

A. SPECIFIC AIMS

Goals and Objectives: Prostate cancer (PCa) survivors, especially ones with a history of hormone therapy (e.g., androgen deprivation therapy and/or androgen receptor blockers), encounter a host of physical, psychosocial, and cognitive symptoms. **Exercise can mitigate these symptoms and lower risk of cancer reoccurrence**, however, only approximately 12% of PCa survivors meet recommended levels of exercise. **Golf is a multimodal recreational activity which combines physical activities and cognitive tasks in an outdoor green and social environment.**

We have demonstrated that the golf program can feasibly and safely improve physical capacity and cognitive function in healthy older adults, with >90% adherence, but it has never been studied in PCa survivors. Also understudied in PCa exercise trials are Black, Asian/Pacific Islander, and Hispanic survivors. The *Golf Recreational Exercise for Enhanced Survivorship (GREENS)* study aims to introduce a support-group type exercise program that includes pelvic floor exercises, golf-specific warmup exercises, golf practice, and on-course golf play to underrepresented PCa survivors, in order to improve the survivorship experience and the participant's quality of life (QOL).

GREENS is designed specifically to enhance PCa survivors' physical and cognitive function, psychosocial health, and overall QOL. The results of the proposed pilot trial will provide the following information: 1) **safety**, **feasibility**, and **adherence** of the program, 2) **efficacy** of the program to improve health, psychosocial, cognitive, and QOL outcomes, 3) the **facilitators and barriers** to participation, and 4) pilot data to improve the **design** of future trials and apply for federal and foundation funding, as well as industrial and community support (e.g. golf courses, golf manufacturers, professional golf communities, etc).

Overall, our **long-term goal** is to promote a better understanding of the role of exercise and supportive care in cancer survivorship, and to facilitate the development of sustainable therapeutic golf programs that can benefit cancer survivors and their communities.

Study Aim 1: To recruit, screen, and enroll the intended sample cohort.

- **Hypothesis 1:** We will successfully **recruit**, **screen**, and **enroll**, Black, Hispanic, Asian/Pacific Island, and Native American PCa survivors, 55-85yrs, who have received ADT, in a distribution approximating the PCa incidence among these underrepresented ethnic groups.

Study Aim 2: To examine the safety, feasibility, and adherence, of the 10-wk GREENS program.

- **Hypothesis 2:** The program will be **safe** (few/minor golf-related adverse events), **feasible** (~\$1,000/participant, able to train staff, accommodate course scheduling, conduct pre- and post-assessments, and manage the data), and **adherent** (participants will attend >80% of sessions).

Study Aim 3: To analyze the pre-post intervention data and examine the effects (assessed by Hedges *g*) of the program on: 1) physical capacity 2) psychosocial wellness, 3) health, and 4) cognition.

- **Hypothesis 3:** The program will demonstrate medium to large effects while improving **physical capacity** (strength/power, endurance, balance), **psychosocial wellness** (well-being, sense of control, QOL), **health** (fatigue, sleep, incontinence, circulating biomarkers), and **cognition** (memory, verbal learning).

Study Aim 4: To disseminate the findings and apply for NIH and DOD federal funding.

- **Hypothesis 4a:** The findings will be disseminated at conference presentations and in top peer-reviewed oncology and exercise-science publications.
- **Hypothesis 4b:** With the findings, we will be able to appropriately power ($\beta = 0.8$; $p < 0.05$) a future RCT and apply for NIH NCI **PAR 21-033** and DOD **W81XWH-22-HDRA** federal funding, as well as industrial and community support.

