

Quiz Policies

Eligibility

The NCSF online quizzes are open to any currently certified fitness professional, 18 years or older.

Deadlines

Course completion deadlines correspond with the NCSF Certified Professionals certification expiration date. Students can obtain their expiration dates by reviewing either their certification diploma or certification ID card.

Cancellation/Refund

All NCSF continued education course studies are non-refundable.

General Quiz Rules

- You may not have your quiz back after sending it in.
- Individuals can only take a specific quiz once for continued education units.
- Impersonation of another candidate will result in disqualification from the program without refund.

Disqualification

If disqualified for any of the above-mentioned reasons you may appeal the decision in writing within two weeks of the disqualification date.

Reporting Policy

You will receive your scores within 4 weeks following the quiz. If you do not receive the results after 4 weeks please contact the NCSF Certifying Agency.

Re-testing Procedure

Students who do not successfully pass an online quiz have the option of re-taking. The fees associated with this procedure total \$15 (U.S) per request. There are no limits as to the number of times a student may re-test.

Special Needs

If special needs are required to take the quiz please contact the NCSF so that appropriate measures can be taken for your consideration.

Quiz Rules

What Do I Mail Back to the NCSF?

Students are required to submit the quiz answer form.

What do I Need to Score on the Quiz?

In order to gain the .5 NCSF continued education units students need to score 80% (8 out of 10) or greater on the CEU quiz.

Where Do I Mail My Quiz Answer Form?

You will mail your completed answer form to:

NCSF

Attn: Dept. of Continuing Education

5915 Ponce de Leon Blvd., Suite 60

Coral Gables, FL 33146

How Many CEUs Will I Gain?

Professionals who successfully complete the any continuing education quiz will gain .5 NCSF CEUs per quiz.

How Much does each quiz cost?

Each quiz costs the student \$15.00.

What Will I Receive When The Course Is Completed?

Students who successfully pass any of the NCSF online quizzes will receive their exam scores, and a confirmation letter.

How Many Times Can I Take The Quizzes For CEUs?

Individuals can take each NCSF quiz once for continuing education credits.

Strength and Power Training for Endurance Sports

Strength and high-velocity power training components are not commonly included in the training regiments of many endurance athletes. Although there is widespread acceptance related to the benefits of including power and strength training in endurance programs, many coaches and athletes still forgo the training. Several reasons are given for the exclusion, but most focus on the fear that added bulk will make the athletes slow and that the high tension training will compromise the endurance training performance due to fatigue or soreness. This explains the current trend of avoidance of power and strength training for many endurance athletes.

It is true that the added weight, gained in response to strength training is considered undesirable by endurance coaches. This is particularly true when one considers the optimal physical build of the world's leading marathon runners; low body mass, lean, and generally small. However, completely sacrificing any strength and/or power training in order to add a greater volume of an aerobic/endurance training component may not be the most effective way to improve the *performance* of endurance athletes, even at the elite level. Likewise, training for power and strength performance does not have to promote mass gains when properly programmed.

Research performed at the Norwegian University of Science and Technology, the Research Institute for Olympic Sports in Finland, the Academic Center, Navarra Dept. of Investigation for Medicine and Sport in Spain (Centro de Estudios), and Australian Universities seem to provide evidence that strength training has its place in the total performance paradigm for endurance athletes. Storen et al. investigated the effect of maximal strength training on running economy (RE) at 70% of $VO_2\text{max}$ as well as time to exhaustion at maximal aerobic speed (MAS) in well-trained male and female runners. The control group maintained only their "normal" (typical) endurance training while the intervention group supplemented four sets of four half-squats 3 times per week for 8 weeks at the subjects' individual 4-repetition maximum. The high intensity of the protocol and relatively low volume of the strength component was used to prevent added mass. As would be expected, 1-RM and rate of force development (RFD) increased in the intervention group quite significantly over the control; 33.2% and 26.0% respectively. Surprisingly however, RE and MAS especially, increased significantly in the intervention group compared to control; 5% and 21.3% respectively, even without changes in $VO_2\text{max}$ or bodyweight.

In complement, Hoff et al. examined the effects of maximal strength training on the work economy of female cross-country skiers. The typical attributes of the subjects were 17.9 +/- .3 yrs. and 55.3 +/- 1.3 ml*kg*min $VO_2\text{max}$. To maintain sport-specificity, a specially instrumented ski-ergometer was used to simulate double-poling. A significant improvement in double-poling economy was observed in the strength-trained group compared to the endurance-only group. Anaerobic threshold did not change for either group, but time to exhaustion was significantly elevated in the strength trained-group when compared to the control group after training. According to the study's authors, the

effects of strength-training resulted in a significant reduction in the relative available force employed, thereby prolonging duration of exertion.

