Knowledge of Exercise Prescription Guidelines Among Certified Exercise Professionals

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Abstract

Zenko, Z and Ekkekakis, P. Knowledge of exercise prescription guidelines among certified exercise professionals. *J Strength Cond Res* 29(5): 1422–1432, 2015—This survey assessed the knowledge of the "Guidance for prescribing exercise" issued by the American College of Sports Medicine (ACSM) in 2011 among certified exercise professionals. A sample of 1,808 certified exercise professionals (66.70% women, mean ($\pm SD$) age = 38.28 ± 12.56 years) responded to electronic invitations. The 11-question online questionnaire assessed knowledge of the recommended frequency, duration, and intensity ranges in terms of heart rate, metabolic equivalents, and ratings of perceived exertion. Respondents had 7.45 ± 8.07 years of work experience and represented all 50 U.S. states. On average, participants answered 42.87 ± 1.69% of the questions correctly. Gender, age, and years of professional experience were not associated with overall knowledge of the guidelines. Likewise, having 1, 2, or 3+ certifications made no difference in overall knowledge. However, there were significant differences between levels of education ($F = 7.12$, $p < 0.001$), from 38.72 ± 1.62% for "some college" to 47.01 ± 1.71% for "doctorate." There were also significant differences by primary job role ($F = 3.45$, $p < 0.001$) but no category exceeded 49% (e.g., personal trainers: 40.59 ± 1.66%; clinical exercise physiologists: 44.18 ± 1.70%). The respondents rated their knowledge of the exercise prescription guidelines as 7.01 ± 1.69 of 10 but rated the level of knowledge necessary to practice safely and effectively as 8.32 ± 1.64 ($t = 28.60$, $p < 0.001$). This survey, the first at this scale to investigate the knowledge of exercise prescription guidelines among certified exercise professionals, showed that there is room for improvement, considering that the average score was below 50%.

Key Words evidence-based practice, professionalization, knowledge translation

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Introduction

The development of evidence-based guidelines specifying the dose of physical activity that health and exercise professionals should prescribe or recommend to the public (19,22) is an important component of the broader activity-promotion effort. Although awareness of the importance of physical activity for health is nearly universal in western countries (30,32), specific knowledge of these guidelines and recommendations has been persistently poor. This has been the case since the days of the first guidelines in the 1970s. For example, according to the "Fitness in America" survey of 1979 (26), "while most of the public understand the importance of strengthening the heart and lungs, many are unclear about the types or amount of activity required to do so" (p. 47).

Poor knowledge of the guidelines may contribute to the problem of physical inactivity (35). It is, therefore, reasonable to propose that increasing this knowledge should be targeted by public health interventions. Indeed, in the forerunner of the Healthy People federal program, which was launched in 1980 under the title "Promoting Health/Preventing Disease: Objectives for the Nation," one of the objectives was to increase by 1990 to over 70% the proportion of adults able to identify the duration of exercise needed to effectively promote cardiovascular fitness (3,34). Despite indications that knowledge rates would have to be raised severalfold to reach this target (8), no objective pertaining to knowledge of the guidelines was ever included in the Healthy People program.

In the absence of a specific intervention, the problem of poor knowledge of the guidelines has persisted unabated. Surveys have consistently indicated that medical professionals are either unaware of the existence of exercise prescription guidelines or unable to recall what the guidelines are (1,11,14,15,40,41). Likewise, members of the general public exhibit poor knowledge of physical activity recommendations (4,6,8,10,25,29,31).

The poor level of knowledge among medical professionals and the general public could be explained by the lack of specialized training or focus required to keep up with the periodic updates. However, it seems reasonable to expect exercise professionals, especially those certified by recognized organizations, to know the guidelines and keep abreast of updates. However, the level of knowledge of exercise prescription guidelines among exercise professionals has not been investigated systematically. In the only known survey conducted in the United States, Malek et al. (27) administered 10 questions on exercise prescription to 115 health fitness professionals from southern California. Notably, however, only 22 had a Bachelor's degree in kinesiology and only 11 were certified by either the American College of Sports Medicine (ACSM) or the National Strength and Conditioning Association (NSCA). The average knowledge score was 41% but it differed greatly between the 11 professionals certified by the ACSM or NSCA (who averaged 86%) and the 104 who were not certified by these organizations (who averaged 35%). Furthermore, Bauman and Finch (5) and Ferney et al. (18) surveyed 2 small groups of exercise scientists attending conferences on sport science and medicine in Australia. In 2009 (18), the percentage of exercise scientists who gave correct answers to 4 of 5 questions pertaining to the 2007 recommendations by the ACSM and the American Heart Association (22), at only 18.2%, was lower than that of public health practitioners (30.1%), allied health professionals (21.2%), and other professionals (18.3%), surpassing only that of medical practitioners (11.8%).

The absence of more surveys evaluating the knowledge of evidence-based guidelines among exercise professionals represents a striking void in the literature. More broadly, virtually nothing is presently known about the sources of information that exercise professionals use in their practice (13,38). This is a crucial omission for several reasons. First, exercise professionals have substantial societal reach. They are the individuals who interact directly with the exercising public and should be putting the guidelines into practice. Although the exact number of exercise professionals is difficult to estimate, it is illustrative that according to the Bureau of Labor Statistics, more than 250,000 individuals in the United States list their occupation as "fitness trainer or instructor." This number is expected to increase by 24% during the current decade, reaching approximately 312,000 by 2020. The International Health, Racquet and Sportsclub Association estimates that in the United States alone, 6.4 million people use the services of personal trainers, one of the largest categories of exercise professionals.

