# Adaptive Sports for Disabled Veterans

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# PREFACE

The VA Evidence Synthesis Program (ESP) was established in 2007 to provide timely and accurate syntheses of targeted healthcare topics of importance to clinicians, managers, and policymakers as they work to improve the health and healthcare of Veterans. These reports help:

- Develop clinical policies informed by evidence;
- Implement effective services to improve patient outcomes and to support VA clinical practice guidelines and performance measures; and
- Set the direction for future research to address gaps in clinical knowledge.

The program is comprised of four ESP Centers across the US and a Coordinating Center located in Portland, Oregon. Center Directors are VA clinicians and recognized leaders in the field of evidence synthesis with close ties to the AHRQ Evidence-based Practice Center Program and Cochrane Collaboration. The Coordinating Center was created to manage program operations, ensure methodological consistency and quality of products, and interface with stakeholders. To ensure responsiveness to the needs of decision-makers, the program is governed by a Steering Committee comprised of health system leadership and researchers. The program solicits nominations for review topics several times a year via the program website.

Comments on this evidence report are welcome and can be sent to Nicole Floyd, Deputy Director, ESP Coordinating Center at Nicole.Floyd@va.gov.

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# ACKNOWLEDGMENTS

This topic was developed in response to a nomination by Lucille Beck, PhD and Joel Scholten, MD for the purpose of determining the benefits and harms associations with participation in adaptive sports for Veterans with disabilities as well as to identify facilitators and barriers to participation. The scope was further developed with input from the topic nominators (*ie*, Operational Partners), the ESP Coordinating Center, the review team, and the technical expert panel (TEP).

In designing the study questions and methodology at the outset of this report, the ESP consulted several technical and content experts. Broad expertise and perspectives were sought. Divergent and conflicting opinions are common and perceived as healthy scientific discourse that results in a thoughtful, relevant systematic review. Therefore, in the end, study questions, design, methodologic approaches, and/or conclusions do not necessarily represent the views of individual technical and content experts.

The authors gratefully acknowledge the following individuals for their contributions to this project:

## Operational Partners

Operational partners are system-level stakeholders who have requested the report to inform decision-making. They recommend Technical Expert Panel (TEP) participants; assure VA relevance; help develop and approve final project scope and timeframe for completion; provide feedback on draft report; and provide consultation on strategies for dissemination of the report to field and relevant groups.

**Lucille Beck, PhD**
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## Technical Expert Panel (TEP)

To ensure robust, scientifically relevant work, the TEP guides topic refinement; provides input on key questions and eligibility criteria, advising on substantive issues or possibly overlooked areas of research; assures VA relevance; and provides feedback on work in progress. TEP members are listed below:

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## Peer Reviewers

The Coordinating Center sought input from external peer reviewers to review the draft report and provide feedback on the objectives, scope, methods used, perception of bias, and omitted evidence. Peer reviewers must disclose any relevant financial or non-financial conflicts of interest. Because of their unique clinical or content expertise, individuals with potential conflicts may be retained. The Coordinating Center and the ESP Center work to balance, manage, or mitigate any potential nonfinancial conflicts of interest identified.

# EXECUTIVE SUMMARY

## INTRODUCTION

The term "adaptive sports" is used to describe a sport that has either been adapted specifically for persons with a disability or created specifically for persons with a disability. For persons with physical disabilities, organized sports can be traced back to the early 1900s. However, opportunities expanded greatly in the post-World War II era, when adaptive sports began to be used for rehabilitation of Veterans. Many of the early programs were in downhill skiing but the range of available sports and opportunities for participation at all levels, from recreational to competitive, has broadened greatly.

Within the Department of Veterans Affairs (VA), the vision of the National Veteran Sports Programs and Special Events (NVSP&SE) office is "to be leaders in the provision of adaptive sports and therapeutic arts programs that complement VA's rehabilitation system of care for Veterans and members of the Armed Forces with disabilities." The national rehabilitation events are intended to "provide opportunities for Veterans to improve their independence, well-being, and quality of life through adaptive sports and therapeutic arts programs."

