Public Health Interventions for Osteoarthritis - updates on the Osteoarthritis Action Alliance's efforts to address the 2010 OA Public Health Agenda Recommendations

L.F. Callahan[1-4], K.R. Ambrose[1], A.L. Albright[1], M. Altpeter[1], Y.M. Golightly[1,4-6], K.F. Huffman[1], A.E. Nelson[1,2], S.E. Weisner[1]

[1]Osteoarthritis Action Alliance, Thurston Arthritis Research Center, University of North Carolina; [2]Department of Medicine, [3]Departments of Orthopaedics and Social Medicine, University of North Carolina; [4]Department of Epidemiology, Gillings School of Global Public Health, University of North Carolina; [5]Injury Prevention Research Center, University of North Carolina; [6]Division of Physical Therapy, University of North Carolina, Chapel Hill, NC, USA.

Leigh F. Callahan, PhD
Kirsten R. Ambrose, MS
Allison L. Albright, MPH
Mary Altpeter, PhD
Yvonne M. Golightly, PT, PhD
Katie F. Huffman, MS
Amanda E. Nelson, MD
Serena E. Weisner, MS

Please address correspondence to:
Dr Leigh F. Callahan,
Thurston Arthritis Research Center,
University of North Carolina,
3300 Thurston Building, CB 7280,
Chapel Hill, NC 27599-7280, USA.
E-mail: leigh_callahan@med.unc.edu

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ABSTRACT

Osteoarthritis (OA) is a painful joint disease affecting more than 32.5 million adults in the US and over 350 million adults worldwide. The prevalence is expected to rise continually over the next several decades with significant impacts to societal health and economic costs as well as individuals' daily activities and quality of life. In 2008, the Centers for Disease Control and Prevention (CDC) and the Arthritis Foundation (AF) led a collaborative effort to address approaches to reduce the burden of OA via public health interventions, policies (systems and environmental), and communication strategies. This collaboration resulted in the National Public Health Agenda for OA (OA Agenda), which was vetted by more than 75 stakeholder organisations and released in 2010. The OA Agenda listed ten recommendations focused on public health interventions for OA including weight management, physical activity, self-management education, and injury prevention, and policies, systems, communication, research and evaluation. In 2011, the CDC and AF mobilised the OA Action Alliance (OAAA), a national coalition of organisations concerned with mitigating the public health impact of OA, to operationalise the recommendations set forth in the OA Agenda. Since then, the OAAA has grown to include more than 110 organisations that work collectively to increase awareness about the prevention and management of OA, provide educational resources, and expand access to evidence-based programmes for target audiences including individuals with OA, community-based organisations, healthcare systems and providers, and policymakers. This review highlights the OAAA's progress to date in addressing the OA Agenda recommendations; successes and challenges in delivery of effective communication, programmes, and resources; and future implications.

Introduction

Osteoarthritis (OA) is the most common form of arthritis, affecting an estimated 32.5 million adults in the United States (US) (1) and 350 million adults worldwide (2). OA can be a serious, painful disease that limits activities of daily living and reduces quality of life, with substantial direct, indirect, and intangible economic costs (1, 3). When the disease burden of OA and rheumatoid arthritis (RA) has been examined in patients seen in rheumatology practices, the burden of OA is as severe as RA (4, 5). And, mortality is often overlooked as a serious outcome for rheumatic diseases as a whole; however, recent evidence links OA with increased mortality (3, 6-13). Two of the most common risk factors for OA, age and obesity, have been on the rise in the US for decades.

The *National Public Health Agenda for OA* (*OA Agenda*) was launched in 2010 in response to the expected escalating prevalence, health impact and economic consequences of OA (14, 15). Leadership from the Centers for Disease Control and Prevention (CDC) and the Arthritis Foundation (AF) initiated a collaboration in 2008 to address approaches to reduce the public health burden of OA. A small Steering Committee provided policy guidance and oversight. Two workgroups were created to develop White papers, one focused on public health interventions and the other on policies and communication strategies. Work group members represented a range of disciplines including

rheumatology, orthopedics, physical therapy, nursing, epidemiology, psychology, nutrition, occupational health, exercise physiology, nutrition, healthy aging, biomechanical engineering, public health, public health policy, social marketing and communication. In April 2009, the White papers were vetted at an OA Summit with more than 75 participants from a wide range of organisations. This collaboration led to the creation of the *OA Agenda* which was released in February 2010 in tandem with a national Ad Council campaign about OA that was developed in partnership with the AF and the American College of Rheumatology (ACR) (16).

The *OA Agenda* had three overall goals: 1) Ensure availability of evidence-based intervention strategies – such as self-management education, physical activity, injury prevention, and weight management and healthy nutrition – to all Americans with OA; 2) Establish supportive policies, communication initiatives and strategic alliances for OA prevention and management; and 3) Initiate needed research to better understand the burden of OA, its risk factors and effective strategies for intervention (14, 17). The *OA Agenda* included 10 recommendations; the first four focused on public health interventions for OA, while the last six focused on policies, systems, communication, research and evaluation (14, 17).

In 2011, the AF and the CDC spearheaded the creation of the Osteoarthritis Action Alliance (OAAA) (15), a group of organisations committed to implementing the recommendations outlined in the *OA Agenda*. From 2011 to 2014, the AF was the lead organisation for the OAAA. In 2014, leadership of the OAAA was transferred to the Thurston Arthritis Research Center (TARC) at the University of North Carolina at Chapel Hill (UNC). The OAAA has grown from an initial alliance of approximately 35 organisations to more than 110 organisations. OAAA members include groups from a wide range of sectors, including universities, health care systems, professional societies, parks and recreation, business and industry, community-based organisations, and patient advocacy groups (15).

