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Men and women differ in their interest and willingness to participate in exercise and sports science research

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Abstract

Unequal proportions of male and female participants in exercise research might be attributed, in part, to differences in interest and willingness to participate. We tested if men and women are equally interested and willing to undergo exercise research procedures and if they consider different factors when deciding to participate. Two samples completed an online survey. Sample 1 (129 men, 227 women) responded to advertisements on social media and survey-sharing websites. Sample 2 (155 men, 504 women) was comprised of undergraduate psychology students. In both samples, men were significantly more interested to learn their muscle mass amount, running speed, jump height, and ball throwing ability, and more willing to receive electrical shocks, cycle or run until exhaustion, complete strength training that causes muscle soreness, and take muscle-building supplements (all $p \leq 0.013$, $d = 0.23$–0.48). Women were significantly more interested to learn their flexibility, and more willing to complete surveys, participate in stretching and group aerobics interventions, and participate in home exercise with online instruction (all $p \leq 0.021$, $d = 0.12$–0.71). Women rated the following significantly more important when deciding to participate: study's implications for society; personal health status; confidence in own abilities; potential anxiety during testing; type of research facility; time to complete study; and invasiveness, pain/discomfort, and possible side effects of procedures (all $p < 0.05$, $d = 0.26$–0.81). Differences in interest and willingness to participate in research probably contribute to different proportions of men and women as participants in exercise research. Knowledge of these differences might help researchers develop recruitment strategies aimed at encouraging both men and women to participate in exercise studies.

KEYWORDS

biomedical research, exercise, men's health, physical fitness testing, psychology, sports, sports medicine, women's health

Section V: Psychology of Sport, Exercise, and Health.

1 | INTRODUCTION

Research studies within exercise and sports science often include more male than female participants.[1–5] The cause of this difference has been stated or implied to be investigator bias or discrimination against women.[1,2,4,6] Such conclusions warrant further discussion because a cross-sectional difference in participant representation does not reveal the cause of that difference and the difference could be due to various factors.

Recently, after reviewing literature on willingness to participate in psychology and biomedical research, Nuzzo[7] argued that differences in interest and willingness to participate in research could partly explain different proportions of male and female participants in exercise and sports science research. Women, for example, are more willing than men to complete surveys, but they are less willing to undergo painful or unpleasant procedures.[7] One study also found women were less willing than men to participate in cardiovascular clinical trials due, in part, to greater perceived risk of harm from trial participation.[8] Moreover, men and women differ in the types of physical activity that interest them and the types of health conditions that impact their lives.[7] Thus, an expectation of equal male and female representation in all areas of exercise and sports science research seems untenable. That said, there is a lack of information on men's and women's interest and willingness to participate in exercise and sports science research. There is also a lack of information on the factors that influence men's and women's decisions to participate in such research. Thus, the aim of our survey study was to examine if differences exist between men and women in appeal of various exercise types, interest in specific areas of health and medicine, interest in learning of particular health and fitness attributes, willingness to undergo certain study procedures and interventions, and the importance of various factors when deciding whether to participate in research. The results could inform ongoing discussions about male and female participation in exercise and sports science[1–7] and other areas of biomedical research.

2 | MATERIALS AND METHODS

2.1 | Sample and recruitment

The survey was administered to two samples. Sample 1, called Miscellaneous Sample henceforth, was recruited via social media (e.g., Twitter) and survey-sharing websites. The survey-sharing websites included Survey Circle, Psychological Research on the Net, and Social Psychology Network. Sample 1 participants completed the survey between June 3, 2021 and August 11, 2021. Sample 2, called Psychology Sample henceforth, was recruited through the Psychology Department at Grand Valley State University as part of an undergraduate course; students could earn course points by choosing to participate in research studies, such as ours, or they could choose to undertake other research enrichment activities. Sample 2 participants completed the survey between September 23, 2021 and December 7, 2021. For each sample, we aimed to recruit at least 130 men and 130 women to achieve 80% power to detect small-to-medium effects (e.g., $d = 0.35$).

2.2 | Survey

An online survey (Appendix S1) was developed and hosted in Qualtrics. We developed the survey content based on our knowledge of exercise and sports science research, particularly areas of study where there have been indicators of female underrepresentation. We did not pilot the survey prior to beginning data collection.

The cover page of the survey described the study purpose and procedures and provided the opportunity to consent to participate in the survey. If consent was obtained, individuals were advanced to the first question of the survey. The survey consisted of 15 questions, several of which included many items (sub-questions). The initial questions in the survey asked about birth sex, age, geographic location, highest level of sport competition, current exercise training frequency, previous participation in exercise science research, and if participants were exercise science students or professionals. Participants were asked how interested they are to be a participant in an exercise science study (topic unspecified) in the future. Participants were also asked how appealing they find various types of exercise (e.g., jogging, swimming), how interested they are in various areas of health and medicine (e.g., sports medicine, bone health), how interested they are to learn about various health and fitness characteristics of themselves (e.g., leg strength, flexibility), how willing they are to undergo certain procedures used in exercise science research (e.g., blood draw, magnetic brain stimulation), how willing they are to participate in various interventions that last 2–3 months (e.g., strength exercise program, taking a new weight loss supplement), and how important certain factors are to them when deciding to participate in research (e.g., study topic, invasiveness of study procedures). Responses were measured using 5-point Likert scales (e.g., 1—not at all willing, 2—slightly willing, 3—fairly willing, 4—very willing, 5—extremely willing). The fitness characteristics, test procedures, interventions, and decision factors included as items in the current survey were selected based on their common use in exercise science

research, their relevance to other papers on the topic of male and female representation in exercise research (e.g., strength training; muscle strength, soreness, and pain),[1,2] and previous hypotheses of why men and women might exhibit unequal interest and willingness to participate in exercise research.[7]

Participants were also asked if they prefer that a male or female investigator administer tests to them in an exercise study. The Likert scale labels for this question were: 1—strongly prefer a male researcher, 2—slightly prefer a male researcher, 3—no preference, 4—slightly prefer a female researcher, 5—strongly prefer a female researcher.

2.3 | Statistical analysis

Chi-square analysis was used to determine if the two samples differed in demography. Men's and women's survey responses were compared to determine if differences existed. Means, SDs, t scores from independent samples t-tests, p values, and effect sizes (Cohen's d) were computed. Although ordinal data can be profitably analyzed using parametric tests, we also repeated all comparisons using the Mann–Whitney U-test, the nonparametric alternative to the independent samples t-test. Results were highly similar and were qualitatively (i.e., statistically significant or not) the same in 171 of 172 comparisons.

Percentages of men and women who answered survey items at particular levels of agreement were also computed (Tables 1–8 in Appendix S2). Factor analysis, using Jamovi software, was also conducted. A description of this analysis, and results from it, are presented in Tables A–H in Appendix S3. Finally, we used correlation analysis to assess agreement in size and magnitude of differences in the Miscellaneous and Psychology Samples. Statistical significance was set at $p \leq 0.05$.

