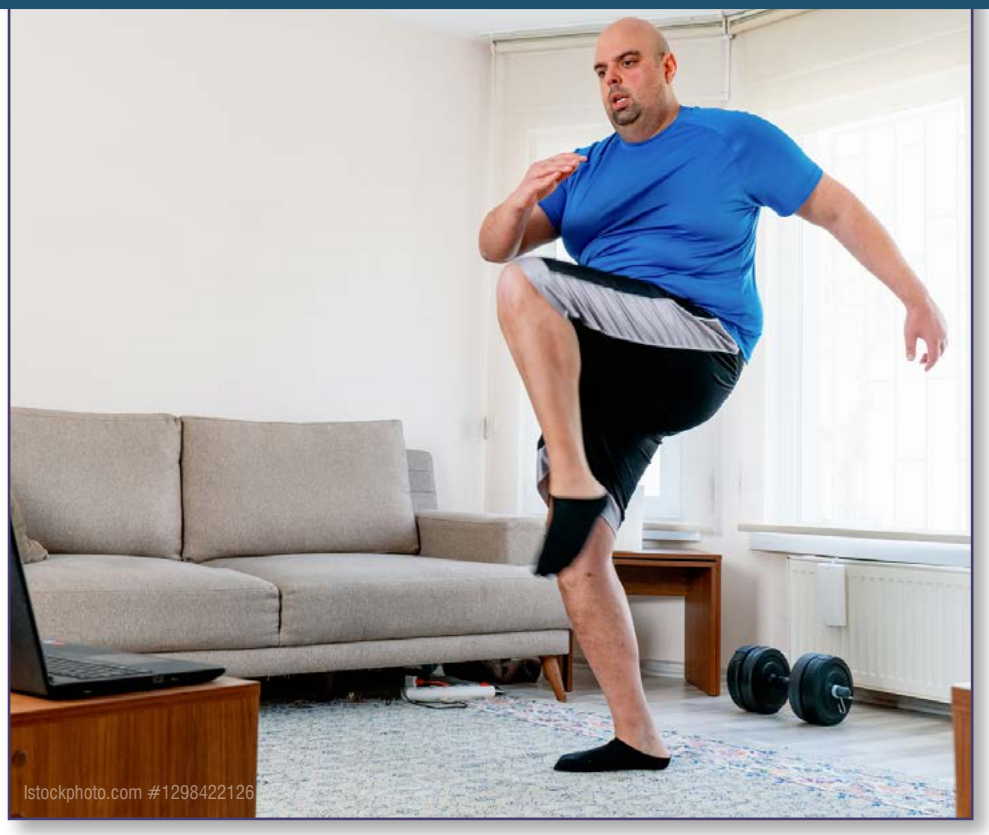
Disrupting Sedentariness With Short Exercise Bouts Improves Insulin/Glucose Metabolism

You don't have to see the whole staircase, just take the first step.
Martin Luther King, Jr.

By Tobias Engeroff, Eszter Füzeki, Lutz Vogt, and Winfried Banzer; Han C. G. Kemper, Academic Editor



The health consequences of prolonged sedentary behavior—defined as activities with ≤1.5 metabolic equivalents of energy expenditure in a sitting or reclining posture—include an increased risk for cardiometabolic diseases and all-cause mortality; it has also been suggested to negatively affect mood and well-being. Fitness and exercise may counteract the detrimental metabolic and mood adaptations during prolonged sitting. Interrupting sitting with short exercise bouts could be a further option to limit the negative effects of sedentariness in settings which do not allow replacement or reduction of sitting time. Multiple meta-analyses of randomized controlled trials (RCTs) consistently confirmed the beneficial effect of exercise on markers for glucose and fat metabolism during sedentary behavior.

This study distinguishes the immediate effects of a single bout vs. work-load and intensity-matched repeated exercise breaks on subjective well-being, blood glucose, and insulin response during sedentary time; and assesses the influence of fitness and caloric intake on metabolic alterations during sedentariness

Methods & Results

Based on contradictory results concerning the non-inferiority of a single bout of exercise, the specific objective of this study was to assess if exercise prior to sitting leads to comparable beneficial effects on well-being, glucose, and insulin metabolism than repeated exercise breaks during sedentary behavior. This study also analyzed the moderating effects of dietary caloric intake and cardiorespiratory fitness on metabolic alterations during sedentary behavior.

Eighteen women underwent cardiopulmonary exercise testing and 3 4-hour sitting interventions: 2 exercise interventions (70% VO2max, 30 min, cycle ergometer: (1) cycling prior to sitting; (2) sitting interrupted by 5 × 6 min cycling, and 1 control condition (sitting). Participants consumed 1 meal—consisting of white toast bread, cheese, and jam—with a caloric value of 1124 kJ/100 g (268.41 kcal/100g), and a macronutrient proportion of 51% carbohydrate, 35% fat, and 14% protein. Participants chose the portion size of their meal during their first intervention, and the portion size was kept constant for the other 2 interventions. The meal ingestion during each of the 3 trials took part immediately before the 4 hours of sitting, and was the first bolus received after an overnight fast. Each subject completed 3 interventions: 1. A single bout of 30 min exercise (70% VO2max cycling on an ergometer) prior to uninterrupted sitting; 2. Sitting interrupted by 5 exercise breaks of 6 min ergometer cycling each (70% VO2max); 3. Uninterrupted sitting without exercise. The interventions were separated by a minimum of 7 days and a maximum of 21 days, and were performed in a balanced (block-randomization of sequence) design. Total sitting time was 4 hours in all 3 trials. Sitting mimicked basic aspects of office work. Participants read, worked, or used the internet on their laptops.

Exercise breaks (4057 ± 2079 μU/mL·min)

This article has been excepted from "The Acute Effects of Single or Repeated Bouts of Vigorous-Intensity Exercise on Insulin and Glucose Metabolism during Postprandial Sedentary Behavior," by the authors noted above, which was published online on April 7, 2022, in *International Journal of Environmental Research and Public Health* 2022 Apr 7;19(8):4422. doi: 10.3390/ijerph19084422. Editing has occurred, including the renumbering of tables, and references have been removed for brevity. Use is per CC BY 4.0.

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reduced insulin values compared to a single bout of exercise (5346 ± 5000 μU/mL·min) and the control condition (6037 ± 3571 μU/mL·min) ($P \leq 0.05$). ANCOVA revealed moderating effects of caloric intake (519 ± 211 kilocalories) ($P \leq 0.01$), but no effects of cardiorespiratory fitness (41.3 ± 4.2 mL/kg/min). Breaks also led to lower depression, but higher arousal compared to a no exercise control ($P \leq 0.05$). Both exercise trials led to decreased agitation ($P \leq 0.05$). Exercise prior to sitting led to greater peace of mind during sedentary behavior ($P \leq 0.05$). Just being fit or exercising prior to sedentary behavior are not feasible to cope with acute detrimental metabolic changes during sedentary behavior. Exercise breaks reduce the insulin response to a meal. Despite their vigorous intensity, breaks are perceived as positive stimulus. Detrimental metabolic changes during sedentary time could also be minimized by limiting caloric intake.

Discussion

This experiment underlines the influence of caloric intake on glucose and insulin spikes during postprandial sedentariness, and also on the insulin-lowering effect of exercise breaks. The sample showed a broad range of cardiorespiratory fitness. However, fitness had neither an impact on detrimental changes in glucose or insulin metabolism during sedentary behavior, nor on the beneficial effect of exercise breaks. Nor did fitness influence acute metabolic changes during prolonged sitting in postprandial state; as such, future studies need to analyze whether body composition or other modifiable factors which are related to fitness influence metabolic reactions during sedentary time.

The data shows that both the insulin response to food intake during sitting and the insulin-lowering effect of exercise breaks are related to the number of calories ingested. Consequently, adjusting the timing or amount of food and beverage intake during sedentary behavior could be an important intervention strategy to mitigate detrimental metabolic effects.

The study findings support the hypothesis that breaks, but not a single exercise bout, can maintain enzymatic function or attenuate degradation of insulin-independent glucose transporters during prolonged sitting.

Neither a single exercise bout prior to sitting nor exercise breaks during sitting led to lower ratings of well-being during sedentary behavior compared to a no-exercise control. Both intervention forms led to lower self-perceived agitation. Continuous exercise in the morning also induced a greater feeling of peace of mind. Breaking sedentariness with vigorous-intensity exercise bouts induced higher arousal and lower levels of depression after 4 hours of sitting. Against anecdotal evidence, these findings indicate that both interventions are perceived as a positive experience when applied in a sedentary setting.

Conclusions

In summary, the study authors showed that in a realistic setting with a meal mimicking a typical western breakfast and a sedentary period of 4 hours (simulating half a workday until lunch break), regular short exercise breaks, but not exercise prior to sitting, can lower blood insulin levels in premenopausal, healthy, female participants. Caloric intake strongly influences metabolic regulation and must be considered when interpreting these and other findings. In this study cohort, cardiorespiratory fitness had no influence on changes of cardiometabolic markers. Direct comparison of participants with high vs. low cardiorespiratory fitness in larger study samples might yield more insight whether, and if yes, to what extent, fitness can protect from the acute negative health effects of sedentary behavior. The results of this study confirm that for good health and good mood, not only staying active according to recommendations, but also breaking up long periods of sitting, is of high relevance. Physically active breaks, even with vigorous intensity, are perceived as a positive influence during prolonged sitting. This study also suggests that limiting food and beverage intake with high carbohydrate content during sedentary behavior might mitigate negative metabolic effects.

Physical Activity Guidelines for Americans

Do what you can, with what you have, where you are.
Teddy Roosevelt

Below are the key evidence-based guidelines included in the second edition of *Physical Activity Guidelines for Americans* from the U.S. Department of Health and Human Services, which can be found at https://www.health.gov/PAGuidelines/.

Preschool-Aged Children

- Preschool-aged children (ages 3 through 5 years) should be physically active throughout the day to enhance growth and development.
- Adult caregivers of preschool-aged children should encourage active play that includes a variety of activity types.

Children and Adolescents

- It is important to provide young people opportunities and encouragement to participate in physical activities that are appropriate for their age, that are enjoyable, and that offer variety.
- Children and adolescents ages 6 through 17 years should do 60 minutes (1 hour) or more of moderate-to-vigorous physical activity daily:
  - **Aerobic:** Most of the 60 minutes or more per day should be either moderate-or vigorous-intensity aerobic physical activity and should include vigorous-intensity physical activity on at least 3 days a week.
  - **Muscle-strengthening:** As part of their 60 minutes or more of daily physical activity, children and adolescents should include muscle-strengthening physical activity on at least 3 days a week.
  - **Bone-strengthening:** As part of their 60 minutes or more of daily physical activity, children and adolescents should include bone-strengthening physical activity on at least 3 days a week.