The purpose of this report is to systematically review the available evidence on the benefits and harms of adaptive sports participation and the barriers to and facilitators of participation. With input from our Operational Partners and Technical Expert Panel members, the scope of the project was limited to the following medical conditions: amyotrophic lateral sclerosis (ALS), limb amputation, hearing loss or deafness, multiple sclerosis (MS), post-traumatic stress disorder (PTSD), spinal cord disorder, spinal cord injury (SCI), stroke/cerebrovascular accident (CVA), traumatic brain injury (TBI), or visual impairment or blindness. Further, the scope was limited to the adaptive sports listed in Executive Summary Table 1.

**Executive Summary Table 1. Adaptive Sports Eligible for Inclusion in Evidence Review**

| | | |
|---|---|---|
| Alpine skiing | Golf | Surfing |
| Archery | Hand-cycling | Swimming |
| Athletics/ Track & field | Kayaking/Canoeing | Table Tennis |
| Billiards | Nordic Skiing | Tennis (including Wheelchair Tennis) |
| Boccia (Bocci, Bocce) | Para-Triathlon | Weightlifting-Power Lifting |
| Climbing | Sailing | Wheelchair Basketball |
| Curling | Shooting | Wheelchair Fencing |
| Cycling | Sitting Volleyball | Wheelchair Lacrosse |
| Equine Assisted Activities and Therapies (EAAT) | Sled Hockey | Wheelchair Rugby |

We addressed the following key questions:

**Key Question 1.** What is the effectiveness of participation in adaptive sports programs among individuals with amyotrophic lateral sclerosis (ALS), limb amputation, hearing loss or deafness, multiple sclerosis (MS), post-traumatic stress disorder (PTSD), spinal cord disorder, spinal cord

injury (SCI), stroke/cerebrovascular accident (CVA), traumatic brain injury (TBI), or visual impairment or blindness?

**Key Question 1a.** Does the effectiveness vary by frequency/duration of adaptive sport program participation?

**Key Question 1b.** Do particular patient groups (*ie*, age range, gender, race, time since injury, time involved in adaptive sports, type and/or severity of disability) benefit more than others from adaptive sports participation?

**Key Question 2.** What are the potential harms of participation in adaptive sports programs among individuals with amyotrophic lateral sclerosis (ALS), limb amputation, hearing loss or deafness, multiple sclerosis (MS), post-traumatic stress disorder (PTSD), spinal cord disorder, spinal cord injury (SCI), stroke/cerebrovascular accident (CVA), traumatic brain injury (TBI), or visual impairment or blindness?

**Key Question 3.** What are the known facilitators of and barriers to the participation in adaptive sports programs among individuals with amyotrophic lateral sclerosis (ALS), limb amputation, hearing loss or deafness, multiple sclerosis (MS), post-traumatic stress disorder (PTSD), spinal cord disorder, spinal cord injury (SCI), stroke/cerebrovascular accident (CVA), traumatic brain injury (TBI), or visual impairment or blindness?

# METHODS

## Data Sources and Searches

We searched MEDLINE, EMBASE, SPORTDiscus, and Rehabilitation and Sports Medicine Source from 1995 to July 2018 using Medical Subject Headings (MeSH) and key words for the adaptive sports and medical conditions of interest.

## Study Selection

Citations were entered into Distiller SR (Evidence Partners). Titles were reviewed by a single investigator or research associate. Abstracts of titles identified as potentially eligible were reviewed independently by 2 reviewers with a citation moving to full-text review if either reviewer considered the citation eligible. At the full-text review, agreement of 2 reviewers was needed for study inclusion or exclusion; disputes were resolved by discussion with input from a third reviewer, if needed.

Due to the large number of citations, we also used the DistillerAI (Artificial Intelligence) feature to complete an AI Audit review of titles. References identified by Distiller AI were reviewed at the abstract level by an investigator and proceeded to full-text review as described above.