3 | RESULTS

3.1 | Sample characteristics

The Miscellaneous and Psychology Samples included 356 and 659 participants, respectively, and details regarding their demographic characteristics are provided in Table 1 in Appendix S4. Both samples consisted of more women (64% and 77%, respectively) than men, although this pattern was significantly stronger in the Psychology Sample (χ^2 [1, $N = 1015$] = 18.55, $p < 0.001$). Compared to the Psychology Sample, participants in the Miscellaneous Sample were significantly more likely to be older (χ^2 [5, $N = 1009$] = 432.31, $p < 0.001$), a student or professional in exercise science (χ^2 [1, $N = 1015$] = 13.78, $p < 0.001$), to have competed at a higher level of sport (χ^2 [4, $N = 1014$] = 142.41, $p < 0.001$), to exercise more frequently (χ^2 [4, $N = 1014$] = 23.02, $p < 0.001$), and to previously have participated in exercise research (χ^2 [1, $N = 1014$] = 43.95, $p < 0.001$). Participants in the Miscellaneous Sample resided in several countries, but predominantly the United States, Australia, and United Kingdom; all participants in the Psychology Sample resided in the United States. In the Miscellaneous Sample, 100 participants entered the survey through the website Survey Circle. The number of participants who entered through other websites was not tracked.

3.2 | Appeal of various types of exercise

In both samples, golf and weightlifting were rated significantly more appealing by men, whereas dancing, group aerobics, stretching, walking, yoga, and cardiovascular exercise with gym equipment were rated significantly more appealing by women (Table 1, Figure 1). A significant difference was observed in the appeal of cycling in the Psychology Sample (women > men) but not the Miscellaneous Sample. Across items, significant agreement was observed between the two samples (r (9) = 0.92, $p < 0.001$).

3.3 | Interest in various areas of health and medicine

In both samples, men reported significantly greater interest in sports medicine, muscle health, and men's health, whereas women reported significantly greater interest in psychological health and women's health (Table 1, Figure 1). A significant difference was observed in interest in community health in the Miscellaneous Sample (women > men) but not the Psychology Sample. A significant difference was observed in interest in bone health in the Psychology Sample (men > women) but not the Miscellaneous Sample. Significant agreement was observed between the two samples (r (8) = 0.93, $p < 0.001$).

3.4 | Interest in various health and fitness attributes

In both samples, men reported significantly greater interest in learning their muscle mass amount, running speed, jump height, and ball throwing ability, whereas women were more interested in learning their flexibility (Table 2, Figure 2). Significant differences were observed in interest in arm strength, body fat percentage,

TABLE 1 Appeal of exercise types and interest in areas of health and medicine.

	Miscellaneous sample						Psychology sample					
	Men[a]		Women[b]				Men[c]		Women[d]			
Survey item	*M*	SD	*M*	SD	*t*	*p*	*M*	SD	*M*	SD	*t*	*p*
Exercise types												
Cardiovascular exercise with gym machines (e.g., treadmills)	2.49	1.08	2.82	1.23	−2.48	0.014	2.97	1.28	3.26	1.18	−2.61	0.009
Cycling	2.84	1.20	3.00	1.23	−1.24	0.214	2.86	1.22	3.23	1.15	−3.41	<0.001
Dancing	1.91	1.19	3.06	1.40	−7.86	<0.001	1.68	0.96	3.19	1.46	−12.14	<0.001
Golfing	2.15	1.32	1.73	1.08	3.21	0.001	2.83	1.52	1.92	1.20	7.76	<0.001
Group aerobics	1.52	0.93	2.60	1.27	−8.39	<0.001	1.58	0.85	2.31	1.18	−7.14	<0.001
Jogging	2.89	1.26	2.74	1.35	1.02	0.310	2.79	1.22	2.73	1.30	0.45	0.650
Stretching	2.70	1.26	3.34	1.28	−4.53	<0.001	3.28	1.00	4.00	1.00	−7.74	<0.001
Swimming	2.77	1.20	3.14	1.34	−2.56	0.011	3.35	1.21	3.54	1.31	−1.63	0.104
Walking	3.34	1.13	4.04	1.06	−5.86	<0.001	3.32	1.08	4.15	0.94	−9.25	<0.001
Yoga	2.37	1.31	3.33	1.34	−6.55	<0.001	2.41	1.20	3.86	1.17	−13.32	<0.001
Weightlifting (e.g., dumbbells, barbells, and weight machines)	4.14	1.09	3.48	1.38	4.65	<0.001	4.04	1.16	3.52	1.40	4.22	<0.001
Health and medicine areas												
Heart health	3.49	1.14	3.55	1.12	−0.46	0.648	3.03	1.18	3.12	1.21	−0.75	0.453
Psychological health	3.72	1.11	4.14	0.97	−3.74	<0.001	3.51	1.15	3.88	1.14	−3.52	<0.001
Sports medicine	3.17	1.35	2.79	1.35	2.56	0.011	2.93	1.34	2.67	1.34	2.10	0.036
Women's health	2.36	1.20	4.01	1.01	−13.77	<0.001	2.34	1.07	3.85	1.08	−15.26	<0.001
Physical fitness	4.12	0.96	3.89	1.08	1.95	0.052	3.55	1.26	3.47	1.24	0.76	0.450
Community health	2.88	1.13	3.17	1.18	−2.20	0.028	2.74	1.13	2.91	1.25	−1.46	0.144
Bone health	2.98	1.17	3.07	1.18	−0.63	0.529	2.93	1.18	2.66	1.29	2.27	0.023
Muscle health	3.80	1.09	3.51	1.11	2.39	0.017	3.43	1.24	2.94	1.34	4.05	<0.001
Men's health	3.81	1.10	2.56	1.21	9.62	<0.001	3.37	1.20	2.64	1.23	6.52	<0.001
Family and child health	3.11	1.22	3.20	1.34	−0.60	0.551	3.02	1.22	3.66	1.25	−5.57	<0.001

Note: For the question on exercise types, participants were asked: "How appealing do you find the following types of exercise?" (Likert scale: 1—not at all appealing, 5—extremely appealing). For the question on health and medicine areas, participants were asked: "How interested are you in the following types of health and medicine?" (Likert scale: 1—not at all interested, 5—extremely interested). Items are listed in the order presented in survey. See Figure 1 for effect sizes.

[a]Item sample sizes ranged from 126 to 128.

[b]Item sample sizes ranged from 223 to 225.

[c]Item sample sizes ranged from 152 to 155.

[d]Item sample sizes ranged from 489 to 504.

