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*Original Research*

# Rollers Versus Trainers: 10-Km Time Trial

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ABSTRACT

***International Journal of Exercise Science 10(1): 497-505, 2017.*** The primary aim of this investigation was to determine which cycling training device, Rollers or Trainers, was most effective in improving 10-km time trial. Eight male and 6 female volunteers (N = 14; age = 23.6 ± 4.6 yrs; height = 172.7 ± 9.9 cm; body mass = 68.4 ± 10.4 kg; % body fat = 16.9 ± 7.7; $VO_{2max}$ = 61.0 ± 9.4 $ml \cdot kg^{-1} \cdot min^{-1}$) provided informed consent prior to participation. Participants performed a10-km time trial at baseline and were then randomly assigned into one of three groups: Rollers (R), Trainers (T), or Control (C). Participants assigned to the R or T groups attended 24 supervised workout sessions throughout an 8-wk period (F: 3 days/week; I: 65-80% $HR_{max}$; D: 40 min; M: R or T). There were no significant differences in baseline 10-km time trial between R, T, and C groups [$F(2,12) = 0.34$, $p = .72$]. There was a significant difference in 10-km time trial improvement between groups post-assessment when controlling for baseline values ($F = 17.04$, $p < .001$). R participants improved by 20.4s [$t(4) = 4.86$, $p = .008$] and T participants improved by 12.8s [$t(4) = 4.57$, $p = .01$], while there was no significant improvement for subjects in C. Participants using R and T displayed significant decrements in time with respect to the 10-km time trial. However, R had a greater improvement in 10-km time trial when compared to T.

KEY WORDS: Cycling, performance, training, indoor equipment

## INTRODUCTION

The world of recreational cycling provides a myriad of physiological and psychological benefits to those who participate within this endeavor (4, 9). Due to its variability in styles, from road cycling to mountain biking, the options for a daily dose of exercise on the bicycle are endless and allows individuals of all ages and interests to become involved. In the realm of competitive cycling, however, genetic endowment, nutrition, and training are all critical aspects of improving cycling performance. A large volume of training and the precision of an exercise prescription are requisites in order to ascend and attain the sub-elite and elite levels of the sport. In an effort to maintain said high-level status, many cyclists train throughout the entire year, even during the off-season.

In order to continue training during the off-season, when cycling outdoors is extremely limited via inclement weather-related conditions; intuitively, competitive cyclists will turn to alternative options such as indoor training. For instance, cyclists can join a commercial gym and participate in the indoor cycling classes or purchase home-based indoor equipment such as a stationary cycle ergometer or Trainer or Rollers. While the first two options (i.e., indoor cycling classes and purchasing stationary cycle ergometer) will allow the cyclists to get some form of cycling in during the offseason, the only caveat, however, is that cyclists are not utilizing own personal racing bike during these classes and workouts. For this reason, most competitive cyclists purchase either indoor Rollers and/or Trainers. Briefly, Trainers is a device in which the cyclist fastens the back wheel of the bicycle onto the device itself. Because the back wheel is fastened to a set object, it is a secure and stable method for cyclists to train and ride a bicycle indoors. Due to the stability of Trainers, balance and coordination are eliminated from being a necessity when riding on Trainers. Rollers, on the other hand, is a more dynamic way to cycle indoors due to the fact that the bicycle is not fastened or secured to the device. The cyclists simply places the bicycle onto the Rollers and begins cycling. Balance and coordination, therefore, are paramount to ensure that the cyclist maintain momentum and stay upright when cycling on Rollers. To date, there have been very few scientific studies examining the pros, cons, and benefits received when using indoor cycling equipment (4, 2, 10).

There is a relative paucity of scientific studies investigating the multitude of indoor cycling devices, specifically, Rollers and Trainers. As such, the recreational consumer will typically turn towards the internet, social media, and/or discuss the options with the store worker at the local cycling shop to select the best equipment to meet the recreational cyclist's goal(s). Conversely, the competitive cyclists will turn towards websites known specifically within the domain of elite cycling to obtain as much information as possible prior to purchasing a system that will help achieve the off-season goal(s). Despite the volume of information gained via internet, social media, and/or word-of-mouth, it is all anecdotal. With that said, scientific research examining the various types of indoor cycling equipment would be extremely beneficial to the recreational and competitive cyclists so that these consumers may be duly informed prior to making a purhase.

Therefore, the objective of this investigation was to determine which indoor cycling training device, Rollers or Trainers, is most effective in improving a 10-km time trial. Findings gleaned from this study will simply provide knowledge and information to enlighten and educate the consumer.