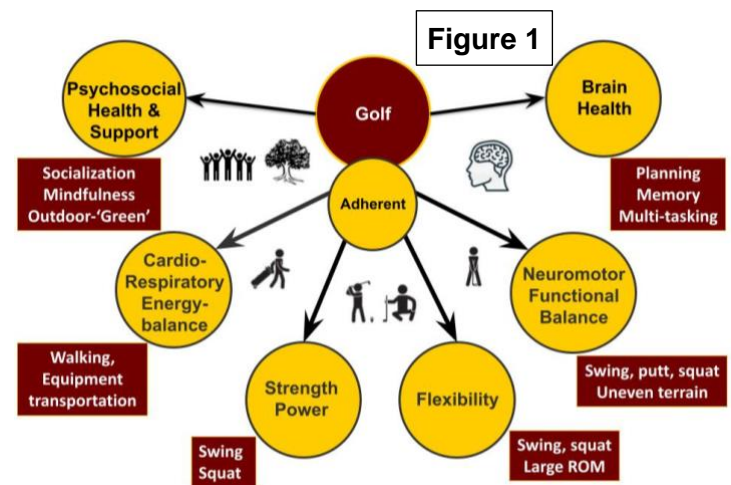
B. BACKGROUND AND SIGNIFICANCE

Prostate Cancer and Hormone Therapy: According to the National Cancer Institute (NCI), prostate cancer (PCa) is the 2nd most common type of cancer in males, behind skin cancer.¹⁻³ It has a 5-year relative survival rate of 96.8% and the most common age range at diagnosis is between 55-74 years. The effects of cancer treatments such as hormone therapy (e.g. androgen deprivation therapy (ADT) and/or combination of ADT and androgen receptor blockers) are detrimental to overall quality of life (QOL) during survivorship, and these effects are amplified by the aging process and other comorbidities.^{4,5} Common symptoms for PCa survivors include: 1) declined physical capacity 2) loss of muscle strength & function, 3) increased fatigue, 4) inactivity, 5) increased BMI, 6) decreased bone health, 7) increased fall & fracture risk, 8) poorer cognitive function, 9) increased anxiety and depression, 10) reduced sleep quality, 11) incontinence, and 12) poorer overall QOL.⁵⁻¹⁰

PCa and Exercise: Exercise-oncology is a growing area of research, and activity-interventions in PCa survivors have been shown to **address multiple symptoms and reduce chances of recurrence**. Current exercise guidelines, put forth by the American College of Sports Medicine (ACSM), recommend that survivors should “be as physically active as their age, abilities, and cancer status will allow”, which hints at the importance of exercise adherence and exercise prescription flexibility.⁵ Exercise has demonstrated consistent improvements in physical function, fatigue, anxiety, depressive symptoms, and health-related QOL, in survivors of PCa, with evidence primarily in traditional resistance and aerobic types of exercise.⁴ Within the past decade, however, **recreational activities and sports**, including dragon boat racing, soccer, group-based walking, and group yoga, have demonstrated physical and psychological benefits in cancer survivors.¹¹⁻¹³ Furthermore, the group-based, recreational nature of these activities, appear to promote better adherence and long-term engagement. Most notably, soccer programs conducted in Danish men with PCa resulted in numerous health benefits while successfully retaining participants for attendance and extended longitudinal follow-ups (1-year and 5-year).^{11,12,14-17}

Unfortunately, while effective, only approximately 12% of PCa survivors meet the ACSM exercise guidelines of 150 minutes of moderate-intensity or 75 minutes of strenuous-intensity exercise per week, and twice weekly resistance exercise.¹⁸ Exercise program adherence is affected by barriers specific to the PCa journey, however, a number of facilitators, such as structured group exercise, exercise variety, and attitudes and subjective intention, have also been reported to influence participation.¹⁹

Golf is a unique therapeutic activity: Golf can be prescribed as a unique multimodal recreational activity that combines varying intensities of physical activity and cognitive tasks in an outdoor and socialized environment (**Figure 1**).²⁰⁻²² Over the last two decades, our team and other researchers have explored the therapeutic effects of golf in a numerous aspects of health including mortality rate, cardiovascular and metabolic health, physical function (static and dynamic balance, strength, flexibility), cognitive function (memory and attention), psychosocial health (quality of life, socialization, stress, confidence), and long-term physical activity engagement. In 2009, a Swedish cohort study found that a cohort of more than 300 thousand golfers had 40% reduction of mortality rate compared to the non-golfing counterparts, regardless of age, gender, and socioeconomic status.²³ In 2018, a 20-year cohort study of British men reported golf, along with few other activities, in midlife were among the strongest predictors of physical activity participation in old age, which officially demonstrated the anecdotal observation of golfers’ long-term adherence to the activity.²⁴ In 2022, golf was recommended by a group of international uro-oncologists to be used as a mean to improve wellbeing among PCa survivors, especially given the social limitations of the Coronavirus pandemic.²⁵ Despite the positive evidence from various disciplines and countries, no formal investigation has been done to examine the safety, feasibility, and therapeutic effects of a prescribed golf program specifically designed for PCa survivors.



Underrepresentation in PCa & Exercise

Research: Data from the National Cancer Institute's Surveillance, Epidemiology, and End Results (SEER) program indicates that PCa incidence rates are greatest in Black persons (183/100k), followed by White (110/100k), Hispanic (89/100k), Native Americans (70/100k), and Asian/Pacific Island persons (60/100k) (**Figure 2**).²⁶ Nonetheless, in a recent report, non-Hispanic White persons made up over 80% of participants in PCa Lifestyle trials (including exercise), whereas Black persons made up only 17% and all other ethnicities combined accounted for only 4% of participants (**Figure 3**).²⁷ Thus, there exists a large disparity between those ethnicities at greatest risk for PCa and those that are enrolled in these types of trials.^{28,29} This proposed study seeks to address this disparity by enrolling Black, Hispanic, Asian/Pacific Island, and Native American participants, according to their incidence rates per 100k. We do not plan to enroll White participants.