In a separate yet similar study conducted by the same authors, 20 year old male cross country skiers with an average VO_2max of $70 \text{ ml}\cdot\text{kg}^{-1}\cdot\text{min}^{-1}$, the high-intensity strength trained group's (3 sets of six reps at 85% of the 1-RM on a ski pole simulator) time to exhaustion increased significantly over the control group. The conclusion was that "the increased aerobic endurance performance was [facilitated] by improved work economy."

Mikkola et al. studied the effects of concurrent endurance and explosive training. EMG, RFD, aerobic capacity, and work economy in cross country skiers were evaluated in a control group (only endurance trained) and an experimental group (27% of training volume replaced with explosive strength training). The volume control of this design lends greater support to conclusions drawn as it was not affected by the limitations of previously mentioned studies that *supplemented* strength training without control for total volume of training. Non-significant changes were found in several of the performance measures however, the steady-state oxygen consumption during an isokinetic double-poling test was significantly decreased in the experimental group compared to the control. Again, improvements in sport-specific economy were observed with no changes in VO_2max in either group. There were also no decreases in VO_2max /aerobic performance in the experimental group, even with a decrease in the amount of endurance training for the experimental group.

Two Finnish studies examining moderately trained middle-aged (~38 years old) men, training either with a strength (S) only or combined strength + endurance (SE) protocol also attempted to explain the interference theory of concomitant exercise training. At completion of the study similar increases were observed in virtually all measured parameters of performance for both groups. This data does not support the concept of the universal nature of the interference effect. But researchers suggest these results may not reflect what occurs in well trained individuals, as these individuals were not highly-trained. Untrained individuals should be expected to respond and improve in measured parameters to a greater extent due to low starting values when compared to highly-trained elite-level athletes. The results did suggest, however, that "even low-frequency concurrent strength and endurance training leads to interference in explosive strength development."

Due to the fact that the literature seems to consistently conclude that greater improvements in performance are observed when strength/power training is supplemented or at least part of the endurance/aerobic component is supplanted by strength/power training, researchers have shifted focus in an attempt to determine the mechanism(s) of increased performance. Irrespective of age, sex, specific sport (running and cross country skiing were evaluated), training status, or even the volume of the strength/power component, the literature seems to conclude that a strength/power component that is properly implemented into an endurance athlete's training protocol positively affects economy and therefore performance in endurance competition.

Whether or not the increase in exercise economy is due to a change in the force-velocity relationship and the mechanical power output is currently debated. Osteras et al. concluded that a shift in the force velocity relationship and an increase in the mechanical power output improved the efficiency of endurance athletes and hence aggregating a strength/power training component is highly beneficial.

All the evidence related to the benefits of anaerobic training for endurance performance supports training logic from a neuro-physiological standpoint. Early evidence supports a reduction in percentage of maximal output at the same absolute workloads due to greater force capabilities and a consequent decrease in the perceived work, therefore creating lower metabolic distress. These higher force thresholds reduce the stress of peripheral fatigue which can compromise movement form and therefore affect economy. The lower perceived effort also encourages lipid-driven aerobic metabolism, sparing glycogen which may even improve lactate threshold with appropriate training. This benefit may be further enhanced when additional reliance is placed on the anaerobic system during endurance events (i.e. the final leg of a race). An additional benefit, not mentioned in the literature, is the possible prevention of injury from reduced training volume of repetitive actions and better muscular balance due to strength gains in antagonist muscle groups. Regardless of the specific mechanism or, more likely, the combination of the aforementioned, it seems to be in the best interest of participants who engage in endurance sports or recreation to add anaerobic training to their training program.

Works Cited

1. : [J Strength Cond Res](#). 2007 Aug;21(3):973-8. [Links](#)
Strength training and aerobic exercise: comparison and contrast.
[Knuttgen HG](#).
2. **Maximal Strength Training Improves Running Economy in Distance Runners.**
[Støren O](#), [Helgerud J](#), [Støa EM](#), [Hoff J](#).
3. **Maximal strength training improves work economy in trained female cross-country skiers.**
[Hoff J](#), [Helgerud J](#), [Wisløff U](#).

4. **Maximal strength training improves aerobic endurance performance.**
[Hoff J](#), [Gran A](#), [Helgerud J](#).

5. **Concurrent endurance and explosive type strength training increases activation and fast force production of leg extensor muscles in endurance athletes.**
[Mikkola JS](#), [Rusko HK](#), [Nummela AT](#), [Paavolainen LM](#), [Häkkinen K](#).