Adults

- Adults should move more and sit less throughout the day. Some physical activity is better than none. Adults who sit less and do any amount of moderate-to-vigorous physical activity gain some health benefits.
- For substantial health benefits, adults should do at least 150 minutes (2 hours and 30 minutes) to 300 minutes (5 hours) a week of moderate-intensity, or 75 minutes (1 hour and 15 minutes) to 150 minutes (2 hours and 30 minutes) a week of vigorous-intensity aerobic physical activity, or an equivalent combination of moderate- and vigorous-intensity aerobic activity. Preferably, aerobic activity should be spread throughout the week.
- Additional health benefits are gained by engaging in physical activity beyond the equivalent of 300 minutes (5 hours) of moderate-intensity physical activity a week.
- Adults should also do muscle-strengthening activities of moderate or greater intensity and that involve all major muscle groups on 2 or more days a week, as these activities provide additional health benefits.

Older Adults

In addition to the key guidelines for adults, the following key guidelines are just for older adults:

- As part of their weekly physical activity, older adults should do multicomponent physical activity that includes balance training as well as aerobic and muscle-strengthening activities.
- Older adults should determine their level of

Continued on page 34

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effort for physical activity relative to their level of fitness.

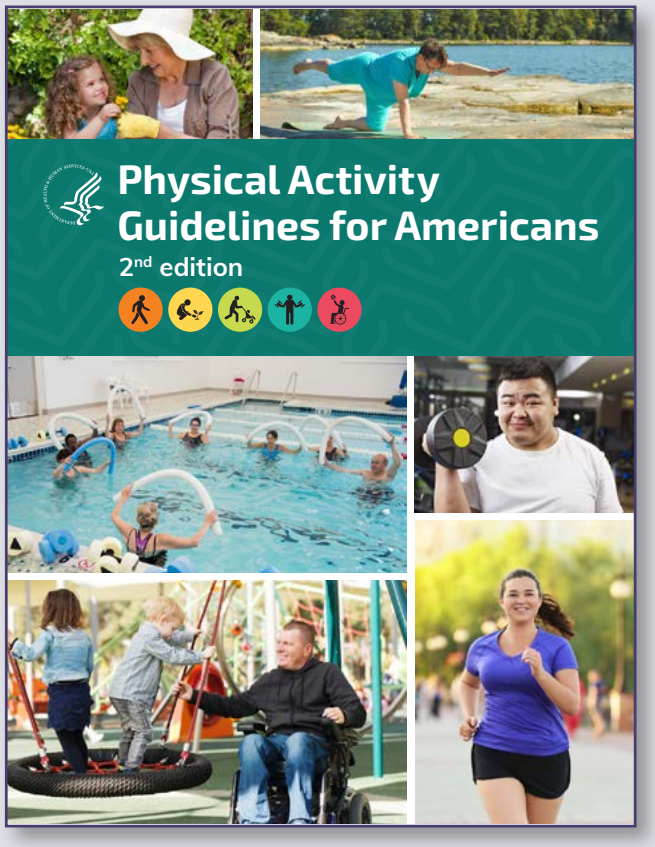
- Older adults with chronic conditions should understand whether and how their conditions affect their ability to do regular physical activity safely.
- When older adults cannot do 150 minutes of moderate-intensity aerobic activity a week because of chronic conditions, they should be as physically active as their abilities and conditions allow.

Women During Pregnancy/ Postpartum Period

- Women should do at least 150 minutes (2 hours and 30 minutes) of moderate-intensity aerobic activity a week during pregnancy and the postpartum period. Preferably, aerobic activity should be spread throughout the week.
- Women who habitually engaged in vigorous-intensity aerobic activity or who were physically active before pregnancy can continue these activities during pregnancy and the postpartum period.
- Women who are pregnant should be under the care of a health care provider who can monitor the progress of the pregnancy. Women who are pregnant can consult their health care provider about whether or how to adjust their physical activity during pregnancy and after the baby is born.

Adults With Chronic Health Conditions and Adults With Disabilities

- Adults with chronic conditions or disabilities, who are able, should do at least 150 minutes (2 hours and 30 minutes) to 300 minutes (5 hours) a week of moderate-intensity, or 75 minutes (1 hour and 15 minutes) to 150 minutes (2 hours and 30 minutes) a week of vigorous-intensity aerobic physical activity, or an equivalent combination of moderate- and vigorous-intensity aerobic activity. Preferably, aerobic activity should be spread throughout the week.
- Adults with chronic conditions or disabilities, who are able, should also do muscle-strengthening activities of moderate or greater intensity and that involve all major muscle groups on 2 or more days a week, as these activities provide additional health benefits.
- When adults with chronic conditions or disabilities are not able to meet the above key guidelines, they should engage in regular physical activity according to their abilities and should avoid inactivity.
- Adults with chronic conditions or symptoms should be under the care of a health care provider. People with chronic conditions can consult a health care professional or physical activity specialist about the types and amounts of activity appropriate for their abilities and chronic conditions. ler



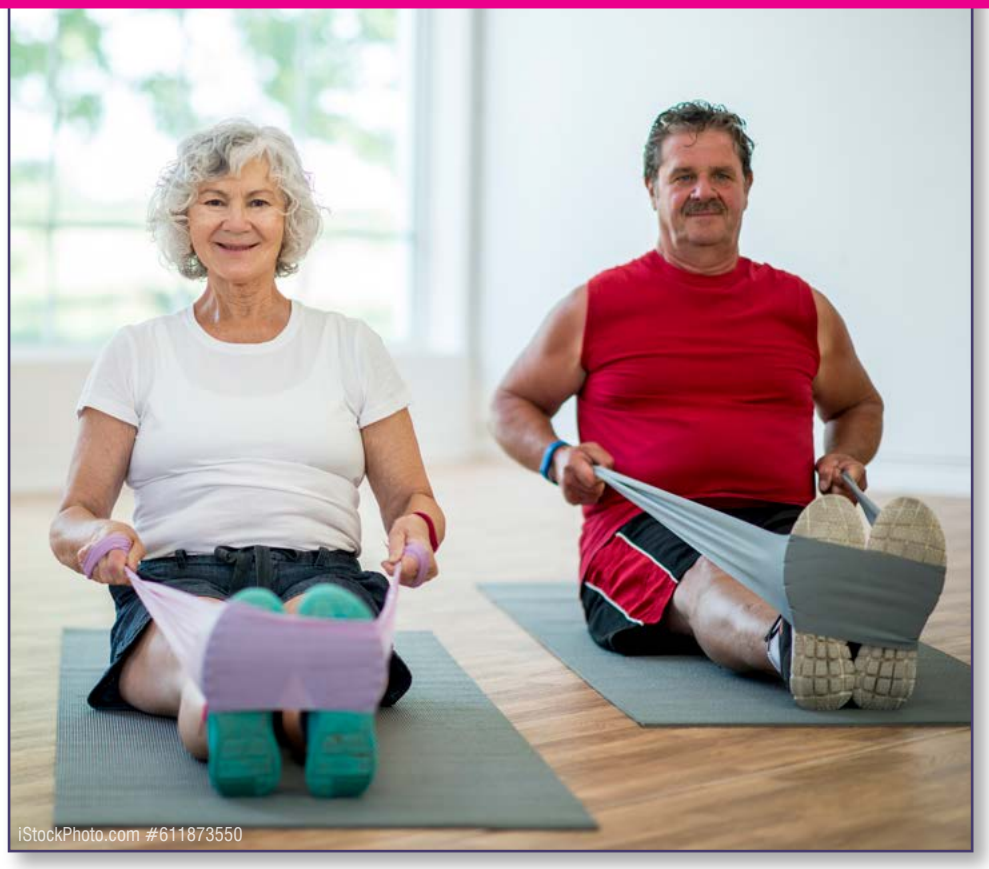
The Move Your Way Campaign

The Move Your Way campaign was created by the Office of Disease Prevention and Health Promotion within the U.S. Department of Health and Human Services to be used by communities, health professionals, educators, and others to communicate to consumers in plain language about the recommendations from the Guidelines, promote the health benefits of meeting the recommendations, and provide tips for how consumers can meet the recommendations. Campaign resources, including interactive tools, fact sheets, videos, and graphics, are available at **https://www.health.gov/PAGuidelines/**.

Resistance Training Protects Age-Related Muscle Mass Loss*

You have to exercise, or at some point you'll just break down.

Barack Obama



The old adage is right: aging is not for sissies. Data shows that age-related losses in skeletal muscle mass, strength, and function weaken physiological resilience leading to increased vulnerability to catastrophic events. Each body may age in response to its unique life events, but every body does age. The Baby Boom generation (those born 1946–1964), benefitted greatly from the public health advances of the early 20th century with longer a life span. That longer lifespan, however, has consequences in the form of diverse chronic disease morbidity—for example, cardiovascular disease, diabetes, or osteoarthritis.

While one can age without disease, there is a natural decline in physical resilience which can lead to physical disability, mobility impairments, falls, diminished quality of life, and reduced independence. Chronic disease only piles on to this natural decline. Sarcopenia may be the best-known age-related decline, with a rising prevalence with age: 10% in those over 60 years, rising to 50% in those over 80 years. This loss of muscle mass, which generally starts after age 30, is known to increase after age 60, and loss is greater in the lower limbs than the upper limbs. Decreasing muscle mass is part of the causal pathway for strength loss, disability, and morbidity in older adults, though some would argue that decreased muscle mass may be secondary to strength loss. Indeed, grip strength serves as a clinically relevant biomarker of disability and early mortality and has been labeled a "biomarker of aging."

The prescription to exercise, or at least move, has been around for centuries. "Walking is man's best medicine" comes from the father of modern medicine, Hippocrates, who was born in 470 BC. But what kind of exercise is best? While aerobic has been encouraged for decades, resistance training has gained ground, particularly as it can help prevent loss of muscle mass—so much so, the National Strength and Conditioning Association developed a Position Statement* documenting all the evidence in support of this form of movement, particularly for older adults.

What Resistance Training Can Do

Muscle disuse can be prevented and may be reversible with the proper treatments. Studies consistently show that resistance training among older adults is feasible and can be effective in a variety of ways

- Negating muscle weakness and physical frailty
- Mitigating age-related intramuscular adipose infiltration
- Improving physical performance, and
- Increasing muscle fiber area.