Second, knowledge of the guidelines represents a good indicator of the transition of the field of exercise science to the era of evidence-based practice, following the example of other health-related fields (2). Full implementation of the model of evidence-based practice would require exercise professionals to develop expertise in locating, critically appraising, and synthesizing original research evidence. However, given the absence of relevant components in current academic curricula, it is reasonable to speculate that most exercise professionals are not prepared to fully implement this process. Using evidence-based guidelines developed by experts under the auspices of respected scientific bodies has been proposed as "the next best thing," a more realistic path toward evidence-based practice (28).

Third, knowledge of evidence-based guidelines is an issue inherently intertwined with the professionalization and professional reputation of the field of exercise science. Although there are various proposals about the core competencies that exercise professionals should have (12,40), the ability to issue prescriptions or recommendations that reflect the current research evidence is generally considered paramount. Presumably, knowledge of the guidelines should result in exercise prescriptions or physical activity recommendations of the highest effectiveness and safety. In turn, this knowledge should be perceived as representing added market value and, therefore, result in higher compensation rates for those professionals who possess it.

Thus, the purpose of this survey was to assess the level of knowledge of the exercise prescription guidelines issued by the ACSM in 2011 (19) among certified exercise professionals. The guidelines, entitled "Quantity and quality of exercise for developing and maintaining cardiorespiratory, musculoskeletal, and neuromotor fitness in apparently healthy adults: Guidance for prescribing exercise," were selected because, unlike the "ACSM's Guidelines for exercise testing and prescription," they are publicly available for free on the Web site of the ACSM. The stated purpose of the guideline document is "to provide scientific evidence-based recommendations to health and fitness professionals in the development of individualized exercise prescriptions for apparently healthy adults of all ages." Thus, the centrality of this document to the mission of exercise professionals is self-evident. The guidelines, which updated earlier ones issued in 1998, were the result of a multiyear effort by an 8-member writing group, were based on over 400 scientific reports, and are believed to encapsulate the latest knowledge on the use of exercise for improving physical fitness and health.

Given the past preliminary results, we anticipated that the survey would reveal deficiencies in knowledge but there was no firm basis for estimating the severity of these deficiencies. Of particular interest was the possible impact of frequent changes in certain elements of the guidelines, mainly intensity, on the current level of knowledge. Although guidelines for other important health behaviors (e.g., the Recommended Daily Allowances for caloric and macronutrient intake) have remained invariant for a long enough period to allow the information to permeate textbooks, educational curricula, and continuing education programs, exercise prescription guidelines change every few years. Although the rationale for this strategy seems defensible (i.e., to ensure that the guidelines always reflect the latest scientific evidence), the possible downside is that inconsistency results in confusion (16). For this reason, it was anticipated that knowledge would be lowest for questions pertaining to the recommended ranges of intensity, as these have been revised more frequently than the ranges for duration and frequency. We anticipated that professionals with more experience, more certifications, higher educational attainment, those working in clinical (e.g., clinical exercise physiologists, rehabilitation specialists) or academic settings (e.g., academics, researchers), and those reporting that they draw information for their practice primarily from scientific sources (e.g., journals, books, conferences) would exhibit higher levels of knowledge. Finally, we predicted that the respondents would perceive their level of knowledge of the guidelines to be higher than their actual knowledge and, in turn, would rate the desirable level of knowledge even higher than their own perceived level of knowledge.

Methods

Experimental Approach to the Problem

To accomplish the main purpose of the study, namely to assess the knowledge of exercise prescription guidelines among exercise professionals, we developed a short survey, described in detail below. The survey included questions about several variables that were expected to moderate the level of knowledge, as stated in the Introduction (i.e., years of experience, number of certifications, educational attainment, primary job role, primary source of information used in professional practice). Finally, to assess whether the respondents perceived a "knowledge gap" (i.e., that they possessed less knowledge than they deemed desirable), a series of additional questions assessed the level of confidence about the knowledge of the guidelines, the perceived level of knowledge, and the desirable level of knowledge. Responses to these questions were compared with the actual level of knowledge, as indicated by the total knowledge score.

Subjects

The sample consisted of 1,808 exercise professionals certified by the American College of Sports Medicine. These participants responded voluntarily to an electronic invitation to complete an online survey (as described in the section on Procedures below). The sample consisted of 1,206 women (66.70%) and 602 men (33.30%), with a mean ($\pm SD$) age of 38.28 $\pm$ 12.56 years (range from 19 to 93 years) and 7.45 $\pm$ 8.07 years of work experience (range from 0 to 52 years). Additional participant characteristics are shown in Table 1. The project was approved by the Institutional Review Board at Iowa State University. As the survey dealt with a nonsensitive topic and posed minimal risk to respondents, the requirement of written informed consent was waived, in accordance with federal law (i.e., 45 CFR 46.117).