The current goals of the OAAA continue to align with the recommendations set forth in the *OA Agenda:*

1. Invoke policymakers at all levels in all sectors (*e.g.* lawmakers, businesses, school officials, community leaders) to make OA a public health priority as reflected in policy decisions and funding allocations;
2. Foster communities to build capacity to prevent or manage OA by disseminating information and resources about effective community interventions (*e.g.* evidence-based interventions, environmental and policy changes) and supporting implementation of these interventions;
3. Mobilise health systems and health care professionals to proactively identify and comprehensively address OA in their clinical care (*e.g.* decision prompts, pain management, physical activity as a vital sign, referral to community-based programmes);
4. Engage individuals with OA, their family/friends and caregivers with strategies to minimise disease progression and optimise quality of life through effective clinical and self-management strategies (*e.g.* physical activity, movement, weight management, and self-management education);
5. Promote prevention of the onset of OA through effective injury prevention and weight management strategies.

This review summarises the OAAA accomplishments that address the four public health interventions recommended to prevent and manage OA (Fig. 1). These recommendations are: 1) Self-management education should be expanded as a community-based intervention for people with symptomatic OA, 2) Low impact, moderate intensity aerobic physical activity and muscle strengthening exercise should be promoted widely as public health interventions for adults with OA of the hip and/or knee. 3) Existing policies and interventions that have been shown to reduce OA-related joint injuries should be promoted, implemented and enforced. And 4) Weight management should be promoted for the prevention and treatment of OA, and national nutrition and dietary guidelines for the general population should be followed by adults with OA to select a quality diet while staying within calorie requirements (17).

Self-management education

Self-management education helps adults with a chronic disease learn how to successfully manage their condition and improve their quality of life. Research has documented that self-management education is an effective public health intervention for OA (18-21). The effects include modest improvements in pain and disability, as well as reductions in depression, anxiety and distress (18-21). Although the benefits are modest on an individual level, they translate into significant population health improvements when delivered as population-level interventions. The self-management education programmes that have demonstrated benefits for people with arthritis are noted in Table I. Despite evidence of benefits for adults with arthritis, participation rates in self-management programmes are low, with only 11% of adults with arthritis participating in these programmes. However, there is a slight increase in participation of 17% for adults that report arthritis attributable activity limitations (AAALs) (20).

The OAAA has expanded self-management education as a community-based intervention for people with symptomatic OA in several ways (Table II). The OAAA has hosted ten webinars relevant to self-management education and maintains a playlist on YouTube that includes these webinars as well as the CDC's webinars on self-management. OAAA staff and members have made numerous presentations at National and State meetings highlighting the importance of self-management education as an intervention for OA. Presentations have been given to a variety of organisational sectors and personnel including area agencies on aging, senior centers, health departments, health educators and others. Content of these presentations includes the national burden of arthritis and OA, OA comorbidities, and the self-management and physical activity programmes that are

Fig. 1. *National Public Health Agenda for Osteoarthritis 2010:* Recommended Public Health Interventions. Self-management education and physical activity focus primarily on reducing the symptoms and progression of OA for individuals with the disease. Weight management focuses on prevention of OA, as well as on reducing the symptoms and progression of disease for those with OA. Injury prevention focuses on primary OA prevention (17).

Table I. CDC Recommended and promising programmes that are proven to improve the quality of life of adults with arthritis (59).

Self-Management Education Programmes (60)	Physical Activity Programmes (36, 61-66)
Recommended Programmes	
Arthritis Self-Management Programme	Active Living Every Day
Chronic Disease Self-Management Programme	EnhanceFitness®
Programa de Manejo Personal de la Artritis (Spanish Arthritis Self-Management Programme)	Fit & Strong!
Tomando Control de su Salud (Spanish Chronic Disease Self-Management Programme)	Walk With Ease (Instructor-led format)
Promising Programmes	
The Arthritis Toolkit (Chronic Disease Self-Management: Toolkit for Active Living)	Arthritis Foundation Aquatic Programme
Better Choices, Better Health® (CDSMP internet-based)	Arthritis Foundation Exercise Programme
Better Choices, Better Health® for Arthritis (ASMP internet-based)	Walk With Ease (Self-directed format)

endorsed by the CDC as arthritis-appropriate evidence-based interventions (AAEBIs) or deemed to be promising practices. In addition, the OAAA has coordinated with the National Council on Aging's Center for Healthy Aging to track participation within these programmes among individuals with reported rheumatic disease.

Physical activity

Physical activity is an important strategy for reducing the symptomatic burden of OA. Physical activity is effective and safe, yet most adults with OA do not meet the recommended levels of 150 minutes per week set forth in the *Physical Activity Guidelines for Americans, 2nd Edition* (22, 23). Physical activity can have immediate benefits like improving sleep and reducing anxiety, and moving just 10 more minutes a day can make a difference in OA pain and improve overall health status (22). In fact, the most substantial gains are found when a person increases physical activity from 0 to 60 minutes a week (24-26). Physical activity strengthens muscles, keeps joints flexible, preserves good balance, improves function, and helps to maintain a healthy weight, all of which are particularly important for people with arthritis. Physical activity can decrease pain and improve physical function by about 40% and may reduce healthcare costs (27).

Environmental and policy strategies to increase physical activity

Adults with OA may not understand or believe that an active life is within their reach and may feel that physical activity is not possible with painful joints and impaired function and may even exacerbate OA. To address this issue, the OAAA developed the 2011 report, *Environmental and Policy Strategies to Increase Physical Activity Among Adults With Arthritis,* which focuses on the benefits of physical activity and methods to make physical activity more convenient and accessible to people with arthritis (28). The strategies in this report were designed to be implemented by organisations that work in and influence six key sectors that have the potential to reach adults with arthritis: 1) community and public health; 2) health care professionals; 3) transportation, land use, and community design; 4) business and industry; 5) park, recreation, fitness and sport; and 6) mass media and communication. To facilitate such implementation, the report was developed into an online toolkit, the *Physical Activity Implementation Guide*, which includes population-based statistics about arthritis prevalence and economic burden, implementation strategies and examples of successful programmes and resources tailored to each of the six sectors (15).

To further spread the *Physical Activity Implementation Guide*, the OAAA partnered with the American Council on Exercise (ACE) to develop an infographic to emphasise the importance of physical activity for those with arthritis, as well as strategies for increasing physical activity (15). The Alliance is also working with ACE to revamp their continuing education course about physical activity for OA targeted to fitness professionals. In addition, the OAAA has published several articles in the peer-reviewed literature to promote the *Physical Activity Implementation*

Table II. Summary of OAAA Accomplishments Related to the *National Public Health Agenda for OA* Intervention Recommendations.