Studies also show resistance exercise provides improvements in

- muscle quality
- bone density
- metabolic health and insulin sensitivity
- management of chronic health conditions
- quality of life
- psychological well-being

*This article attempts to summarize "Resistance training for older adults: position statement from the National Strength and Conditioning Association," by Maren S. Fragala, Eduardo L. Cadore, Sandor Dorgo, Mikel Izquierdo, William J. Kraemer, Mark D. Peterson, and Eric D. Ryan. The article was published in the August 2019 issue of the *Journal of Strength and Conditioning Research*, the official journal of the National Strength and Conditioning Association. doi: 10.1519/JSC.0000000000003230. Readers are encouraged to review the original, which is available online for free.

Continued on page 36

Continued from page 35

- extended independent living, and
- reduced risk for falls and fractures.

On a cellular level, the position statement provides evidence that resistance training may "improve metabolic capacity of skeletal muscle by improving glucose homeostasis, preventing intramuscular lipid accumulation, increasing oxidative and glycolytic enzyme capacity, enhancing amino acid uptake and protein synthesis, and shifting the anabolic/catabolic milieu toward anabolism through release."

In addition to being a complement to aerobic activity's positive effects, resistance training has been called a "medicine" on its own because data shows it can

- lessen aging's effects on both functional capacity and neuromuscular function
- improve muscle strength, mass, and power output
- improve bone mineral density
- reduce abdominal and visceral fat mass, and
- lower hemoglobin A1c in adults with type 2 diabetes.

Yet, less than 9% of older adults use resistance training due to concerns about safety, health, pain, and fatigue, or a lack of social support.

Recommendations

Using scientific evidence, professional expertise, and age-appropriate patient use considerations, these authors developed this position statement providing evidence for each recommendation. The 11 recommendations are broken into 4 sections that target the older population: program variables, positive physiological adaptations to resistance training, functional benefits, and considerations for frailty, sarcopenia, or other chronic conditions.

Program Variables

A properly designed resistance training program with appropriate instructions for exercise technique and proper spotting

- is safe for healthy older adults
- should include an individualized, periodized approach working toward 2–3 sets of 1–2 multijoint exercises per major muscle group, achieving intensities of 70–85% of 1 repetition maximum (1RM), 2–3 times per week, including power exercises performed at higher velocities in concentric movements with moderate intensities (i.e., 40–60% of 1RM)
- should follow the principles of individualization, periodization, and progression.

Positive Physiological Adaptations

A properly designed resistance training program

- can counteract the age-related changes in contractile function, atrophy, and morphology of aging human skeletal muscle
- can enhance muscular strength, power, and neuromuscular functioning
- can facilitate adaptations to resistance training in older adults that are mediated by neuromuscular, neuroendocrine, and hormonal adaptations to training.

Functional Benefits

A properly designed resistance training program

- can improve mobility, physical functioning, performance in activities of daily living (ADL), and preserve independence
- can improve an older adult's resistance to injuries and catastrophic events such as falls
- can help improve the psychosocial well-being of older adults.

Frailty, Sarcopenia, or other Chronic Conditions

Resistance training programs can be adapted

- for older adults with frailty, mobility limitations, cognitive impairment, or other chronic conditions
- to accommodate older adults residing in assisted living and skilled nursing facilities (with portable equipment and seated exercise alternatives). ler

Improving Walker Device Safety Keeps Patients Moving Forward

Innovation is an act of defiance against the status quo.
Anthony Pompliano

By Laura Fonda Hochnadel

Aluminum frame walkers have been helping people get around since the late 1940's. Did you ever wonder if they could do more?

Inspiration comes to us in many forms. For Tim Visos-Ely, his inspiration came from personal experience with his grandmother. Not quite 10 years ago, Grandma Chris had a series of strokes that left her with impaired mobility, and she began using a walker, said Visos-Ely. The family assumed that using a walker would improve her mobility and help prevent falls. However, "nothing really changed. Her mobility continued to decline, and she continued to have issues with walking," he said, including suffering a fall.

Her continued decline in mobility, independence, and confidence prompted Visos-Ely to question how her walker use might be affecting her health. As a mechanical engineering student at the University of Colorado, Boulder, he had already gained experience working with a medical device manufacturer to redesign a walker, for which a patent was received. He also learned about the process of getting US Food and Drug Administration (FDA) approval for a medical device, which will eventually help in navigating their path toward reimbursement.* In the meantime, Visos-Ely sought another route, one that brought technology and walkers together–walker attachment technology (see inset photo).

"The idea was that I would create an attachment to a walker so I wouldn't need to go through the same barriers and hurdles" as is required to get FDA approval for a Class I medical device, he said. Visos-Ely put together a team to start a company, StrideTech Medical (Boulder, CO), to develop a device, called StrideTech Go, which integrates sensors and biofeedback onto existing walkers to correct unsafe use in real-time. "If you're not using the walker correctly, you can actually cause more harm than good and cause falls," he said. Key challenges that lead to falls with walkers include excessive weight on the walker handles and/or excessive distance between the user and the walker.

The StrideTech Go kit (see page 41) includes the smart unit with rechargeable battery and grip covers embedded with force sensors that attach to the walker handles with Velcro. The force sensors vibrate when excessive weight is placed on the handles while left- and right-hand force measurements can determine asymmetrical gait. An additional sensor, mounted to the frame, measures the distance from the user's hips to the walker frame. A red LED flashes visibly when these sensors detect excessive distance between the frame of the walker and the user.

Healthcare professionals using StrideTech Go with patients will be able to see improved compliance with correct walker use, explained Visos-Ely. "They will have access to critical data that showcases the progress a patient is making with their mobility."

He explained: Utilizing an app, healthcare professionals can set up patient profiles in a way that biofeedback warnings are customized to

*The new CPT code 98975 covers: remote therapeutic monitoring (eg, respiratory system status, musculoskeletal system status, therapy adherence, therapy response), initial set-up, and patient education on use of equipment.

Continued on page 41

Peripheral Artery Disease

Peripheral Artery Disease (PAD) is a deadly chronic condition that can lead to heart attack, stroke, or amputation.

1 in 3

- Diabetics age 50+
- Smokers age 50+
- Everyone age 70+

Have PAD

$390 billion

annual US healthcare costs attributable to PAD

100,000 amputations

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Continued from page 39

each individual. Feedback thresholds, the point at which the patient is cued to correct their body position or weight bearing, is automatically suggested after having a patient walk with the technology for 30 seconds. The feedback level is then set to the appropriate setting for the individual. As the patient progresses through their rehabilitation, the healthcare professional can adjust these feedback thresholds as progress is made. Several patient profiles can be created on 1 device so each StrideTech Go unit can be used across multiple patients.

For those patients who have the accessory placed on their walker full time, progress reports can be sent from the app and utilized for documentation, assessment, patient training, and family member peace of mind. In the future, it might be possible that data driven analysis of a user could enable the device to become more than a training tool, but also a diagnostic measuring device. "Imagine being able to detect slight variations in weight distribution on the left and right side of a patient's walker," said Visos-Ely. "Or the time-of-day usage to note an increase in activity at nighttime. These data could help detect asymmetry and changes in gait over time, which could alert providers to underlying issues such as pain, or the nighttime usage might indicate a urinary tract infection or changes in cognition. Abnormal low activity or long response time to feedback cues can also indicate unsafe mobility or cognitive decline." These are only a few examples of the potential insights this technology could provide, he said.

"Three years of R&D has gone into the patented StrideTech Go technology," said Visos-Ely. "To inform product direction and business strategy, StrideTech Medical (the company he cofounded) has brought on a team of highly experienced advisors and partners." These advisors shared critical details on how StrideTech Go will be implemented to decrease falls in various healthcare settings.

Included in the R&D Visos-Ely mentioned was quantifying walker use. "Physical therapists will verbally explain how to use your walker," he said, but that instruction does not include how far away to stand from the walker and how much weight to place on the handles. "A huge

part of the last 3 years has been collecting data in order to validate that part of our technology. We've worked with Denver University's biomechanical lab, and we've done our own testing," he said, through volunteer recruitment at free walker repair workshops the company hosted.

The results are promising, as evidenced by several White Papers, which have been published to the company's website, discussing the short- and long-term efficacy of StrideTech Go. The long-term case study followed the progress of a user, Barbara, over the course of 11 weeks. On a weekly basis, the StrideTech team would meet with Barbara to download the previous week's data from the device, display walker use data, and get feedback on how well the device was functioning.

Looking at the average of her hip distance comparing Week 1 to Week 11 showed a decrease from 10.2 inches to 7.5 inches, and collected data showed a more than 30% decrease in walker misuse—defined as the daily number of hip distance and force misuses as a percentage of daily activity—from her starting week. The data was also able to establish Barbara's patterns of daily activity.

The next steps, according to Visos-Ely, include producing 100 units to validate the manufacturing process of StrideTech Go, completing partnerships to further test with multiple users, and raising funds to facilitate and further the mission of preventing falls.

To learn more about this product, visit stridetechmedical.com.

Laura Fonda Hochnadel is Associate Editor at Lower Extremity Review.

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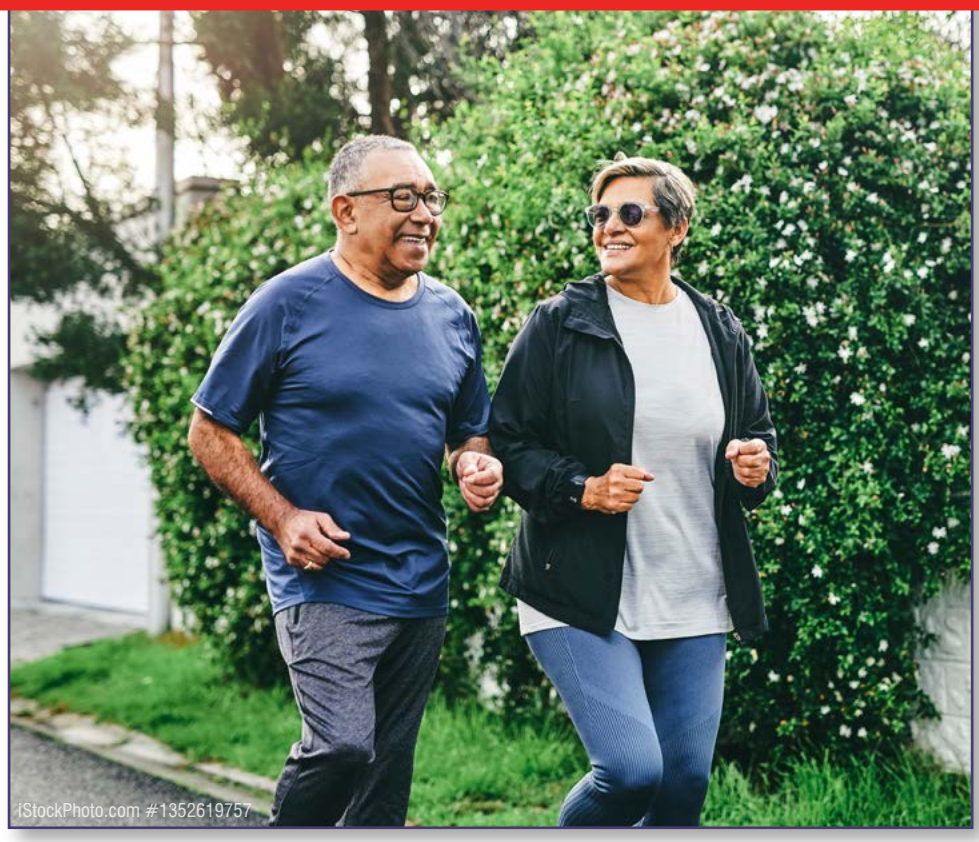
Exercise Program Improves Gait Speed in People with DPN