## METHODS

*Participants*

Recreational and competitive cyclists were recruited from the University and the surrounding community. Prior to volunteering in the research study, each participant completed the American Heart Association/American College of Sports Medicine Pre-Screening Questionnaire. If prospective participant(s) answered 'yes' to any one of the questions within the pre-screening health history questionnaire, participant(s) were then required to obtain a signed permission form from the participant's primary-care physician to participate in this study. Participants within the current study were deemed apparently healthy. In addition to the pre-screening questionnaire, participants read the informed consent form for the study. After reading the informed consent form, if participants did not have any questions or further question(s) regarding the study, then the participants signed the informed consent form approved by the University's Institutional Review Board for human participant use.

Voluntary participation was sought from 16 participants (9 males and 7 females). One male participant dropped out of the study for unknown reasons, whereas, one female dropped out due to a pre-existing knee injury. A total of 14 participants (8 males and 6 females) completed the study.

*Protocol*
Participants were asked to complete 5 Sessions. Three hours prior to each session, participants were asked to refrain from any type of caffeinated food/beverages that may influence exercise performance. Additionally, researchers asked participants to abstain from vigorous physical activity/exercise the night before each Session. Below highlights the details of each Session required for each participant.

Session 1: Pre-Assessment of $VO_{2max}$ and DXA Analyses - Participants arrived at the University of North Carolina Wilmington's (UNCW) Human Performance Lab (HPL) during the appointed day and time. In this session, participant's height, body mass, $VO_{2max}$, and body composition were measured. Upon entering the HPL, participants were asked to void, change into proper cycling attire, and remove all metal objects (i.e., jewelry, rings, bracelets, etc…) from the body. Participants were asked to remove shoes and socks and stand against a wall with both heels together with calves, buttocks, upper back, and back of head pressed up against a wall to allow a technician to measure height to the nearest 0.635 centimeter (cm). After height was assessed, participants stood on a Tanita BWB-800 Electronic Scale (Japan) that quantified participant's body mass to the nearest 0.045 kilogram (kg). After height and body mass were measured twice, body composition was quantified via General Electric Dual Energy X-ray Absorptiometry (DXA) Lunar Prodigy Advance (USA). More specifically, participants were asked to lie down, face-up, on the blue mat, with arms/hands resting comfortably by the side, both legs/feet relatively close together. Once positioned on the DXA, a technician performed a DXA scan and obtained body composition measurement. The DXA was calibrated on a daily basis prior to data collection. Calibration procedures were set forth by the manufacturer guidelines and adhered to prior to data collection. Once the DXA analysis was completed, participants warmed up on a Monark Ergomedic 874 E (Sweden) prior to the maximal graded exercise test to quantify $VO_{2max}$. During the cycling protocol to maximal effort, participants breathed into a one-way valve mouthpiece. The mouthpiece was connected to a series of tubes feeding into the Parvo Medics TrueOne 2400 Metabolic Measurement

System (USA), which analyzed the volume of oxygen and carbon dioxide content of the participant's breath. The cycling protocol to maximal effort required participants to pedal at a constant 85 revolutions per minute (rpm). This cadence was selected based on previous studies revealing that an average of about 85 rpm is the preferred cadence for well-trained cyclists (5, 6, 11). After each 2-min stage, a technician incrementally increased the resistance by .25 kg until volitional exhaustion occurred or until participants could no longer maintain the required 85 rpm after two verbal warnings to increase the rpm. Heart rate and $VO_2$ data were collected and recorded during the final 15-seconds of each 2-min stage.

Session 2: Pre-Assessment of 10-km Time Trial - Prior to the onset of the 10-km time trial (TT), several technicians drove and critically scanned the 10-km loop to clear rocks and/or ancillary debris deemed potentially unsafe. After the roads within the 10-km TT were cleared, technicians recorded the ambient temperature and humidity by way of Vaisala HM34 Humidity Temperature Meter (Sweden) before and after the 10-km TT. Additionally, wind speed was also assessed before and after the 10-km time trial via Compact Wind Gauge Kit E39815 (USA).

Upon arrival at the 10-km TT location, cyclists brought and used personally-owned road bike of choice and were given time to warm up at own discretion. Once participants were warmed up, participants rode to the starting point of the 10-km TT. Once participants arrived at the starting point, the cyclists rode individually and had a 5-min staggered start from one another. Participants were instructed to provide maximal effort in completing the 10-km TT as quickly as possible. A stop watch was used and time was measured to the nearest 1/100 of a second. After completing the pre-10-km TT, participants were randomly assigned to one of three groups: 1) Rollers (R) or 2) Trainers (T) or 3) Control (C).