Specific Intervention Topic	OAAA Accomplishments
Self-Management (SME)	• Conducted 10 webinars; maintain self-management webinars on YouTube. • Delivered presentations about importance of SME at national and state conferences for a variety of community stakeholders. • Created a national database to track SME participants with arthritis and rheumatic disease in collaboration with National Council on Aging.
Physical Activity (PA)	• Created 2011 report, *Environmental and Policy Strategies to Increase Physical Activity Among Adults With Arthritis*. • Created online *Physical Activity Implementation Guide*. • Published several peer-reviewed articles to promote the *Physical Activity Implementation Guide* (29) and expand physical activity as a vital sign assessment in clinical care. • Collaborated with American Council on Exercise to produce physical activity infographic. • Funded a total of 34 organisations across 27 states to increase access to physical activity for adults with OA through a mini-grant programme. • Developed freely accessible, online SME and PA resource library of materials and information to assist community organisations in expanding evidence-based programme offerings for adults with arthritis. • Developed tools to support and enhance every stage of the adoption and implementation process of evidence-based programmes for people with arthritis. • Piloted Walk with Ease (WWE) programme to reach African American adults with OA in a faith-based community; created faith-based community issue brief. • Created online portal for self-directed format of WWE designed to be available to individuals, Health Departments, community-based organisations, businesses, health insurers and payors. • Partnered with Boston University Center for Enhancing Activity and Participation among Persons with Arthritis (ENACT) to create walkability assessment and tool. • Shared walkability efforts in the Surgeon General's Step it Up! report. • Established first Walk with a Doc chapter led by a rheumatologist. • Produced 5 issue briefs related to OA for Walk with a Doc. • Delivered numerous conference presentations on OAAA PA efforts.
Injury Prevention	• Published a position statement in the *World Journal of Orthopedics* and infographic explaining key components of a neuromuscular training programme. • Created injury prevention resource library that is publicly available on the OAAA website and contains brochures and fact sheets for coaches, sports leagues, athletes, and parents. • Recorded 7 Lunch & Learn webinars on injury prevention. • Delivered didactic and clinical workshop presentations to key professional societies. • Increased engagement with athletic trainers and sports medicine professionals via targeted health messaging to attendees of key professional societies. • Partnered with National Athletic Trainers Association (NATA) to have OAAA consensus statement and guidance included in their online resource library. • Engaged members to feature OAAA and its injury prevention resources in articles in *USA Today*(48)(48)(48)(48)(48)(48)(48)(48)(46), *NATA News*, and the Board of Certification for Athletic Trainers. • Developed an interactive online toolkit for coaches, parents and other stakeholders about neuromuscular training that includes videos and user-friendly guidance within a mobile-friendly application.
Weight Management	• Sponsored two symposia at the annual Obesity Week conference hosted by The Obesity Society (TOS) and the American Society for Metabolic and Bariatric Surgery. • Worked with the Obesity Action Coalition (OAC) to produce an article connecting OA and obesity for *Your Weight Matters Magazine*, and participated in OAC annual conference. • Participated as a partnering champion in the National Obesity Care Week campaign to promote awareness and improvements in obesity care. • Published a commentary on the implications of obesity on musculoskeletal health in the North Carolina Medical Journal. • Produced a White paper under review, "*Exercise prescription for management of weight and osteoarthritis in young and middle-aged adults: synthesis from a systematic review"*. • Established weight management resource library that includes brochures on weight management and joint pain, an issue brief *"The Vicious Cycle of Obesity, Osteoarthritis (OA), and Disability"* and numerous recorded webinars about weight management. • Developed a CME webinar on obesity, OA, physical activity, and patient communication for primary care practitioners, obesity medicine specialists, and other interested clinical care providers.
Cross-cutting Four Interventions	
Health Communications	• Created a comprehensive communication plan outlining tactics, target audiences, messaging platforms, and collection and evaluation of reach and engagement metrics. • Operationalised communications plan to expand the quality, specificity, reach, and engagement with health messaging and resource dissemination associated with the four recommended public health interventions for OA. • Utilised 100+ OAAA membership member organisations and other partners as a successful dissemination network. • Launched the StandUp2OA campaign with a variety of readily available and free tools, videos, resources and infographics, in May 2018, the only campaign focused on prevention of OA. • Contributed to an article in the *Wall Street Journal* in late April 2018 to launch the StandUp2OA campaign. • Developed comprehensive communication outlets including website, social media, webinars, articles, videos. • Established OAAA on Facebook, Twitter, Instagram, LinkedIn, YouTube, and HealthUnlocked. • Launched a Facebook group as a peer support opportunity. • Developed OAAA blog with patient friendly-language and information about OA management, prevention, and awareness. • Created e-newsletters featuring weekly Research Roundup of peer-reviewed journal articles, Bi-weekly Digest of OA in the news media, resource blasts, and Monthly Member Spotlight. • Developed two comprehensive educational toolkits targeted to pharmacists and to a broad range of primary care providers to promote education about OA and to encourage referral of patients to evidence-based interventions.

Guide (29) and to encourage expansion of physical activity as a vital sign assessment in clinical care (30-32).

OAAA mini-grant programme

Given that physical activity remains the most recommended strategy in treatment guidelines for OA (33-35), the OAAA is continually exploring and implementing strategies to increase access to physical activity across the nation. In 2015, the OAAA initiated a competitive mini-grant programme to encourage organisations to use the *Physical Activity Implementation Guide* to establish environmental and policy strategies for increasing physical activity among adults with OA in their local communities. The response to this programme revealed the substantial interest and readiness among community organisations to implement physical activity programmes and the need for financial resources to do so.