Walking is the best possible exercise. Habituate yourself to walk very far.
Thomas Jefferson

By Renan L. Monteiro, Jane S. S. P. Ferreira, Érica Q. Silva, Ronaldo H. Cruvinel-Júnior, Jady L. Veríssimo, Sicco A. Bus, and Isabel C. N. Sacco



Diabetic peripheral neuropathy (DPN) is associated with decreased muscle strength and physical activity level, as measured by steps per day and reduced gait speed. Studies suggest that motor and sensory deficits and reduced foot-ankle range of motion (ROM) are related to decreased physical activity levels, as are the reduced quality of life (QoL) and decreased gait speed associated with DPN. Additionally, diabetes progression and DPN compromise musculoskeletal function, leading to limitations in everyday physical functioning.

This study sought to determine whether a foot-ankle therapeutic exercise program can improve daily physical activity (i.e., number of steps) and fast and self-selected gait speed in people with diabetic peripheral neuropathy (PWDPN), as well as modify risk-factor outcomes in this population.

Methods

The primary aim of this single-blind randomized controlled trial (RCT) was to investigate the effects of a 12-week foot-ankle therapeutic exercise program on daily physical activity level (number of steps measured by an accelerometer) and self-selected and fast-gait speeds in PWDPN. Secondary aims were to investigate the effectiveness of this intervention at 6, 12, and 24 weeks on passive and static ankle-joint ROM, tactile (10-g monofilament) and vibration sensitivity (tuning fork), DPN symptoms (Michigan Neuropathy Screening Instrument), QoL by the EuroQoL 5-dimensions (EQ-5D) questionnaire, foot health and functionality by the Foot Health Status Questionnaire, hallux and toe muscle strength (pressure platform), and foot ulcer incidence at 1-year follow-up. All primary and secondary outcomes were planned to be assessed at 1-year follow-up; however, due to the COVID-19 pandemic, these aims were modified.

Seventy-eight volunteers with DPN were allocated into a control group (CG), which received usual care (inspect your feet daily, wear socks without elastic and seams, cut your nails properly, avoid cutting corns or blisters without supervision, avoid going barefoot or wearing shoes without socks or slippers, and seek medical attention whenever you identify foot problems), and an intervention group (IG), which received usual care plus a 12-week foot-ankle exercise program. The exercise protocol was performed twice weekly under in-person supervision by a physiotherapist, and twice weekly at home, remotely supervised through Educational Diabetic Foot Software. Both protocols consisted of warm-up exercises, intrinsic foot muscle strengthening, extrinsic foot-ankle muscle strengthening, and functional exercises, such as balance and gait training (See table on page 44).

Results & Discussion

IG participants increased their fast-gait speed after 12 weeks of the program and maintained this greater speed, even after 1 year. The IG participants showed a mean difference of

This article has been excepted from "Foot-ankle therapeutic exercise program can improve gait speed in people with diabetic neuropathy: a randomized controlled trial," by the authors noted above, which was published online on May 9, 2022, in the journal Scientific Reports 12, 7561 (2022). https://doi.org/10.1038/s41598-022-11745-0. Editing has occurred, including the renumbering of tables, and references have been removed for brevity. The table on page 47 is from the online Supplementary information. Use is per CC BY 4.0.

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Table. Foot-ankle therapeutic exercise program description.

CATEGORIES		EXERCISE	PROGRESSION
Warming Exercises	Level 1	1. Stretching the sole of the foot	2 x 30 sec → 2 x 1 min → 3 x 1 min
		2. Massage foot with the ball	1 x 1 min → 2 x 1 min → 3 x 1 min
		3. Move your feet up, down, and in circles	1 x 10 rep → 2 x 10 rep → 3 x 10 rep → 4 x 10 rep
		4. Calf muscle stretching	1 x 20 sec
	Level 2	5. Writing words with your feet	Short words → long words
		6. Interlacing your fingers and toes and making circular movements	1 x 20 rep each foot
		7. Toe manipulation	1 x 20 rep each toe
		8. Massage with the ball without contact of the heel	Press during 1 min each foot
		9. Self-massage	1 x 20 secs
Intrinsic Muscle Exercises	Level 1	1. Toe alternate	1 x 10 rep (sitting) → 1 x 10 rep (standing)
		2. Pick up objects with y our toes	Cotton: 1 x 10 rep → 2 x 10 rep
		3. Wringing towel with feet	Ball: 1 x 10 rep → 2 x 10 rep
		4. Open and close toes (from the second to the fifth)	Pencil: 1 x 10 rep → 2 x 10 rep
		5. Squeeze toe separators	1 x 5 rep → 1 x 10 rep
			1 x 10 rep → 1 x 20 rep → 1x 10 rep (with elastic bands) → 1 x 20 rep (with elastic bands)
			1 x 10 rep → 2 x 10 rep → 3 x 10 rep (each foot)
	Level 2	6.Toes flex with theraband	1 x 10 rep → 2 x 10 rep → 2 x 10 rep (standing)
		7. Plantar arch raise	1 x 10 rep → 2 x 10 rep → 3 x 10 rep
		8. Walk with your toes pressed to the floor	1 x 10 steps, pressing 1 sec → 2 x 10 steps → 3 x 10 steps
		9. Short-foot exercise	1 x 10 rep → 2 x 10 rep → 3 x 10 rep
Ankle Exercises	Level 1	1. Climb on the tip of feet	1 x 5 rep → 1 x 10 rep → 1 x 15 rep
		2. Kick the floor	1 x 30 rep → 2 x 30 rep → 2 x 40 rep
		3. Tighten the ball	1 x 10 rep → 1 x 15 rep → 1 x 20 rep
		4. Step forward and backward	2 x 15 rep → 2 x 20 rep → 2 x 30 rep
	Level 2	5. One foot balance	1 x 10 sec → 2 x 10 sec → 1 x 20 sec → 2 x 20 sec
		6. Strengthening the medial musculature of the foot	1x10 rep (yellow theraband) → 1x10 rep (red theraband)
		7. Strengthening the lateral musculature of the foot	1x10 rep (yellow theraband) → 1x10 rep (red theraband)
Functional Exercises	Level 1	1. Walking across the steps	1 x 5 rep → 1 x 10 rep → 1 x 15 rep
		2. Walk changing direction	1 x 10 rep
		3. Walk changing direction (diagonal)	1 x 10 rep
	Level 2	4. Walk through obstacles	2 x 15 rep → 2 x 20 rep → 2 x 30 rep
		5. Walking through obstacles on unstable ground	1 x 10 rep → 1 x 15 rep → 1 x 20 rep

Continued on page 47

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Continued from page 44

0.18 m/s compared with CG participants, a greater increase than that recommended for clinical improvement and mortality reduction (0.10 m/s). Thus, the foot-ankle exercise program presented in this study potentially promotes an indirect protective effect against mortality risk.

The number of steps taken over a 6-day period did not differ between groups after 12 weeks. While all participants started the study at a moderate activity level (7,641 and 8,092 steps in the CG and IG, respectively), the CG showed decreasing activity level, to 7,093 steps, by the 1-year follow-up. The IG remained at a moderate activity level at the 1-year follow-up (8,458 steps). The status of being moderately active represented a health advantage for the IG, because in addition to helping with lifestyle and activities of daily living (ADL), more steps could improve musculoskeletal capacity, especially foot-ankle muscle strength.

After 12 weeks of foot-ankle training, the IG showed increased ankle dorsiflexion ROM compared with the CG ($P = 0.048$; interaction effect). In the 24-week and 1-year follow-ups, there were no differences between groups in ROM. Nor were there significant differences between foot-ankle training and usual care on toe muscle strength. These findings and the positive results from other cited RCTs and non-controlled studies reinforce the importance of exercising the foot-ankle to gain this clinically relevant outcome.

The foot-ankle intervention did not affect DPN symptoms and tactile sensitivities. However, after 12 weeks of foot-ankle training, the IG presented better vibration sensitivity compared with the CG ($P = 0.030$; interaction effect), and that difference was maintained at the 1-year follow-up assessment ($P = 0.023$; interaction effect). The clinical importance of vibration sensitivity for the development of diabetic foot ulcers has been demonstrated by research associating current or past DFUs with altered tuning fork vibration perception.

The foot-ankle exercise program yielded a positive effect on QoL at the 24-week follow-up compared with the CG. Compared to baseline assessment, the IG showed a significantly improved QoL score at 12 ($P = 0.006$, time effect) and 24 ($P = 0.006$, time effect) weeks, as well improved foot pain scores at 12 and 24 weeks ($P = 0.044$ and $P = 0.026$; time effect, respectively). The CG also showed improvements in foot health after 1 year, compared with baseline and 6 weeks ($P = 0.001$ and $P = 0.025$; time effect, respectively). The foot-health improvement in the CG might be due to the usual-care guidance offered to the patient during the orientation session, with the placebo effect also being an important consideration.