Prostate cancer incidence rates per 100k

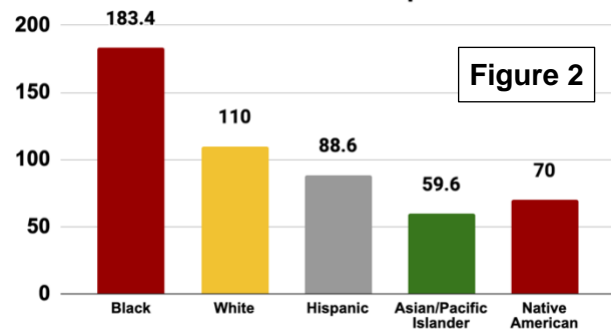


Figure 2

Prostate cancer exercise studies participant distribution by race

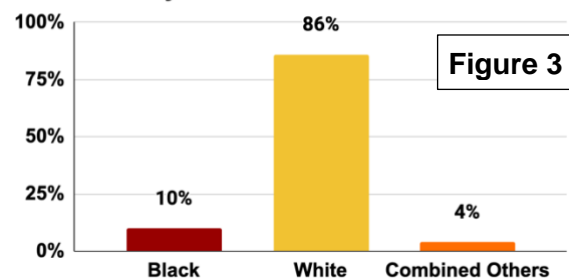


Figure 3

C. INNOVATION

The GREENS study is innovative in four distinct areas: 1) the study will use a **multimodal recreational exercise** intervention, **golf**, never before evaluated in PCa survivors, 2) the study will provide **pelvic floor muscle training**, in combination with the multimodal intervention, 3) the study will specifically target **underrepresented ethnically diverse PCa survivors**, 4) the study will introduce a recreational sport that is also underrepresented among minority groups, and 5) the study will promote golf as a therapeutic activity for cancer survivors and **engage the golf industry and community to support long-term sustainable golf programs** for cancer survivors and other clinical populations in the future.

Recreational Exercise: Traditional exercise interventions must be grouped with other activities to provide a *comprehensive* program that addresses the multiple components (strength, endurance, flexibility, balance, cognition, and psychosocial wellbeing) of a complete exercise-activity intervention.^{6,30} **Traditional** exercise programs also tend to be repetitive and performed in an indoor setting. **To address these limitations, exercise oncologists have recently begun examining the feasibility and effectiveness of recreational-activity interventions, including soccer, dancing, and even dragon boat racing.**^{11–13} Recreational activities are advantageous because they are “multi-modal” and include inherent components of strength/power, endurance, flexibility, and balance. Moreover, because they are played in groups (teams) of participants they increase participant socialization and provide a safe environment for participants to share their experiences and support each other.^{12,31} Additionally, recreational activities require planning, strategizing, cooperation, and multi-tasking; thus, they are cognitively challenging. Finally, team participation, accountability, and competition appear to improve adherence compared to traditional exercise as well as structured support group programs.¹⁹ One multi-modal recreational activity that has not been evaluated in PCa survivors is golf (**Figure 1**). Recent studies from our group and others demonstrated that golf can improve physical capacity (e.g. strength, balance, walking speed) and cognitive function (e.g. dual-tasking, memory) with moderate to large effect sizes, and that golfers have better static and dynamic balance, and balance confidence than age-matched Tai Chi practitioners.^{20–22,32–34} Moreover, in an exit survey, our participants reported improvements in mental well-being, stress management, sleep, concentration, friendship opportunities, and social support.²⁰ Thus, we hypothesize that the GREENS program will adequately address a host of symptoms and issues faced by PCa survivors. **A second innovative aspect** of GREENS is that we will provide pelvic floor muscle training, which will address urinary incontinence, a common side effect of PCa treatment. **The third innovative aspect** of the proposed study is that we will be enrolling Black, Hispanic, Asian/Pacific Island, and Native

Americans, to address the disparate enrollment of Non-Hispanic White persons in PCa exercise studies (detailed above). **The fourth innovative aspect** of GREENS is that we will be introducing a recreational activity, golf, which has a reputation of being a “white, rich-man’s sport, played at country clubs” to persons of color, at an affordable public golf course. In truth, golf play *is affordable* in the LA area, especially for persons ≤62 yrs., with the average cost of playing 9 holes on the only \$8.88 (±2.18).³⁵ Additionally, within a 30-mile radius of downtown Los Angeles, there are 29 courses with green fees for 18 holes under \$20 (golfnow.com).³⁵ It is true, however, that a disproportionate percentage of White golfers (67%) compared to golfers of color, play the sport.³⁶ By design, the GREENS program will address this additional disparity. **The fifth innovative aspect** of GREENS is that we will promote golf as a therapeutic activity to engage the golf industry and community to support long-term sustainable golf programs for PCa survivors.