Procedures

An 11-item multiple-choice survey was developed to evaluate knowledge of core components of the guidelines (i.e., frequency, duration, intensity). Of primary concern in selecting items for the survey was to be fair and pragmatic, targeting only elements of central importance and practical value, as opposed to obscure or tangential pieces of information. Thus, the items assessed (a) the recommended frequency of moderate-intensity physical activity (i.e., 5–7 days per week), (b) the recommended duration of moderate-intensity physical activity per day (i.e., at least 30 minutes per day, accumulated throughout the day, with each bout of activity lasting for at least 10 minutes), (c) the recommended frequency of vigorous-intensity physical activity (i.e., at least 3 days per week), (d) the recommended duration of vigorous-intensity physical activity per day (i.e., at least 20 minutes per day, accumulated throughout the day, with each bout of activity lasting for at least 10 minutes), (e) the definition of one "metabolic equivalent unit" (MET) as a metric of intensity (i.e., 3.5 ml of oxygen per kilogram of body weight per minute), (f) the definition of the range of "moderate" intensity in terms of METs (i.e., 3.0–5.9), (g) the definition of the range of "vigorous" intensity in terms of METs (i.e., 6.0–8.7), (h) the definition of the range of "moderate" intensity in terms of percentages of maximal heart rate (i.e., 64–76%), (i) the definition of the range of "vigorous" intensity in terms of percentages of maximal heart rate (i.e., 77–95%), (j) the definition of range of "moderate" intensity in terms of the rating of perceived exertion (RPE), with a copy of the 6–20 RPE scale provided for reference (i.e., 12–13), and (k) the definition of the range of "vigorous" intensity in terms of the RPE (i.e., 14–17).

Each question was accompanied by 5 response options, selected to be unambiguously mutually exclusive and as straightforward as possible. For example, the 5 options accompanying the question "How often should healthy adults perform vigorous-intensity physical activity?" ranged from "At least 1 day per week" to "At least 5 days per week." The comprehensibility of the survey was tested by administering it to a large sample of undergraduate students in kinesiology without any problems (results reported elsewhere).

The survey was prefaced by a paragraph that was designed to (a) specify the set of guidelines about which the survey would be inquiring, (b) explain that these guidelines have several similarities to other recent guidelines that the respondents might have seen (and could, therefore, draw information from), and (c) prompt the memory of respondents by revealing an important element of the guidelines (i.e., "According to the current guidelines, healthy American adults should engage in moderate-intensity physical activity, vigorous-intensity physical activity, or a combination of the two, on a regular basis"). Respondents were also urged to provide answers based solely on their recollection, without using other materials or reminders to find the answers. Moreover, it was emphasized that the survey was entirely anonymous and confidential.

After the 11-item knowledge quiz, respondents were also asked a series of additional questions. First, they were asked to indicate whether they felt they knew the answers or had to guess (I knew all the answers; I knew most of the answers; I knew about half of the answers; I knew fewer than half of the answers; I was guessing for most of the answers). Second, after Allen et al. (1), we assessed the gap between the

TABLE 1. Knowledge score (%) for each level of the categorical variables examined.

Variable	Levels	*n*	*M*	*SD*	Lower 95% CI	Upper 95% CI
Gender	$F_{(1,1806)} = 1.61$, $p = 0.205$					
	Men	602	42.15%	18.13%	40.70%	43.60%
	Women	1,206	43.22%	16.40%	42.30%	44.15%
Number of certifications	$F_{(2,1805)} = 2.11$, $p = 0.121$					
	1	1,179	42.36%	16.29%	41.43%	43.29%
	2	434	43.30%	17.89%	41.61%	44.99%
	3+	195	44.94%	18.94%	42.27%	47.62%
Educational attainment	$F_{(4,1803)} = 7.12$, $p < 0.001$					
	High school	93	39.59%	17.30%	36.03%	43.15%
	Some college	54	38.72%	16.20%	34.30%	43.14%
	Bachelor's	864	41.46%	16.65%	40.34%	42.57%
	Master's	657	44.64%	17.13%	43.33%	45.95%
	Doctorate	140	47.01%	17.14%	44.15%	49.88%
Primary job role	$F_{(11,1795)} = 3.45$, $p < 0.001$					
	Academic	111	48.73%	18.90%	45.17%	52.28%
	Corporate Wellness	122	45.68%	16.47%	42.72%	48.63%
	Student	27	44.44%	17.35%	37.58%	51.31%
	Clinical Ex Physiologist	279	44.18%	17.05%	42.18%	46.19%
	Other Med/Clin Specialty	110	44.13%	16.92%	40.93%	47.33%
	Health Wellness Coach	141	43.84%	16.38%	41.12%	46.57%
	Supervisory	78	43.47%	19.20%	39.15%	47.80%
	Exercise Leader	110	42.81%	17.34%	39.53%	46.09%
	Rehabilitation Specialist	128	42.47%	15.69%	39.73%	45.22%
	Researcher	42	41.99%	14.88%	37.35%	46.63%
	Personal Trainer	622	40.59%	16.58%	39.28%	41.89%
	Other	37	35.87%	15.14%	30.82%	40.92%
Confidence in responses	$F_{(4,1803)} = 11.05$, $p < 0.001$					
	Knew all	66	42.01%	19.90%	37.12%	46.90%
	Knew most	917	45.38%	17.38%	44.25%	46.50%
	Knew about half	594	40.50%	16.15%	39.20%	41.80%
	Knew fewer than half	126	40.26%	14.75%	37.66%	42.86%
	Was guessing for most	105	38.01%	15.63%	34.98%	41.03%
Perceived knowledge gap	$F_{(2,2805)} = 1.02$, $p = 0.362$					
	Know more than needed	198	42.93%	18.41%	40.35%	45.51%
	Know as much as needed	533	43.71%	17.54%	42.22%	45.21%
	Know less than needed	1,077	42.43%	16.44%	41.45%	43.42%
Primary source of information	$F_{(1,1806)} = 17.00$, $p < 0.001$					
	Scientific*	1,274	43.93%	17.08%	42.98%	44.87%
	Nonscientific†	534	40.33%	16.55%	38.92%	41.74%