For Key Question 1 and 2 we included intervention studies comparing participation in an adaptive sports program to usual care, no intervention, or other intervention among individuals with a medical condition of interest. We label these as “sports program studies”. To expand the number of potentially eligible studies and provide possible information for the development of future programs, we also included studies of individuals participating in organized adaptive sports activities although the activity wasn’t specifically implemented for the purpose of

determining whether participation provided benefits or harms. We label these as "sports activity participation studies" – typically cross-sectional observational studies.

For Key Question 3 we included studies assessing facilitators of and barriers to participation in adaptive sports among individuals with a medical condition of interest.

At all levels of review, the inclusion and exclusion criteria were as follows.

*Inclusion:*

- Age 18 and older with 1 or more medical conditions of interest (ALS, limb amputation, hearing loss or deafness, MS, PTSD, spinal cord disorder, SCI, CVA, TBI, or visual impairment or blindness);
- Participation in 1 or more adaptive sports of interest (Executive Summary Table 1) at the community level or higher (to include adaptive sports programs that begin during inpatient rehabilitation and continue to an outpatient/community-based phase);
- Reporting an outcome of interest; *primary outcomes* of interest were a) clinically important changes in health and wellness, daily functioning, self-esteem, perceived competence, community reintegration, participation in social activities, participation in employment, mood//quality of life, and health care utilization; b) harms related to participation in adaptive sports; and c) barriers and facilitators related to adaptive sports participation; *secondary outcomes* were: a) participation in adaptive sports programs and b) improvement in physical health or PTSD scale scores.

*Exclusion:*

- Sports programs with modifications of equipment or environment/culture exclusively based on participant age;
- Individual fitness programs or other activities done outside of a program led by a coach or program director (exception – athlete training for competition);
- Study of a sport activity other than pre-defined sports of interest or where >75% of participants are involved in sport not of interest;
- Study of a group of individuals with condition not pre-defined as condition of interest or where >75% do not have a condition of interest;
- Rehabilitation programs with no "sport" component;
- Study of "physical activity" levels where physical activity includes items like household work, gardening, volunteering outside the home (*ie*, studies of physical activity must have included a "sport" component);
- Engineering/modeling studies;
- Human performance laboratory studies.

## Data Abstraction and Quality Assessment

We abstracted study design and demographic data from eligible studies including medical condition(s), age, gender, and time since injury/diagnosis; adaptive sport; and US Veteran status. We also abstracted primary and secondary outcomes of interest (see Inclusion, above).

We did not formally assess risk of bias of individual studies due to the many study design variants in the included literature. For each included study, we reviewed critical elements of either observational and experimental studies or qualitative studies based on checklists developed by the Joanna Briggs Institute (http://joannabriggs.org/).

### Data Synthesis and Analysis

For Key Question 1, tables were developed by outcome and stratified by whether the study reported on an adaptive sport program ("sports program studies") or provided a cross-sectional view of adaptive sport participants ("sports activity participation studies"). Subgroups of interest included: time since injury or diagnosis, frequency/duration of participation, age, gender, race, and type and/or severity of disability.

For Key Question 2, we also report outcomes from adaptive sports program and sports activity participation studies.

For Key Question 3, the International Classification of Functioning, Disability, and Health (ICF) model was used to summarize motivators to participation in adaptive sports, facilitators of participation, and barriers to participation.

For all Key Questions, findings were narratively synthesized.

We did not formally rate the overall quality of the evidence due to heterogeneity of participants, adaptive sports, study designs, and outcomes assessed.

## RESULTS

### Results of Literature Search

Searching multiple bibliographic databases (1995 to July 2018) and removing duplicate citations yielded a total of 13,404 citations. Review at the title level excluded nearly 12,000 citations leaving 1,631 for abstract review. Over 1,100 abstracts were excluded resulting in 450 articles for full-text review with an additional 23 from DistillerAI. Following full-text review, there were 118 articles eligible representing 114 studies. Twenty-four of the articles provided data on elite athletes (*eg*, Paralympians or World Championship participants) and were not included in our analyses, as findings would be of limited applicability to the Veteran population.