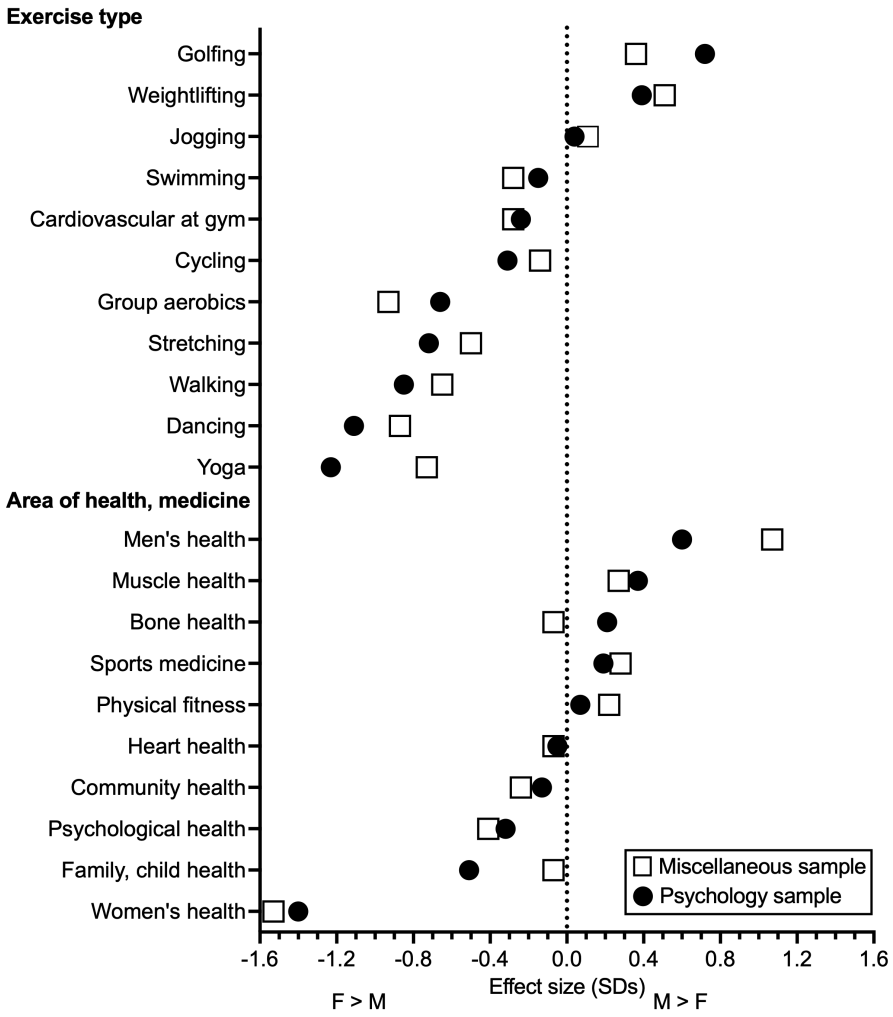

FIGURE 1 Effect sizes of differences between men and women in appeal of various types of exercise and interest in areas of health and medicine in the Miscellaneous Sample (white squares) and Psychology Sample (black circles). Items are rank-ordered by the size of the difference in the Psychology Sample. Positive effect sizes, which are to the right of the vertical dotted line, indicate greater male than female means. Negative effect sizes, which are to the left of the vertical dotted line, indicate greater female than male means. See Table 1 for mean values and full names of survey items.

visual acuity, hand-eye coordination, reaction time, and highest level of pain that can be tolerated during exercise in the Psychology Sample (men > women) but not the Miscellaneous Sample. Significant agreement was observed between the two samples ($r(14) = 0.76$, $p < 0.001$).

A significant difference was observed in interest in participating in an exercise science research study (topic unspecified) in the Miscellaneous Sample (men: 3.33 ± 1.14, women: 3.05 ± 1.13, $p = 0.028$, $d = 0.24$) but not the Psychology Sample (men: 2.66 ± 1.03, women: 2.52 ± 1.02, $p = 0.13$, $d = 0.14$). A total of 5% of men and 10% of women in the Miscellaneous Sample, and 14% of men and 17% of women in the Psychology Sample, indicated they were not at all interested in being a participant in an exercise science study in the future.

3.5 | Willingness to undergo various procedures

In both samples, men were significantly more willing to receive strong electrical shocks, cycle or run until exhaustion, compete against others on an obstacle course task, and complete strength training that causes muscle soreness and joint stiffness for 2–5 days, whereas women were more willing to complete online surveys about exercise (Table 3; Figure 3). Significant differences were observed in willingness to play a new challenging game of strategy, undergo a biopsy of the thigh muscle, and undergo magnetic brain stimulation in the Psychology Sample (men > women) but not the Miscellaneous Sample. A significant difference was observed in willingness to stay awake for 48 h without sleep in the Miscellaneous Sample (men > women) but not the Psychology Sample. Significant agreement was observed between the two samples ($r(16) = 0.84$, $p < 0.001$).

Factor analysis indicated that most of these items could be grouped into three factors representing the following underlying constructs: Intrusion (8 items), Challenge (4 items), and Reflection (4 items) (Appendix S3). In both samples, men tended to endorse Intrusion items more than women did, although this difference was not significant (Miscellaneous Sample: men: 2.92 ± 0.90, women: 2.75 ± 0.88, $p = 0.073$, $d = 0.20$; Psychology Sample: men: 2.91 ± 0.88, women: 2.75 ± 0.98, $p = 0.081$, $d = 0.16$). In both samples, men endorsed

TABLE 2 Interest in learning about self in various areas of health and fitness in an exercise science research study.

	Miscellaneous sample						Psychology sample					
	Men[a]		Women[b]				Men[c]		Women[d]			
Survey item	*M*	SD	*M*	SD	*t*	*p*	*M*	SD	*M*	SD	*t*	*p*
Arm strength	3.63	1.12	3.48	1.20	1.15	0.251	3.61	1.08	3.13	1.13	4.62	<0.001
Body fat percentage	3.82	1.13	3.71	1.21	0.88	0.38	3.71	1.14	3.47	1.33	2.08	0.038
Running speed	3.36	1.38	2.83	1.37	3.51	<0.001	3.59	1.26	3.00	1.27	5.03	<0.001
Visual acuity	3.35	1.25	3.20	1.23	1.03	0.302	3.46	1.17	3.06	1.18	3.77	<0.001
Flexibility/joint range of motion	3.29	1.22	3.59	1.17	−2.31	0.021	3.42	1.11	3.69	1.11	−2.68	0.007
Muscle mass amount	3.88	1.12	3.59	1.20	2.20	0.029	3.67	1.13	3.25	1.28	3.66	<0.001
Hand-eye coordination	3.63	1.14	3.50	1.16	1.00	0.319	3.99	0.98	3.63	1.07	3.73	<0.001
Leg strength	3.73	1.14	3.65	1.18	0.63	0.53	3.72	1.17	3.75	1.12	−0.36	0.717
Balance ability on one leg	3.39	1.30	3.54	1.19	−1.14	0.254	3.47	1.20	3.56	1.13	−0.87	0.383
Jump height	3.36	1.27	2.74	1.28	4.37	<0.001	3.39	1.32	2.98	1.25	3.52	<0.001
Ball throwing ability	3.17	1.33	2.75	1.31	2.88	0.004	3.42	1.28	2.84	1.28	4.99	<0.001
Body weight	3.28	1.30	3.14	1.35	0.94	0.349	3.25	1.24	3.18	1.37	0.58	0.564
Cardiovascular endurance	3.70	1.15	3.54	1.21	1.26	0.21	3.37	1.22	3.17	1.29	1.78	0.076
Reaction time	3.59	1.22	3.54	1.19	0.36	0.717	3.95	1.01	3.58	1.12	3.72	<0.001
Core/abdominal muscle strength	3.69	1.11	3.56	1.20	0.95	0.342	3.54	1.22	3.55	1.23	−0.03	0.973
Highest level of pain you can tolerate during exercise	3.55	1.34	3.28	1.44	1.74	0.084	3.80	1.35	3.35	1.43	3.46	<0.001