*"Scientific" sources of information included journal articles, books, conferences, and clinics.
†"Nonscientific" sources of information included past experience, other professionals, the World Wide Web (e.g., blogs), magazines, television, and other mass media.

perceived present and needed levels of knowledge of the guidelines. This was done by asking the following 2 questions: (a) "Please indicate how well you think you know the current physical activity guidelines on a scale from 0 to 10 (with 10 being perfect knowledge)" and (b) "Please indicate how well one should know the current physical activity guidelines to be able to function as an exercise professional safely and effectively," also on a scale from 0 to 10 (with 10 being perfect knowledge). Third, to contribute to the inquiry about the sources of knowledge used by exercise professionals (38), respondents were asked to indicate the primary source of information they use for their professional practice. The response options included (a) other professionals, (b) scientific journals, (c) books, (d) conferences and clinics, (e) Web (e.g., blogs), (f) magazines, (g) television and other media, and (h) past experience.

After obtaining Institutional Review Board approval, the authors contacted the Vice President for Evidence Based Practice and Scientific Affairs of the ACSM to request support for the project. Subsequently, with the assistance of the National Director of Certification and Registry Programs and the Assistant Director of Certification, an e-mail message was sent on April 1, 2013 to approximately 27,000 addresses registered in the mailing list of certification programs. A reminder e-mail was sent a week later and the survey closed on April 12, 2013. The invitation message was entitled "Special Message for ACSM Certified Pros: Complete this quick survey and be entered to win!" and its text was as follows:

> We are conducting research with the help of the ACSM to see how well the updated exercise prescription guidelines are being transmitted to exercise professionals in a variety of settings (personal trainers, clinicians, wellness coaches, etc.). This research is very important as a way of learning about the current state of our industry, and for potentially leading the way to simplify the process of information dissemination to improve our field. Please take 5 minutes to answer a few questions about yourself and take a short multiple-choice quiz about the current health recommendations. It is completely anonymous, and at the end you can enter for a chance to win one of several copies of the new *ACSM's Guidelines for Exercise Testing and Prescription, 9th edition*, which became available in February and is valued at $40.00.

The invitation directed recipients to an online survey created on the CreateSurvey.com platform. On completion of the survey, 93.75% of the respondents chose to enter the drawing for copies of the *Guidelines for Exercise Testing and Prescription* (9th edition). Examination of the postal addresses showed that all 50 U.S. states were represented.

Statistical Analyses

The responses to the survey are presented as descriptive statistics (mean, *SDs*, and 95% confidence intervals [CIs]) for the total knowledge score (expressed as a percentage) and responses to individual questions. In addition, the relation of the total score to continuous personal variables (e.g., age, years of experience) was examined with Pearson's product-moment correlations. The effects of categorical variables on the total knowledge score were examined with independent-sample *t*-tests (for independent variables with 2 levels, such as gender) or 1-way analyses of variance (ANOVAs, for independent variables with more than 2 levels). Statistically significant ANOVAs were followed up with Tukey-Kramer Honestly Significant Difference (HSD) tests to identify significant pairwise differences. An alpha level of 0.05 was used. The study was more than adequately powered to detect small differences between mean values (for $d = 0.20$ and $\alpha = 0.05$, $1-\beta > 0.95$).

Results

Overall Performance

The mean $\pm$ *SD* score on the 11-item quiz was 4.72 $\pm$ 1.87 (95% CI, 4.63–4.80), corresponding to a percent correct of 42.87 $\pm$ 17.00 (95% CI, 42.08–43.65). The median was 5 correct responses out of 11. Ten respondents (0.55%) had no correct answers, whereas 3 (0.17%) were correct on all 11 questions.

Highest and Lowest Item Scores

The best performance was on the item inquiring about the definition of 1 MET in terms of oxygen uptake, with 78.60% of the respondents selecting the correct answer (i.e., 3.5 $ml \cdot kg^{-1} \cdot min^{-1}$). The second best performance was recorded on the item inquiring about the recommended duration of moderate-intensity physical activity per day, with 67.37% responding correctly (i.e., at least 30 minutes per day, accumulated throughout the day, with each bout of activity lasting for at least 10 minutes). However, the worst performance was recorded on items inquiring about the definition of the terms "moderate" and "vigorous" intensity, particularly in terms of percentages of maximal heart rate and RPE. Specifically, the worst performance was recorded on the item inquiring about the definition of "vigorous" intensity in terms of percentages of maximal heart rate, with only 13.50% of respondents selecting the correct answer (i.e., 77–95%). The second worst performance was recorded on the item inquiring about the definition of the "moderate" intensity in terms of RPE, with 18.31% of respondents answering correctly (i.e., 12–13 on 6–20 scale). The third worst performance was on the item inquiring about the definition of "vigorous" intensity in terms of RPE, with 21.74% of respondents selecting the correct answer (i.e., 14–17 on 6–20 scale). The fourth worst performance was recorded on the item inquiring about the definition of "moderate" intensity in terms of percentages of maximal heart rate, with 24.39% of respondents recognizing the correct answer (i.e., 64–76%).

