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Self-reported exercise behaviour and perception of its importance to recreational divers

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ABSTRACT

Background: *This study examined self-reported physical activity and perceptions of exercise importance among certified divers in two distinct age groups.*

Materials and methods: *Questionnaires were distributed by hand at dive sites in three states of the United States, half to students from an academic programme in scuba diving at a regional university. The survey included questions about health status, dive history, certification levels, structured exercise activity levels and perceived importance of regular exercise to their health, diving ability, and safety. Also included was the Godin-Shephard Leisure-Time Physical Activity Questionnaire, a validated physical activity classification instrument for use among adults.*

Results: *Non-students were older than the students and had greater diving experience. There was no detectable difference between groups in perceived exercise importance to health ($p = 0.69$), diving ability ($p = 0.75$), or diving safety ($p = 0.25$). Fitting age, sex, occupation and number of dives to a generalised linear model to predict Godin-Shephard scores, number of dives was removed first ($p = 0.43$), followed by student status ($p = 0.33$). Remaining predictors of Godin-Shephard exercise scores were age (–0.004 per year, $p < 0.0001$) and sex (males = + 0.11, 95% CI 0.04–0.17, $p = 0.0012$). Both groups reported similar structured exercise regularity, overall health and perceived importance of regular exercise for health, diving and safety.*

Conclusions: *Despite acknowledging the importance of exercise, Godin-Shephard scores for physical activity decrease with age.*

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Key words: Godin-Shephard, students, SCUBA, diving

INTRODUCTION

Scuba diving as both a recreational and professional activity has grown in popularity over the past 50 years. It has been reported that over 3.1 million Americans participated in scuba diving activities in 2015, with almost 900,000 reporting at least eight or more dives [1]. Although a relatively safe activity when participants are properly trained and prepared, scuba diving can be physically demanding and there are associated medical risks with diving and related activities [2]. Participation in the sport is not governed by medical clearance requirements, except during the initial certification process, thus leaving much of the decision to participate in safe diving practices in the hands of the individual diver, including medical clearance and fitness to dive issues. According to research from Divers Alert Network, there were over 550 deaths associated with scuba diving activities between 2010 and 2013 [3]. The majority of these fatalities were in male divers over the age of 40. The risk of sudden cardiac death increases in middle-aged individuals and is disproportionately higher in older individuals who participate in irregular or infrequent bouts of exercise, such as irregular diving frequency [4]. In recreational diving fatalities, the two most reported medical conditions of the deceased are hypertension and heart disease, although other conditions including asthma and diabetes are also reported [3]. The leading cause of a disabling injury in much of the diving literature is cardiovascular disease. Hypertension is also a significant medical condition self-reported by divers and is

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a risk factor for a serious cardiac event [5]. Cardiovascular risk has been found to increase in individuals over the age of 40 due to both the normal aging process and decreased physical activity levels associated with that aging process [6]. Thus, cardiovascular disease is a leading cause of death and disability in modern society with over 600,000 deaths per year [6] and cardiovascular risk factors associated with poor health and fitness are a leading contributor to diving injuries and fatalities [3].

Although increased public education efforts stressing the importance of physical exercise, proper nutrition, and stress management techniques have led to wider acknowledgement of the importance of cardiovascular health to overall well-being and fitness, a large percentage of today's population remain at elevated risk of cardiovascular disease. Individuals that participate in activities that elevate both stress and physical demands upon the human body, such as scuba diving, increase the potential risk for a serious acute cardiac event, including heart attack and stroke [7]. Although scuba diving is considered a low intensity activity in the water under benign conditions, cardiovascular workload can increase significantly when faced with an unexpected current, a stressful situation such as losing a buddy or equipment malfunction, or even a long surface swim back to an exit point. Thus, it is critical for the safe diver to develop and maintain the necessary fitness levels to deal with these unexpected events.

