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Effectiveness of Using Exercise App in Improving Exercise Adherence and Aerobic Endurance of Football Players

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Abstract

Introduction. The use of mobile apps known as mHealth is starting to shape the delivery of physical therapy care not only in patients but also to the healthy population. Using an exercise app is a potential strategy to promote physical activity among individuals. Thus, this pilot study examined the utility of the Nike® Training Club app in increasing exercise adherence and enhancing aerobic endurance.

Methods. The study utilized one-way repeated measures over time quasi-experimental design. It used purposive sampling to select 10 college football players aged 18-25 years old. After downloading the app, the participants were required to perform a workout plan composed of 15–45 minutes workouts through circuit interval training. The 20-day workout plan was done for 6 weeks (3-4 workouts per week). Aerobic endurance was measured at baseline and every after 2 weeks of intervention using Cooper's 12-minute run test.

Results. An extremely high adherence rate (85%, SD = 2.11) to exercise was exhibited by the participants based on recorded logs in the app. Also, the participants agreed that the app was easy to use ($\bar{x}$ = 3.9, SD = .18) due to its user-friendly interface, uncomplicated design, and comprehensive features. Results also showed an improvement in their aerobic endurance at the end of the 6-week training with a change of 3.8 ml/kg/min, however, ANOVA showed no statistically significant difference in VO_2 max from baseline to post-tests [F (3, 10) = 2.18, p = .11].

Discussion. A high adherence to exercise may be achieved when exercise is facilitated using the app. The app has potential to provide information that could lead to improvements in aerobic endurance and can be a useful tool in maintaining an active lifestyle among the well population.

***Keywords*:** aerobic endurance, exercise adherence, football, mHealth, Nike® Training Club

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Introduction

The technological advances of the fourth industrial revolution are starting to shape the delivery of physical therapy care not only in patients but also to the healthy population or clients. The use of mobile apps in health and medicine known as mHealth is one of the breakthroughs of this era. With the growing smartphone industry, mHealth apps are increasingly becoming more popular (Rainie & Fox, 2012, as cited by Voth et al., 2016) making it a potential strategy to increase exercise adherence not only in patients but for the healthy population as well. mHealth has promising results in improving outcomes in the various aspects of health. However, further studies are still necessary to assess the risks and harms that comes with usage (Dicianno et al., 2015).

Various authors have studied the effectiveness of mHealth apps in increasing physical activity (Glynn et al., 2014; Padmasekera, 2014). However, there is limited literature on its effectiveness for aerobic endurance and its application in the healthy population particularly in sports. Aerobic endurance (VO_2 max) is an important determinant in any physical sports particularly in football (Ranković et al., 2010). The absence of engagement in physical activities after the end of competitive season puts them in a state of deconditioning, thus, maintaining adherence to exercise is important. Depending on the features available, mHealth exercise apps have a potential in addressing barriers to exercise adherence (Litman et al., 2015).

One of the most popular exercise training apps in the market is Nike® Training Club by Nike® Inc. This app is designed to encourage and enhance physical activity by motivating and guiding individuals through a variety of activities. It offers more than 150 custom-built workouts with instructional video demonstration of each exercise and audio support with a virtual trainer (pre-recorded voice) telling the trainee how to perform a particular exercise. It offers other functionalities such as the ability to set music, share on social media, set specific goals, automatically track progress, and earn rewards. The app offers different medals when the user reaches certain milestones and has voice encouragements. It is free of charge indefinitely after download in both Android and iOS platforms and has full and efficient functionality after downloading the selected video workouts through the app, which can then be used without ongoing data connection (Adamakis, 2017).

Padmasekera in 2014 conducted a pilot study on fitness apps as valid alternative to the gym. Three apps were found to fulfill the inclusion and exclusion criteria of the study: Nike® Training Club, Instant Fitness, and Gorilla Workout Free. Exercise was then performed as per each app's guidance and caloric expenditure was measured using a validated device. This caloric expenditure was then compared with the control exercises, which included slow speed jogging, WiiFit Plus exercises, and RPM indoor gym cycling program. Nike® Training Club was most effective of the three apps in terms of caloric expenditure with a mean of 5.32 calories per minute. Nike® Training Club and Fitness apps were as effective as RPM and Wii Fit Plus groups. The author found that the Nike® Training Club app was superior in engaging the user in physical activity (Padmasekera, 2014).