Gender, Age, Work Experience, and Certifications

There was no difference between men (averaging 42.15%) and women (averaging 43.22%), $F_{(1,1806)} = 1.61$, $p = 0.205$. Neither age ($r = -0.03$, $p = 0.176$) nor years of work experience ($r = -0.04$, $p = 0.096$) were associated with the knowledge score. Likewise, respondents with 1 ($n = 1{,}179$, averaging 42.36%), 2 ($n = 434$, averaging 43.30%), or 3 or more ($n = 195$, averaging 44.94%) certifications from reputable organizations (e.g., ACSM, NSCA, American Council on Exercise) did not differ significantly in their knowledge scores, $F_{(2,1805)} = 2.11$, $p = 0.121$.

Educational Attainment

However, a 1-way ANOVA showed a significant effect of the highest level of educational attainment, $F_{(4,1803)} = 7.12$, $p < 0.001$. Post hoc analysis using the Tukey-Kramer HSD showed that respondents with a doctoral degree (e.g., PhD, MD, DPT; $n = 140$) or a Master's degree ($n = 657$) scored significantly higher than respondents with a Bachelor's degree ($n = 864$), with scores averaging 47.01%, 44.64%, and 41.46%, respectively. Smaller groups of respondents, those with a high school diploma ($n = 93$) or some college ($n = 54$), scored lower, 39.59% and 38.72%, respectively.

Primary Job Role

The primary job role also had a significant effect, $F_{(11,1795)} = 3.445$, $p < 0.001$. Academics/educators ($n = 111$, averaging 48.73%) scored the highest. However, their score did not differ significantly from that of corporate wellness specialists ($n = 122$, averaging 45.68%), students ($n = 27$, averaging 44.44%), clinical exercise physiologists ($n = 279$, averaging 44.18%), other medical or clinical specialists ($n = 110$, averaging 44.13%), health and wellness coaches ($n = 141$ averaging, 43.84%), individuals with supervisory roles in the fitness industry ($n = 78$, averaging 43.47%), exercise leaders ($n = 110$, averaging 42.81%), rehabilitation specialists ($n = 128$, averaging 42.47%), or researchers ($n = 42$, averaging 41.99%). They only differed significantly from the scores of personal trainers ($n = 622$, averaging 40.59%) and "others" ($n = 37$, averaging 35.87%).

Confidence in Responses

On the question inquiring about the level of confidence of respondents in their performance, the responses indicated relatively high levels of confidence. More than half of the respondents ($n = 917$, 50.72% of the sample) believed that they "knew most of the answers" and a few more ($n = 66$, 3.65% of the sample) reported that they "knew all the answers." Those who evidently had some self-doubts about their knowledge included those who estimated that they "knew about half of the answers" ($n = 594$, 32.85% of the sample), those who reported that they "knew fewer than half of the answers" ($n = 126$, 6.97% of the sample), and those who admitted that they were "guessing for most of the answers" ($n = 105$, 5.81% of the sample). In actuality, however, these estimates were inaccurate. Although 54.37% of respondents believed that they knew "all" or "most" of the answers, fewer than one-third answered more than half of the questions correctly ($n = 590$, 32.63% of the sample). Nevertheless, the perception of confidence was statistically associated with the actual level of knowledge, $F_{(4,1803)} = 11.05$, $p < 0.001$. Those who reported that they "knew most of the answers" scored the highest (45.38%). Their knowledge score was significantly higher that of those who believed that they "knew about half of the answers" (40.50%), those who believed that they "knew fewer than half of the answers" (40.26%), and those who admitted that they were "guessing for most of the answers" (38.01%). However, the average knowledge score of those who reported that "knew all the answers" (42.01%) did not differ significantly from that of the other categories.

Perceived and Needed Knowledge

On the question "how well you think you know the current physical activity guidelines on a scale from 0 to 10, with 10 being perfect knowledge," the mean score ($\pm SD$) was 7.01 $\pm$ 1.69 (95% CI from 6.93 to 7.09). On the question "how well one should know the current physical activity guidelines to be able to function as an exercise professional safely and effectively" (also answered on a scale from 0 to 10, with 10 being perfect knowledge), the mean score was 8.32 $\pm$ 1.64 (95% CI from 8.24 to 8.39). The difference was statistically significant, $t\,(1807) = 28.60$, $p < 0.001$. The gap between the perceived present and needed levels of knowledge of the guidelines averaged 1.31 $\pm$ 1.94 units (95% CI from 1.22 to 1.40), representing an overall perceived knowledge deficit of approximately 13% (Figure 1). The gap was significantly smaller for men (0.91) than women (1.51), $F_{(1,1806)} = 7.581$, $p = 0.006$. Compared with women, men perceived both their current knowledge to be higher (7.16 vs. 6.93) and the needed knowledge to be lower (8.07 vs. 8.44).