6. **Neuromuscular adaptations during concurrent strength and endurance training versus strength training.**
[Häkkinen K](#), [Alen M](#), [Kraemer WJ](#), [Gorostiaga E](#), [Izquierdo M](#), [Rusko H](#), [Mikkola J](#), [Häkkinen A](#), [Valkeinen H](#), [Kaarakainen E](#), [Romu S](#), [Erola V](#), [Ahtiainen J](#), [Paavolainen L](#).

7. **Effects of combined resistance and cardiovascular training on strength, power, muscle cross-sectional area, and endurance markers in middle-aged men.**
[Izquierdo M](#), [Häkkinen K](#), [Ibáñez J](#), [Kraemer WJ](#), [Gorostiaga EM](#).

8. **Maximal strength-training effects on force-velocity and force-power relationships explain increases in aerobic performance in humans.**
[Østerås H](#), [Helgerud J](#), [Hoff J](#).

CEU Quiz

1. Which of the following is a reason why endurance athletes have avoided strength and/or power training in the past?
 - a. Added bulk will slow down the endurance performance
 - b. Time spent strength training will take away from aerobic training
 - c. Limited knowledge to the benefits
 - d. All of the above are correct

2. True or False. Strength/Power training will always result in added mass
 - a. True
 - b. False

3. Norwegian researchers had endurance runners incorporate 4-RM squats into their strength program 3 times per week for 8 weeks and observed which changes?
 - a. No change in running economy; decreased maximal aerobic speed
 - b. Improved running economy; no change in maximal aerobic speed
 - c. Improved running economy; improved maximal aerobic speed
 - d. Decreased running economy; improved maximal aerobic speed

4. Hoff et al noted which changes in female cross-country skiers when a strength training program was initiated?
 - a. Anaerobic threshold increased
 - b. Time to exhaustion was significantly increased
 - c. Slower times due to added bulk
 - d. None of the above were observed

5. Mikkola et al controlled for the volume of training and had an experimental group participate in explosive training for 27% of the time, which led to which change?
 - a. Decreased V_{O_2max}
 - b. Decreased steady-state oxygen consumption
 - c. Improved sport-specific economy
 - d. Both b and c are correct

6. The Finnish studies mentioned in the article observed improvements in study participants throughout all measured parameters due mainly to the fact that _____.
 - a. The individuals were highly trained athletes
 - b. The individuals were NOT highly trained athletes
 - c. The programming was conducted once per week
 - d. The strength training was not programmed appropriately

7. An abundance of literature seems to support the claim that _____ is improved when supplemented with strength/power training.
- Movement economy
 - Endurance performance
 - Aerobic performance
 - All of the above are correct
8. Osteros et al observed a shift in the _____ curve when a strength/power program was supplemented in endurance athletes' training, which led to increased _____.
- Force-velocity; body composition
 - VO₂max; mechanical power output
 - Force-velocity; mechanical power output
 - VO₂max; body composition
9. Strength training for endurance athletes reduces the percentage of maximal power output at the same absolute workloads, thereby _____ metabolic distress and _____ perceived effort.
- Increasing; increasing
 - Decreasing; decreasing
 - Increasing; decreasing
 - Decreasing; increasing
10. Due to a reduced perceived effort that occurs in endurance athletes after they have participated in a strength program, _____ is encouraged, which can spare _____ for later use and may increase lactate threshold.
- Anaerobic metabolism; protein
 - Lipid-drive aerobic metabolism; glycogen
 - protein utilization; fat
 - sugar; fat

Quiz Answer Form

FIRST NAME _____ LAST NAME _____ M.I. _____

TITLE _____

ADDRESS _____ APT. _____

ADDRESS _____

CITY _____ STATE _____ ZIP _____

COUNTRY _____ POSTAL CODE _____

CERTIFICATION NO. _____ CERTIFICATION EXP. ____/____/____

MEMBERSHIP NO. _____ MEMBERSHIP EXP. ____/____/____

Quiz Name	Member Price	Total
	\$15	



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Amex



Check/Money Order

Account No. _____

Exp. Date _____

Security Code _____

Signature _____

Date _____

Quiz Answers

- | | |
|----------|-----------|
| 1. _____ | 6. _____ |
| 2. _____ | 7. _____ |
| 3. _____ | 8. _____ |
| 4. _____ | 9. _____ |
| 5. _____ | 10. _____ |

Fill in each blank with the correct choice on the answer sheet. To receive 0.5 CEUs, you must answer 8 of the 10 questions correctly.

Please mail this Quiz answer form along with the proper enclosed payment to:

NCSF
5915 Ponce de Leon Blvd., Suite 60
Coral Gables, FL 33146

Questions? 800-772-NCSF