Although there is substantial number of available exercise apps freely available for download, their effectiveness is still in question. Thus, this pilot study examined the potential utility of the Nike® Training Club app in the Philippine setting in terms of increasing exercise adherence and enhancing aerobic endurance.

Methods

Ethical Considerations

Ethical approval was granted by the Mariano Marcos State University (MMSU) Research Ethics Review Board and all participants provided written informed consent.

Research Design

The study utilized one-way repeated measures over time quasi-experimental research design. It is quasi-experimental in nature since there was no randomization of participants and there was no control group due to small number of male football varsity players who willingly agreed to participate in the study.

Research Design

Purposive sampling was used in this study. Inclusion criteria in the selection of participants were as follows: (1) football players aged 18-25 years old and enrolled in MMSU during Academic Year 2018-2019; represented their respective colleges in university games; (2) physically prepared based on Modified Physical Activity Readiness Questionnaire (mPAR-Q); and (3) own a smartphone with App Store (for iOS users) or Play Store (for AndroidOS users). Potential participants were excluded if they have sustained recent musculoskeletal injury in the past six weeks, have undergone surgical operation in the past six months or answered "yes" in any of the questions in the mPAR-Q. Thus, there were only 10 football players who complied with the inclusion and exclusion criteria and volunteered to participate.

The Physical Activity Readiness Questionnaire (PAR-Q) is a screening tool completed by persons who plan to undergo a fitness assessment or to become more physically active; for example, when initiating physical activity (PA) participation that is beyond a person's habitual daily activity level or when beginning a structured PA–exercise program. Screening is also recommended when a person is joining a health club, commencing a training program with a fitness professional, or joining a sports team. If a person provides a positive response to any question on the PAR-Q, they are directed to consult their physician for clearance to engage in unrestricted or restricted PA (Goodman et al., 2011).

Nike® Training Club Workout Plan

The participants downloaded the Nike® Training Club app in their mobile phones and entered correct values for age, gender, weight, and height in the app. The participants were required to perform the same workout plan, composed of 15 to 45 minutes workouts in the form of circuit interval training, which ranges from moderate to high intensity. The workouts were repetition-based or time-based. All the participants performed the 20-day workout plan for a duration of 6 weeks (3-4 times per week). It was arranged from short duration to long duration workouts following the overload principle (Table 1).

Table 1. Workouts included in the Workout Plan

Day	Workout	Description
1	Activation station	A 15-minute intermediate level moderate intensity workout good for increase metabolism, and legs and lower body endurance and overall fitness.
2	Ascend and descend	A 15-minute intermediate level high intensity workout good for cardiovascular fitness, core, lower body strength and total body endurance.
3	Metabolic kick hit	A 17-minute intermediate level moderate intensity workout good for conditioning, overall fitness, power development and speed.
4	Engine fire	A 15-minute intermediate level moderate intensity workout good for legs, lower body power, lower body strength and muscular endurance.
5	The baseline push	A 15-minute intermediate level high intensity workout good for agility, conditioning, lower body endurance and quickness.
6	The leg up	A 15-minute advanced level high intensity workout good for agility, building endurance, power development and sport performance.
7	Metabolic kick hit	A 17-minute intermediate level moderate intensity workout good for conditioning, overall fitness, power development and speed.
8	The take-off	A 15-minute intermediate level high intensity workout good for building endurance, cross training, leg strength and quick burn.
9	Hit challenge	A 20-minute intermediate level high intensity workout good for calorie burn, conditioning, full body endurance, functional strength and overall fitness.
10	The fast forward	A 21-minute intermediate level moderate intensity workout good for agility, athleticism, core conditioning and total body endurance.
11	The circuit breaker	A 29-minute intermediate level moderate intensity workout good for core stability, running strength, total body endurance and upper body strength.
12	Burpees, bounds and bridges	A 30-minute advanced level high intensity workout good for core stability, lower body endurance, mobility and muscular endurance.
13	Metabolic kick hit	A 17-minute intermediate level moderate intensity workout good for conditioning, overall fitness, power development and speed.
14	Leg apocalypse now	A 30-minute intermediate level high intensity workout good for cross training, lower body endurance and stamina.
15	The power start	A 30-minute intermediate level moderate intensity workout good for conditioning, full body endurance, functional strength and sport performance.
16	Metabolic kick hit	A 17-minute intermediate level moderate intensity workout good for conditioning, overall fitness, power development and speed.
17	Burpees beach	A 31-minute intermediate level moderate intensity workout good for building endurance, core, legs and metabolic burn.
18	Controlled blast	A 45-minute intermediate level high intensity workout good for core conditioning, cross training, increase metabolism and total body endurance.
19	Peaks and valleys	A 45-minute intermediate level moderate intensity workout good for core conditioning, full body endurance, lower body power and shoulder stability.
20	Metabolic kick hit	A 17-minute intermediate level moderate intensity workout good for conditioning, overall fitness, power development and speed.