Sessions 3: 8-Week Exercise Sessions via Rollers or Trainers - In this Session, participants in groups R (n = 5) and T (n = 5) arrived with at UNCW's Hanover Gymnasium to train. Participants were required to bring the same personally-owned road bike and train Monday, Wednesday, and Friday from 06:00 to 07:00 for the next 8 weeks. Researchers encouraged the C group (n = 4) to train normally throughout the 8 weeks as if each participant was not involved with the research study. Percentage of heart rate (HR) zones were calculated based on the maximal HR attained during the participant's $VO_{2max}$ test (Session 1). After a 10-min warm-up, participants began the 40-min workout session, which was partitioned into eight 5-min intervals. As displayed in Table 1, for example, within Week 1, cyclists rode at light intensity for 4.5 min, and then during the last 30s of the 5-min interval, cyclists rode at vigorous intensity. This 5-min interval was repeated 8 times for 40-min. As the weeks ensued to Week 8, the cyclists rode for less time at light intensities and more time at vigorous intensities.

Participants adorned a HR monitor to visually determine and modulate, if necessary, the level of intensity to mirror the prescribed HR intensity. More precisely, participants were able to visually fine-tune the level of effort given the respective calculated target $HR_{max}$ during the vigorous (80%) and light (65%) interval sets. Moreover, the technicians present during each workout would monitor the participants HR during these exercise sessions to politely remind participants to obtain the prescribed HR during the vigorous and light exercise session. After the 40-min workout session was completed, participants were instructed to cool down until HR decreased <55% $HR_{max}$. Adherence rate throughout the 8-week program was 71.6%.

**Table 1.** 8-week exercise sessions.

| Week | Vigorous Intensity/Duration | Light Intensity/Duration |
|---|---|---|
| 1 | 80% $HR_{max}$/0.5 min | 65% $HR_{max}$/4.5 min |
| 2 | 80% $HR_{max}$/1.0 min | 65% $HR_{max}$/4.0 min |
| 3 | 80% $HR_{max}$/1.5 min | 65% $HR_{max}$/3.5 min |
| 4 | 80% $HR_{max}$/2.0 min | 65% $HR_{max}$/3.0 min |
| 5 | 80% $HR_{max}$/2.5 min | 65% $HR_{max}$/2.5 min |
| 6 | 80% $HR_{max}$/3.0 min | 65% $HR_{max}$/2.0 min |
| 7 | 80% $HR_{max}$/3.5 min | 65% $HR_{max}$/1.5 min |
| 8 | 80% $HR_{max}$/4.0 min | 65% $HR_{max}$/1.0 min |

Session 4: Post-Assessment of $VO_{2max}$ and DXA Analyses - In this Session, participants and technicians replicated Session 1.

Session 5: Post-Assessment of 10-km Time Trial - In this Session, participants and technicians replicated Session 2.

*Statistical Analysis*

Mean and standard deviations for baseline and post-assessment values were computed. Statistical analyses were conducted to determine if differences were present at baseline and from baseline to follow-up within the Trainers, Rollers, and Control groups and also between the groups in the 10-km time trial. All of the analyses were conducted using IBM SPSS Statistics 20. Analysis of variance (ANOVA) was used to determine if there were significant differences between the groups at baseline. A paired t-test was run to determine if there were mean differences from pre to post intervention for each group. Analysis of covariance (ANCOVA) was used to determine if significant differences existed post intervention when controlling for baseline results. If necessary Bonferroni post-hoc test was used to determine where groups mean differences lie. In addition, partial eta square and Cohen's d effect sizes were calculated. Statistical significance was established at $p \leq 0.05$.

## RESULTS

Table 2 reveals the descriptive measures of the 14 study participants.

**Table 2.** Descriptive measurements of the study participants (*N* = 14).

| Variables | Mean± SD |
|---|---|
| Age (yrs) | 23.6±4.6 |
| Height (cm) | 172.7±9.9 |
| Body Mass (kg) | 68.4±10.4 |
| Body Fat (%) | 16.9±7.7 |
| $VO_{2max}$ ($ml \cdot kg^{-1} \cdot min^{-1}$) | 61.0±9.4 |

Tables 3, 4, and 5 reveal the statistical analyses amongst the Rollers, Trainers, and Control groups.