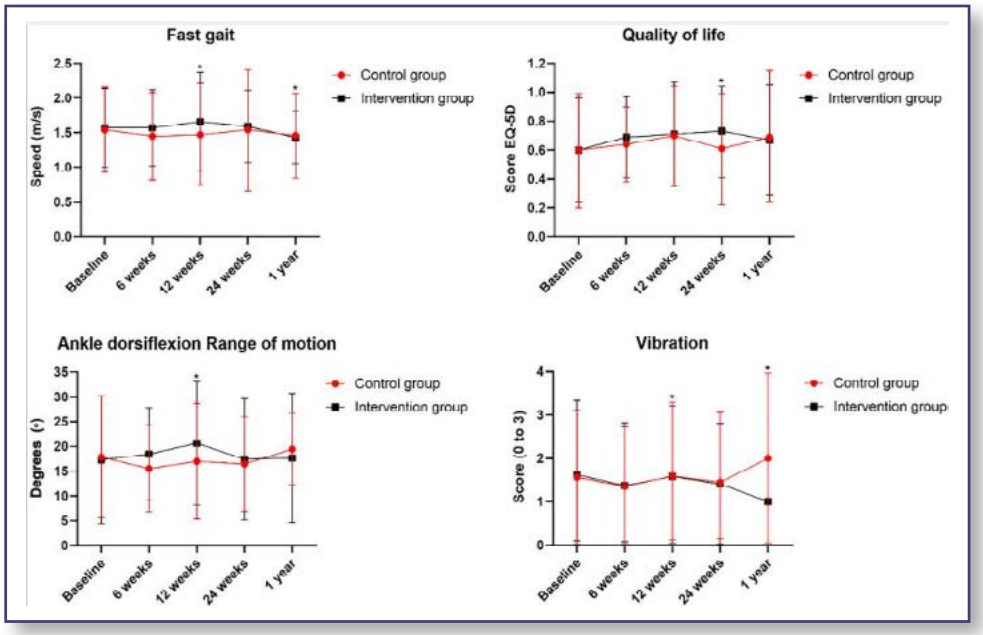


Figure. Difference between intervention group and control group on fast gait speed, quality of life, ankle range of motion and vibration outcomes.

Over a 1-year follow-up, 1 participant from each group developed a plantar foot ulcer. The IG participant was diagnosed about 13 weeks after randomization, whereas the CG participant was diagnosed about 5 weeks after randomization. Due to an insufficient number of participants with foot ulcers, it cannot be determined whether the later time to develop an ulcer in the IG participant was linked to the intervention.

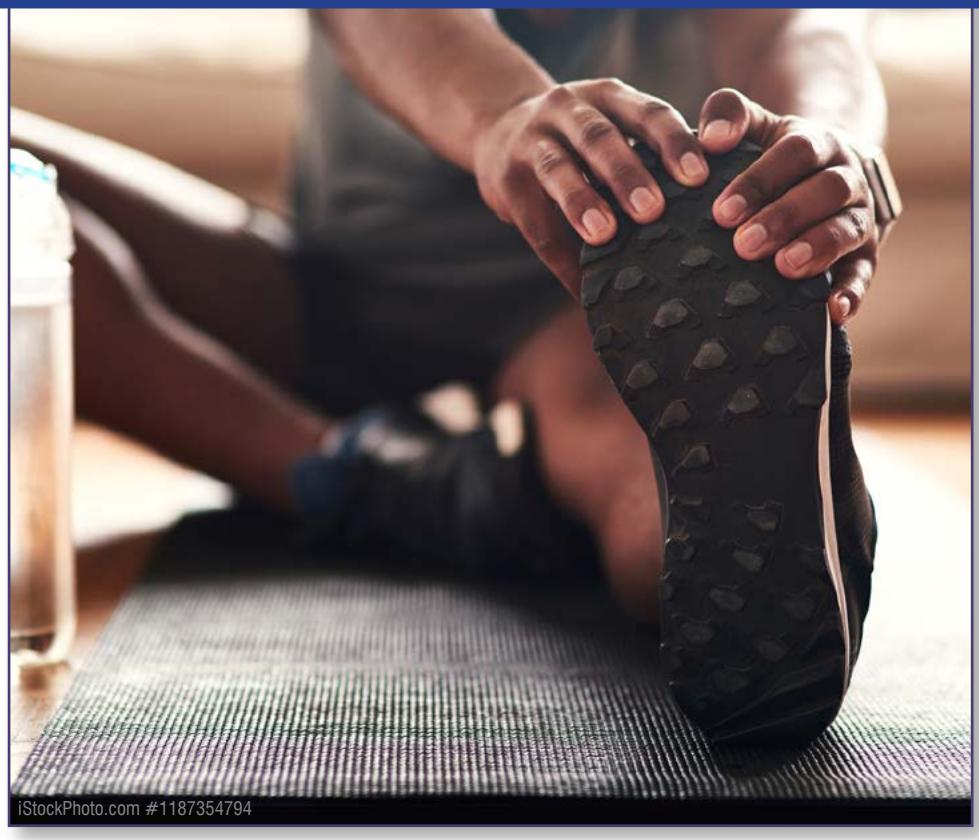
Conclusions

The study authors concluded that the 12 weeks of the foot-ankle therapeutic exercise program showed positive effects compared with usual care on the primary outcome of fast-gait speed, and on the secondary outcomes of foot-ankle ROM, vibration sensitivity, and QoL. However, no effects were seen on the 2 other primary outcomes after 12 weeks (self-selected gait speed and number of steps), although a 1,365-step difference between groups was observed at 1-year follow-up. Improvements in vibration sensitivity and ROM may indicate an improvement in modifiable risk factors for foot ulceration, whereas an increase in gait speed may be an indicator related to mortality reduction in this population. Taken together, the findings of our study suggest that foot-ankle exercises may be an effective complementary treatment strategy for improving some musculoskeletal and functional deficits related to DPN. For other outcomes, larger trials are needed to further investigate the effects of such an exercise program. ler

Best Practice Guide Encourages Stretching Moves for Plantar Fasciitis

First law of motion: objects in motion stay in motion.
Sir Isaac Newton

By Dylan Morrissey, Matthew Cotchett, Ahmed Said J'Bari, Trevor Prior, Ian B Griffiths, Michael Skovdal Rathleff, Halime Gulle, Bill Vicenzino, Christian J Barton



Plantar heel pain (PHP) is common and can have a negative impact on physical and mental health. Despite this prevalence, existing guidelines lack clear, high-quality recommendations for treating people with this condition. The question then is, how should clinicians treat pain and improve function in people with PHP? The authors set out to answer this question by developing a best practice guide (BPG) for the management of PHP.

Methods & Results

The authors synthesized high-quality randomized controlled trials (RCTs), elicited expert clinical reasoning, and surveyed patients to produce this BPG.

Of the 51 trials included in the review, 8 RCTs of 9 interventions could be considered for primary proof of efficacy. The 9 interventions included radial extracorporeal shockwave therapy (ESWT), focused ESWT, custom foot orthoses, prefabricated foot orthoses, dry needling, magnetized insoles, calf stretching, foot taping, and wheatgrass cream.

Forty people with PHP completed the online survey and 14 experts were interviewed resulting in 7 themes and 38 subthemes. There was good agreement between the systematic review findings and interview data about taping and plantar fascia stretching for first step pain in the short term. Clinical reasoning advocated combining these interventions with education and footwear advice as the core self-management approach. There was good expert agreement with systematic review findings recommending stepped care management with focused shockwave for first step pain in the short term, medium term, and long term and radial shockwave for first step pain in the short term and long term. Good agreement was also found to 'step care' using custom foot orthoses for general pain in the short term and medium term.

The synthesis of this quantitative (review) and qualitative (expert interviews and patient survey) data led to the development of a core approach for people with PHP. The core approach consists of the best evidence-based interventions of plantar fascia stretching and low dye taping complemented by an individualized education approach. All recommended core approach components should be used simultaneously for about 4–6 weeks before consideration of adjunctive interventions such as ESWT or orthoses. Expert interviews strongly emphasized the need to implement this education and self-management approach prior to applying the interventions identified to have strong evidence when pain remains unchanged from baseline. The timelines were derived from the qualitative components and reflect the time required for someone to respond to the core approach, but recognize a need to adjust these timelines based on individual circumstances.

Discussion

The BPG defines a core approach (Figure)

This article has been excerpted from "Management of plantar heel pain: a best practice guide informed by a systematic review, expert clinical reasoning and patient values" by the authors noted above, which was published in the *British Journal of Sports Medicine*. 2021;55:1106–1118. doi: 10.1136/bjsports-2019-101970. Editing has occurred, including the renumbering of tables, and references have been removed for brevity. Use is per CC BY 4.0.

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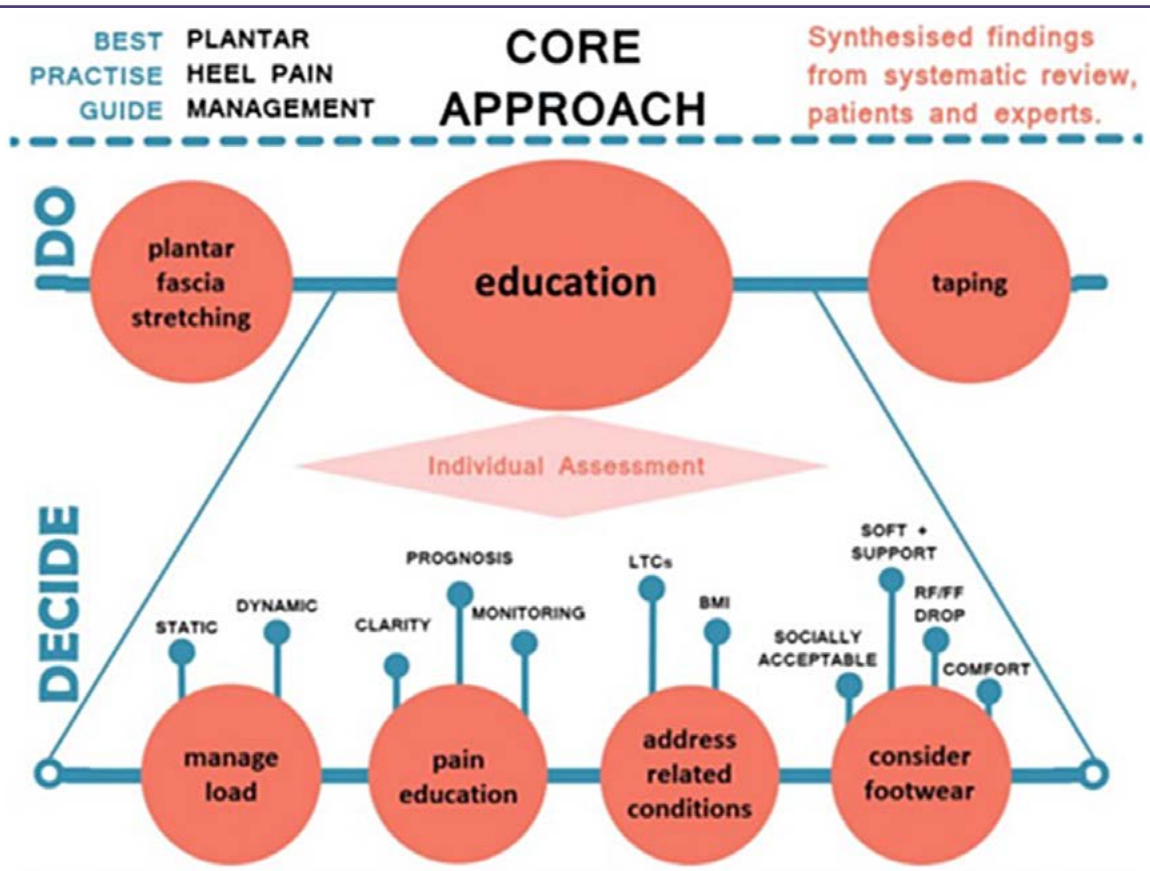

Figure. Core approach to the management of plantar heel pain based on the best available evidence, expert opinion and the patient voice. The top layer ("DO") of tapin, stretching and education are required initial interventions with each patient. The individual assessment ("DECIDE") is of which specific educational aspects are needed. BMI, body mass index; FF, forefoot; LTC, long-term conditions; RF, rearfoot.

to management, which consists of supported self-management interventions of plantar fascia stretching and taping (labelled 'DO' in the figure) to support the plantar fascia, alongside less well-defined educational interventions (labelled 'DECIDE' in the figure). The expert interviews indicated that education should adopt a realistic tone as recovery may take several weeks or months but stress the positive prognosis, and gave clear direction that this education should encourage: individual assessment; footwear advice to ensure comfort in shoes that allow a small rearfoot to forefoot drop while also considering social acceptability to improve adherence; load management to break up long periods of static loading or problematically rapid training changes in more athletic populations; support to address comorbidities such as type 2 diabetes; teaching patients the parameters required to self-monitor the pain response to activity and how to interpret pain with respect to tissue damage in order to allay fears of long-term consequences.