The Nike® Training Club app has an activity log where the workout done each session is listed along with the number of minutes it is accomplished. Every 2 weeks, the assessors monitored each participant's activity log. To validate the participants' exercise adherence, the assessors requested them to perform a random set of exercises. Exercise adherence was analyzed using the number of workouts completed based on the participant's log in the app.

After 6 weeks of exercising using Nike® Training Club app, the participants answered the Health Information Technology Usability Evaluation Scale (Health-ITUES) at the outdoor track of MMSU. The Health-ITUES is a validated and reliable instrument to evaluate usability of information technology tools. It is a 20-item scale comprised of four subscales: (1) quality of work life, (2) perceived usefulness, (3) perceived ease of use, and (4) user control. User control and perceived ease of use capture user-system interaction, whereas perceived usefulness evaluates task accomplishment through system use and quality of work life represents higher expectations of system impact (Schnall et al., 2018). In this study, the Perceived Ease of Use subscale was adopted as an instrument for measuring participant's ease of use of mHealth technology based on user-system interaction. The subscale used a Likert scale from 5 (strongly agree) to 1 (strongly disagree).

Schnall and colleagues (2018) conducted a validation study on Health-ITUES for usability assessment of mobile health technology. Variability was evaluated for each of the four subscales. The study found that slightly more than half (60%) scored the maximum score for the Perceived Ease of Use subscale. In terms of criterion validity, the Perceived Ease of Use subscale was moderately to strongly correlated with the Post-Study Usability Questionnaire (PSSUQ) as to system usefulness (ra = .57), information quality (ra = .52), interface quality (ra = .50), and overall (ra = .59). All correlations significant at the p<.001 level. The PSSUQ is an instrument for assessing user satisfaction with system usability and was developed as a usability assessment tool that was specifically for use in the context of scenario-based usability testing, although additional research has indicated that this may be useful for field evaluation as well (Lewis, 1992 as cited in Schnall et al., 2018).

Aerobic Endurance Testing

VO_2 max is the gold standard for measuring aerobic endurance of an individual. The Cooper's 12-minute run test (CRT) is an indirect measure of VO_2 max. It is preferred in field studies more than the laborious and complicated direct measurement. In the study of Bandyopadhyay in 2015 on the validity of CRT for estimation of maximum oxygen uptake in male university students, it showed a significant correlation ($r = .93$, $p < 0.001$) with directly measured VO_2 max. Moreover, the CRT produced reliable results with a high reliability coefficient ($\varphi = .96$) among long distance runners (Penry et al., 2011). The following normative data for males (Cooper, 1968) is available for this test:

Table 2. Normative Data for Males for VO_2 max

Age	Excellent	Above Average	Average	Below Average	Poor
13-14	>2700m	2400-2700m	2200-2399m	2100-2199m	<2100m
15-16	>2800m	2500-2800m	2300-2499m	2200-2299m	<2200m
17-19	>3000m	2700-3000m	2500-2699m	2300-2499m	<2300m
20-29	>2800m	2400-2800m	2200-2399m	1600-2199m	<1600m
30-39	>2700m	2300-2700m	1900-2299m	1500-1999m	<1500m
40-49	>2500m	2100-2500m	1700-2099m	1400-1699m	<1400m
>50	>2400m	2000-2400m	1600-1999m	1300-1599m	<1300m