D. PRELIMINARY STUDIES

We recently reported the safety, feasibility, and efficacy of a golf intervention program for healthy, non-golfing, older adults. Our first study examined a 12-week program for male Military Veterans at a VA golf course (**Figure 5**). We reported no adverse events, no dropouts, a **94% adherence rate**, and improvements in walking, strength, agility, balance, dual-task processing, and cognition (NIH Cognition Toolbox).^{21,37} We then expanded our investigation to include non-golfing male and *female* older adults playing at an open community golf course.²⁴ Here again, we had no AE’s or dropouts, and **adherence was > 92%**.^{20,35} Similarly, we found improvements in overall fitness (strength, balance), multi-tasking, memory, cognition, and circulating CRP levels.^{20,22} Additionally, these two studies demonstrated the feasibility of recruiting, enrolling, and safely training an ethnically diverse group of participants (**Figure 4**). Based upon 1) the success of these preliminary investigations in ethnically diverse, healthy populations, 2) our previous experience developing exercise programs for cancer survivors (e.g., HIIT), and 3) the multiple challenges PCa survivors face, we now want to test the program in an ethnically diverse, cohort of PCa survivors.

GHA + GIVE Participant Distribution by Race

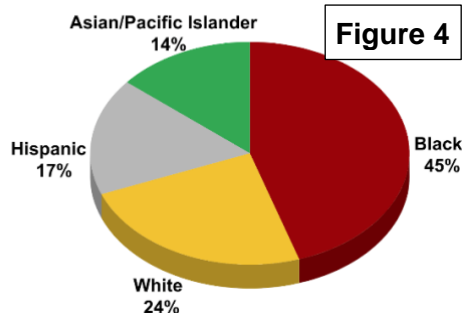


Figure 4



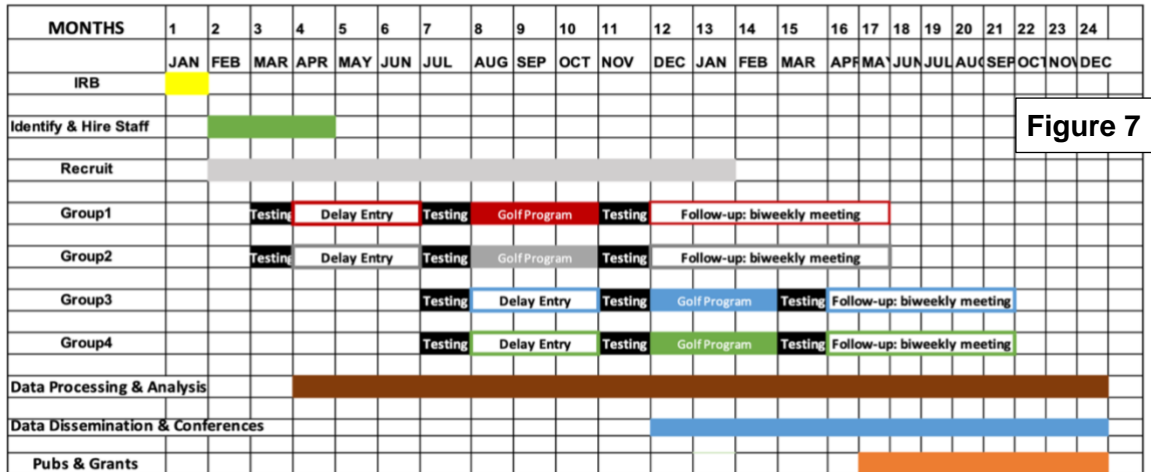
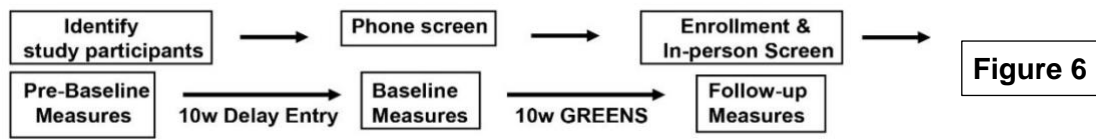
Figure 5

E. RESEARCH DESIGN

GREENS Study Design and Overview: The proposed pilot study design is a *delayed-entry, pre-post, intervention study*, with pre-baseline, baseline, and follow-up measures (**Figure 6 & 7**). The delayed entry design will help address test-retest bias and provide an internal “control group” comparison. Twenty PCa survivors will be enrolled in 4 groups/waves of 5 participants. After pre-baseline measurements and 10wk delay period, each wave will undergo 10-weeks of golf instruction and complimentary exercises. The training sessions will be held twice weekly, for 90 min/ea., and led by a PGA Professional and Research Associates. Training sessions will include golf-specific warm-up exercises (e.g., body-weight squats) and PCa-specific exercises (e.g., Kegels). After the training program, there will be a six-month follow-up period where participants will meet at the golf course biweekly to meet with the instructor or research associate. The goal of the follow-up period is to collect self-reported information on golf participant and quality of life in a semi-structured support group setting.