The systematic review showed ESWT had the best evidence of any adjunctive treatments, demonstrating positive efficacy in the short-, medium-, and long-term. It is typically used for people with non-resolving, persistent symptoms. As ESWT is inferior to stretching for acute symptoms, it is recommended when patients are failing to recover optimally using the core approach. Focused shock wave is applied so that the peak intensity is deep to the skin thus being targeted directly at the lesion and RCTs showed moderate positive short-term findings on pain of large effect. Radial ESWT results in peak intensity at the surface and showed moderate positive effects, again of large effect at all time points for patient-reported outcomes.

Other options are available for those patients who do not respond to core treatment or ESWT. Custom orthoses can be considered based on positive evidence of moderate strength and lower effect size than ESWT for short-term outcomes. This progression is extrapolated from expert interviews and systematic review findings. Prefabricated or custom orthoses are often prescribed for PHP. However, none of the trials included in this review used the same orthosis. All differed in the prescription process, casting technique, shell material, top-covers, and modifications, thus limiting trial comparison. The prescription of foot orthoses in clinical practice, whether customized or prefabricated, commonly involves a process of both education and orthosis modification to optimize the dose and biomechanics. No included RCTs followed this process, possibly limiting efficacy of orthoses. Furthermore, prefabricated orthoses, as used in the included trials, were shown to be ineffective. Therefore, it can be recommended that a single orthosis prescription is not used for all presenting patients, an assertion supported by expert

Continued on page 52

Continued from page 51

opinion in this study. Given the contrast with custom orthoses, it may be that having a range of prefabricated orthoses may be a suitable strategy so that prescription can be individualized. This approach would be a priority for future cost-effectiveness trials, given the lower cost compared with casting or scanning.

Dry needling had a positive effect on pain and function in the short term. One study showed that dry needling can be considered to have neutral evidence of effect but could be considered as an adjunct intervention to the core approach, with lower priority than orthoses. Trigger point dry needling is also associated with minor adverse events such as needle site pain and to a lesser extent minor bruising. Findings from the interviews indicated that dry needling is not a first-line treatment but may be considered to influence pain and muscle tension when combined with other interventions.

Corticosteroid and platelet-rich plasma injection therapy was carefully assessed, both in the trials and the semi-structured interviews as this is a commonly used intervention. However, no such RCTs have been performed. This is an intervention for which placebo control is readily achievable and represents a priority for future research—perhaps in patients where ESWT has failed to yield optimal results.

Resistance exercises of the affected area and limb are often effective as part of first-line care for chronic musculoskeletal problems such as osteoarthritis of the hip or knee and common tendinopathies. While there is moderate evidence for stretching the plantar fascia, the authors' systematic review could not identify evidence in favor of more comprehensive exercise approaches. Furthermore, the expert interviews did not provide a theme on hidden efficacy and was divided on whether such resistance exercises are useful or not.

Information obtained from the 3 methods used to formulate the BPG was generally consistent. For example, the need for positivity when discussing prognosis was expressed by experts and mirrored in the patient survey responses. Furthermore, there was strong agreement between the patient survey findings and the content of the core intervention while expert interviews and the systematic literature review were in agreement about the efficacy of the various interventions. The agreement was also good where the published evidence was unclear. For example, there is an absence of high-quality trials of progressive strengthening while the expert interviews showed very divergent views on likely efficacy.

Taking into consideration each patient's past treatment history and experience, the BPG can guide patients and clinicians. It can also inform future research. Patients having access to summary resources such as figure 2 should reduce some of the inconsistency they report when seeking guidance from internet and other resources. ler

Continued on page 55

Home-Based Stretching Effective for Plantar Fasciitis

A 2020 study from Thailand found a 3-week home-based stretching program was effective for patients with plantar fasciitis. The exercise program was a home-based stretching exercise for calf and plantar fascia that patients could perform by themselves; it was progressed by week (Figure). To ensure the patients were able to follow the program properly, a physiotherapist taught the exercise program until they remembered and were able to exercise on their own accurately. Patients also received both handbook and video clips of the exercises for use via smartphone. In addition, the researcher reminded them to follow the exercise twice a week by Line chat or telephone. Participants were re-checked and were assigned more progressively of exercise after the 5th day and 10th day of the intervention program.

The exercises consisted of gastrocnemius, soleus, and plantar fascia stretching. Duration for each stretching exercise was 20-30 sec, resting between exercises for 10 sec, and doing each exercise for 10 sets. Patients spent a total time for the exercise around 20 minutes per day, 5 days per week over the duration of 3 weeks.

The authors concluded that this program was effective for reducing pain, enhancing function and muscle strengths of the ankle plantarflexors, invertors, evertors, great toe flexors, and less toe flexors in patients with plantar fasciitis.

Source: *Boonchum H, Bovonsunthonchai S, Sinsurin K, Kunanusornchai W. Effect of a home-based stretching exercise on multi-segmental foot motion and clinical outcomes in patients with plantar fasciitis. J Musculoskelet Neuronal Interact. 2020;20(3):411-420.*

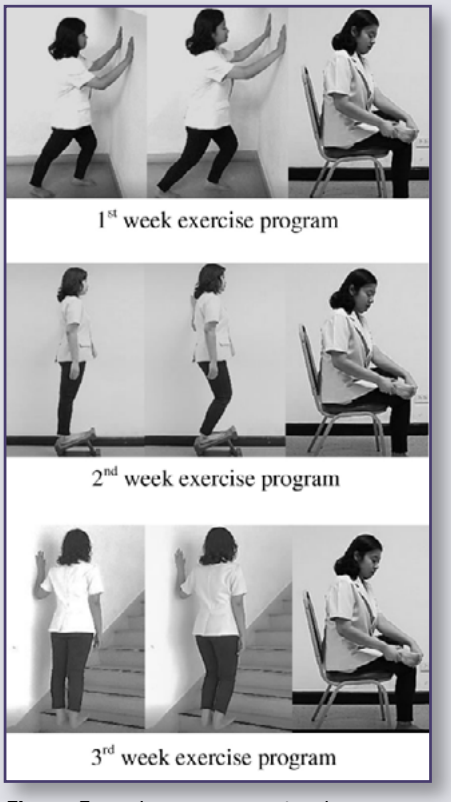

Figure. Excersise program protocol.

Returning to Exercise After COVID-19: Guidance for Mid-2022

During recovery it's important to listen to how your body feels.
@PaulGoughPhysio

As the world moves into yet another phase of the COVID-19 pandemic, Australian sports experts in public health, cardiology, sports medicine, pediatrics, and sports training issued revised guidance for returning to sport after infection. They noted that the 2022 Omicron variant of SARs-CoV-2 (the virus that causes COVID-19) continues to evolve in clever ways, making evidence-based guidance difficult. However, previously published guidance, they noted, focused on the early experience with cardiac and respiratory complications, and required updating to reflect current reality, which includes readily available vaccines and improved therapies.

Noting Omicrom's lesser virulence yet greater transmissibility than previous variants, the experts recommended the need for considering an individual's unique experience with the virus, namely the duration and severity of the symptoms, as well as pre-existing medical concerns, prior fitness level, and the intensity of the chosen post-COVID exercise. Their point is to minimize any non-COVID related complications, such as those musculoskeletal injuries that often occur when individuals, who have been inactive, return too suddenly to a prior activity level.

While acknowledging the severity of cardiac symptoms (myocarditis in particular) early in the pandemic, the authors state that "even without vaccination, the risk of cardiac complications in young athletes following COVID-19 infection has been relatively low."

As for a real-world return to exercise, they note that Australia and New Zealand have minimum 7-day isolation policies for anyone who tests positive. The important question they ask is this: "when is it safe for most individuals to return to exercise? The question needs to be framed in two parts: (1) safety for the individual (in terms of risks of developing complications) and (2) safety for other individuals that the recuperating individual comes in contact with on return (in terms of potential to infect others)."

They also see this moment in time as an opportunity to reset the culture of training: they hope that their guidance on the slow return can help displace that notion of pushing through when sick that often leads to viral fatigue syndrome.