Pre-test and post-tests were conducted at the outdoor track of MMSU, City of Batac, Ilocos Norte as it is where football training and competition are conducted, thus easily accessible to the participants. Two licensed physical therapists served as assessors in measuring the VO_2 max of participants at pre-test (Week 0) and post-tests every after 2 weeks of intervention (Week 2, 4, and 6).

Before testing, the assessors made sure there were no obstructions along the 400m track. The participants performed the following exercises for warm up: hip swing (30 reps); full squats (20 reps); alternating lunges (20 reps); high knee march (20 reps); and jumping jack (30 reps). After the warm-up, the participants were instructed to run as fast as they could within 12 minutes. The first whistle served as the participants' cue to start running and the second was the cue to stop. The assessors recorded the distance a participant completed, measured from the starting line to the tip of the back leg heel. The VO_2 max was calculated using this formula: (22.351 x kilometers) – 11.288.

Statistical Analysis

Exercise adherence was analyzed through descriptive statistics such as frequency, percentage, mean and standard deviation. A scale (with equal class width of 4) developed by a statistician, was used to interpret the frequency of workouts performed.

Frequency range	Descriptive interpretation
17 – 20	Very high adherence
13 – 16	High adherence
9 – 12	Moderate adherence
5 – 8	Low adherence
1 – 4	Very low adherence

Perceived ease of use was analyzed through mean and standard deviation. This statistician-developed scale was used to interpret the mean results.

Mean range	Descriptive interpretation
4.51 – 5.00	Strongly agree
3.51 – 4.50	Agree
2.51 – 3.50	Neutral
1.51 – 2.50	Disagree
1.00 – 1.50	Strongly disagree

Aerobic endurance was analyzed using one-way ANOVA and F test to determine if there is a significant difference in the aerobic endurance of the participants' pre-test and post-tests measures. Statistical significance is at 5% critical level. SPSS v.21 was used for all statistical analysis.

Results

Exercise Adherence in Using the Nike® Training Club App

The participants were expected to perform 20 workouts from the Nike® Training Club app for a duration of 6 weeks. Based on the total number of workouts recorded in the activity log, the participants performed 14 to 20 workouts from the app. Thus, an average of 17 workouts (85%) indicated that there was a very high adherence to exercise shown by the participants. Notably, 6 of the 10 participants have very high adherence to the workouts given (Table 3).

Table 3. Exercise adherence based on the number of workouts performed by participants *(n=10)*

Participants	f	%	Descriptive Interpretation
P1	17	85	Very high adherence
P2	20	100	Very high adherence
P3	20	100	Very high adherence
P4	19	95	Very high adherence
P5	16	80	High adherence
P6	15	75	High adherence
P7	17	85	Very high adherence
P8	17	85	Very high adherence
P9	14	70	High adherence
P10	15	75	High adherence
$\bar{x}$	17	85	Very high adherence
SD	2.11		

Legend: f – frequency, % - percentage, $\bar{x}$ - mean, SD – standard deviation

Perceived Ease of Use of the Nike® Training Club App

Overall, the participants agreed that the Nike® Training Club app was easy to use ($\bar{x}$ = 3.9). They agreed that the app has well-labeled icons and simple instructions on how to use it. They agreed that they were able to learn the use of the app easily and were comfortable with their ability to use the app (Table 4).

