Hockey 'Fitness' Testing

for adolescent players

The good.
The bad.
The irrelevant.

Six decades of irrelevant lab fitness tests

Hockey endurance is nothing like marathon endurance.

We haven't learned

HOCKEY ENDURANCE is the maintenance of skating speed, quickness, agility, along with stick skills, decision-making, strength, and gritty competitiveness – each shift and for an entire game.

Picture a fast shift in the Stanley Cup playoffs – the bursts to full speed, physical battles, stops, starts, turns, accelerations, decelerations, and coasting when it's smart.

Running or bicycling in marathon competitions also requires great endurance, but a different kind. It doesn't include physical battles or random sprints to 100% speed. So why should a hockey player's endurance be evaluated from a test for marathoners? Why monitor maximum volume of oxygen used per minute (Max Vo2) while running or biking?

The answer is simple: hockey fitness can NOT be evaluated this way,

but it has been for 60 years, and it still is (eg: NHL combine). In 1978, on the basis of bicycle tests it was stated in the Medical Tribune (Toronto) by a prominent physiologist, that Hockey is a 'physiological cakewalk.' So, extra fitness training on a bike was recommended. Five years later, Howard Green's team showed that if testing was done on-ice, there was no advantage to adding bike training after practice for the entire season (Daub 1983).

If teenagers do slow 'cardio' as a workout – biking or jogging – that's time and energy that could be invested in building speed and hockey-endurance instead of slow habits.

Of course, kids are encouraged to run or ride bikes for Fun and Mobility.

But training workouts need to be fast intervals.



Whether we call this a 'cardio-respiratory' test or leave the lower body out of the photo – it's the same mistake we've made for 60 years of testing hockey players: ignoring what the legs are doing …

… as if all that matters in a fitness test is what the heart and lungs contribute, and it doesn't matter whether he is skating, swimming, running, biking … or just sitting.

Of course, it matters. Metabolism in Gluteus Medius and Maximus, the large muscles of skating hip abduction, contributes a great deal to expired CO_2 and uptake of O_2 measured at the mouth piece.

Hockey Fitness Requires HIIT ***{High Intensity Interval Training}***

So, fitness testing must measure the effects of HIIT

There are no substitutes; Slow 'Cardio' doesn't prepare you for hockey endurance as HIIT does

How laboratory testing led to mis-characterization of hockey fitness

***Swimmers said**, we don't run or ride bikes for long distances, so if you test, please test what we do.*

***Hockey didn't say it, but assumed** the unique interval nature was known:*

- *High-Intensity Intervals, not slow, steady distances;*
- *frequent short sprints to full speed – like a 40-yard dash;*
- *accelerations, decelerations, changes of direction;*
- *stick skills and creative decisions;*
- *physical battles for the puck, heavy hits – and – by the way;*
- *games are played on skates, not stationary bikes or treadmills.*

Does it matter?
Adolescent players have been advised to train incorrectly for Hockey endurance for 60 years. It's called 'Cardio.'
High Intensity Intervals on-ice are required in testing, training.

Can mathematical manipulation of research data change it's meaning?

Beware! It is common to report research findings after the original data has been massaged or 'arithmetized' beyond recognition – altered by multiplying or dividing by body mass. This can drastically distort relationships (comparisons, correlations) and mislead athletes and coaches who use the information to plan training programs.

* ***Example 1:* Fast runners are fast skaters until bogus math distorts the facts.**

Suppose player A gets beat in short sprints when (s)he races player B, but A is much heavier – actually obese. When body mass is multiplied by average acceleration, it turns out that A generates more force (F=m•a). If told to train for force (or power) you might respond, "I'd rather train to win the race."

* ***Example 2:* Athletes should leave calculations out and just win the competition.**

Player A above doesn't jump as high as B, but if body mass is factored in player A exerts greater force and power – with a lower jump. It is jump height, not power, that is highly related to skating speed.