The importance of understanding energy expenditure and the specific metabolic demands associated with diving has long been recognised in the diving literature [8]. Although energy requirements for a specific dive vary due to the uniqueness of the specific circumstances (depth, current, surface swim, equipment configuration, etc.) research suggests a 7–10 MET capacity as a safe minimum for diving [9, 10]. Additionally, it has been shown that the aging process has a potential negative effect on cardiovascular structure and function and may increase the associated risks of diving and higher cardiovascular workloads in the older diver [11]. It has been suggested that standardised physical fitness assessments be utilised by divers in an effort to quantify age-related loss of function [12]. Currently, however, there is a dearth of research into the fitness levels, and exercise behaviours, of recreational divers.

Although the efficacy of exercise before, during, and after diving is controversial, recent research has suggested that there is a positive effect of pre and mid-dive exercise on the formation of venous gas bubbles, thus decreasing the potential incidence for decompression sickness [13–15]. In addition to the effect acute exercise has on venous bubble formation, there are significant long-term positive benefits of regular exercise as well. Increased physical activity has been shown to increase lean body mass in individuals while also leading to a concurrent decrease in fat mass. Increased body mass, and more specifically, elevated body fat, may play a role in the incidence of decompression illness through increased nitrogen storage and slower off-gassing rates from adipose tissue [16]. Finally, improved strength and flexibility also allow divers to deal with increased mechanical workloads, such as gear assembly and removal on the surface, or equipment manipulation while at depth (valve adjustments, equipment retrieval, etc.). Mier and Kegeles (2002) [17] suggested that increased participation in resistance training exercises is beneficial for divers and nominated specific exercises for the rescue diver in an effort to increase their functional strength. A comprehensive fitness programme designed to target overall fitness would be of benefit to divers in regards to overall safety and dive comfort, and could be part of initial or additional dive training, and/or routine skills maintenance in active divers.

Physical activity patterns in diving communities are not well described. A study of 200 professional divers in France found 40% were overweight or obese (body mass index ≥ 25) while a review of 163 recreational diving fatalities found 82% were overweight or obese [3, 18]. Physical benefits associated with exercise training include increased cardiorespiratory fitness, improved flexibility and mobility, increased muscular strength, power, and endurance, and improved body composition [19]. The American College of Sports Medicine recommends the following guidelines for exercise training by healthy adults: 3–5 days a week of moderately intense aerobic exercise for 20–60 minutes, 2–3 days a week of resistance training exercises for each major muscle group, and 2–3 days a week of moderate stretching activities to improve overall flexibility and mobility [19].

Organisations such as the Divers Alert Network educate the dive community on the importance of physical fitness and exercise for diving. However, participation rates in exercise activities in the active diving population are unknown. If exercise and related interventions are to positively impact the fitness of divers then it is important to better understand what types of structured physical activity, or exercise, current student and certified divers participate in and their personal views on the importance of fitness for diving. Thus, the purpose of this preliminary investigation was twofold: 1) To examine self-reported physical activity patterns in both student and certified divers and 2) To examine perceptions of the importance of exercise and physical fitness in both student and certified divers.

MATERIALS AND METHODS

Following approval by the Institutional Review Board of Western Illinois University, 188 surveys were distributed among scuba students and certified divers across the United States. The majority of the scuba students were from an ac-

ademic programme in scuba diving at a regional Midwestern University in the United States. Participants were asked to complete the questionnaire by hand (Appendix 1) and any questions regarding the survey instrument were addressed by the principle investigator (CK).

SURVEY INSTRUMENT

The 18-question survey instrument included questions about the general health status of the individuals, dive history, certification levels, typical dive profile, and typical diving conditions (Appendix 1). Additionally, each respondent was asked to answer survey questions regarding their current exercise patterns and their perceived importance of exercise to their physical health, dive ability, and overall dive safety. These additional questions included the Godin-Shephard Leisure-Time Physical Activity Questionnaire, a validated physical activity classification instrument for use among adults [20].