### Summary of Results for Key Questions

#### *Key Question 1*

Fifty-five studies reported an objective measure of at least 1 effectiveness outcome of interest. We grouped outcomes into 7 categories: Health and Wellness, Daily Functioning, Self Esteem/Perceived Competence, Mental Health (including mood, depression, and PTSD), Quality of Life, Community Reintegration/Social Participation, and Employment. We also grouped studies into 2 groups: sports program studies and sports activity participation studies. Sports program studies described an adaptive sports program with multiple sessions over a period of a few days or weeks. Outcomes were often assessed both before and after participation in the program. Sports activity participation studies were typically cross-sectional, providing a one-time assessment of participants who engage in adaptive sports.

### *Sport Program Studies*

Evidence of the effectiveness of implementing an adapted sports program is largely from studies of equine assisted activities and therapies (EAAT) and in populations with a history of PTSD, MS, or CVA. There is little information about effectiveness of adaptive sports programs involving other sport activities and other populations.

#### *Outcomes by Sport*

**Equine Assisted Activities and Therapies (EAAT).** Various forms of EAAT for individuals with PTSD were consistently associated with improved mental health outcomes (including overall mental health, depression, PTSD, and anxiety symptoms). Three of the 4 studies of EAAT for individuals with PTSD enrolled exclusively US Veterans. EAAT may be associated with improved balance and reduced fatigue in those with a history of MS. Other outcomes in individuals with PTSD, MS, or history of CVA were infrequently reported.

**Hiking/Climbing.** Findings from 3 studies of hiking and/or climbing programs for individuals with MS suggest that program participation was not associated with changes in different aspects of health and wellness including balance, fatigue, and cognitive function. Other outcomes were reported by only 1 study.

**Golf.** Golf programs, evaluated in 3 studies enrolling individuals with a history of CVA, may be associated with improved balance but there was little reporting of other outcomes including measures of cognitive function, daily functioning (walking task), depression symptoms, or impact of health on quality of life.

**Fly-fishing.** Results from 2 fly-fishing programs for Veterans with PTSD symptoms found program participation was associated with improvement in PTSD symptoms and other mental health outcomes. There was limited reporting of other outcomes.

**Ski/Snowboard, Curling, Surfing, Multiple Sport Program.** There was limited reporting (2 or fewer studies) of outcomes for these activities with studies including individuals primarily with PTSD or SCI. Available studies suggest that ski/snowboard, surfing, and multiple sports programs may be associated with improved mental health symptoms including PTSD symptoms, depression, and mood.

#### *Outcomes by Population*

**PTSD.** Among 8 studies of individuals with PTSD (7 of which enrolled exclusively Veterans), EAAT, fly-fishing, ski/snowboard, or surfing programs were associated with improved mental health outcomes. Few studies reported other outcomes of interest.

**Multiple Sclerosis**. In 5 studies of individuals with MS, EAAT programs were generally associated with improved balance. There was little reporting of other outcomes. Similarly, there was little reporting of outcomes associated with hiking/climbing programs (3 studies).

**Stroke.** For individuals with a history of CVA, results were mixed regarding influence on balance with 1 of 3 studies finding an association between program participation and improved

balance. Both EAAT and golf therapy programs may be associated with improved quality of life but overall few studies reported outcomes of interest.

**Spinal Cord Injury.** For individuals with SCI, few outcomes were reported to allow assessment of effectiveness of ski/snowboard programs, wheelchair curling, or multi-sport programs (1 study of each sport).

**Multiple Conditions.** A single study of a multisport program for 18 US Veterans with a variety of post-combat disabilities found that program participation was associated with improved self-esteem, mood, and quality of life.

### *Sports Activity Participation Studies*

Evidence of the effectiveness of adapted sports activity participation is largely from studies assessing participation in sports overall and in populations with SCI. There is little information about effectiveness of participation in specific sports or in other populations.

#### *Outcomes by Sport*

**Wheelchair Basketball, Wheelchair Rugby, Goal ball, Cycling, Soccer.** There was little information on outcomes among participants in these sports. No outcome was reported by more than 1 study.