Note: Participants were asked: "How interested are you to learn the following about yourself in an exercise science research study?" (Likert scale: 1—not at all interested, 5—extremely interested). Items are listed in the order presented in survey. See Figure 2 for effect sizes.

[a]Item sample sizes ranged from 126 to 128.

[b]Item sample sizes ranged from 223 to 225.

[c]Item sample sizes were 154 or 155.

[d]Item sample sizes ranged from 501 to 504.

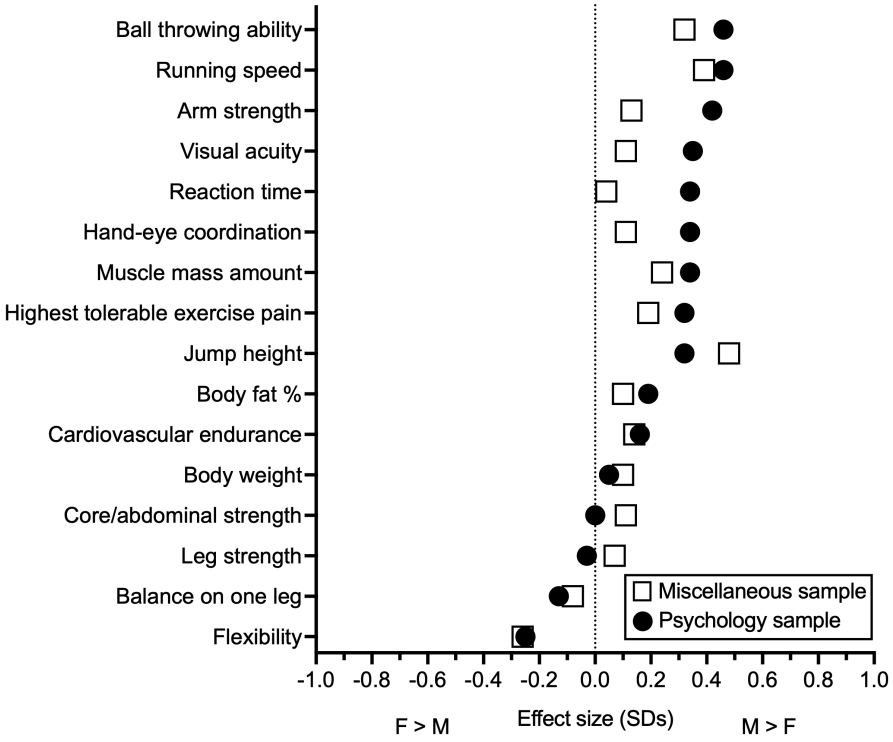

FIGURE 2 Effect sizes of differences between men and women in interest in learning of various health and fitness attributes about one's self in the Miscellaneous Sample (white squares) and Psychology Sample (black circles). See Figure 1 legend for notes on figure presentation and interpretation. See Table 2 for mean values and full names of survey items.

Challenge items significantly more than women did (Miscellaneous Sample: men: 3.54 ± 1.05, women: 3.04 ± 1.11, $p < 0.001$, $d = 0.46$; Psychology Sample: men: 2.90 ± 0.98, women: 2.44 ± 0.97, $p < 0.001$, $d = 0.47$). In both samples, no statistically significant difference existed for endorsement of Reflection items (Miscellaneous Sample: male: 3.28 ± 1.15, female: 3.29 ± 1.01, $p = 0.913$, $d = -0.01$; Psychology Sample: male: 3.03 ± 0.98, female: 3.15 ± 1.03, $p = 0.201$, $d = -0.12$).

3.6 | Willingness to participate in various interventions lasting 2–3 months

In both samples, men were significantly more willing to take muscle-building supplements, whereas women were significantly more willing to participate in stretching interventions, group aerobics interventions, and home exercise interventions that involve online coaching and instruction (Table 3; Figure 3). A significant difference was observed in willingness to participate in a strength exercise program in the Miscellaneous Sample (men > women) but not the Psychology Sample. A significant difference was observed in willingness to participate in taking a new weight loss supplement in the Psychology Sample (women > men) but not the Miscellaneous Sample. Significant agreement was observed between the two samples ($r(5) = 0.84$, $p = 0.019$).

3.7 | Importance of various factor when deciding to participate in research

In both samples, women rated the following factors significantly more important when deciding whether to participate in research: implications of study results for society, invasiveness of study procedures, possible side effects of study procedures, amount of pain or discomfort with study procedures, amount of time required to complete study procedures, type of facility where the research is conducted, level of confidence in ability to complete study procedures, potential anxiety that might be experienced during testing, and physical or mental health status (Table 4; Figure 4). A significant difference was observed in the importance of researcher qualifications and trust in researchers in the Miscellaneous Sample (women > men) but not the Psychology Sample. A significant difference was observed in importance of learning new things about one's self in the Psychology Sample (women > men) but not the Miscellaneous Sample. Finally, women in both the Miscellaneous Sample (women: 3.36 ± 0.73, men: 3.02 ± 0.55, $p < 0.001$, $d = -0.51$) and Psychology Sample (women: 3.84 ± 0.86, men: 2.89 ± 0.68, $p < 0.001$, $d = -1.15$) were significantly more likely to prefer a female researcher administer tests to them in an exercise science study. Significant agreement was observed between the two samples ($r(15) = 0.56$, $p = 0.013$).

Factor analysis indicated that most of these items could be grouped into two factors representing Costs (9

TABLE 3 Willingness to undergo various procedures and participate in interventions lasting 2–3 months as part of an exercise science research study.