DATA COLLECTION

Data were collected "on-site" by the primary investigator from both university classes and national and regional dive locations in the United States, including open water dive sites in California, the Great Lakes region, and Midwestern states. Divers were approached at popular dive sites and asked if they would be willing to participate in the research study. Upon verbal approval, each participant was asked to sign an Institutional Review Board approved consent form and then complete the three page questionnaire. Following completion, each questionnaire was returned directly to the primary investigator, any identifying information was removed and the participant survey was assigned a participant identification number. Upon completion of data collection, a convenience sample of 188 questionnaires were completed; five questionnaires (3%) were then removed from the data set due to incomplete data and 32 (17%) were ineligible due to being incomplete or not yet certified to dive, leaving 156 completed. Data from the remaining 156 completed surveys were coded and analysed using SAS (Cary, NC). Chi Square tests investigated differences in occupational status. Trends for differing perceptions of importance of exercise to health, diving ability and diving safety were tested for with Mantel-Haenszel Chi Square tests. The null hypothesis that there was no difference between groups in Godin-Shephard exercise scores was tested using a General Linear Model, initially with age, sex, occupation and number of dives experience included. The model was optimised using the Log Likelihood Ratio Statistic.

RESULTS

Students were younger ($p < 0.0001$), had lower body mass index ($p = 0.006$) and their highest diving certification was lower than for non-students ($p < 0.0001$). Regarding their diving experience, students reported having made fewer dives ($p < 0.0001$), fewer dives per year ($p = 0.0001$) and to have been diving for fewer years ($p < 0.0001$). Anthropometry, dive experience and health status are presented in Table 1.

Three questions examined perceived importance of regular exercise. There was no detectable difference between groups in perceived exercise importance to health ($p = 0.69$), diving ability ($p = 0.75$), or diving safety ($p = 0.25$). There were no detectable trends towards different perceptions of importance of exercise to health ($p = 0.93$), diving ability ($p = 0.29$), or diving safety ($p = 0.15$). Fitting age,

Table 1. Anthropometry, diving experience and health factors by occupational status

	Students (n = 73)	Non-students (n = 83)	Overall (n = 156)	P
Age [years] (mean ± SD)	21 ± 2	44 ± 14	33 ± 15	< 0.0001
Male:Female	78%:22%	86%:14%	82%:18%	0.23
Body mass index [kg/m^2] (mean ± SD)	26 ± 5	28 ± 6	27 ± 5	0.006
Open water diver only	33 (45%)	11 (13%)	44 (28%)	< 0.0001
Beyond open water diver	40 (55%)	71 (87%)	111 (72%)	
Median logged dives	10	146	30	< 0.0001
Mean years certified to dive	2 (1%)	12 (12%)	7 (11%)	< 0.0001
Median dives per year	7	25	11	< 0.0001
Current structured exercise programme?	77	69	72	0.26
Health? 1 = Excellent, 3 = Good, 5 = Poor (mean ± SD)	2.3 ± 0.8	2.3 ± 0.9	2.3 ± 0.9	0.11
How often work up a sweat each week?				0.22
Often	39 (53%)	34 (41%)	73 (47%)	
Sometimes	23 (32%)	36 (43%)	59 (38%)	

sex, occupation and number of dives to a generalised linear model to predict Godin-Shephard scores, number of dives was removed first (p = 0.43), followed by student status (p = 0.33). Remaining predictors of Godin-Shephard exercise scores were age (–0.004 per year, p < 0.0001) and sex (males = +0.11, 95% CI 0.04–0.17, p = 0.0012).

DISCUSSION

The benefits of regular physical activity include increased cardiorespiratory endurance, increased muscular strength and endurance, decreased risk of sudden cardiovascular death, and improved cognitive function. Knowledge of actual exercise behaviour and perception of the importance of exercise is needed to develop educational interventions highlighting the need for structured physical activity in the diving community. This preliminary study found no differences between groups in perception of the importance of exercise and descriptive data indicated that divers across all age groups do participate in regular physical activity.