**Multiple Sports.** Among studies enrolling participants from a variety of sports, the most commonly studied population was individuals with SCI. Participation in adaptive sports for individuals with SCI was consistently associated with greater self-esteem, athletic identity, and self-efficacy, and higher quality of life. Results were less consistent for mental health, community integration, and employment outcomes. Sports participation was associated with better balance outcomes for individuals with visual impairment. Quality of life was generally higher among sports participants with various medical conditions.

#### *Outcomes by Population*

**Spinal Cord Injury.** Fifteen of 20 studies enrolling individuals with SCI included participants from a variety of sports. Participation in adaptive sports was consistently associated with greater self-esteem and self-efficacy and better quality of life. Results were less consistent for mental health, community integration, and employment outcomes, and there was little reporting for health and wellness or daily functioning. Few outcomes were reported for individuals with SCI participating in wheelchair basketball or wheelchair rugby.

**Visual Impairment.** Among individuals with visual impairment, 1 study reported that participation in either goalball or soccer was associated with improved balance, while separate studies of these sports found no difference in balance measures between blind goalball players and blind sedentary individuals or blind soccer players and sighted soccer players. There were few reports of other outcomes

**Limb Amputation.** A single study of 11 soccer players with limb amputations reported a balance score and a quality of life measure but without a comparison (either pre-participation or another group).

**Multiple Conditions.** Sports participation (representing multiple sports) by individuals with multiple conditions was generally associated with higher quality of life. Other outcomes were reported by a single study.

### *Key Questions 1a and 1b*

Few studies (and no sports program studies) reported on whether effectiveness varied by frequency or duration of adaptive sports participation. More frequent participation was associated with higher athletic identity scores. One study reported that scores on several mental health measures were more favorable in the "high active" group compared to the "low active" or inactive groups.

Similarly, few studies (and no sports program studies) reported on whether effectiveness varied by age, gender, race, time since injury, time involved in adaptive sports or type and/or severity of disability. Three studies of individuals with SCI participating in multiple sports reported higher athletic identity scores for males than females, while a study of wheelchair athletes (multiple sports) found ego and task orientation were similar for male and female participants. One study reported higher self-esteem sports for Veterans who had participated in the Veterans adaptive sports events for 5 to 10 years compared to those who participated for less than 5 years. A study of individuals with SCI (multiple sports) reported no correlation between level of activity, time from injury, level of injury, or age and scores on a community integration questionnaire. One study reported that each year of participation in adaptive sports was associated with an increase in employment through the first 10 years of participation.

### *Key Question 2*

Fourteen research articles were eligible for our analysis of harms associated with adaptive sports participation: 4 RCTs, 1 cohort study, 7 cross-sectional studies, and 2 case series. There were 6 sports program studies and 8 sports activity participation studies.

There was little evidence of harms associated with adaptive sports participation, whether in formal program studies or in sports activity participation studies. Four of 6 program studies reported there were no injuries among participants. In the 2 other studies, the injuries were largely minor events. All but 1 of the sports activity participation studies enrolled wheelchair athletes (predominantly SCI); reported harms were shoulder and wrist pain. Overall, few adaptive sports or populations of interest were represented in the literature and few studies were designed to determine specific harms associated with an adaptive sports program.

### *Key Question 3*

Thirty-seven studies, presented in 40 papers, reported on barriers (n=25), facilitators (n=15), and motivators (n=24) to participation in adaptive sports. Thirty-six of these were observational and 1 was of an experimental design (RCT). Among the observational studies, 14 were cross-sectional, 2 were cohort, 3 were conducted in focus groups, 10 were interviews, 1 was a narrative analysis, and 6 were of mixed methods. The questionnaires and surveys were either completed via mail or administered in person. Six studies reported exclusively on barriers, 3 on facilitators, 4 on motivators, and 23 on a mix of factors related to participation.

We used a modified version of the International Classification of Functioning and Disability Health framework (ICF) to conceptualize the reported barriers, facilitators, and motivators associated with participation in adapted sports. The framework includes the following categories: health conditions, body functions and structure, activity, participation, environmental factors, and personal factors.

Barriers to adaptive sports participation were similar across studies reporting on different medical conditions and different sports. Reported barriers were mainly due to physical environmental factors such as a lack of information, cost, accessibility, or transportation concerns. Personal barriers included fear of injury/pain, lack of time, and low self-esteem.