In 2017, the OAAA restructured the mini-grant programme to narrow the focus to delivery of Arthritis-Appropriate Evidence-Based Interventions (AAEBIs) with emphasis on the AF's Walk With Ease (WWE) programme. WWE is available in two formats: instructor-led (*i.e.* group) and self-directed (*i.e.* individual), and is six-weeks in length (36). Both formats center on the WWE Guidebook, which is designed as a workbook for participants to learn about arthritis management and how to engage in physical activity safely. Although it is categorised by the CDC as a physical activity programme (Table I), many of the programme's components are key self-management concepts, including action plan development, identifying goals and barriers, tracking progress, and facilitating long-term walking upon completion. Similar to self-management programmes, Walk With Ease helps people with OA learn to build confidence in managing symptoms while also learning to increase physical activity in a safe and comfortable way. The programme has been shown to reduce the pain of arthritis, decrease disability, and improve participants' self-efficacy for exercise (36-38). Since 2017, the competitive mini-grant programme has expanded access and availability of WWE to promote long-term sustainability, and ultimately, to increase the number of people with arthritis across the U.S. who benefit from engaging in effective physical activity programmes.

Since its inception, the OAAA mini-grant programme has funded a total of 34 organisations across 27 states to increase access to physical activity for adults with OA. "State reach" is an important metric for CDC and is consistent with the OAAA's mission of addressing the national burden of OA. Information about all of the grantees to date, including funded projects, lessons learned, best practices, and focused case studies can be found on the OAAA website (15). Beyond simply funding organisations, the OAAA also developed a robust, freely accessible, online resource library of materials and information to assist community organisations in expanding evidence-based programme offerings for adults with arthritis specific to making the case for implementing AAEBIs locally; identifying the best AAEBI to fit their organisation's culture or budget; tools to facilitate programme implementation, fidelity tracking, and participant data collection; and strategies to market programmes locally and retain participants (15). Where possible, the OAAA has curated on its website existing high-quality tools and resources from partners such as CDC, AF, and grantees that have developed replicable and adaptable tools and strategies (*e.g.* marketing materials, participant coaching messages). In addition, where gaps were identified, the OAAA developed tools to support and enhance every stage of the adoption and implementation process.

Despite the achievements of the mini-grant programme, the OAAA recognised several challenges with this approach. First, mini-grants were provided to organisations already experienced and/or actively delivering evidence-based programmes. These organisations were more likely to be able to start quickly and be successful in the 1 year of funding and more likely to have the infrastructure and community engagement to sustain the programme long term. While it is important to support those organisations, the OAAA is also interested in partnering with communities that may not have programmes or resources available. Second, the WWE participant population reached through the mini-grants has consisted overwhelmingly of older white women. The OAAA recognises that access to programmes is often lacking among younger working individuals, men of all ages, people of colour, and individuals living in rural or underserved communities.

We have taken steps to address these disparities with the hope of reaching those groups and individuals that were missed by our previous efforts. The OAAA piloted a WWE programme to reach African American adults with OA in a faith-based community in North Carolina with broad health communication and resources, given the active role that religious institutions take to serve their communities. The OAAA is pursuing partnerships with additional faith-based communities to identify strategies and best practices for WWE programme delivery, and with state and regional entities that focus on employee worksite wellness initiatives.

Leveraging the wide appeal and accessibility of the self-directed WWE, the OAAA has recently developed an online registration portal for adults with OA who are interested in taking part in this format of the programme. Not only has this portal helped to facilitate broad expansion of WWE to rural and underserved communities – as well as those who prefer self-directed over group programmes – it has also been extremely attractive to employers who are looking for cost-effective programmes that support healthy habits at worksites. The original launch gave people who completed the registration survey a free WWE Guidebook (39). An initial promotional launch in late January 2019, using online communication such as e-newsletters, blog posts, social media, and paid Facebook advertisements yielded over 1,200 responses in just 2 months; and within six months, the online portal engaged participants in all 50 states. Following this early success, the OAAA is actively developing a more robust portal that will provide additional

data collection and reporting features to support partnerships with businesses, community organisations, health insurers, and payors that are interested in providing WWE as an employee benefit, at minimal cost, efficiently and sustainably.

Arthritis walkability

To augment our expansive infrastructure of resources and actions to promote physical activity, the OAAA actively promotes "walkability" for arthritis. The concept of "walkability" has gained attention as a way to promote walking and physical activity, and generally refers to how well a community promotes walking and other physical activity behaviours, given the presence or absence of different features in an environment. The OAAA worked closely with Boston University Center for Enhancing Activity and Participation among Persons with Arthritis (ENACT) to gain a better understanding of the environmental factors that influence walking behaviours among people with arthritis. A modified Delphi method was used to administer a survey in two rounds to groups of healthcare providers and consumers, yielding general consensus on eight key environmental features that each group rated as valuable for people with arthritis: 1) safety from crime, 2) safety from injury, 3) walkways free of objects blocking path, 4) walking areas separate from roads, 5) smooth and level walkways, 6) street lighting, 7) places to sit and rest, and 8) ramps and railings at stairs. The walkability audit assessment and tool can be found on our website (15). Further, the OAAA contributed to the CDC's Status Report for *Step It Up! The Surgeon General's Call to Action to Promote Walking and Walkable Communities* (40) with our walkability efforts and participation in the Walk With A Doc programme. To the latter, the OAAA partnered with UNC TARC in October 2015 to establish the first Walk With a Doc chapter hosted by a rheumatologist. In addition, we developed 5 issue briefs related to OA for the Walk with a Doc resource library that are used by walk leaders in chapters nationally and around the world.

The OAAA regularly promotes physical activity for arthritis during professional society meetings and has presented at several conferences on physical activity for arthritis as well as the implementation guide and WWE grant programmes. Physical activity accomplishments are listed in Table II.

Injury prevention

One of the strongest risk factors for OA development and progression is joint injury. Individuals with a history of knee injury, such as an anterior cruciate ligament (ACL) tear or meniscus injury, have a 3-6 times higher likelihood of developing knee OA than the general population (41, 42). Indeed, it has been estimated that up to 50% of individuals with an ACL tear will develop knee OA within 10-15 years following an ACL injury (41, 43). There are more than 50,000 ACL injury-related surgeries each year in America, each costing an average of $17,000 per surgery and an average of 6-month recovery time (44). Joint injury is common in the general population, and it occurs at a higher rate in athletes. In particular, youth who participate in running and jumping sports such as soccer, football, and basketball have an increased risk of major lower limb injuries (41). These injuries can be season- or even career-ending for student athletes and professionals. Specifically, for female athletes, there is an increased risk of re-injury and decreased quality of life due to limited knee functionality (41, 45). A traumatic knee injury such as an ACL tear can decrease quality of life and increase the likelihood of comorbidities and years of life lived with disability (46).