**Table 3.** Pre- and post- intervention data for Rollers group (N = 5).

| Variables | Pre-Intervention (M±SD) | Post-Intervention (M±SD) |
|---|---|---|
| Body Mass (kg) | 67.6±9.4 | 68.3±10 |
| Body Fat (%) | 15.0±7.0 | 15.5±6.8 |
| $VO_{2max}$ ($ml \cdot kg^{-1} \cdot min^{-1}$) | 61.5±6.9 | 59.5±4.0 |
| 10-km TT (s) | 1011.0±126.3 | 990.6±113.4[a] |

[a] $p \leq 0.05$

**Table 4.** Pre- and post- intervention data for Trainers group (N = 5).

| Variables | Pre-Intervention (M±SD) | Post-Intervention (M±SD) |
|---|---|---|
| Body Mass (kg) | 65.6±11.3 | 64.8±12.4 |
| Body Fat (%) | 15.4±5.4 | 13.3±4.8 |
| $VO_{2max}$ ($ml \cdot kg^{-1} \cdot min^{-1}$) | 59.1±10.8 | 63.8±11.5 |
| 10-km TT (s) | 1021.4±133.2 | 1008.6±125.9[a] |

[a] $p \leq 0.05$

**Table 5.** Pre- and post- intervention data for Control group (N = 4).

| Variables | Pre-Intervention (M±SD) | Post-Intervention (M±SD) |
|---|---|---|
| Body Mass (kg) | 72.8±11.7 | 71.6±12.1 |
| Body Fat (%) | 21.1±10.9 | 20.8±11.5 |
| $VO_{2max}$ ($ml \cdot kg^{-1} \cdot min^{-1}$) | 62.8±12.5 | 59.8±13.3 |
| 10-km TT (s) | 1008.5±189.2 | 1010.0±192.7 |

In regards to the pre-intervention 10-km TT time, ANOVA revealed no significant differences in baseline data between Roller, Trainer, and Control group [$F(2,12)=0.34$, $p = 0.72$]. Results from the ANCOVA, however, revealed a significant difference in post- intervention 10-km TT time between groups when controlling for baseline values ($F=17.04$, $p < 0.001$, $\eta_p^2 = 0.76$). Bonferroni post-hoc test identified significant mean differences at between Roller vs Trainer, and Roller vs Control, with the Roller group having faster average times for the 10-Km TT. In addition, there were mean differences between pre- and post-intervention for both Roller [$t(4)=4.86$, $p = 0.008$, Cohens' $d = 0.67$] and Trainer [$t(4)=4.57$, $p = 0.01$, Cohens' $d = 0.1$] groups. There was no mean difference in the 10-km TT for the Control group ($p>0.05$, Cohen's $d = 0.01$).

## DISCUSSION

The current study was unique in such a way whereby current researchers sought to answer an applied question, "*Which training device is more effective in improving 10-km time trial performance – Rollers or Trainers?*" Based on the statistical analyses, participants in both the Roller and Trainer group performed had significant improvements and the Roller group had significantly better average times compared to both the Trainer and the Control groups.

Due to the practicality of the current study, it was difficult to seek similarities and contrasts from other studies within the cycling literature. Of interest, however, it was noted by Arkesteijn and colleagues (1) that there were no significant mean differences in training efficiency and pedaling kinematics between cycling on the treadmill compared to cycling on Trainers, however, these researchers did note that there were significant differences in muscle fiber recruitment between the two modalities. As supported by a study conducted by Blake and Wakeling (3), these researchers noted that muscular coordination pattern and cadence does differ depending upon environment, terrain, and modality of training. Within the current study, it too was prominent that there were marked differences between modality of training, specifically, Rollers versus Trainers. More precisely, the cyclists that have never used the Rollers had a steep and rapid learning curve. These participant's perception was that Rollers evoked greater muscle recruitment within the core, in an effort to maintain balance on the Rollers (8). As such, these cyclists were required to not only focus upon recruiting muscle fibers within the legs, but also center the participant's attention on recruiting muscle fibers within the core as well. Those on the Trainers, however, had no problems in regards to balance, thereby allowing these cyclists to simply focus upon the leg muscles rather than leg plus core muscles.

With that said, however, perhaps this may help to explain why Rollers exhibited superior performance benefits compared to Trainers. For example, it could be speculated that throughout the 8-weeks of training, individuals cycling on the Rollers were anecdotally able to recruit greater muscles mass within the core, thereby allowing these participants to maintain a straighter, more linear path throughout the 10-km TT and to withstand the environmental conditions, notably, head and crosswind. Statistically, data analyses revealed that both Trainers and Rollers improved 10-km TT by 12s and 20s, respectively.