* ***Example 3:* $VO_{2\ max}$ *fails as a measure of endurance on professional teams.***

In fitness tests $V0_{2\ Max\ or\ peak}$ is most often expressed as a fraction (ml of O_2 per minute / body mass). Researchers might not include the units each time in their report., and we ignore the fact that the fraction is as much a reflection of body mass as oxygen consumption.

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* ***So, what does this mean? A large superstar basketball or hockey player moves faster and farther than anyone for an entire game, and has a huge absolute O_2 uptake. But lab tests under-estimate his stamina because of the large denominator.***

The range of body weights on a football, basketball, or hockey team is too great to compare individuals correctly using this criteria, or to compare aerobic fitness of Hockey, BB or FB players to marathoners. But it is done all the time.

3/4 is not 3

If a class of fourth graders is told to write the fraction 3/4, no one would write just the number '3' . Considering a similar fraction (squat strength / body mass) it is common – and 100% wrong – for researchers to simply report 'squat strength,' and not mention the denominator body mass.

Several articles have claimed to find a relationship between maximum squat strength and skating speed. One group tested elite teenage hockey players, and ignored the denominator in the title and abstract. The fraction (squat strength / body mass) was related to skating speed, not squat strength by itself. This is just plain wrong. Whoever reads this title and ignores the faulty math throughout the article, is led to believe that squat strength is related to skating speed.

Other researchers and strength coaches might assume the title is factual, and recommend maximum squats as a plan to skate faster. Similar neglect has misled athletes for decades.

In fifty years, our research found that squat strength is NOT related to skating speed. Body mass is ! Generally, larger players are slower especially in short sprints with changes of direction. There are many exceptions, of course: some large players are quick (Tom Wilson for example). But on average, the bigger, taller players are not as quick. ***So the denominator of the fraction is the reason the fraction is inversely related to skating speed. Squat strength is not.***

Squats can be a valuable lift. of course.

Squat strength and stability are valuable for contact in a game. But there is little reason, and no evidence to believe they build speed. Why? (1) The range of motion does not include the large muscles that abduct the leg at the hip. ·2) Holding the bar prevents arms from multiplying lower body force naturally. (3) Like all lifts, squats are slow, and there's deceleration in the last half of the motion; acceleration is required.

One solution? Supersets alternating one- or two-leg jumps with squats.



But there is also good news from the lab

College Pre-season Dryland Training Study

Six weeks of HIIT {*High-Intensity Interval Training*} improves on-ice and off-ice explosiveness, plus lab and skating measures of endurance

High intensity, short sprints, jumps, and hills were timed to ensure quality training for speed, meaning the work:rest ratio allowed significant recovery.

After six weeks of dryland training, the post-tests showed improvement in sprint speed, vertical jump, and skating top speed, and acceleration – the goals for six weeks prior to official skating practices.

What was not expected were the significant improvements in laboratory measures of:

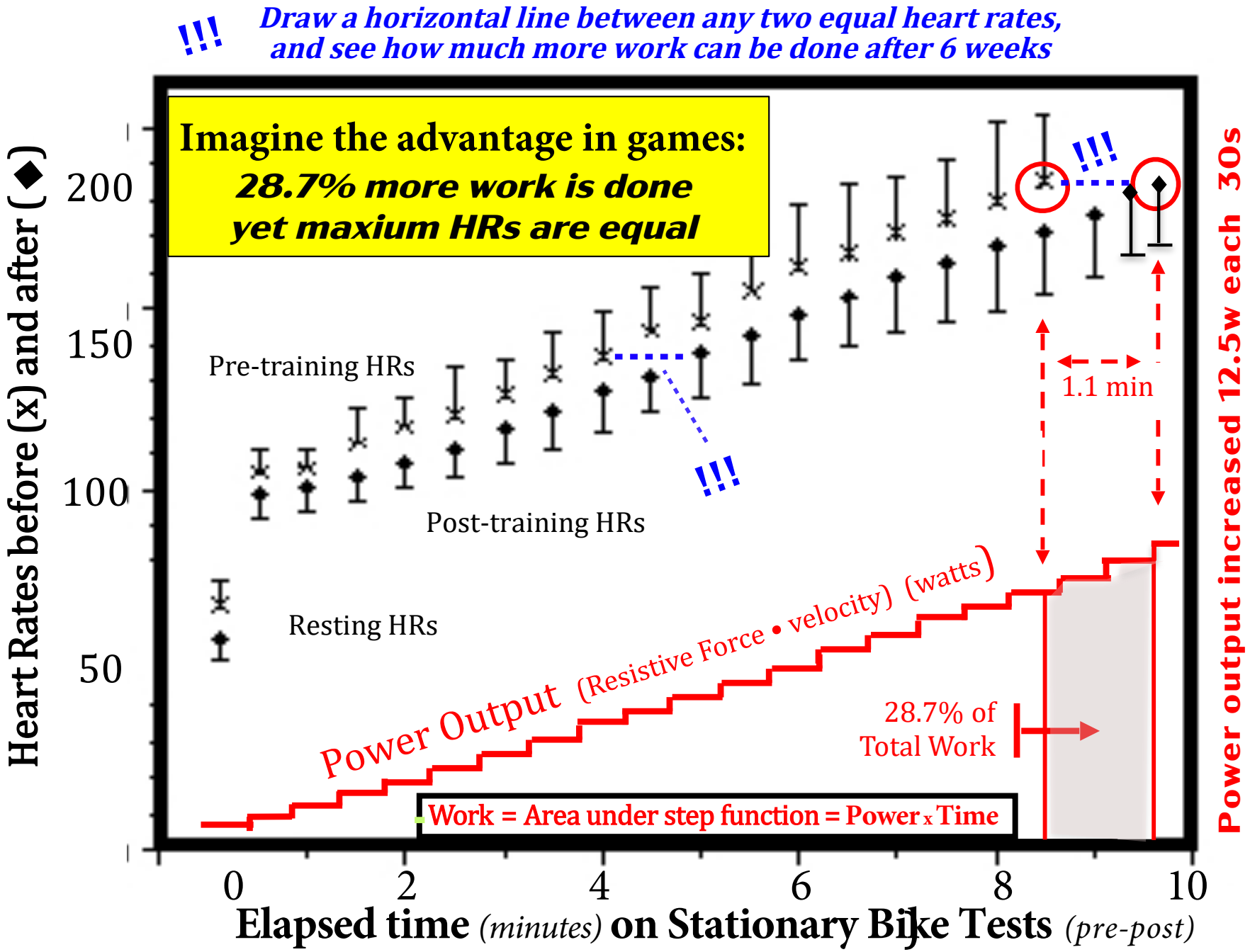
Cardiovascular efficiency, and
Total work capacity (aerobic plus anaerobic metabolism).

This is a remarkable result, given that endurance was never a priority in this training.

It is why two gold medal Olympic teams (1980 men, 2018 women) trained exclusively with HIIT. Slow 'Cardio' was not part of the plan.

Of all the improvements measured during the Graded Exercise Test, the most important for hockey is: TOTAL WORK DONE increased by 28.7% while Maximum HRs were identical in the Pre-Post testing. This is cardiovascular efficiency, even if measured on stationary bikes.

Six-week college pre-season HIIT dryland training



Physiological Efficiency is evident in the preceding graph.

Players did 28.7% more work before HR reached max; imagine this advantage in games

Of course the amount of energy needed to achieve a given work load remains the same. Therefore, a lower HR at each workload after training represents improved <u>efficiency</u> in two parameters:

(1) <u>Cardiovascular</u>: a stronger, more efficient heart muscle pump and increased vascular density;

(2) <u>Metabolic</u>: more efficient utilization of O_2 by the muscles, including the 'Lactate shuttle' where lactate is burned aerobically as a fuel.

so ...

In six weeks of HIIT training that improved skating, running, jumping power, the training also increased Hockey endurance.