Recruitment efforts will be led by doctors Pinski, Liu, Lee, Kirages, and Yamada. As a genitourinary (GU) oncologist at USC Norris/Keck, Dr. Pinski will identify and refer eligible PCa survivors. As director of LACSP and member of the California Cancer Registry (CCR), Dr. Liu will identify eligible PCa patients from the CSP program and following the required registry protocol, identify, contact, screen, and enroll patients from the

CCR. Lastly, Drs. Kirages and Yamada will identify potential participants from the USC Faculty PT Clinics at HRA and UPC.



Eligibility: Black, Hispanic, Asian/Pacific Island, and Native American PCa survivors, 55-85yrs, who are currently receiving hormone therapy are eligible for enrollment. Additional Inclusion/exclusion criteria are provided in Table 1.

| Inclusion | Exclusion |
|---|---|
| <ul style="list-style-type: none"> • First time, primary diagnosis of localized or regional PCa • Currently receiving ADT and/or androgen receptor blocker for ≥ 6 months • Older adult male: 55-85 years old • The ability to stand independently without external support • No or minimal golf experience (played <5 time in the past 10 years) • African American, Asian Pacific Islander, Hispanic, Native American, or mixed descent • English Speaking | <ul style="list-style-type: none"> • Second cancer diagnosis (excluding non-invasive skin cancers) or bone metastases • AJCC stage IVA and IVB prostate cancer diagnosis³⁸ • Prostatectomy less than 6 months prior to study enrollment • Dementia and Alzheimer's Disease assessed via the Telephone Memory Impairment Screen³⁹ • Currently exceeding ACSM recommended exercise guidelines³⁰ • Symptomatic cardiovascular disease, active angina, uncontrolled hypertension (SBP>160 or DBP>90, high resting pulse HR>90), symptomatic orthostatic hypotension • Unstable asthma, exacerbated COPD • Rheumatoid arthritis, unstable ankle, knee, hip, shoulder, or wrist joints • History of injury or orthopedic operation within the last 6 months • Movement disorders (e.g., PD or other neurological disorders), hemiparesis or paraparesis • Severe vision or hearing problems |

Screening Procedures: We plan to use a 2-part screening process that includes both *phone-* and *in-person* screens. Once identified, potential participants will be contacted by phone, consented for a phone screen, and screened using a set of questionnaires (e.g., Memory Impairment Screen, inclusion, and exclusion questionnaires), to assess eligibility. After passing the phone screen, potential participants will be scheduled for their in-person screen and pre-baseline visit. At the pre-baseline visit, potential participants will be consented and evaluated for any existing exclusionary conditions. If they meet the inclusion/exclusion criteria, they will be enrolled and have pre-baseline measures taken.

Golf Program: The twenty participants will be enrolled in batches of five golfers at a time, and each group will receive twice-weekly golf instruction, for 90 minutes per session, over 10 weeks. Instruction will be imparted by a Professional Golf Association (PGA) certified golf instructor, at the Monterey Park Golf Course (MPGC) in Monterey Park, CA. The program is designed to be as safe and effective as possible for people with no or limited experience in the sport. It is progressive in nature and includes specific pelvic floor muscle exercises

Principal Investigator: Salem, George

(PFM), golf-specific preparatory exercises, driving range, putting, and course activities (**Figure 8**). The emphasis of the program is on physical activity and exercise, and not golf performance. To prepare participants for the physical challenges of golf, initial training will commence with 45 min of golf- and PFM-exercises. At the start of the program, participants will be trained in how to perform the proper PFM contractions. Once established, the participants will contract their PFM while performing the body weight squat, standing leg raise, quadruped hip extension, bridge, and loading drills. Instruction will also be given for the participant to hold a PFM contraction through ball impact during the golf swing. PFM exercises will address urinary incontinence, a common side effect of PCa treatment.⁴⁰⁻⁴³ The duration of the warm-up period, putting, and driving range activities will be decreased progressively from week one to week seven, so that by week seven onwards, only 20 min of these activities will take place and the remaining time will be on the course. On-course play will commence during week four, with two holes of play. During each successive week, the driving range time will be reduced, and the number of holes played increased, until participants can play nine holes independently by week ten.

| Weeks | Conditioning | Golf Training |
|-------|---|---|
| 1-3 | Golf Specific Drills + Exercises + Pelvic floor muscle activation 45 minutes | Introduction to Golf Swing Training 45 minutes |
| 4-7 | Golf Specific Drills + Exercises 20-30 minutes | Golf Play 2-5 holes |
| 8-10 | Dynamic Warm Up 10 min | Golf Play 6-9 holes |

2 sessions/week; 90 minutes/session

Figure 8

Outcome Measurements: related to the Study Aims will be taken at pre-baseline (-10 weeks), baseline (0 weeks), and follow-up (10 weeks) timepoints. Selected outcome measurements are those recommended by the ACSM International Multidisciplinary Roundtable on Exercise and Cancer⁶ and The International Cognition and Cancer Task force⁴⁴, and measures commonly used in previous PCa exercise trials.