	Miscellaneous sample						Psychology sample					
	Men[a]		Women[b]				Men[c]		Women[d]			
Survey item	*M*	SD	*M*	SD	*t*	*p*	*M*	SD	*M*	SD	*t*	*p*
Procedures												
Blood draw from arm	3.49	1.26	3.27	1.34	1.51	0.133	2.90	1.28	2.90	1.42	0.01	0.996
Cycle vigorously on stationary bike until you cannot any longer	3.59	1.28	3.11	1.29	3.36	<0.001	2.83	1.19	2.55	1.19	2.49	0.013
Brain MRI scan	3.70	1.26	3.50	1.34	1.32	0.189	3.45	1.19	3.35	1.42	0.77	0.44
Playing a new, challenging game of strategy	3.95	1.08	3.76	1.14	1.53	0.126	3.90	1.06	3.51	1.11	3.84	<0.001
Online survey about experiences with exercise	3.91	1.05	4.21	0.90	−2.90	0.004	3.85	1.03	4.06	1.01	−2.21	0.028
Strong electrical stimulation of your nerve or muscle	3.36	1.25	2.86	1.30	3.51	<0.001	3.10	1.25	2.47	1.33	5.22	<0.001
Keep detailed journal of food, calorie intake for one week	3.30	1.26	3.20	1.28	0.77	0.443	2.81	1.36	2.97	1.40	−1.25	0.213
Biopsy taken from your thigh muscle	2.21	1.29	1.99	1.18	1.66	0.098	2.19	1.24	1.83	1.20	3.31	<0.001
Strength training exercise that will cause muscle soreness and joint stiffness for 2–5 days	3.70	1.17	3.21	1.28	3.53	<0.001	3.39	1.29	2.86	1.36	4.32	<0.001
Magnetic brain stimulation	2.73	1.36	2.46	1.39	1.80	0.073	2.74	1.26	2.36	1.35	3.11	0.002
Weekly online meetings with personal trainer to discuss diet and exercise goals	3.37	1.40	3.56	1.31	−1.30	0.195	2.94	1.37	3.05	1.50	−0.80	0.427
Bone or joint x-ray	3.40	1.37	3.48	1.30	−0.52	0.602	3.36	1.21	3.27	1.36	0.73	0.463
Run vigorously on treadmill until you cannot any longer	3.41	1.32	2.87	1.34	3.62	<0.001	2.59	1.31	2.21	1.29	3.21	0.001
Competing against others on an obstacle course task	3.49	1.40	2.97	1.45	3.27	0.001	3.51	1.39	2.77	1.42	5.70	<0.001

(Continues)

TABLE 3 (Continued)

	Miscellaneous sample						Psychology sample					
	Men[a]		Women[b]				Men[c]		Women[d]			
Survey item	*M*	SD	*M*	SD	*t*	*p*	*M*	SD	*M*	SD	*t*	*p*
Have arm placed in sling and immobilized for 2 weeks	1.59	0.99	1.63	1.00	−0.35	0.726	1.79	1.07	1.93	1.25	−1.32	0.186
Saliva sample	3.72	1.30	3.66	1.32	0.40	0.691	3.39	1.40	3.44	1.35	−0.38	0.703
Staying awake for 48 h without any sleep	2.17	1.35	1.87	1.20	2.20	0.028	2.50	1.46	2.24	1.48	1.87	0.062
Online focus group with 5–10 other people where you openly discuss your experiences with exercise	3.15	1.34	3.09	1.30	0.38	0.702	2.53	1.35	2.53	1.38	0.03	0.979
Interventions lasting 2–3 months												
Take a new weight loss supplement	2.40	1.30	2.42	1.39	−0.13	0.898	2.08	1.09	2.59	1.43	−4.07	<0.001
Take a new muscle-building supplement	2.96	1.35	2.39	1.33	3.85	<0.001	3.08	1.27	2.56	1.34	4.30	<0.001
Cardiovascular exercise program	3.55	1.12	3.65	1.12	−0.77	0.444	2.97	1.16	2.98	1.22	−0.07	0.942
Stretching/flexibility exercise program	3.52	1.25	3.90	1.12	−2.99	0.003	3.48	1.14	3.70	1.07	−2.24	0.025
Group aerobics exercise	2.46	1.25	3.37	1.30	−6.42	<0.001	2.27	1.13	2.92	1.31	−5.53	<0.001
Strength exercise program	4.13	0.98	3.85	1.13	2.32	0.021	3.55	1.13	3.37	1.30	1.52	0.130
Home-based exercise program with online coaching and instruction	3.52	1.22	3.78	1.15	−2.00	0.046	2.71	1.30	3.36	1.28	−5.47	<0.001

Note: For the question on procedures, participants were asked: "How willing are you to undergo the following procedures as part of an exercise science research study? Assume you will be reasonably compensated for your participation and that the study has been approved by a research ethics committee at a university or hospital." (Likert scale: 1—not at all willing, 5—extremely willing). For the question on interventions lasting 2–3 months, participants were asked: "How willing are you to participate in the following types of interventions as part of an exercise science research study? Assume the interventions last 2–3 months, that you will be reasonably compensated for your participation and that the study has been approved by a research ethics committee at a university or hospital." (Likert scale: 1—not at all willing, 5—extremely willing). Items are listed in the order presented in survey. See Figure 3 for effect sizes.

[a]Item sample sizes ranged were 127 or 128.

[b]Item sample sizes were 223 to 225.

[c]Item sample sizes ranged from 153 or 155.

[d]Item sample sizes ranged from 500 to 504.