Most respondents ($n = 1{,}077$, 59.57% of the sample) perceived a knowledge deficit, averaging 2.49 $\pm$ 1.52 units (95% CI from 2.40 to 2.58). However, there were also respondents who perceived that their knowledge surpasses the level required "to be able to function as an exercise professional safely and effectively." These respondents ($n = 198$, 10.95% of the sample) averaged a perceived knowledge surplus of 1.61 $\pm$ 1.08 units (95% CI from 1.45 to 1.76). Finally, 533 respondents (29.48% of the sample) perceived no knowledge gap (i.e., that their current knowledge of the guidelines is precisely the level they need "to be able to function as an exercise professional safely and effectively"). However, the actual knowledge of these 3 groups did not differ significantly, $F_{(2,1805)} = 1.02$, $p = 0.362$. Their scores averaged 42.43%, 42.93%, and 43.71%, respectively.

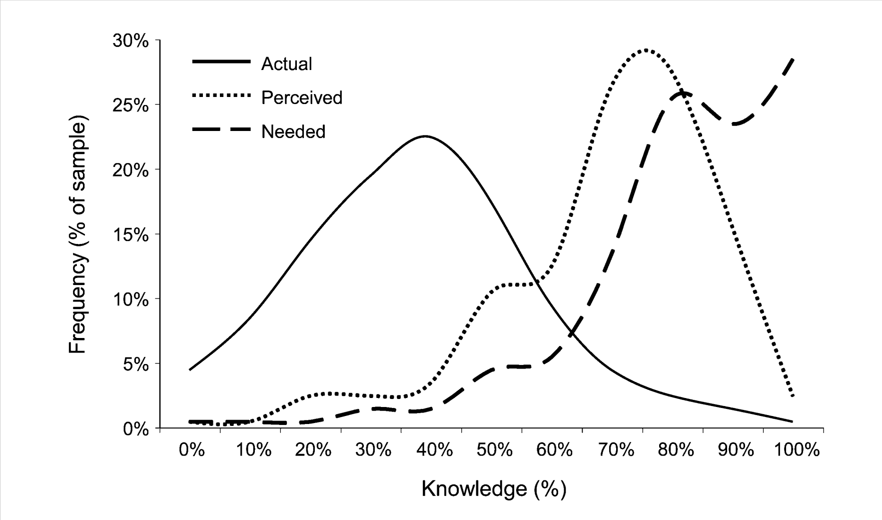

Figure 1. Smoothed (interpolating spline) frequency distributions for actual knowledge (% of correct responses on knowledge quiz), perceived knowledge (converted to % from 0 to 10 scale), and perceived needed knowledge of the exercise prescription guidelines "to be able to function as an exercise professional safely and effectively" (converted to % from 0 to 10 scale).

Primary Source of Information

Finally, most respondents reported that the primary source of information they use in their professional practice is scientific journals ($n = 629$, 34.79% of the sample), books ($n = 389$, 21.52% of the sample), and conferences and clinics ($n = 256$, 14.16% of the sample). Fewer respondents reported that they primarily rely on nonscientific sources of information, such as their own past experience ($n = 209$, 11.56% of the sample), other professionals ($n = 151$, 8.35% of the sample), the World Wide Web, such as blogs ($n = 142$, 7.85% of the sample), magazines ($n = 29$, 1.60% of the sample), or television and other media ($n = 3$, 0.17% of the sample). A comparison of the knowledge scores of the 1,274 respondents in the former category and the 534 in the latter category was statistically significant, $F_{(1,1806)} = 17.00$, $p < 0.001$. Their scores averaged 43.93% and 40.33%, respectively.

Discussion

Advocates of the role of exercise in the promotion of health have been mainly focusing on strengthening the exercise prescription skills of physicians (24). Although the value of this endeavor is indisputable, the attention directed toward appraising and strengthening the exercise prescription skills of exercise professionals seems disproportionately low by comparison. This is presumably a reflection of the fact that, while most exercise science academic curricula include courses partly or entirely devoted to exercise prescription (17), this information is absent from most medical curricula (15,20,41). However, as the present evaluation of the knowledge of exercise prescription guidelines among certified exercise professionals demonstrates, there is also considerable room for improvement in this vitally important target group.

Published surveys investigating the knowledge of specific practice guidelines among health professionals are rare. This rarity may be attributed to the fact that when the results of such surveys are published, they commonly reveal levels of knowledge that seem surprisingly low. For example, 877 physicians from 18 U.S. states, who were quizzed about their knowledge of 5 key concepts pertinent to the National Cholesterol Education Program guidelines (e.g., pharmacologic characteristics of lipid-lowering agents, cardiovascular risk factors, diagnosis, and treatment of metabolic syndrome) scored below 25% (37; i.e., 21.8% for residents, 23.2% for attending physicians). Similarly, fewer than 50% of physicians specializing in obstetrics and gynecology, who worked at a top-rated U.S. hospital, picked the correct answers on a multiple-choice quiz about the breast cancer screening guidelines issued by the United States Preventive Services Task Force; only 48.7% knew the appropriate age for initiating breast cancer screening and 46.2% knew the recommended frequency of screening for women between the age of 50 and 74 years (23).