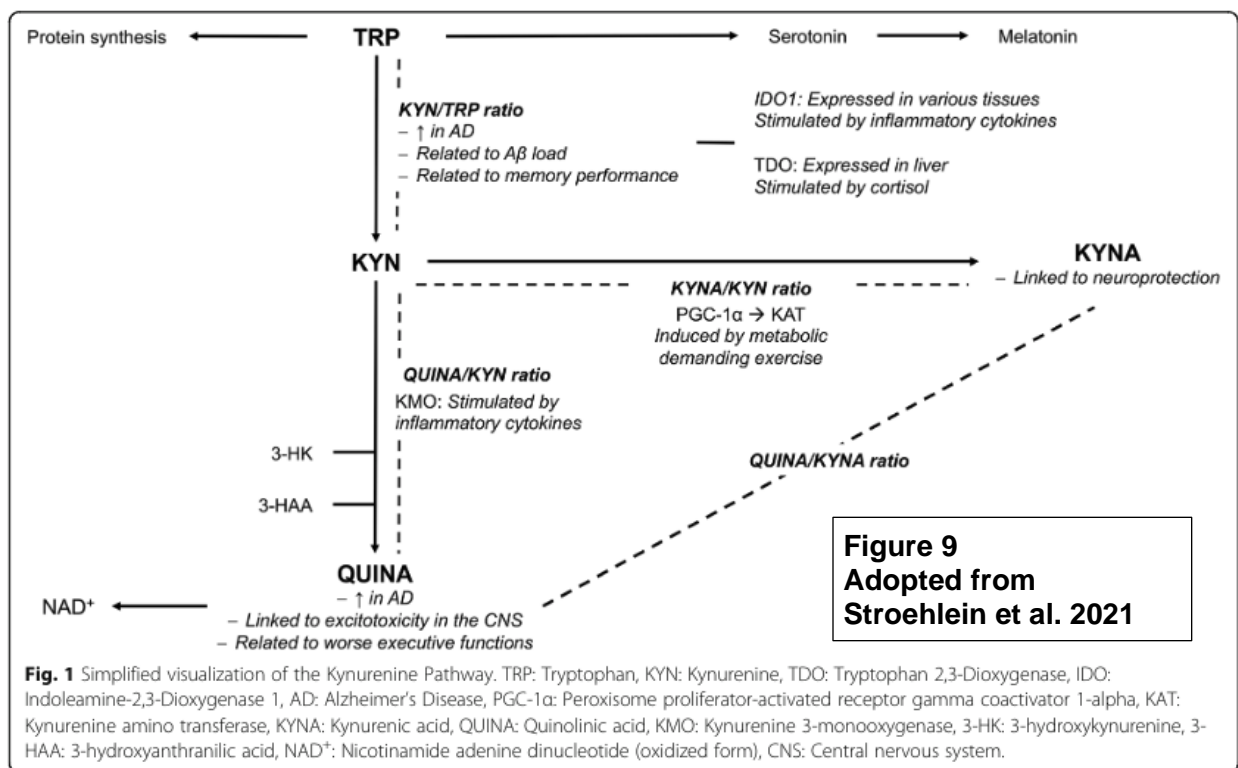
- **Enrollment rate:** Percentage of qualified participants who enroll in the study.
- **Barriers & facilitators of enrollment:** Factors that prevents qualified participants for enrolling to the study.
- **Safety and AE's:** Possible side effects will be monitored at each instructional lesson. Participants will be asked questions related to their health using a standardized adverse event (AE) questionnaire addressing potential AEs related to golf play (e.g., elbow pain/injuries) and PCa health (e.g., incontinence).
- **Adherence:** Adherence will be based on percent attendance in the classes.
- **Feasibility:** The GREENS program will be evaluated for: 1) preparation and staff training efficiency, 2) the ability to accommodate course scheduling, 3) the cost of the program per participant, 4) success in conducting pre-post assessments, and 5) the study team's ability to recruit an ethnically diverse group of underrepresented PCa survivors.
- **Anthropometrics & Health Status:** Height, mass, resting heart rate, resting blood pressure and BMI.
- **Physical Capacity:** walking speed, timed up and go, chair stand, 6-min walk, grip strength, heel raise, (Rikli) functional reach, muscle dynamometry.⁴⁴⁻⁴⁶
- **Circulating biomarkers:** C-reactive protein (CRP), TNF α , VEGF (MILLIPLEX® Human Circulating Cancer Biomarker Magnetic Bead Panel - Cancer Multiplex Assay).^{47,48}
- **QOL:** Functional Assessment of Cancer Therapy – Prostate (FACT-P), EORTC QLQ-C30.⁴⁹
- **Cognition:** Hopkin's Verbal Learning Test- Revised (HVLt-R).^{44,45}
- **Balance confidence** Activities Specific Balance Confidence (ABC) Scale.⁵⁰
- **Fatigue:** EORTC QLQ-FA12.^{51,52}
- **Incontinence:** International Consultation on Incontinence Questionnaire-Short Form (ICIQ-SF).⁵³
- **Sleep quality:** The Pittsburgh Sleep Quality Index.⁵⁴
- **Anxiety:** The Memorial Anxiety Scale for Prostate Cancer (MAX-PC).^{55,56}
- **Qualitative Assessment:** Semi-structured support groups will examine barriers to participation & adherence, program satisfaction, perceived benefits in health, cognition, & psychosocial wellness, and opportunities for program improvement.^{57,58}