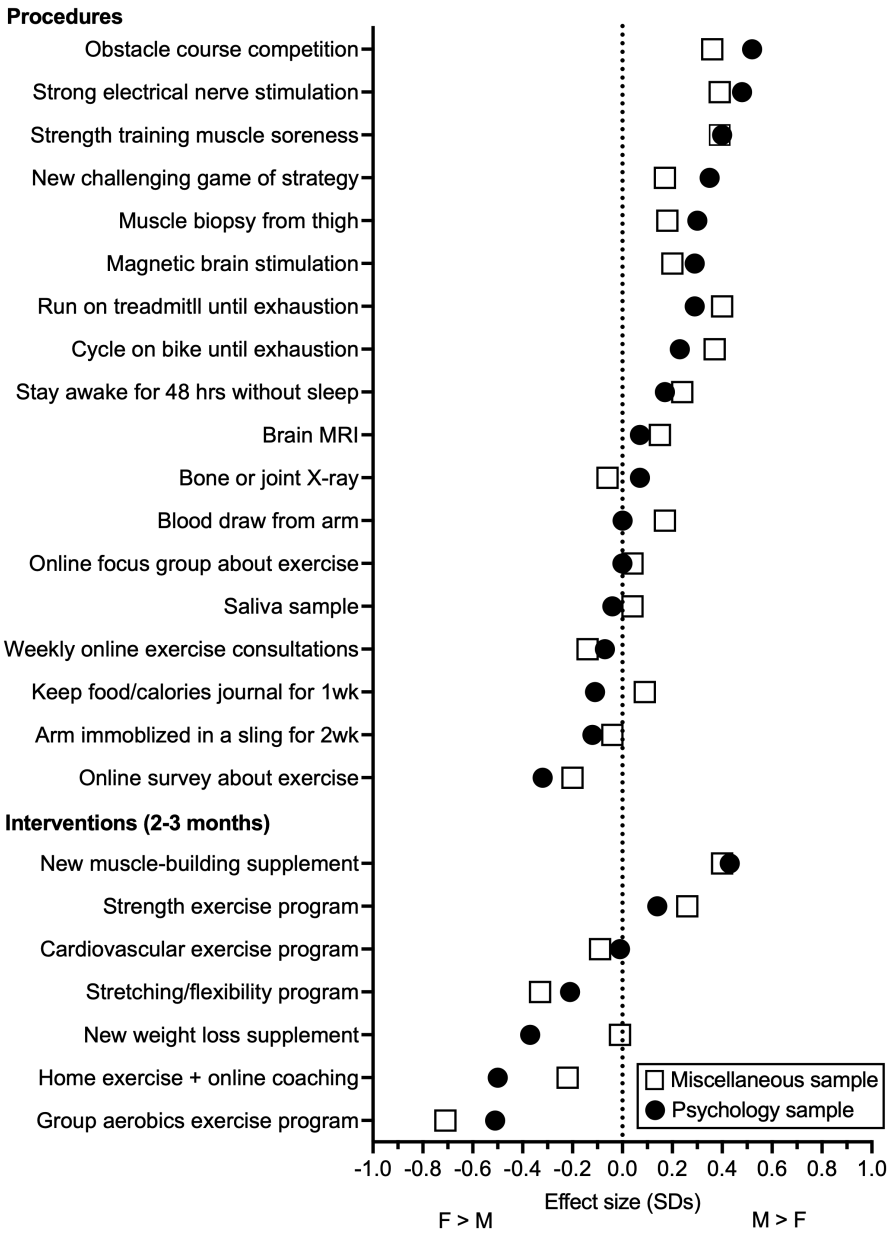

FIGURE 3 Effect sizes of differences between men and women in willingness to undergo certain procedures and participate in intervention programs that last 2–3 months as part of an exercise science research study in the Miscellaneous Sample (white squares) and Psychology Sample (black circles). See Figure 1 legend for notes on figure presentation and interpretation. See Table 3 for mean values and full names of survey items.

items) and Benefits (6 items) of participating in research (Appendix S3). In both samples, women endorsed Costs items significantly more than men did (Miscellaneous Sample: men: 3.37 ± 0.75, women: 3.82 ± 0.73, $p < 0.001$, $d = -0.61$; Psychology Sample: men: 3.44 ± 0.65, women: 3.83 ± 0.76, $p < 0.001$, $d = -0.52$). In both samples, women endorsed Benefits items more than men did, although this difference was only significant in the Psychology Sample (Miscellaneous Sample: men: 3.65 ± 0.81, women: 3.71 ± 0.74, $p = 0.501$, $d = -0.07$; Psychology Sample: men: 3.35 ± 0.76, women: 3.52 ± 0.79, $p = 0.02$, $d = -0.22$).

4 | DISCUSSION

The overarching finding from the current study is that men and women are not equally interested or willing to participate in exercise and sports science research. Significant differences exist in (a) appeal of various exercise types (Table 1; Figure 1); (b) interest in various areas of health and medicine (Table 1; Figure 1); (c) interest in learning of various health and fitness attributes (Table 2; Figure 2); (d) willingness to undergo various study procedures and interventions (Table 3; Figure 3); and (e) importance of various factors when deciding whether to participate in research (Table 4; Figure 4). Men appear to be more interested and willing than women to participate in exercise studies and to undergo procedures that are discomforting, exhaustive, and involve monitoring or improving muscle mass and power. Women appear to be more interested and willing to complete surveys about exercise and undergo procedures that involve monitoring or improving flexibility. Also, when deciding to participate in research, women give more consideration to factors such as pain, invasiveness, and side effects of study procedures; personal health, anxiety, and confidence; and whether the

TABLE 4 Importance of various factors in deciding whether to participate in research studies.

	Miscellaneous sample						Psychology sample					
	Men[a]		Women[b]				Men[c]		Women[d]			
Survey item	*M*	SD	*M*	SD	*t*	*p*	*M*	SD	*M*	SD	*t*	*p*
Study topic	3.87	1.04	3.73	0.98	1.17	0.243	3.48	1.02	3.61	1.03	−1.40	0.162
Implications of the study results for society	3.27	1.09	3.55	1.05	−2.44	0.015	3.05	1.10	3.25	0.99	−2.14	0.033
Implications of the study results for you	3.64	1.08	3.70	1.09	−0.53	0.598	3.50	1.10	3.61	1.00	−1.14	0.257
To make money	2.63	1.31	2.84	1.26	−1.49	0.137	3.34	1.19	3.37	1.23	−0.24	0.812
To learn new things about yourself	3.90	0.92	3.85	0.98	0.43	0.667	3.62	0.98	3.88	1.01	−2.75	0.006
To socialize and meet new people	2.46	1.30	2.55	1.27	−0.62	0.536	2.94	1.13	3.26	1.20	−3.01	0.003
To improve your health and fitness	3.88	1.04	3.98	1.02	−0.87	0.383	3.71	1.11	3.90	1.08	−1.98	0.049
To learn about new scientific equipment, procedures	3.58	1.08	3.45	1.15	1.02	0.307	3.31	1.15	3.19	1.20	1.12	0.261
Amount of time required to complete study procedures	3.51	1.06	3.78	1.04	−2.32	0.021	3.37	1.01	3.67	1.03	−3.23	0.001
Possible side effects of study procedures	3.84	0.98	4.17	0.98	−3.00	0.003	3.84	1.09	4.04	1.09	−2.00	0.046
Amount of pain or discomfort with study procedures	3.16	1.16	3.85	1.08	−5.65	<0.001	3.49	1.15	3.98	1.07	−4.82	<0.001
Degree of invasiveness of study procedures	3.53	1.14	3.94	1.08	−3.37	<0.001	3.43	1.11	3.87	1.13	−4.21	<0.001
Type of facility where the research is conducted	2.88	1.12	3.48	1.15	−4.72	<0.001	2.88	1.04	3.23	1.11	−3.48	<0.001
Qualifications of the researchers and how much you think you trust them	3.65	1.08	4.07	0.99	−3.73	<0.001	3.77	1.02	3.80	1.12	−0.30	0.766

TABLE 4 (Continued)

	Miscellaneous sample						Psychology sample					
	Men[a]		Women[b]				Men[c]		Women[d]			
Survey item	***M***	**SD**	***M***	**SD**	***t***	***p***	***M***	**SD**	***M***	**SD**	***t***	***p***
Level of confidence in your ability to complete study procedures	3.44	1.05	3.76	1.02	−2.86	0.004	3.40	0.95	3.74	0.99	−3.85	<0.001
Level of anxiety you think you might experience during study procedures	2.88	1.27	3.40	1.23	−3.80	<0.001	3.10	1.14	3.97	1.05	−8.85	<0.001
Your physical or mental health status	3.41	1.15	3.92	1.07	−4.18	<0.001	3.73	1.06	4.17	0.93	−4.99	<0.001

Note: Participants were asked: "How important to you are the following factors when deciding if you want to participate in a research study?" (Likert scale: 1—not at all important, 5—extremely important). Items are listed in the order presented in survey. See Figure 4 for effect sizes.