Despite the magnitude of impact of injuries, injury prevention is a behavioural challenge since it is natural to not think about it until it is too late. How is it possible to engage persons about a hypothetical problem that they may never have? This challenge is somewhat similar to other preventative behaviours such as exercise and diet for heart disease prevention. The messaging primarily focuses on the immediate effects of injury, but should also include delayed effects such as OA. In this regard, the role of the OAAA is to assist the many invested organisations to promote injury prevention behaviour, with the overall effort beneficial to the more immediate consequences of injury as well as concern for eventual OA.

Neuromuscular training programmes can reduce the risk of an ACL tear and other knee injuries by up to 80% (47). The OAAA advocates for neuromuscular training programmes that reduce the risk of injury, thereby reducing the risk of developing posttraumatic OA. This has been accomplished through a multifaceted and multimedia approach including OAAA publication of a position statement in the *World Journal of Orthopedics* and infographic explaining key components of a neuromuscular training programme, including specific exercises along with appropriate dosing (47). Several brochures and fact sheets for coaches, sports leagues, and parents have been developed and are available in the OAAA resource library (15). The OAAA continues to provide educational resources about posttraumatic OA and to promote implementation of injury prevention training though our Lunch & Learn webinar series (7 recorded webinars to date on injury prevention), targeted health messaging, and both didactic and clinical workshop presentations delivered to key professional societies such as the National Athletic Trainers' Association (NATA), American College of Sports Medicine (ACSM), and the Osteoarthritis Research Society International (OARSI).

Partnerships with leading professional organisations also facilitate broader reach of resources, programme delivery and targeted health messaging. Specifically, the OAAA has presented symposia and clinical workshops at the annual conference proceedings of the ACSM and NATA to educate and engage sports medicine practitioners, athletic trainers, fitness professionals, and others. Further, NATA has included the OAAA consensus statement and guidance in their online resource library. NATA has also recognised efforts to increase arthritis awareness, injury prevention strategies, and the OAAA's contributions to both in articles in *USA Today* (48), *NATA News* (49), and the Board of Certification for Athletic Trainers blog (50).

It is important to develop buy-in with coaches and the governing bodies that

are needed to enforce and implement injury prevention programmes. Although coaches are concerned about the health of their athletes, they are concerned primarily about performance. For most sports programmes, having a winning season and well-performing players is vital to programme reputation and job security of coaches. Therefore, it is essential to recognise that neuromuscular training not only reduces the risk of injury but also improves performance (46). An interactive online toolkit for coaches, parents, and other stakeholders about neuromuscular training is in development that will coalesce videos and user-friendly guidance into a mobile-friendly application for coaches and athletes to access real-time during practice (51). Injury prevention accomplishments are summarised in Table II.

Weight management

People who maintain a healthy weight are less likely to develop knee OA and, therefore, less likely to need major surgical procedures to treat OA symptoms (52). Higher body mass index (BMI) is not only a major risk factor for diabetes, cardiovascular disease, cancer, and premature death but is also implicated as a cause of OA. Managing weight with a healthy diet and physical activity can help reduce pain. Research shows that every 1 pound of weight lost can yield up to 4 pounds of relief on knee joints; and losing 15 pounds can cut knee pain in half (53). Weight loss counseling may be a key component of successful weight loss among patients. CDC reports that adults with arthritis and overweight or obesity who receive provider counseling about weight loss are four times more likely to attempt to lose weight; yet, fewer than half of those adults actually receive such counseling (54).

The OAAA has collaborated with national partner organisations such as The Obesity Society (TOS) to raise awareness about weight management as it relates to OA. Specifically, the OAAA has sponsored two symposia at the annual Obesity Week conference hosted by TOS and the American Society for Metabolic and Bariatric Surgery. The OAAA has engaged OAAA member and patient advocacy organisation, the Obesity Action Coalition, with an article connecting OA and obesity in their publication, *Your Weight Matters Magazine,* and participation in their annual conference (55). Since 2016, the OAAA has participated as a partnering champion in the National Obesity Care Week campaign to promote awareness and improvements in obesity care. The OAAA has published a commentary on the implications of obesity on musculoskeletal health in the North Carolina Medical Journal (56). Under review now is a white paper, "*Exercise prescription for management of weight and osteoarthritis in young and middle-aged adults: synthesis from a systematic review."* The OAAA online resource library includes brochures on weight management and joint pain, an issue brief *"The Vicious Cycle of Obesity, Osteoarthritis (OA), and Disability"* and numerous recorded webinars about weight management (15).

Lastly, the OAAA is developing a CME webinar on obesity, OA, physical activity, and patient communication. The course, "Exercise Prescription for Osteoarthritis and Weight Management," is targeted to primary care practitioners, obesity medicine specialists, and other interested clinical care providers to improve patient care, education and referral to evidence-based physical activity programmes that benefit both obesity and OA. A summary of accomplishments related to weight management is presented in Table II.

Health communications

It was recommended in the *2010 OA Agenda* that a well-designed communication strategy be initiated and sustained to enhance understanding and change attitudes and behaviour among specific target audiences, including consumers, healthcare providers, policy makers, employers and the business community, and community organisations. In 2015, the OAAA developed a comprehensive communication plan outlining tactics, target audiences, messaging platforms, and collection and evaluation of reach and engagement metrics. To date, the OAAA has operationalised the plan to expand the quality, specificity, reach, and engagement with health messaging and resource dissemination associated with the four recommended public health interventions for OA described in this article. The OAAA has over 100 member organisations, providing a significant network for wide dissemination of OA resources and public health messages. Our member organisations and other partners serve as a successful dissemination network.