While the figure provides their detailed recommendations on when to return to exercise, they conclude that most individuals can safely return 7-14 days after infection. They caution, however, that the timeline to return should be guided by the individual's health and fitness history. ler

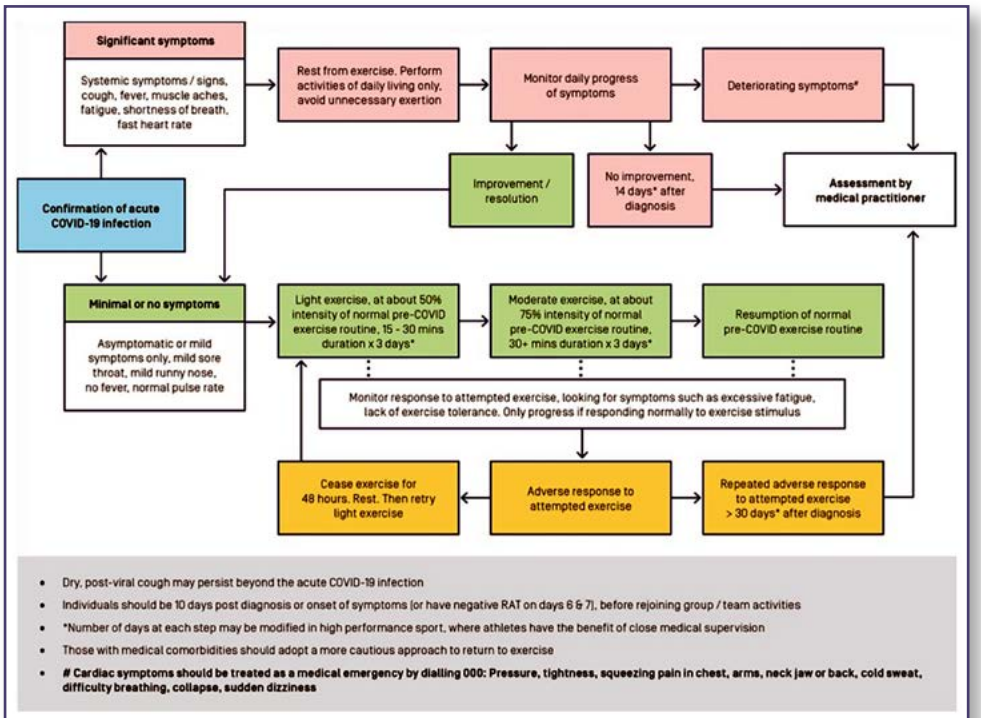

Figure. Graduated return to exercise after COVID-19 infection. Reprinted with permission from Elsevier Ltd. All rights reserved.

This article summarizes "Return to exercise post-COVID-19 infection: A pragmatic approach in mid-2022," by David C. Hughes, John W. Orchard, Emily M. Partridge, Andre La Gerche, and Carolyn Broderick. The article was published June 7, 2022, in the *Journal of Science and Medicine in Sport*. 2022;25(7):544-547. doi: 10.1016/j.jsams.2022.06.001. Readers are encouraged to review the original, which is available online for free.

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SMALL		5.5-8.5	6-8	1/2", 3/4" or 1-1/4"
MEDIUM		9-11	8.5-10	
LARGE		11.5-13.5	10.5-13	
X-LARGE		14+	13.5+	

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New & Noteworthy

Noteworthy products, association news, and market updates

FIT360 COMMUNITY REACHES 2 MILLION PAIRS OF CUSTOM ORTHOTICS

Since the day FIT360 started in 2017, the focus has been on providing an open software solution, to allow its user base to create insoles quickly, but always patient focused. The company's customers around the world are connected and sharing ideas and processes. For example, FIT360's SLS and Multi-Jet-Fusion users offer a print service to other labs and clinic customers around the globe.

Now, FIT360 has announced that this community has created over 2 million pairs of unique insoles for patients and athletes worldwide, 17% of which have been nylon printed devices. This percentage is growing daily. The second 1 million pairs were created over the past 14 month.

"The 7 of us at FIT360—that together provide a fully digital and carbon positive service—are extremely proud of our achievements and those of our growing community," said Chris Lawrie CEO.

OACTIVE ALIGN OA KNEE BRACE

VQ OrthoCare®, a provider of non-invasive, non-drug, medical solutions focused on bone, joint, and soft-tissue conditions, has introduced the OActive® Align™ Osteoarthritis Knee Brace. The brace offers clinicians an easy solution for custom fitting and aligning the brace to produce exceptional patient outcomes. The brace employs a unique combination of features that precisely fit the anatomy, align the brace hinge axis, and secure it in its most effective position for corrective pain relief. Dual Q-hinge angle adjustments and a heat-formable tibial cuff, with an included exothermic heat pack for custom molding, achieve this in a simple yet highly effective way. The OActive® Align™ is available in prefabricated sizes and custom-manufactured models measured with the company's proprietary digital measurement system, eCast™.

VQ OrthoCare
800/266-6969
vqorthocare.com

MAKING ROBOTIC ASSISTIVE WALKING MORE NATURAL

A team of graduate students in Caltech's Advanced Mechanical Bipedal Experimental Robotics Lab (AMBER), led by Professor Aaron Ames, PhD, Bren Professor of Mechanical and Civil Engineering and Control and Dynamical Systems, is developing a new method of generating gaits for robotic assistive devices; their goal is to guarantee stability and achieve more natural locomotion for different users.

Their work combines hybrid zero dynamics (HZD)—a mathematical framework for generating stable locomotion—with a musculoskeletal model to control a robotic assistive device for walking. The musculoskeletal model is a computational tool to noninvasively measure the relationship between muscle force and joint contact force. HZD is currently used to create stable walking gaits for bipedal robots, and the muscle model represents how much a muscle stretches or contracts with a given joint configuration.

The team demonstrated its approach on a battery-operated, motorized prosthetic leg. The battery powers the motors, which turn the joints. The motor movement is dictated by the mathematical algorithm developed by the researchers.

"The muscle activity pattern of a human walking without the prosthetic is what we want to get closer to," said Rachel Gehlhar, a graduate student in mechanical and civil engineering. Directly embedding musculoskeletal models into the optimization problem—the algorithm ultimately producing gaits for the prosthesis—provides a foundation for generating gaits that can feel more natural.

One surprising discovery was that the combination of HZD and the muscle models generated desired walking gaits faster than had been expected. Forcing the robotic model to follow the patterns of muscle-tendon relationships adds further constraints to the gait-generation optimization problem, so one might expect the problem to be more difficult to solve. But with these additional constraints, a stable walking gait developed after fewer iterations of the optimization problem.

This work helps bridge the gap between

methods that use algorithms to produce desired walking motion and the field of biomechanics. The resulting collaboration brings the AMBER lab a step closer to translating natural motion to a robotic assistive device like a prosthesis, with potential applications in full body exoskeleton devices for people with paraplegia.

RELIEF PAIN DISCOMFORT LOTION

Moore Relief Pain Discomfort lotion is a scientifically proven, fast-acting, effective therapy that helps relieve neuropathic skin discomfort. The product was developed by Milton Moore, MD, a dermatologist and pharmacist. In clinical research tests, patients applied the lotion topically to areas in which they experienced recurring pain from carpal tunnel syndrome, sciatica, back, knee, fibromyalgia, and diabetic neuropathy. Most patients reported apparent relief of 75% to 100%, and the relief lasted from 7 to 24 hours with 1 application. The patent-pending product is formulated with moisturizing and anti-inflammatory agents such as aloe vera, extracts of algae, argan oil, as well as other natural ingredients. These products use Dr. Moore's patented transdermal delivery system, which enables the active ingredients to be absorbed by the skin quickly.

Moore Relief Pain and Burn Dermaceuticals
moorerelief.com

ADAPT HIKE MAX INSOLES

Superfeet expanded its Adapt insole collection with its Adapt Hike Max Insoles designed for hiking. The insoles are equipped with the company's patented Adaptive Comfort Technology™ to flex with the foot for comfort and provide efficient heel-to-toe turnover, adapting to the foot's natural motion. The Adapt Hike Max Insoles feature 2 layers of Aerolyte foam; high rebound forefoot pad to maximize energy return and maintain big toe flexibility during propulsion; dynamic heel cup with cushioning and strategically placed cutouts based on the anatomical location of the major joints; and Moisturewick to improve wicking, breathability, and odor control.

Superfeet
800/634-6618
superfeet.com

METEOR MINI MASSAGE BALL

MyoStorm has introduced the Meteor Mini recovery product for soft tissue and joint pain. Just like the Meteor, only 50% smaller, this mini massage ball boasts 4 levels of vibration specifically designed to be therapeutic, a portable size and shape, and a heating feature, which reaches 120 degrees. The Meteor Mini is designed to help in a range of treatments including plantar fasciitis, shin splints, sciatica, and more. Its size and shape make it perfect for targeting stiff muscles, knots, and general soreness after workouts and it's calibrated for everyday aches and pains. The Meteor Mini was created by a team of professional athletes, engineers, and doctors to be effective and versatile. Using hundreds of hours of research, the team designed the Meteor Mini around the specific amplitudes and frequencies that scientific studies have shown to be effective at reducing pain and promoting muscle recovery.

MyoStorm
sales@myostorm.com
myostorm.com

STUDY COMPARES PROSTHETIC FEET AND FUNCTIONAL MOBILITY ACROSS PROCEDURE CODES

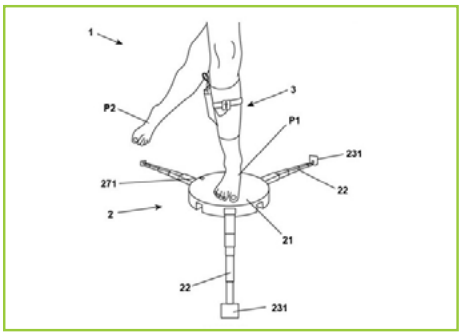
Hanger, Inc. announced results of its Outcomes ASsessment and DISsemination II (OASIS II) study, which evaluates the effectiveness of 10 common prosthetic feet models across L5981 (all lower extremity prostheses, flex-walk system or equal) and L5987 (all lower extremity prosthesis, shank foot system with vertical loading pylon) procedure codes, as assigned by the Centers for Medicare & Medicaid Services (CMS)'s Pricing, Data, Analysis and Coding (PDAC) contractor for orthotic and prosthetic devices. The second study in the OASIS series by the Hanger Institute for Clinical Research and Education reports L5987-coded feet are associated with improved mobility compared to the L5981 category; this finding confirms results reported previously in a purely dysvascular/diabetic population of 738 individuals with amputation in the Institute's Mobility Analysis of Amputees (MAAT) 5 study. The latest study also questions whether prosthetic feet and componentry should be categorized based on functional outcomes instead of mechanical

features.

The OASIS II study was designed to investigate real-world evidence on several highly utilized prosthetic feet that were re-coded from L5987 to L5981 due to a lack of visual distinct vertical loading mechanism. The analysis compared functional outcomes of 526 users across a variety of etiologies who utilized prosthetic feet that retained an L5987 coding, prosthetic feet that were newly assigned an L5981 coding, and those that sustained an L5981 coding. Results showed no significant difference in functional mobility for individuals with prosthetic feet that had their coding modified to L5981, compared to those that retained the L5987 designation.

To read more about the study, visit hangerclinic.com/blog/published-research/oasis2/.

NEW KNEE REHABILITATION DEVICE PATENTED



Researchers from the Universidad Carlos III de Madrid (UC3M) and the Universidad Complutense de Madrid (UCM) have designed and patented a new device for carrying out knee rehabilitation and strengthening exercises. The proposal involves a physiotherapeutic technical aid system for knee rehabilitation, which determines and reduces the risk of suffering a new injury during rehabilitation. In addition, this device could also be used in the world of sports competitions, both for use in physiological analysis and for performance improvement exercises.