Against this backdrop, the results of this survey should not be interpreted as indicating a problem that is unique or specific to exercise professionals. However, given the absence of a score over 50% in any of the groups examined (e.g., respondents with different levels of educational attainment, primary job roles, number of certifications), the results should provide a stimulus for reflection. Although this survey cannot offer concrete explanations for the observed level of knowledge, analysis of the response patterns can offer some useful insights. For example, it is noteworthy that the best performance was recorded on items inquiring about elements that have either always been invariant (78.60% of respondents knew that 1 MET is defined as a metabolic rate of 3.5 $ml \cdot kg^{-1} \cdot min^{-1}$) or have remained consistent for decades (67.37% of respondents knew that adults should accumulate at least 30 minutes of moderate-intensity activity per day, with each bout lasting for at least 10 minutes).

By the same token, the fact that the lowest scores were associated with intensity-related questions is also of exceptional significance. Of the different elements of prescription guidelines, the recommended ranges of intensity have undergone the most revisions over the years. This inconsistency is arguably unavoidable from a scientific standpoint since the guidelines must always reflect the evolving evidence base. At the same time, however, inconsistency predictably generates confusion (16). The 2011 revision of the guidelines (19) changed not only the definitions of the intensity ranges but also the ranges themselves. In the 1998 edition, "moderate" intensity was defined as 55–69% of maximal heart rate, whereas this was changed to 64–76% in 2011. The 1998 edition did not include a "vigorous" range of intensity but rather a "hard" (70–89%) and a "very hard" (≥90%) range. It is possible that these changes contributed to only 24.39% of respondents being able to identify 64–76% of maximal heart rate as the range of "moderate" and only 13.50% being able to identify 77–95% as the range of "vigorous" intensity. It has been suggested that future revisions of the guidelines should take into consideration the fine balance between the scientific necessity of minor upward or downward adjustments in the boundaries of these ranges and the potential for confusion that these adjustments can create among practitioners and the public (16).

Like Malek et al. (27), we found no association between years of work experience and the knowledge score. However, Malek et al. (27) found significant differences in the knowledge of exercise prescription guidelines between 11 professionals certified by either the ACSM or the NSCA (86%) and 104 professionals not certified by these organizations (35%), as well as between 22 professionals with a Bachelor's degree in kinesiology (70%) and 93 professionals without such a degree (33%). All the participants in this survey were ACSM certified and, thus, we could not replicate Malek et al.'s (27) comparison between certified and noncertified professionals. We did, however, extend Malek et al.'s (27) finding regarding the influence of formal education. In this sample, although respondents with a Bachelor's degree did not differ significantly from high school graduates or those with some college experience, respondents with a Master's or doctoral degree had knowledge scores that were significantly higher than those of all other categories. These results suggest that knowledge of exercise prescription guidelines may be more likely to be acquired by those with considerable academic attainment, perhaps even beyond a Bachelor's degree.

Taken together, these findings seem consistent with the interview-derived observations by De Lyon and Cushion (13), who noted "a clear disparity between the knowledge accredited fitness trainers acquire during their formal education and the knowledge later used during their professional practice" (pp. 1416–1417). While knowledge acquired during degree courses was portrayed by fitness trainers as "too disparate from that needed to perform the fitness trainer role" (p. 1412), learning on the job was described as "the most important way of developing knowledge" (p. 1413).

The perceived gap between present and needed levels of knowledge of the exercise prescription guidelines revealed several interesting phenomena. Certified exercise professionals seem confident about their knowledge, averaging 7.01 on a 10-point scale, in which 10 signifies "perfect knowledge." Given the overall average knowledge score of 42.87%, it could be argued that exercise professionals exaggerate their knowledge of the guidelines by a factor of 1.6. Overconfidence about knowledge of core concepts of professional practice is common. For example, in a survey of primary care staff in Scotland, only 13% of general practitioners, 7% of practice nurses, and 9% of health visitors knew the physical activity guidelines for health. Nevertheless, 66%, 71%, and 80% of them, respectively, either "agreed" or "strongly agreed" that they have sufficient knowledge to advise patients about physical activity (14). Similarly, although only 12% of a sample of physicians in the United States reported familiarity with ACSM guidelines for exercise prescription, 74% perceived that they had adequate knowledge to prescribe exercise (39).

Perceived knowledge deficits are typically revealed in surveys under the following 3 conditions. First, when health professionals are asked why they do not provide exercise prescriptions or physical activity recommendations, perceived lack of knowledge typically emerges as one of the leading explanations (1,33). Second, evidence for a perceived deficit in knowledge is found when respondents are asked whether they would like to have more knowledge (33). Third, when respondents are asked to not only evaluate the adequacy of their current knowledge but also to specify the ideal level of knowledge, a "knowledge gap" tends to emerge (1). The latter option was selected in this study, revealing a perceived knowledge deficit of approximately 13%. Similar findings have been reported by Allen et al. (1). On a scale ranging from 1 (no present knowledge) to 5 (strong knowledge), cardiologists rated their perceived current knowledge of exercise prescription as 3.6 but the needed knowledge between 4.3 and 4.6. Likewise, family practitioners rated their perceived current knowledge as 2.5 but the needed knowledge between 4.2 and 4.3.