Analytical Approach: Estimated changes in the outcome measures will be evaluated using Hedges' g statistic (for small sample sizes), with 0.2, 0.5, and 0.8 representing small, medium and large effect sizes, respectively.⁵⁹ Sample size (SS) calculations that reflect the number of participants per group required to develop an adequately powered ($\beta = 0.8$; $p < 0.05$) two-arm RCT with an intervention and a control group will also be determined for future study designs and funding programs. Focus group recordings will be transcribed and analyzed using Framework analyses.^{57,58}

F. EXPERIMENTAL DETAILS

The proposed project is at the pilot; however, prior evidence has demonstrated the holistic effects of golf. Therefore, we have selected validated physical, cognitive, and psychosocial outcome measurements to capture the effects. Below are several examples of how our outcome measures were selected based on current evidence in the literature:

Cognition: Cognitive dysfunction is an important cancer treatment side effect, especially in older patients with PCa who have received hormone therapy.^{44,45} Golf has been shown to prove memory in healthy older adults.^{20,60} and attention in older adults with Subjective Memory Complaints (SMC)⁶¹. Furthermore, Stroehlein et al. suggested that learning to play golf had positive influence on the Tryptophan consuming Kynurenine Pathway (**Figure 9**), which is dysregulated in people with Alzheimer's Disease and cognitive impairments.⁶¹ The proposed study will use an objective measurement tool, the Hopkin's Verbal Learning Test – Revised, which is recommended by the International Cognition and Cancer Task Force⁴⁴, and a subjective measurement tool, the Functional Assessment of Cancer Therapy – Prostate (FACT-P)⁵⁶, to capture the potential cognitive effects of golf in PCa survivors on hormone therapy.



Psychosocial Support: PCa survivors faces psychosocial issues such as anxiety, depression, fear of disease recurrence, and fear of sexual dysfunction, etc.⁶² Support group is a useful therapeutic method to help PCa survivors cope with their psychosocial burdens; however, support group is underutilized by PCa survivors and physicians.^{62,63} Men are also less likely to attend support groups than women.⁶³ Recreational sports such as soccer and Dragonboat racing act as alternate forms of support groups and have been successful in recruiting and retaining cancer survivors.^{12,16,64,65} As mentioned above, golf is also a recreational sport that is played in a social and outdoor setting. Furthermore, golf is a popular sport, especially among older men. The proposed study presents a unique opportunity to attract PCa survivors to participate in a multimodal activity that can act as an enjoyable and less formal form of support group. Therefore, the Memorial Anxiety Scale for Prostate Cancer, the FACT-P, and the EORTC QLQ-C30 were chosen to measure the psychosocial effects of the program.

Balance: Decrease bone mineral density and lean body mass are known effects of PCa hormone therapy (e.g., ADT), which can increase risk of falls and fracture.^{66,67} Multimodal exercise programs are essential to fall

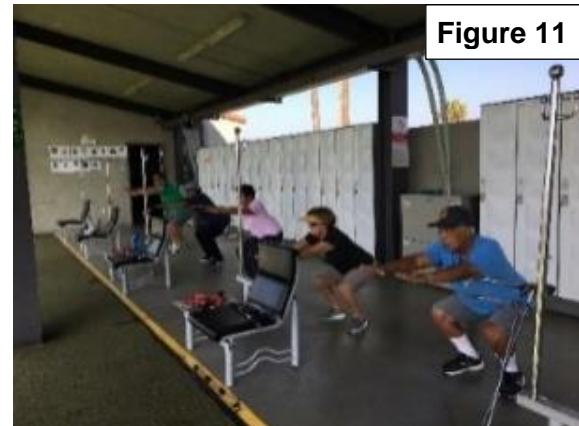
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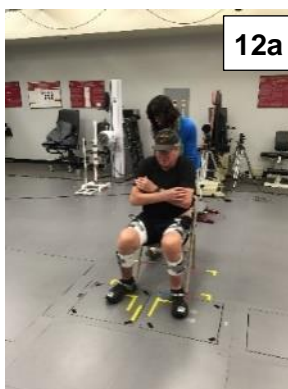
prevention, which is an instrumental part of aging and healthcare. Golf includes tasks such as navigating uneven terrain, dynamic golf swing, and other stability challenging tasks, and has been shown to improve the 8 ft timed up and go (TUG) test and tandem stance test performance.^{20,21} The proposed study will measure the balance effect associated with the program with the subjective Activities Specific Balance Confidence (ABC) Scale⁵⁰ and objective tests such as the TUG test and muscle power test with dynamometers^{20,34,68}.