Reasons for either initiating participation or continuing participation in adaptive sports were similar. Commonly reported reasons for participation included social factors (social contacts, participation in society, interaction with others with similar disabilities) and personal beliefs (improved health/fitness, increased self-esteem/self-efficacy, improved skill, interest in new experiences).

# SUMMARY AND DISCUSSION

## Key Findings and Strength of Evidence

### *Key Question 1*

Evidence for the effectiveness of adaptive sports ***programs*** is limited in quantity, quality, and applicability. Findings come largely from studies of EAAT in selected populations with PTSD (including US Veterans), MS, or CVA who agreed to participate in these programs. Many outcomes of interest were infrequently reported including self-esteem/perceived competence, community integration/social functioning, and employment. No studies reported on health care utilization.

Evidence for the effectiveness of adaptive ***sports activity participation*** is largely from observational studies enrolling selected individuals with SCI and involving multiple sports. We found no studies exclusively enrolling individuals with PTSD, CVA, TBI, MS, ALS, or hearing loss or deafness and few studies limited to a specific adaptive sport.

### *Key Question 2*

There was little evidence of harms associated with adaptive sports programs or adaptive sports participation although few adaptive sports or populations of interest were represented in the literature. Few studies were designed to capture specific harms associated with participation.

### *Key Question 3*

Barriers to participation were similar across sports and population and were mainly due to physical environmental factors including lack of information, cost, accessibility, and transportation concerns. Personal barriers included fear of injury or pain, lack of time, and low self-esteem. Facilitators of participation included social factors (social contacts, participation in society, interaction with others with similar disabilities) and personal beliefs (improved health/fitness, increased self-esteem and self-efficacy, improved skills, and new experiences).

### *Strength of Evidence*

We assessed quality characteristics of included studies but did not formally rate risk of bias or strength of evidence. Approximately half of the included experimental and observational studies did not provide clearly defined inclusion criteria or indicated that participants were "selected". Many provided little demographic data to allow for a determination of the generalizability of findings. Most studies assessed outcomes using validated questionnaires or objective outcomes measures but, for questionnaires, response rates were less than 50% in 42% of the studies. Of the studies where it would be appropriate to adjust for confounding factors, there was evidence of adjustment in about 50%.

For the qualitative studies, approximately 66% reported congruity between theory and research methods. Nearly all did provide evidence of congruity between the research methods and the research questions, were considered to have adequately represented the participants, and included evidence of ethical approval of the study.

## Applicability of Findings to the VA Population

Our findings have implications for VHA and Veterans in the design, development, implementation, and assessment of adaptive sports activities and programs. There appears to be some evidence that EAAT, in selected populations with PTSD, MS, or CVA who agreed to participate in these programs, can be beneficial. However, there is no information on resource use or the applicability to broader populations of individuals and/or program-specific details. In these populations there is little evidence of harm, though providing for broader populations (*eg,* those that are not interested in EAAT or with other medical conditions) should be done with caution and should be evaluated. Other sports activities, populations, and settings have a limited empiric base for program development and implementation. Future programs could be derived from existing programs, modified to specific populations and settings, and should undergo evaluation. Because there is general agreement that sport participation should be encouraged, future questions should examine how this can be done in populations with physical challenges that differ from those not requiring sport activity adaptation. Our findings also help categorize and describe important barriers and facilitators to participation that require additional evaluation and incorporation to ensure successful participation at acceptable costs.

## Limitations

Limitations of the available literature include generally low quality of evidence (*ie,* non-randomized designs, small sample sizes, selected populations) and few studies for many of the adaptive sports and conditions of interest. Disabling conditions were often self-reported and little information was provided about severity of the condition, etiology, comorbidities, or participant demographics. Marked variation in populations, interventions, and outcomes assessment limited data pooling or even semi-quantitative assessment of effect consistency or applicability. Results from EAAT, golf, and fly-fishing programs for individuals with PTSD, MS, or history of CVA may not be generalizable to other sports and other populations. Few studies provided follow-up data to assess whether participation continued and/or whether benefits were maintained.