Currently, 2 clinical assessment exercises—the Y-Balance Test (YBT) and Star Excursion Balance Test (SEBT)—are used to determine the risk of injury to the patient's lower limbs. They are carried out manually, with oversized systems that aren't easily transportable and require constant supervision by physiotherapists.

This new device consists of a platform on which the patient rests the foot of the limb undergoing treatment. The platform contains extendable arms, with presence sensors at each end. During a YBT exercise, the other foot has to go over them. Another set of sensors is attached to the patient's tibia using a calf brace, which measures the lateral tilt and loss of verticality of the kneecap during the YBT test. When the patient is in a position that may be potentially harmful or damaging, the detector communicates this to the base. All this data is sent to the patient's mobile device through a Wi-Fi connection.

"These measures are helpful for physiotherapist work," said Ricardo Vergaz Benito, PhD, from the UC3M Department of Electronic Technology. "They help to personalize the exercises to be carried out with each patient. In addition, the system's portability and connectivity significantly reduce the specialist's constant clinical supervision."

ELECTRONIC TUNING FORK FOR PREDICTION OF DFUS

The ETF128 (electronic tuning fork) is a point-of-care diagnostic instrument designed to improve the prediction of diabetic foot ulcers (DFUs), as validated by a key research study. The ETF128 transforms the most valuable features of the 128 Hz tuning fork into a modern electronic configuration. The result is a 21st century medical instrument designed to provide standardized neurological screening in a variety of clinical settings. The accuracy and reproducibility of the device has been enhanced through integration of a timing function. This allows providers to perform standardized timed vibration tests (TVT). The TVT is especially suited to the diagnosis and tracking of diabetic peripheral neuropathy (DPN). Prompt diagnosis of DPN is critical due to its role as a key precursor leading to foot ulcers, infections, and amputations. Armed with the ETF128, physicians can more rapidly implement preventative strategies aimed at reducing limb loss.

O'Brien Medical
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MAGNAREADY ADAPTIVE TRACK PANT

MagnaReady®, a magnetic apparel company, has debuted its Reach adaptive track pant for men from the ULEX by MagnaReady® collection. Available in both standing and seated fits, the Reach pant is designed to transition from working at home to running errands to the gym without pause. The Reach pants are made with wrinkle-resistant, woven bi-stretch sport crepe fabric. They have a patented magnet closure fly with Gecko Velcro to secure the waistband, which features encased elastic at the back for easier dressing and a more comfortable fit. Loops at the waistband provide added assistance for the individual or a caregiver. Ankle zippers increase leg openings to allow for easier dressing and room for AFOs and leg braces. Sensory-friendly seams

ensure a comfortable skin feel, and pockets are strategically placed with zipper closures to secure personal belongings. The track pants are available in gray and black in sizes XS – XXL.

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'SNAPPING' FOOTWEAR TO HELP PREVENT DIABETIC FOOT COMPLICATIONS

This 3D-printed prototype of self-offloading insoles shows the array of arches to offload the high-pressure areas.

Researchers in the Department of Mechanical Engineering, Indian Institute of Science (IISc), in collabvoration with the Karnataka Institute of Endocrinology and Research (KIER), have developed a set of self-regulating footwear for persons with diabetes. The footwear—a pair of specially-designed sandals—developed by the IISc-led team is 3D printed and can be customized to an individual's foot dimensions and walking style. Unlike conventional therapeutic footwear, a 'snapping' mechanism in these sandals keeps the feet well-balanced, enabling faster healing of the injured region and preventing injuries from arising in other areas of the feet. The footwear can be especially beneficial for people who have diabetic peripheral neuropathy, which leads to a loss of sensation in the foot and irregular walking patterns.

For example, a healthy person usually places their heel first on the ground, followed by the mid-foot and toes, and then the heel again—this gait cycle distributes the pressure evenly across the foot. But due to the loss of sensation, persons with diabetes may not always follow this sequence, which means that the pressure is unevenly distributed. Regions of the foot where the pressure exerted is high are at greater risk of developing ulcers, corns, calluses and other complications.

Most of the therapeutic footwear available in the market is ineffective at off-loading the uneven pressure exerted by the 'abnormal' gait cycle of persons with diabetes, the researchers said. To address this challenge, they designed arches in their sandals that 'snap' to an inverted shape when a pressure beyond a certain threshold is applied. "When we remove the pressure, [the arch] will automatically come back to its initial position—this is what is called self-offloading," explained Priyabrata Maharana, PhD student in the Department of Mechanical Engineering, IISc. "We consider the individual's weight, foot size, walking speed, and pressure distribution to arrive at the maximum force that has to be off-loaded." Multiple arches have been designed along the length of the footwear to off-load the pressure effectively.

ANKLE SYNDESMOSIS REPAIR SYSTEM

Acumed has introduced the Ankle Syndesmosis Repair System with Acu-Sinch Knotless technology. The system was developed by a group of surgeons focused on trauma and the needs of foot and ankle specialists. This tendon and ligament repair device provides a single solution for treating complex injuries. The Acu-Sinch Knotless Implant enables the dynamic stabilization of laxity or syndesmotic disruptions to the tibiofibular joint. The patent-pending release mechanism gives the user control to place the medial button subcutaneously without the need for direct visualization. The trigger mechanism provides tactile feedback, and radiographic indicators enable Flip Button position visualization under fluoroscopy. The Acu-Sinch Knotless buttons may be augmented with a washer or used in conjunction with the Acumed and OsteoMed fibula fracture fixation plates and intramedullary nails with 3.5mm nonlocking screw holes.

Acumed
888/627-9957
acumed.net

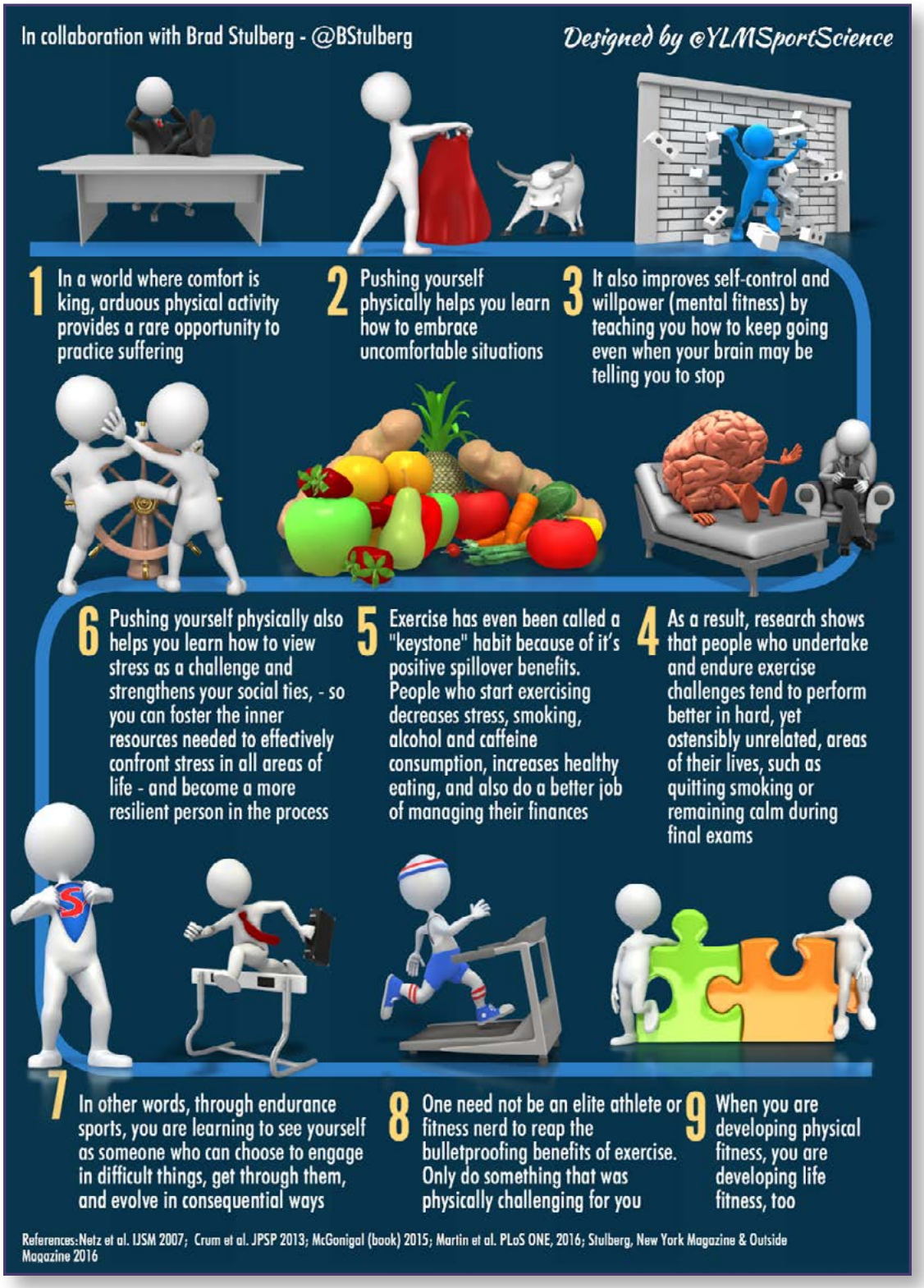
SUMMIT PRO PREFABRICATED INSOLE

Forward Motion (FM) Medical has released the new Summit Pro prefabricated insole. This new insole takes elements and inspiration from other popular FM prefabs to create the ultimate package of comfort, support, and performance. The Summit Pro insole is a medical-grade prefabricated insole that is made to look and fit like a custom orthotic. These impressive insoles feature a semi-rigid shell with a 3-degree extrinsic post, an anti-microbial and anti-odor MicroSilver top cover, high-rebound full length padding, and a hole-in-heel padding accommodation. A wide variety of options are also available such as non-posted, ¾ length, extra padding, vinyl top cover, and high arch shells.

Forward Motion Medical
800/301-5835
www.fdmotion.com

So often in life, things that you regard as an impediment turn out to be good fortune.
Ruth Bader Ginsburg

HOW EXERCISE SHAPES YOU, FAR BEYOND THE GYM



Source: Netz Y et al. Int J Sports Med. 2007;28(1):82-87. Crum AJ et al. J Pers Soc Psychol. 2013;104(4):716-33. McGonigal K. Upside of Stress. 2015: Avery Press. Martin K et al. PLoS One. 2016 Jul 21;11(7):e0159907. Stulberg B. New York Magazine; July 26, 2016.