Non-students were older than the students and had greater diving experience, in years of diving and number of logged dives. Both groups reported similar structured exercise regularity, overall health and perceived importance of regular exercise for health, diving, and safety. Despite acknowledging the importance of exercise, Godin-Shephard scores for physical activity decreased with age. Although the divers appeared to acknowledge the need and value of exercise and its importance to dive safety, their reported activity patterns changed over time. These results suggest the need to both educate divers on the importance of physical activity early in their dive training and stress the need to maintain developed exercise habits throughout their active diving career regardless of age. Divers understand the importance of exercise; motivating them to actually increase their physically active patterns may be the challenge for effective injury prevention.

Limitations for this preliminary investigation include the size of the convenience sample from which data were collected. Additionally, although the data were collected from multiple sites across the United States, the majority of the data were collected from the Midwestern region, which may have resulted in a regional bias. Most active divers in the Midwest have a limited dive season when compared with divers on both coasts and their diving styles, profiles, conditions, and equipment may differ. Finally, the self-reported status of the data also accounts for a limitation in this preliminary study. Future research may examine physical activity behaviours through the use of more objective methods of data collection, including the potential use of "wearable" technology that can track and record actual physical activity levels. This technology would allow for a more accurate assessment of individual physical activity patterns and may potentially allow for the inclusion of "real-time" energy expenditure during periods of both rest and exercise. Additionally, research examining the relationship between physical activity and seasonal diving activity might afford a better understanding of the temporal patterns of exercise behaviour in divers.

Physical fitness is critical for safe diving practices and examining exercise patterns in active divers is crucial for a greater understanding of their knowledge and perceptions of its importance and relationship to diving. More information about these perceptions may lead to a better understanding of actual exercise behaviours in divers and lead to greater educational programming that may be used to increase the safety of both recreational and professional divers. The results of this preliminary investigation suggest that, as with the general population, exercise activity decreases with age. Since there are significant cardiorespiratory and muscular changes due to the normal aging process [11], it is imperative that divers develop a greater understanding of the importance of an exercise regime tailored to the physical needs required for safe diving.

CONCLUSIONS

Exercise is perceived as important to health, diving ability and safety throughout the lifespan, although exercise frequency, assessed using a validated physical activity questionnaire, decreases with age, especially in females. This reduction in exercise frequency occurs regardless of diving experience. Existing perceptions of the importance of regular exercise need to be reinforced with motivational interventions to actually engage in exercise.

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APPENDIX 1

Dive History and Health and Activity Questionnaire

Complete each question accurately. All information provided will be kept strictly confidential.

Part I: Participant Information

Participant:.....
Age:.....
Gender: Female ..... **Male** .....
Height:.....
Weight:..... **lbs.**

Part II: Medical History

2.1. Has your doctor ever said that you have a heart condition and/or that you should only do physical activity recommended by a doctor?
_____Yes _____No

2.2. Do you feel pain in your chest when you do physical activity?
_____Yes _____No

2.3. In the past month, have you had chest pain when you are not doing physical activity?
_____Yes _____No

2.4. Do you lose your balance because of dizziness or have you ever lost consciousness in the past year?
_____Yes _____No o

2.5. Do you have a bone or joint problem that could be made worse by a change in your physical activity?
_____Yes _____No

2.6. Do you have any neurological (nervous) disorders that may impair your ability to do physical activity?
_____Yes _____No

2.7. Is your doctor currently prescribing drugs for your blood pressure or heart condition?
_____Yes _____No

2.8. Do you know of any other reason why you should not do physical activity?
_____Yes _____No

If you answered yes to any of the previous questions, please describe below.

2.9. Are you taking any medications (prescription/non-prescription)?
_____Yes _____No

If so, please list all medications.