Total work with lower HR's is a huge competitive advantage in games!

These findings are consistent with HIIT research before and since this study (reviewed by F.Torma, 2019)

Of course, testing on a bike is vastly different than skating. However, <u>endurance, timed electronically on the ice improved by 5.3%</u>

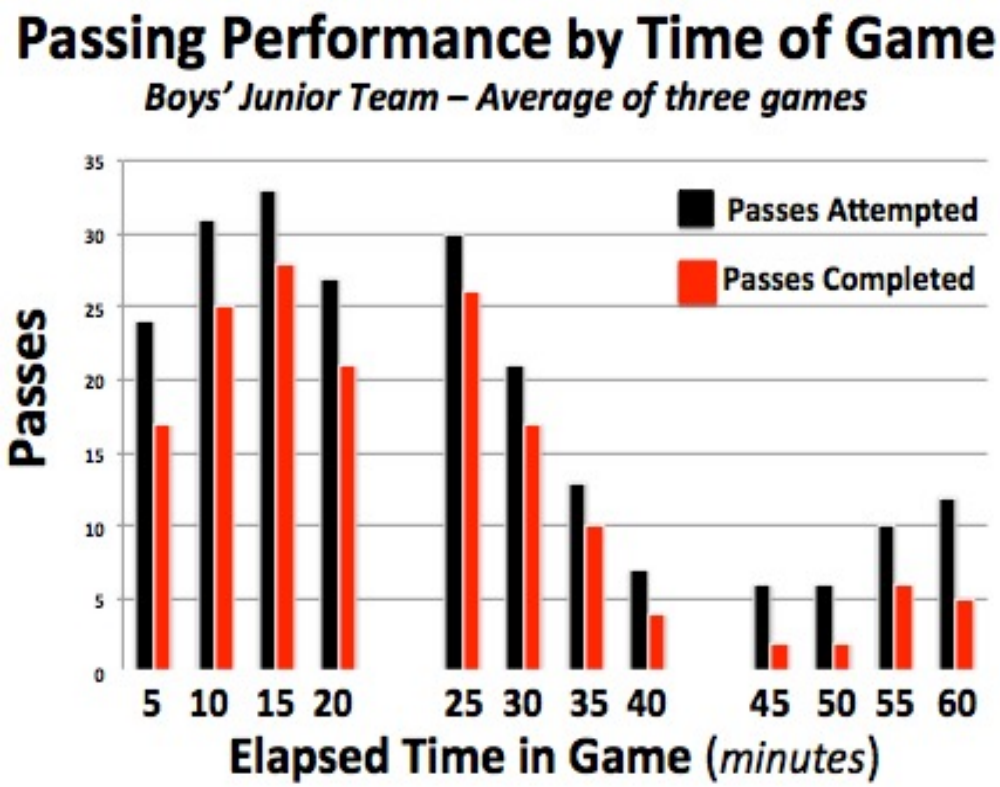
A practical test

Is the erosion of skills an endurance failure?

Brett Strot, a former college and professional player, was Associate Coach with Robb Stauber on the USA Gold Medalist women's team, 2018. He was asked to do an analysis of a boys' junior team that was losing games too often in the third period. Among several factors he studied was passing proficiency. His thoughts about endurance are similar to all hockey coaches.

Near the end of a game, coaches want skills, decisions, competitive toughness, speed, strength, and agility to be just as good as at the beginning.

There can be many explanations, of course. Perhaps the team had a lead, and coaches told players to avoid passes, to "chip it out; dump it in; keep it simple." That's common 'wisdom' at every level … spelled d-u-m-b



This might be a physiological weakness, but the solution is NOT hours of bikes or skating the lines.

The solution is obvious:

"They need fast practices with thousands of passes."

Herb Brooks said that as we drove home from an overly-defensive college game – listening to the college coach explain a loss with the standard garbage about system breakdowns, defensive lapses, turnovers.

Brooks continued "Yes, defense wins games but not when you have the damn puck!"