Following a lead-in article in the *Wall Street Journal* (57), the OAAA launched the StandUp2OA campaign in May 2018, the only campaign focused on prevention of OA. The purpose of this campaign was to coalesce our various objectives and resources to promote awareness for OA prevention around a succinct, impactful message that would attract attention and encourage engagement among our target audiences. The StandUp2OA campaign uses a variety of readily available and free tools, videos, resources and infographics. These resources help to empower patients, healthcare providers, policymakers, and communities to promote OA prevention. This campaign has been successful as indicated by the development of new partnerships and support from industry organisations, an increase in social media engagement and e-newsletter subscribers, and recognition in a major news media outlet (57). As a part of the campaign, the OAAA launched a Facebook group as a peer support opportunity that has attracted several hundred members to date.

Through targeted ads and health messaging, including OA management and prevention, current research, and educational opportunities, the OAAA's reach has grown continually and expanded to engage researchers, adults with OA, and industry-based organisations. The OAAA is present across current social media platforms such as Facebook, Twitter, Instagram, LinkedIn, YouTube, and HealthUnlocked and is continually looking for new and innovative ways to engage and reach those affected by OA. The website includes an "OA Action" blog with patient-friendly language and information about OA management, prevention, and awareness. The OAAA's newsletter list has grown to

reach over 5,000 people through our weekly Research Roundup of peer-reviewed journal articles, Bi-weekly Digest of OA in the news media, resource blasts, and Monthly Member Spotlight. As a resource center, the OAAA keeps an up-to-date resource library of fact sheets, brochures, infographics, and webinars relevant for our differing stakeholder and audience groups. We also curate resources and links from other national partners who have developed educational information for the public. The OAAA disseminates these resources through its own and its member organisation networks. Using relevant social media hashtags for conferences and other trending topics, the OAAA leverages reach and engagement with our resources. Specific for community-based organisations and other entities interested in implementing evidence-based programmes for arthritis, the OAAA maintains an online library of free tools, tips, and strategies to facilitate delivery of such programmes. This particular resource collection has been shared widely via webinars, blogs, journals, and at professional conferences.

The OAAA promotes several evidence-based programmes in addition to Walk With Ease to improve symptoms such as pain and stiffness for adults with OA (Table I). Targeted health messaging is an effective strategy for public health communication, and the OAAA has established a robust infrastructure to support such messaging concerning physical activity for OA, which has been promoted through several communication outlets such as our website, social media, webinars, articles, videos and more. The OAAA's monthly Lunch & Learn webinar series has included 19 presentations focused on physical activity, specifically. Information is available on our website for adults with OA through our blog, resource library and videos developed with our honorary Co-Chairs Lennie and Dianne Rosenbluth. The OAAA has also published in local, regional and national print and online newspapers and magazines and patient advocacy journals (48, 49, 55, 57, 58).

The OAAA reaches healthcare providers through the development and dissemination of educational toolkits about the prevention and management of osteoarthritis. These toolkits are designed to educate healthcare providers about self-management strategies and to encourage patient referral into evidence-based programmes, since adults with arthritis are more likely to participate in these strategies when recommended by a doctor (27). The OAAA has developed two comprehensive educational toolkits targeted to pharmacists (15) and to a broad range of primary care providers (15). In addition to information about osteoarthritis pathophysiology and diagnosis, each toolkit includes information for providers on communicating with patients about the benefits of self-management programmes and resources to help providers and patients identify programmes online and/or in their local communities.

Summary and future implications

Much has been accomplished since 2010, and recent developments have created new opportunities and challenges. Updating the *2010 OA Agenda* to reflect progress to date and avenues needing attention for the coming 5-10 years could reignite interest and awareness for the burden of OA nationwide and provide public health guidance for OA for the future. The OAAA, the CDC, the AF, and many other engaged stakeholders are working together to develop new strategies to address the growing burden of OA taking into consideration the many advances of the past decade. This updated version, the *OA Agenda for 2020,* will be released in the first quarter of 2020 and will serve as a blueprint for OA public health actions, activities, policies and research.

References

1. UNITED STATES BONE AND JOINT INITIATIVE: The burden of musculoskeletal diseases in the United States (BMUS). Fourth ed. Rosemont, IL. 2018.
2. CROSS M, SMITH E, HOY D *et al*.: The global burden of hip and knee osteoarthritis: estimates from the global burden of disease 2010 study. *Ann Rheum Dis* 2014; 73: 1323-30.
3. OSTEOARTHRITIS RESEARCH SOCIETY INTERNATIONAL (OARSI): Osteoarthritis: A Serious Disease. Mount Laurel, NJ: OARSI; 2016.
4. CHUA JR, JAMAL S, RIAD M *et al*.: Disease burden in osteoarthritis is similar to that of rheumatoid arthritis at initial rheumatology visit and significantly greater six months later. *Arthritis Rheumatol* 2019; 71: 1276-84.
5. EL-HADDAD C, CASTREJON I, GIBSON KA, YAZICI Y, BERGMAN MJ, PINCUS T: MD-HAQ/RAPID3 scores in patients with osteoarthritis are similar to or higher than in patients with rheumatoid arthritis: a cross-sectional study from current routine rheumatology care at four sites. *RMD Open* 2017; 3: e000391.
6. PINCUS T, GIBSON KA, BLOCK JA: Premature mortality: a neglected outcome in rheumatic diseases? *Arthritis Care Res* (Hoboken) 2015; 6: 1043-6.
7. BARBOUR KE, LUI LY, NEVITT MC *et al*.: Hip osteoarthritis and the risk of all-cause and disease-specific mortality in older women: a population-based cohort study. *Arthritis Rheumatol* 2015; 67: 1798-805.
8. CLEVELAND RJ, ALVAREZ C, SCHWARTZ TA *et al*.: The impact of painful knee osteoarthritis on mortality: a community-based cohort study with over 24 years of follow-up. *Osteoarthritis Cartilage* 2019; 27: 593-602.
9. CLEVELAND RJ, CALLAHAN LF: Can osteoarthritis predict mortality? *N C Med J* 2017; 78: 322-5.
10. HAUGEN IK, RAMACHANDRAN VS, MISRA D *et al*.: Hand osteoarthritis in relation to mortality and incidence of cardiovascular disease: data from the Framingham heart study. *Ann Rheum Dis* 2015; 74: 74-81.
11. HOCHBERG MC: Mortality in osteoarthritis. *Clin Exp Rheumatol* 2008; 26 (Suppl. 51): S120-4.
12. LOSINA E, WALENSKY RP, REICHMANN WM *et al*.: Impact of obesity and knee osteoarthritis on morbidity and mortality in older Americans. *Ann Intern Med* 2011; 154: 217-26.
13. NUESCH E, DIEPPE P, REICHENBACH S, WILLIAMS S, IFF S, JUNI P: All cause and disease specific mortality in patients with knee or hip osteoarthritis: population based cohort study. *BMJ* 2011; 342: d1165.
14. LUBAR D, WHITE PH, CALLAHAN LF *et al*.: A national public health agenda for osteoarthritis 2010. *Semin Arthritis Rheum* 2010; 39: 323-6.
15. OA ACTION ALLIANCE. CHAPEL HILL, NC: OA Action Alliance, Thurston Arthritis Research Center, University of North Carolina; c2014-2019 [08/21/2019]. Available from: https://oaaction.unc.edu.
16. WHITE PH, WATERMAN M: Making osteoarthritis a public health priority. *Am J Nurs* 2012; 112 (Suppl. 1): S20-5.
17. A National Public Health Agenda for Osteoarthritis. Atlanta, GA: Arthritis Foundation, Centers for Disease Control and Prevention, 2010.
18. CHODOSH J, MORTON SC, MOJICA W *et al*.: Meta-analysis: chronic disease self-management programs for older adults. *Ann Intern Med* 2005; 143: 427-38.
19. DEVOS-COMBY L, CRONAN T, ROESCH SC: Do exercise and self-management interventions benefit patients with osteoarthritis of the knee? A metaanalytic review. *J Rheumatol* 2006; 33: 744-56.
20. MURPHY LB, BRADY TJ, BORING MA *et al*.: Self-management education participation among us adults with arthritis: who's attending? *Arthritis Care Re*s (Hoboken). 2017; 69: 1322-30.