Table 4. Perceived ease of use of the participants *(n=10)*

Items	$\bar{x}$	SD	Descriptive Interpretation
Learning to operate NTC app is easy for me.	4.1	0.74	Agree
It is easy for me to become skillful in using NTC app.	4.1	0.74	Agree
I am comfortable with my ability to use NTC app.	3.9	0.87	Agree
I find NTC app easy to use.	3.7	1.06	Agree
I can always remember how to log on and use NTC app.	3.7	0.67	Agree
Overall	3.9	0.81	Agree

Legend: $\bar{x}$ - mean, SD – standard deviation

Improvement in Aerobic Endurance

Table 4 shows the estimated VO_2 max of the participants measured via CRT. Based on the VO_2 max results, there was a decline of VO_2 max from 28.01 ml/kg/min to 26.25 ml/kg/min when comparing the overall means of Pre-test and Post-test 1 after 2 weeks of training using the Nike® Training Club app. Nonetheless, there was an observed increase in aerobic endurance of the participants at Post-test 2 (29.13 ml/kg/min) and Post-test 3 (31.83 ml/kg/min). More importantly, there was an improvement in the aerobic endurance of the participants at the end of the 6-week training as shown by a difference of 3.82 ml/kg/min between Pre-test and Post-test 3. Although there was a change on the VO_2 max of the participants from Pre-test to Post-tests, the difference was not statistically significant [$F(3, 10) = 2.18$, $p = .11$].

Discussion

Exercise in Using the Nike® Training Club App

Out of 20 pre-selected workouts, an average of 17 (85%) were performed by the participants. This indicates an extremely high adherence rate to the workouts given. This is higher than the 78% adherence rate found in the study of Moseley (2006), which utilized a computer-based training program for home exercises and training diary to record adherence.

As mentioned by the participants, they were encouraged to complete the workouts, seeing their progress in the activity log. The Nike® Training Club app features an activity log where participants can look back and view the workouts they have performed in a summative form and the time it took them to perform each workout. Moreover, the app provided feedback that encourages participants to work toward their activity goals. This provided an opportunity for self-evaluation and reflection that encourages self-efficacy, which is an important predictor of exercise adherence. Furthermore, the participants can do the workouts at home or at the gym and only need minimal equipment.

Based on the anecdotal reports of the participants, they faced issues during the training such as the app not able to work well in some operating systems, poor internet connectivity, and academic workload especially for graduating students. Zapata et al. (2018) found similar barriers influencing adherence to an app-based exercise program in adolescents with painful hyperkyphosis, such as technology device limitations, internet access, and personal factors. Knowing these barriers will help app developers to tailor-fit a set of features to optimize functional outcomes.

Table 5. Pre-test and post-test VO_2 max of the participants based on CRT results

Participants	Pre-test (Week 0)	Post-test 1 (Week 2)	Post-test 2 (Week 4)	Post-test 3 (Week 6)
P1	23.38	21.94	28.64	33.65
P2	23.51	30.31	34.12	35.97
P3	23.51	22.63	26.12	33.41
P4	41.48	29.39	35.09	34.31
P5	30.47	29.41	26.11	38.17
P6	41.74	28.16	25.93	33.41
P7	21.60	22.42	35.89	27.79
P8	24.47	25.71	26.71	27.78
P9	25.01	26.3	26.42	27.04
P10	24.95	26.2	26.27	26.78
Mean ($\bar{x}$)	28.01	26.25	29.13	31.83
SD	7.53	3.10	4.17	4.12

Table 5. ANOVA table of improvement of aerobic endurance

Source of variation	Sum of Squares	Degrees of Freedom	Mean Squares	F value	p value	F critical value
VO_2 max	163.99	3	54.66	2.18	0.11	2.87
Error	903.08	36	25.09			

Level of significance = 0.05

Perceived Ease of Use in Using the Nike® Training Club App

The participants agreed that the Nike® Training Club app has user-friendly interface, uncomplicated design, and comprehensive features. The app interface is expressed in simple language making it easier to operate as well as it did not involve complicated skills in navigating the app. The participants were able to navigate the app easily as the buttons are labeled and the icons are understandable, thus enhancing the learning process. The easy use of the Nike® Training Club app without much effort was necessary for the participants to enjoy its benefits. Thus, the participants were able to make changes in their behavior resulting from regular use of the app for 6 weeks. According to Woldaregay et al. (2018), the ease of use to the participants and the provision of easier way to learn better to prevent decline during trainings are among the motivational factors cited for user engagement with mHealth.