Participants in the studies included in our review likely had a high level of interest in sports participation (many having participated prior to injury/illness); individuals with severe illness or disability and comorbid conditions were typically excluded from the studies.

Common limitations of studies reporting harms were poor documentation and definition of adverse events. Sample sizes were generally low, and most sports activity participation studies lacked comparators. Potential harms associated with adaptive sports participation in many sports of interest or by many populations of interest are unknown

## Research Gaps/Future Research

The Adaptive Sports Grant Program, facilitated and managed by NVSP&SE, may provide an opportunity for future research. The Grants Program supports entities with significant experience in managing a large-scale adaptive sports program, including programs affiliated with a National Paralympic Committee or a National Governing Body authorized to provide Paralympic sports and programs in which at least 50 persons with disabilities participate or the eligible participants reside in at least 5 different congressional districts. Federal agencies are encouraged to partner with non-federal entities to jointly create national, regional, and community-based programs that provide adaptive sports activities for disabled Veterans and members of the Armed Forces.

Our findings strongly support the need for rigorous design and outcome evaluation across a spectrum of individuals, health conditions, interventions, and settings. Specific recommendations pertaining to the key questions addressed are provided below.

### *Key Questions 1 and 2*

Future research could address benefits and harms of participation for other adaptive sports and other medical conditions. Studies could be designed to assess whether effectiveness and harms vary by severity of condition, time since disability or diagnosis, skill level of the participants, or their age, gender, or race and participants could be followed to assess long-term outcomes. Standardized outcome measures should be used to assess a broad range of outcomes including health/wellness, daily functioning, health care utilization, and employment.

Ideally future research into benefit and harms would utilize randomized study designs with appropriate control groups. However, it may be difficult to recruit an adequate sample size, and funding for such research may be difficult to obtain.

### *Key Question 3*

The understanding of barriers to and facilitators of participation would benefit from longitudinal studies that assessed the factors influencing regular participation over an extended period in the individual's life. Such work could be built into any new regional or national programs. The bulk of evidence reported addressed why people continued to participate in sports versus facilitators to assist individuals in initiating participation.

A gap in the evidence remains concerning the applicability and generalizability to larger populations, including a broader US population including those without an overt interest in sports participation, women, and racial and/or ethnic minorities. Several sports of interest including hand-cycling, para-triathlon, sled hockey, snowboarding, soccer, surfing, wheelchair fencing, and wheelchair lacrosse were not represented in the literature.

### Conclusions

Evidence for the effectiveness of adaptive sports programs is largely from studies of EAAT in selected populations with a history of PTSD, MS, or CVA. Thus, the strength of evidence to inform developing, implementing, making available, and evaluating the effects of adaptive sports programs or informal adaptive sports participation is low. There is insufficient evidence for other adaptive sports or populations and it is unknown whether findings from a particular sport in a particular population are generalizable. There was little evidence of harms associated with adaptive sports program participation although, again, few adaptive sports or populations of interest were represented in the literature. Barriers to and facilitators of adaptive sports participation were similar across studies reporting on a broader range of medical conditions and adaptive sports. Future research could focus on other adaptive sports and populations, other outcomes including harms, and long-term follow-up to determine if participation is sustained and if benefits are maintained.

## ABBREVIATIONS TABLE

| Abbreviation | Definition |
|---|---|
| ***Medical Conditions*** | |
| ALS | amyotrophic lateral sclerosis |
| CVA | cerebrovascular accident/stroke |
| MS | multiple sclerosis |
| PTSD | post-traumatic stress disorder |
| SCI | spinal cord injury |
| TBI | traumatic brain injury |
| ***Other*** | |
| ADLs | activities of daily living |
| EAAT | equine-assisted activities and therapies |
| ICF | International Classification of Functioning and Disability Health |
| NVSP&SE | National Veteran Sports Programs and Special Events |
| NVWG | National Veterans Wheelchair Games |
| RCT | randomized controlled trial |
| VA | Department of Veterans Affairs |
| VHA | Veterans Health Administration |
| WSC | Winter Sports Clinic |