21. WARSI A, LAVALLEY MP, WANG PS, AVORN J, SOLOMON DH: Arthritis self-management education programs: a meta-analysis of the effect on pain and disability. *Arthritis Rheum* 2003; 48: 2207-13.
22. PIERCY KL, TROIANO RP, BALLARD RM *et al*.: The Physical Activity Guidelines for Americans. *JAMA* 2018; 320: 2020-8.
23. Physical Activity Guidelines for Americans, 2nd edition. Washington, DC: U.S. Department of Health and Human Services, 2018. Report No.
24. LEITZMANN MF, PARK Y, BLAIR A *et al*.: Physical activity recommendations and decreased risk of mortality. *Arch Intern Med* 2007; 167: 2453-60.
25. MOORE SC, PATEL AV, MATTHEWS CE *et al*.: Leisure time physical activity of moderate to vigorous intensity and mortality: a large pooled cohort analysis. *PLoS Med* 2012; 9: e1001335.
26. BOLEN J, HOOTMAN J, HELMICK CG, MURPHY L, LANGMAID G, CASPERSEN CJ: Arthritis as a potential barrier to physical activity among adults with diabetes-United States, 2005 and 2007. *MMWR Morb Mortal Wkly Rep* 2008; 57: 486-89.
27. BARBOUR KE, HELMICK CG, BORING M, BRADY TJ: Vital Signs: Prevalence of Doctor-Diagnosed Arthritis and Arthritis-Attributable Activity Limitation - United States, 2013-2015. *MMWR Morb Mortal Wkly Rep* 2017; 66: 246-53.
28. Arthritis Foundation: Environmental and policy strategies to increase physical activity among adults with arthritis. Washington, DC: 2012.
29. WATERMAN MB, WHITE PH: Utilizing the National Physical Activity Plan to create a disease-specific approach: Environmental and Policy Strategies to Increase Physical Activity Among Adults with Arthritis. *J Phys Act Health* 2014; 11 487-8.
30. GOLIGHTLY YM, ALLEN KD, AMBROSE KR *et al*.: Physical activity as a vital sign: a systematic review. *Prev Chronic Dis* 2017; 14: E123.
31. PINCUS T: Pain, function, and RAPID scores: vital signs in chronic diseases, analogous to pulse and temperature in acute diseases and blood pressure and cholesterol in long-term health. *Bull NYU Hosp Jt Dis* 2008; 66: 155-65.
32. PINCUS T, BERGMAN MJ, YAZICI Y: RAPID3-an index of physical function, pain, and global status as "vital signs" to improve care for people with chronic rheumatic diseases. *Bull NYU Hosp Jt Dis* 2009; 67: 211-25.
33. BROWN GA: AAOS clinical practice guideline: treatment of osteoarthritis of the knee: evidence-based guideline, 2nd edition. *J Am Acad Orthop Surg* 2013; 21: 577-9.
34. HOCHBERG MC, ALTMAN RD, APRIL KT *et al*.: American College of Rheumatology 2012 recommendations for the use of nonpharmacologic and pharmacologic therapies in osteoarthritis of the hand, hip, and knee. *Arthritis Care Res* (Hoboken) 2012; 64: 465-74.
35. MCALINDON TE, BANNURU RR, SULLIVAN MC *et al*.: OARSI guidelines for the non-surgical management of knee osteoarthritis. *Osteoarthritis Cartilage* 2014; 22: 363-88.
36. CALLAHAN LF, SHREFFLER JH, ALTPETER M *et al*.: Evaluation of group and self-directed formats of the Arthritis Foundation's Walk With Ease Program. *Arthritis Care Res* (Hoboken) 2011; 63: 1098-107.
37. NYROP KA, CLEVELAND R, CALLAHAN LF: Achievement of exercise objectives and satisfaction with the walk with ease program-group and self-directed participants. *Am J Health Promot* 2014; 28: 228-30.
38. WYATT B, MINGO CA, WATERMAN MB, WHITE P, CLEVELAND RJ, CALLAHAN LF: Impact of the Arthritis Foundation's Walk With Ease Program on arthritis symptoms in African Americans. *Prev Chronic Dis* 2014; 11: E199.
39. Walk with Arthritis. Chapel Hill, NC: OA Action Alliance, Thurston Arthritis Research Center, University of North Carolina; 2019 [08/26/2019]. Available from: walkwitharthritis.org https://oaaction.unc.edu/resource-library/living-with-osteoarthritis/wwe/.
40. United States. Public Health Service. Office of the Surgeon General. Step it up! : the Surgeon General's call to action to promote walking and walkable communities. Washington, DC: U.S. Department of Health and Human Services,; 2015. Available from: http://www.ncbi.nlm.nih.gov/books/nbk538433/.
41. PADUA DA, DISTEFANO LJ, HEWETT TE *et al*.: National Athletic Trainers' Association Position Statement: Prevention of Anterior Cruciate Ligament Injury. *J Athl Train* 2018; 53: 5-19.
42. MUTHURI SG, MCWILLIAMS DF, DOHERTY M, ZHANG W: History of knee injuries and knee osteoarthritis: a meta-analysis of observational studies. *Osteoarthritis Cartilage* 2011; 19: 1286-93.