This survey also found a noteworthy gender effect in the perceived knowledge gap. A gender effect in confidence about knowledge has also been found in surveys of other health professionals, with the men consistently reporting higher levels of confidence than women. For example, in a survey of family practitioners in Australia, Bull et al. (7) found that 51.4% of men, compared with only 31.7% of women, either "agreed" or "strongly agreed" that they were knowledgeable enough to provide specific recommendations about physical activity to their patients. This survey showed that in addition to men overestimating their knowledge more than women, men also tend to underestimate the level of knowledge of exercise prescription guidelines needed "to function as an exercise professional safely and effectively," leading to a knowledge gap of less than 1 unit on a 10-point scale ($8.07 - 7.16 = 0.91$).

The finding that certified exercise professionals report that they primarily derive the information they use in their practice from scientific sources, such as journals, books, and conferences, as opposed to nonscientific sources, such as their own past experience, other professionals, blogs, magazines, or television, is in agreement with a previous study. Hare et al. (21) received mail-in surveys from 325 ACSM-certified exercise professionals (of 500 who were randomly selected from the database of certified professionals). They also found that more respondents reported getting their information (in that case, specifically about weight control) from scientific sources such as textbooks (81%), college classes (80%), scientific journals (79%), and workshops or seminars (78%), than from nonscientific sources such as past experience (51%), other colleagues (49%), or the mass media (20%). Getting information from scientific sources was found in this study to be positively associated with the knowledge of exercise prescription guidelines but the score was still limited to well below 50%.

Readers should evaluate the findings of this survey by taking into account both its strengths and its weaknesses. A considerable strength of this study is its large and inclusive sample of certified professionals. The sample encompasses both genders and very broad ranges of age, work experience, and educational attainment. It also provides satisfactory representation of most major work roles, with most major categories being represented by over 100 respondents. However, an important limitation of the survey is the response rate (approximately 7%), which is at the low end of response rates for online surveys. The overall literature average is 34–35% (9,36). It is important to emphasize that this phenomenon was not the result of poor planning, as we implemented most measures that have been shown to raise the response rate, including a short survey length, sponsorship by a reputable organization (ACSM), targeting a population of professionals, sending a reminder message, and offering compensation (albeit in the form of a lottery for books, not money). The only measure we did not take was to send personalized postcard invitations and reminders through the mail, as this was prohibitively costly given the large size of the target population.

Although this is speculative, we tend to attribute the low response rate to the fact that this was a survey focusing on knowledge (as opposed to opinions or attitudes), a feature known to lower response rates. It is possible, for example, that many respondents might have been hesitant to complete a knowledge quiz sponsored by the same organization from which they had been certified. Although the invitation clearly stressed that the survey was "entirely anonymous and confidential" and that there was "no way to associate the answers with (them) personally," it is plausible that concerns about anonymity or confidentiality could have prevented many professionals from completing the survey. Therefore, readers should not assume that the exercise professionals who volunteered for this survey constitute a random or fully representative sample of the population of exercise professionals. It is reasonable to assume that individuals who volunteer to participate in knowledge surveys are, on average, more confident about their knowledge than those who do not. Therefore, a cautious interpretation of these results is that they probably overestimate the current level of knowledge of exercise prescription guidelines among certified exercise professionals.

In conclusion, on average, the ACSM-certified exercise professionals who volunteered for this survey were able to pick the correct answer on fewer than half of the questions about the ACSM-issued "guidance for prescribing exercise" (19). In particular, fewer than 1 in 4 respondents were able to identify the correct definitions of "moderate" and "vigorous" intensity in terms of percentages of maximal heart rate and RPE.

Practical Applications

Although scores on the knowledge of specific practice guidelines below 50% are not uncommon among health professionals, these results indicate that there is considerable room for improvement in this area. Specifically, there seems to be a knowledge-translation problem (38), in so far as the evidence-based guidelines, despite offering the promise of safer and more effective practice, exhibit less-than-perfect dissemination among exercise professionals. Presumably, the responsibility for this phenomenon is shared between the professionals themselves and the guideline developers. For their part, professionals should be cognizant of the dynamic and continually evolving nature of scientific evidence and, therefore, should seek to update their knowledge by pursuing meaningful continuing education opportunities.

At the same time, guideline developers should recognize that the practice of revising the guidelines in short cycles (such as every 3 or 5 years) may have considerable unintended negative consequences. First, the task of developing new guidelines may be incomplete without also undertaking vigorous and systematic dissemination initiatives. Short revision cycles do not allow sufficient time for new guidelines to fully permeate textbooks, educational curricula, and continuing education programs and thus reach their target audience. Second, the necessity of updates must reflect significant scientific developments rather than the mere passage of time. Because frequent revisions predictably lead to confusion, guideline development should take into account the fine balance between the scientific necessity of minor upward or downward adjustments to the recommended ranges and the potential for confusion that such changes may entail. Third, a potential reason why the guidelines do not reach professional practice may be the format in which they are presented. At present, the guidelines consist of hard-to-remember numerical information presented in technical and highly detailed language. It is possible that this information may be perceived as irrelevant to or inessential for effective practice in the field as it is unaccompanied by a practical system of personalization to individual clients. The development of a protocol, either in paper or computerized form, similar to the Step Test Exercise Prescription (STEP) protocol that has been developed for primary care (33), could perhaps facilitate the translation of the guidelines to practice and help highlight their practical value.

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