In an effort to explain the time differential between the Rollers and Trainers, recently, Mieras and associates (7) concluded that cyclists training indoors and/or lab settings should work at a higher perceived exertion, hence, intensity to acquire similar benefits similar to that of training outdoors to ultimately transcend the participant's efforts into the field, namely, performance. Interestingly enough, within the current study, both groups, Rollers and Trainers, worked at the same relative intensity (i.e., % $HR_{max}$) throughout the 8 weeks, yet still displayed marked differences in 10-km TT performance improvements. This then begs a follow-up question, "*Do Rollers mimic outdoor cycling to a greater extent compared to Trainers*?" There is a great need to further clarify the differences between Rollers and Trainers in regards to differences in performance.

Based on the findings from Olsen (10), however, the answer to the aforementioned question is '*no*'. More precisely, Olsen (10) conducted a study that investigated the comparison of peak power on four different modes of cycling. The four varying modes were cycling on the 1) Road, 2) Rollers, 3) Trainers, and 4) Stationary Ergometer. Olsen (10) revealed that the mode of cycling that achieved the closest mean peak power to that of the road were the Trainers. When cycling on the Trainers, participants evoked 24.6% more power than cycling on the

Rollers. In contrast to the current study, while the power output was not assessed during the 10-km TT, and despite the conclusion from Olsen's (10) study, Rollers still had a greater mean declination of time compared to Trainers. Oslen's (10) findings, however, may explain why Trainers exhibited greater increases in $VO_{2max}$ compared to Rollers. More specifically, Trainers mean increase in $VO_{2max}$ was 4.7 ml·kg$^{-1}$·min$^{-1}$, whereas, Rollers displayed a mean decrease of 2.0 ml·kg$^{-1}$·min$^{-1}$. A potential explanation for this marked fitness-related difference may be that Trainers were able to not only recruit the proper muscle fibers within the participant's legs (3), but also generate a greater power output (10) compared to Rollers.

A limitation to this study was the seasonal influence during which the participants performed the 10-km TT. More precisely, the pre-10-km TT was performed during the latter part of the spring season, then, 8-weeks later; the post-10-km TT was performed mid portion of the summer. Being in the Southeast region of the United States, not surprisingly, the ambient temperature, wind, humidity, and ultimately, heat index during the post-10-km TT was much higher in all respects compared to the pre-10-km TT. To be more precise, during the pre-10-km TT, the early morning ambient temperature was 19.4˚C, humidity was 56.1%, and wind speed ranged from 0 m·s$^{-1}$ to 0.3 m·s$^{-1}$. In contrast, during the post-10-km TT, the early morning ambient temperature was 28.3˚C, humidity was 66.4%, and wind speed ranged from 0 m·s$^{-1}$ to 1.8 m·s$^{-1}$. Remarkably, however, the groups that used both Rollers and Trainers had significantly improved the post-10-km TT time despite the relatively hotter, humid, and windier environmental conditions.

In regards to the pre- and post-10-km TT, the precipitating mindset of the researchers was to transcend the data into practical and real-world living, hence the reason why the researchers chose to perform the 10-km TT outdoors knowingly and having a disregard of the pre- and post- environmental conditions. In regards to future endeavor(s), while having an indoor environmentally-controlled velodrome to assess pre- and post-10-km performance would be preferred, again, it may not be feasible and practical. If not an indoor facility, perhaps future researchers could identify an outdoor 10-km straight away to assess pre- and post-10-km performance, such as a stretch of highway that, for safety purposes, is relatively unused.

With respect to future research, an investigation examining the electromyography (EMG) on participants muscle groups while using both indoor training devices would be incredibly beneficial in exploring this topic more deeply. Placing EMG sensors on several different muscle groups of the participants, including the abdominals, back, and leg muscles, would allow researchers to determine when certain muscle fibers are being recruited on varying modes of indoor training devices. This could provide researchers and practitioners with greater insight as to where the muscular benefits are coming from training on either Rollers or Trainers.

Viewed in concert, the primary aim of this study was to determine the efficacy between two indoor cycling training devices on performance. Statistical analyses revealed that cyclists exercising on the Rollers and Trainers had significant decrements in time with respect to the 10-km TT compared to the Control group. From an applied perspective, findings from this study add to the relative dearth of information in regards to comparing the multitude of indoor cycling devices, specifically, Rollers and Trainers.

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