43. LOHMANDER LS, ENGLUND PM, DAHL LL, ROOS EM: The long-term consequence of anterior cruciate ligament and meniscus injuries: osteoarthritis. *Am J Sports Med* 2007; 35: 1756-69.
44. SUGIMOTO D, MYER GD, MCKEON JM, HEWETT TE: Evaluation of the effectiveness of neuromuscular training to reduce anterior cruciate ligament injury in female athletes: a critical review of relative risk reduction and numbers-needed-to-treat analyses. *Br J Sports Med* 2012; 46: 979-88.
45. HERZOG MM, MARSHALL SW, LUND JL, PATE V, MACK CD, SPANG JT: Incidence of anterior cruciate ligament reconstruction among adolescent females in the United States, 2002 through 2014. *JAMA Pediatr* 2017; 171: 808-10.
46. LABELLA CR, HUXFORD MR, GRISSOM J, KIM KY, PENG J, CHRISTOFFEL KK: Effect of neuromuscular warm-up on injuries in female soccer and basketball athletes in urban public high schools: cluster randomized controlled trial. *Arch Pediatr Adolesc Med* 2011; 165: 1033-40.
47. TROJIAN T, DRIBAN J, NUTI R *et al*.: Osteoarthritis action alliance consensus opinion - best practice features of anterior cruciate ligament and lower limb injury prevention programs. *World J Orthop* 2017; 8: 726-34.
48. SAILOR S: Understanding and preventing ACL injuries. USA Today. 2016 January 6, 2016 (col. USA Today High School Sports).
49. DRIBAN J, DISTEFANO L: Recognizing an Unmet Need During Arthritis Awareness Month. *NATA News* 2016 May 2016: 44-5.
50. DRIBAN J: BOCATC Blog [Internet]. Omaha, NE: Board of Certification for the Athletic Trainer 2016. Available from: https://www.bocatc.org.
51. Remain in the Game: A Joint Effort. Chapel Hill, NC: OA Action Alliance, Thurston Arthritis Research Center, University of North Carolina; 2019 [08/26/2019]. Available from: remaininthegame.org https://oaaction.unc.edu/remain-in-the-game-a-joint-effort/.
52. FELSON DT, ZHANG Y, ANTHONY JM, NAIMARK A, ANDERSON JJ: Weight loss reduces the risk for symptomatic knee osteoarthritis in women. The Framingham Study. *Ann Intern Med* 1992; 116: 535-9.
53. MESSIER SP, GUTEKUNST DJ, DAVIS C, DEVITA P: Weight loss reduces knee-joint loads in overweight and obese older adults with knee osteoarthritis. *Arthritis Rheum* 2005; 52: 2026-32.
54. GUGLIELMO D, HOOTMAN JM, MURPHY LB *et al*.: Health care provider counseling for weight loss among adults with arthritis and overweight or obesity - United States, 2002-2014. *Morb Mortal Wkly Rep* 2018; 67: 485-90.
55. AMBROSE K: Connecting osteoarthritis and obesity. *Your Weight Matters Magazine*. Summer 2016: 16-20.
56. SHULTZ SP, AMBROSE KR: "Where does it hurt?" Implications of obesity on musculoskeletal health. *N C Med J* 2017; 78: 326-31.
57. LANDRO L: Many in middle age have arthritis – they just don't know it. *The Wall Street Journal* 2018 April 22, 2018.
58. CALLAHAN LF: Stepping Up: Push yourself to get active. Carolina Woman. April 2016:24-5.
59. CDC. Lifestyle Management Programs Atlanta, GA: Centers for Disease Control and Prevention; [08/28/2019]. Available from: https://www.cdc.gov/arthritis/interventions/index.htm.
60. Articles about the Chronic Disease Self Management Program Palo Alto, CA: Self-Management Resource Center (SMRC; 2019 [09/04/2019]. Available from: https://www.selfmanagementresource.com/resources/bibliography/cdsmp.
61. CALLAHAN LF, MIELENZ T, FREBURGER J *et al*.: A randomized controlled trial of the people with arthritis can exercise program: symptoms, function, physical activity, and psychosocial outcomes. *Arthritis Rheum* 2008; 59: 92-101.
62. Enhance® Fitness Seattle, WA: Project Enhance, Sound Generations; 2019 [09/04/2019]. Available from: https://projectenhance.org/citations/.
63. Fit & Strong! University of Illinois at Chicago: Institute for Health Research and Policy School of Public Health; 2019 [09/04/2019]. Available from: https://www.fitandstrong.org/about/evidence.html.
64. Active Living Every Day Champaign, IL: Active Living Partners, Human Kinetics; 2019 [09/04/2019]. Available from: https://us.humankinetics.com/blogs/active-living.
65. PATRICK DL, RAMSEY SD, SPENCER AC, KINNE S, BELZA B, TOPOLSKI TD: Economic evaluation of aquatic exercise for persons with osteoarthritis. *Med Care* 2001; 39: 413-24.
66. WANG TJ, BELZA B, ELAINE THOMPSON F, WHITNEY JD, BENNETT K: Effects of aquatic exercise on flexibility, strength and aerobic fitness in adults with osteoarthritis of the hip or knee. *J Adv Nurs* 2007; 57: 141-52.