[a]Item sample sizes ranged from 126 to 128.

[b]Item sample sizes ranged from 222 to 224.

[c]Item sample sizes ranged from 150 or 154.

[d]Item sample sizes ranged from 497 to 504.

researcher who administers the tests to them is a man or woman. Importantly, these differences were observed in two samples.

Men and women reported different levels of appeal for various exercise types. Men rated weightlifting and golf significantly more appealing than did women. Women rated dancing, group aerobics, stretching, walking, yoga, and cardiovascular exercise with gym equipment (e.g., treadmills) significantly more appealing than did men. These results are generally consistent with men's and women's participation rates in these activities,[9,10] and they help to explain the greater willingness of women to participate in group aerobics and stretching/flexibility interventions and the greater willingness of men to participate in strength exercise interventions (Table 3; Figure 3).

Men and women reported different levels of interest in learning of various health and fitness attributes. Of the 16 attributes examined, flexibility was the only one women reported significantly greater interest in learning about than men did. Men, on the other hand, were significantly more interested than women were in learning of their muscle mass amount, running speed, jump height, and ball throwing ability. In the Psychology Sample, men also expressed significantly greater interest than women did in learning of their arm strength, body fat percentage, visual acuity, hand-eye coordination, reaction time, and highest tolerable exercise pain. Men have more muscle mass and consequently can generate more muscle force and power than women, particularly in upper-body muscles even when training history is similar.[11] Moreover, women find men with muscular, mesomorphic builds most physically attractive.[12,13] Thus, fitness attributes that interest men the most appear to be those in which better performance would affirm or accentuate their masculinity. Similarly, women have greater joint range of motion than men at many joints,[14,15] and feedback on flexibility performance might affirm or accentuate their femininity. Nevertheless, although muscle strength of all major muscle groups, whether expressed in absolute or relative-to-body-mass terms, is greater in men than women,[10,11] and, although men participate in strength training more frequently than women,[10] no significant difference existed in interest in learning about leg or core/abdominal strength. However, in the Psychology Sample, men were significantly more interested than women in learning their *arm* strength. Thus, the degree to which strength tests might affirm or accentuate identity as a man or woman could be muscle-specific. The greater male than female interest in being measured on upper-body strength, but not lower-body or core/abdominal strength, corresponds with findings that (a) upper-body strength, size, and attractiveness contribute significantly to male body esteem,[16,17] and (b) men place greater

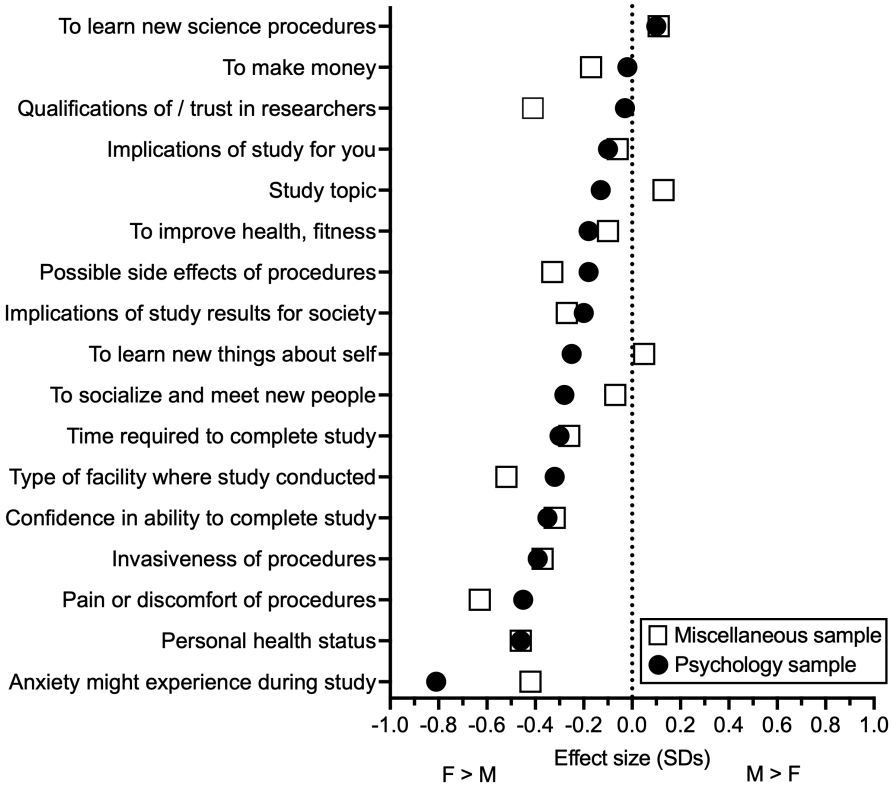

FIGURE 4 Effect sizes of differences between men and women in importance of certain factors when deciding if to participate in an exercise science research study in the Miscellaneous Sample (white squares) and Psychology Sample (black circles). See Figure 1 legend for notes on figure presentation and interpretation. See Table 4 for mean values and full names of survey items.

emphasis on upper-body than lower-body and trunk muscles in their strength training programs, whereas women typically place greater emphasis on lower-body muscles, with no difference between men and women on emphasis on core/abdominal exercises.[18,19]

Men and women reported different levels of willingness to undergo various test procedures. Of the 18 procedures assessed, the only one in which women reported significantly greater willingness to undergo than men did was completing an online survey about exercise experiences. The greater willingness of women to complete surveys in health research has been documented many times.[20–22] Men, on the other hand, reported significantly greater willingness than women to undergo procedures that involve challenge, competition, physical exhaustion, and electrical shocks of nerves or muscles. These findings are consistent with greater male orientation toward challenge and competition, particularly in exercise and sport.[23–26] Men are also more likely than women to report positive attitudes toward competition, enjoy competition, and respond favorably to competition.[26–28] The finding of significantly greater willingness of men to receive strong electrical shocks is consistent with Howe's[29] finding from 1960. Finally, the finding of greater willingness of men to undergo strength training exercise that causes muscle soreness and joint stiffness for 2–5 days might partly explain fewer female than male participants in research on exercise-induced muscle damage, including research that also involves use of unpleasant or discomforting procedures (e.g., cold water immersion) for treatment of muscle damage.[1]