Part III: Dive History

3.1. Please check all levels of dive certification you have earned? If you are currently a SCUBA student, please mark the box next to STUDENT. Additionally, if you have any technical dive training, please mark TECHNICAL TRAINING.

___Open Water
___Advanced Open Water
___Rescue Diver
___Master Scuba Diver
___Divemaster
___Instructor
___Student
___Technical Training

3.2. What current SCUBA specialties do you currently have?

___Deep Diver
___Ice Diver
___Search and Recovery Diver
___Solo Diver
___Enriched Air Diver
___Wreck Diver
___Dry Suit Diver
___Night Diver
___Rebreather Diver
___Cavern Diver
___Cave Diver
___Sidemount Diver
___Closed Circuit Rebreather
___None of the above

3.3. How many dives have you currently logged?.....

3.4. How many years have you been certified to dive?.....

3.5. On average, how many dives do you do annually (per year)?

___0–10
___11–25
___26–50
___51–75
___75–100
___Over 100

3.6. What is your PRIMARY certifying agency?

___NAUI
___PADI
___SSI
___SDI
___TDI
___YMCA

→

3.7. Please check your most TYPICAL dive profile.

___Less than 30 feet
___30–60 feet
___60–90 feet
___90–130 feet
___Over 130 feet
___Don't know
___Student (Have not completed open water dives yet)

3.8. Please check your most TYPICAL dive site conditions you encounter on your training and recreational dives.

___Cold water, limited visibility
___Cold water, good visibility
___Warm water, limited visibility
___Warm water, good visibility

Part IV: Health Behaviour History

4.1. Which of the following best describes your overall general health?

___Excellent
___Very good
___Good
___Fair
___Poor
___Don't know

4.2. Do you currently engage in a structured or planned exercise programme?

_____Yes _____No

4.3. If you answered NO for question 4.2., please mark your reasons for not participating in structured exercise.

___Do not have the time
___Do not have the money
___Told not to exercise by doctors
___Injuries
___Not interested

4.4. How often do you participate in structured or planned exercise activities?

___Never
___1–2 times per week
___3–4 times per week
___5–6 times per week
___Daily
___Other: Please describe .....

4.5. If you answered YES for question 4.2., please mark which types of structured exercise you participate in?

___Weight Training
___Walking
___Jogging
___Bicycling
___Swimming
___Aerobic Dance
___Yoga
___Tai Chi
___Dancing
___Other: .....

4.6. During a typical **7-Day period** (a week), how many times on average do you do the following kinds of exercise for **more than 15 minutes** during your free time (write on each line the appropriate number).

a) STRENUOUS EXERCISE (HEART BEATS RAPIDLY).....Times Per Week
(e.g., running, jogging, hockey, football, soccer, squash, basketball, cross country skiing, judo, roller skating, vigorous swimming, vigorous long distance bicycling)

b) MODERATE EXERCISE (NOT EXHAUSTING).....Times Per Week
(e.g., fast walking, baseball, tennis, easy bicycling, volleyball, badminton, easy swimming, alpine skiing, popular and folk dancing)

c) MILD EXERCISE (MINIMAL EFFORT) .....Times Per Week
(e.g., yoga, archery, fishing from river bank, bowling, horseshoes, golf, snow-mobiling, easy walking)

4.7. During a typical **7-Day period** (a week), in your leisure time, how often do you engage in any regular activity **long enough to work up a sweat** (heart beats rapidly)?

___Often
___Sometimes
___Never
___Rarely

4.8. How important do you personally feel regular exercise is to your overall **health**?

___Not important
___Minimally important
___Important
___Very Important
___Required

4.9. How important do you personally feel regular exercise is to your overall diving **ability**?

___Not important
___Minimally important
___Important
___Very Important
___Required

4.10. How important do you personally feel regular exercise is to your overall diving **safety**?

___Not important
___Minimally important
___Important
___Very Important
___Required