G. ENVIRONMENT

Golf Course: As in the Golf for Healthy Aging study, all golf and exercise training will occur at the Monterey Park Golf Club (MPGC), in Monterey Park, CA. MPGC is a 9-hole public course which includes a driving range, practice putting and chipping greens, a pro-shop, a restaurant, and a snack bar (**Figure 10**). The driving range includes an area where participants can perform their golf-preparation and pelvic floor muscle exercises (**Figure 11**). Our team has a working partnership with MPGC and a long-term resident PGA professional (consultant: Kevin Norwall) who is experienced in teaching a wide range of population.



MBRL: Physical performance, functional testing, and self-report measures will be collected in the Musculoskeletal Biomechanics Research Laboratory (MBRL), which is under the directorship of the PI. MBRL is in USC Health Science Campus (Los Angeles, CA) and has been used extensively in clinical-research studies involving older and younger adults, children, clinical populations, and athletes (**Figures 12a, b, c**). MBRL features a 2,000 square-foot motion-analysis laboratory with 12-camera Qualisys motion-analysis system, four AMTI force platforms, a telemetered EMG system, a slip and fall suspension safety system, and 16 computer workstations. Data analysis is supported by data processing and modeling programs including C-motion, Vicon Clinical Manager, NIH Image, SPSS, DATAPAC 2000, Peak Fit, SIMM, and Virtual Muscle. The facilities also include a technical workshop for hardware maintenance and design, and a separate data processing area.



Figures 12a, b, c. Golf Intervention for Veterans Exercise (GIVE) study participants engaged in functional performance testing (3a, b), and golf related activities (3c) in MBRL.

DORI Metabolic Assay Core will be used to process the blood samples and quantify circulating levels of CRP, PSA, TNFa, and VEGF.

H. STATEMENT OF SCIENCE OUTREACH ADVOCACY

An important mission for our team the Institute for Therapeutic Golf Science (ITGS; website: <https://sites.usc.edu/golfscience/>) and the GREENS (website: <https://fundraise.givesmart.com/vf/GREENS>) project is to engage the cancer and golf community at large. With success and pilot data from prior golf programs and evidence from exercise oncology research, our team has already begun science outreach in international (ACSM, SIO), and regional conferences (SWACSM), integrative health symposiums (<https://www.youtube.com/watch?v=vE2HcaJZ5MU>; **Figure 13**), cancer support group meetings, and oncology research group meetings. These outreach activities have increased exposure on the importance of lifestyle factors to QOL in cancer survivorship, exercise oncology, and the underrepresentation issue within PCa research.



Figure 13

We hope to engage all stakeholders, including cancer survivors, caregivers, clinicians, exercise professionals, golf professionals, golf industry members and leaders, etc., for the following purposes:

1) Education & advocacy: as researchers, we understand that exercise and a proper support system can holistically benefit cancer survivors. It is our duty to share this information and educate all stakeholders who may be less informed, to affect changes in the individuals' lifestyle, communities' support, as well as

policy making. We also hope to advocate for the importance of incorporating physical activity and supportive care into cancer treatment plans. Through our outreach efforts, we can help to raise awareness about the benefits of exercise and supportive care among individuals with cancer and their caregivers and encourage policymakers to make these resources more readily available.

2) Collaboration: by conducting outreach to various stakeholders, we hope to develop new collaborations that can provide new facilities and funding for us to establish sustainable therapeutic golf programs for additional cancer survivors. Golf is a popular sport and there are public and private golf courses across the nation. While some golf courses are crowded, others are underutilized. The golf industry presents an exciting and underutilized opportunity for clinicians, researchers, and exercise professionals across the nation to engage and serve cancer survivors, even in remote cities.

Overall, our mission is to promote a better understanding of the role of exercise and supportive care in cancer survivorship, and to facilitate the development of sustainable therapeutic golf programs that can benefit cancer survivors and their communities. Through education, advocacy, and collaboration, we can work towards improving the QOL for cancer survivors and helping them to thrive beyond their diagnoses.

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