Men and women reported different levels of importance of various factors when deciding whether to participate in research. Of the 17 factors assessed, none of them were considered significantly more important by men than women. Factors considered significantly more important by women than men included invasiveness, pain, and possible side effects of study procedures; amount of time required to complete study procedures; type of facility where research is conducted; implications of study results for society; personal health status; confidence to complete study procedures; and potential anxiety one might experience during study procedures. Greater levels of altruism and anxiety among women than men[30,31] might partly explain why a study's implications for society, and the potential anxiety one might experience during a study, were rated as more important by women. Moreover, lower female than male self-confidence and perceived self-competence in sports and motor skills[32,33] might partly explain why women place greater importance than men do on their confidence to complete study procedures as a factor that influences their decision to participate in research. Greater hesitancy of women than men to participate in experiments that involve painful procedures might be related to greater self-reported fear among women than men in experiencing pain[34,35] and to heightened pain sensitivity among women than men for most pain-inducing modalities.[34,36,37] Finally, although large proportions

of both men (Psychology Sample: 75%, Miscellaneous Sample: 84%) and women (Psychology Sample: 41%, Miscellaneous Sample: 68%) indicated they did not have a preference for a male or female investigator, women indicated a significantly greater preference for female investigators (Psychology Sample: $d = -1.15$; Miscellaneous Sample: $d = -0.51$) (Appendix S2). This finding is consistent with studies that have found that large proportions of patients (40%–90%) do not have preferences for male or female physicians[38,39] or nurses,[40] but women are more likely to prefer treatment from a female medical professional.[38–40] And when undergoing *intimate* medical procedures, men tend to prefer that male medical professionals administer the tests to them, whereas women tend to prefer that female medical professionals administer tests to them.[38–40] Also, in the current study, the percent of women who indicated that they either slightly or strongly prefer that a female researcher administer exercise tests to them was greater in the Psychology (57%) than Miscellaneous Sample (29%). One explanation for this finding is that the Psychology Sample was younger, and younger women are more likely than older women to express preference for treatment by female medical professionals.[40]

Results from the current study are relevant for ongoing discussions about fewer female than male participants in exercise and sports science research.[1,2,4,6,7] Investigator bias or discrimination against women has been stated or implied to be the cause of fewer female than male participants.[1,2,4,6,7] Exclusion of female participants due to concerns about (a) a potential influence of the menstrual cycle on study results[4] and (b) the inadvertent exposure of a fetus to unnecessary and avoidable risk or harm (e.g., drugs)[41] are factors that could contribute to the differential representation. Results from the current study suggest that different preferences of men and women might also partly contribute to different proportions of male and female participants in exercise and sports science research studies.

A critical question is then whether the differences in self-reported preferences documented in the current study are large enough to constitute a major factor in explaining men's and women's differential representation in such studies. We believe they could be. For example, in the Psychology Sample, 18% of men and 12% of women reported being "very willing" or "extremely willing" to have a biopsy taken from their thigh muscle (Appendix S2). Assuming such individuals would enroll in a study involving this procedure, then, all else being equal, men would comprise 60% of participants in such a study. This can also be expressed as a difference of 0.36 standard deviations (Figure 3), which is conventionally described as a small-to-medium size effect. Of the 172 differences presented in Tables 1–4 and Figures 1–4, 50 (29%) indicate a difference in absolute standard deviation of at least this magnitude. Moreover, if a study that involves muscle biopsies also includes other procedures that a man is, on average, more willing to undergo than a woman (e.g., strength training), this would likely magnify the predicted difference in participation based on the muscle biopsy requirement of a study. In sum, our results suggest that differences in self-reported preferences between men and women could explain some of the difference in the proportions of male and female participants in exercise and sport science research studies. Nevertheless, we acknowledge that additional research is needed to determine the extent to which self-reported preferences correspond to actual study enrollment.

The current study has potential limitations that warrant consideration. First, we used samples of convenience, which might not represent the population of adults who would be recruited to participate in exercise and sports science research. Nevertheless, similar results were discovered in two samples who were recruited in different ways. Second, the large number of items assessed might increase the likelihood of Type 1 errors (false positives). This concern is mitigated, however, by the strong and significant correspondence between the two samples in the direction and magnitude of differences across items. Differences arising by chance would not show such associations. Also, factor analysis showed items could sometimes be placed into theoretically meaningful groups, several of which showed significant differences between men and women. Moreover, most differences in the current study complement previous research,[7] which further indicates that such differences were not due to chance. Third, our study addressed proximate, near-term factors, such as men's greater willingness to undergo strength training and women's greater willingness to participate in group aerobics. Such differences are helpful in explaining unequal proportions of adult men and women in some studies. Nonetheless, important questions can be asked about the developmental, social, environmental, biological, and evolutionary factors that may contribute to these proximate differences between men and women, for example, *why* men are typically more interested in undergoing strength training. Our research design did not allow us to test such causal pathways, and a discussion of these pathways is beyond the scope of the current article.

5 | PERSPECTIVE

To our knowledge, the current study is the first to examine men's and women's interest and willingness to participate in exercise and sports science research. We found agreement between two samples that differences

exist between men and women in appeal of various exercise types, interest in specific areas of health and medicine, interest in learning of particular health and fitness attributes, willingness to undergo certain study procedures and interventions, and the importance of various factors when deciding whether to participate in research. Therefore, we conclude (a) differences in interest and willingness to participate in certain study procedures between men and women likely contribute to different proportions of male and female participants in exercise and sports science research, and (b) previous suggestions that investigator bias against women is the sole or primary cause of fewer female than male participants in exercise and sports science research[1,2,4,6] require reconsideration.

Moving forward, the results from the current study might be helpful in developing strategies aimed at encouraging both men and women to participate in exercise and sports science research studies. For example, if a researcher seeks to recruit equal numbers of male and female participants for an exercise *survey* study, the researcher will likely need to advertise or incentive participation in the study in a way that makes participation particularly appealing to men. Similarly, if a researcher seeks to recruit equal numbers of male and female participants for a study that involves an upper-body strength training intervention aimed at increasing the size and strength of upper-limb muscles, the researcher will likely need to advertise the study or incentive it in a way that makes participation particularly appealing to women. Future research will be required to determine the extent to which more targeted recruitment strategies impact participation rates in exercise and sports science research studies. Finally, to the extent that future recruitment strategies are successful at recruiting roughly equal numbers of men and women to participate in exercise and sports science research, the collected data can be segregated by sex to improve our understanding of how men and women might respond to exercise differently.[1,42,43]

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CONFLICT OF INTEREST STATEMENT

The authors declare no conflict of interest in relation to this research.

DATA AVAILABILITY STATEMENT

The data that support the findings of this study are available from the corresponding author upon reasonable request.

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SUPPORTING INFORMATION

Additional supporting information can be found online in the Supporting Information section at the end of this article.

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