Furthermore, the participants' background on the use of mobile apps may have helped them gain confidence in using the Nike® Training Club App. Smartphones, or phones that can connect to the internet and run apps, are the most prevalent type of mobile device in the Philippines and younger adults lead the way in smartphone use (PEW Research Center, 2019).

Improvement in Aerobic Endurance

VO_2 max is considered the best measure of aerobic endurance. It refers to the intensity of aerobic processes and represents the organism's capacity to utilize at a certain moment the maximum amount of oxygen.

Based on the results of the study, improvement in the aerobic endurance at the end of the 6-week training was not seen in all the participants. The decline of mean VO_2 max after 2 weeks of exercise was attributed by the participants to changes of academic schedule (exams and co-curricular activities) and temperature rise during the early summer. Some studies found that high environmental temperature significantly reduces VO_2 max (Gonzalez-Alonso, 2003; Arngrimson et al., 2003 as cited in Jiexu et al., 2013) and impairs aerobic performance (Cheuvront, 2010;

di Prampero, 2003 as cited in Jiexu et al., 2013). Moreover, the participants were adjusting from a state of detraining to retraining since they did not engage in off-season training, which is similar to the findings of Melchiorri (2014). Due to this state, reintroduction of exercise served as "stressor" which disrupts the body's steady state (Jett & Gibb, 2016). Repeated exposure to the stressor eventually resulted in a slight increase in VO_2 max difference of 2.63 ml/kg/min from week 2 to week 4 as the body adapted to increasing exercise workload. But greater VO_2 max difference of 2.7 ml/kg/min was observed between week 4 and week 6 because the workouts in the last few weeks were greater in intensity and duration in accordance with the principle of overload. Although the VO_2 max change of 3.82 ml/kg/min after 6 weeks of training may not be statistically significant, it is clinically significant. Ranković et al. (2010) revealed that VO_2 max is an indicator of physical capability of athletes, particularly, of football participants. Greater VO_2 max means that the body can utilize more oxygen to supply the working systems, thus, there is lesser fatigue and more intense physical activity can be tolerated (Ranković et al., 2010). The present findings of increased aerobic capacity would allow the participants to stay more active in the game and would require fewer rest periods. Furthermore, an increase of 3.5 ml/kg/min of VO_2 max is associated with decrease in mortality rate by 8-14% owing it to decreased risk of cardiac events (Myers et al., 2002, as cited by Kruger et al., 2018).

The insignificant change on the VO_2 max of the participants may be due to limited time for significant physiologic changes to occur since the participants performed the workouts for just 6 weeks. Latip (2014) mentioned that workouts that are greater in intensity can produce greater effects in a limited time of 6-weeks in consideration of the FITT principle (frequency, intensity, timing and type of exercise). However, Clark (2016) stated that significant change in aerobic endurance is not evident until 12 weeks of continuous training and optimal benefits achieved at 32 weeks. This is supported by Belachew and Mengitsu (2018) who found significant changes in aerobic endurance using CRT among 17–19 years male soccer players who participated in physical fitness exercises for 12 weeks.

Limitations

The two scales utilized in interpreting the exercise adherence and perceived ease of use of the participants were developed by a statistician. For future research, scales should be validated to minimize potential threats in the study.

Moreover, the study only investigated the participants' perceived ease of use and did not assess impact, perceived usefulness, and user control. A follow-up study should include these subscales of the Health-ITUES in assessing usability of Nike® Training Club app in health promotion.

Lastly, the study included a sample of 10 participants, training duration of 6 weeks, no control group used, and no randomization done. Thus, future research can investigate the effectiveness of the Nike® Training Club app in improving aerobic endurance when used for more than 6 weeks with more participants, with randomization and control group. According to Julious (2005), for such pilot studies the recommendation is a sample size of 12 per group.

Conclusion

A high adherence to exercise may be achieved when exercise is facilitated using the Nike® Training Club app. The monitoring feature of the app serves to motivate users to engage in exercise regularly. Thus, the app could be given as a home exercise program to optimize wellness or hasten recovery and rehabilitation.

The Nike® Training Club app is easy to use due to its user-friendly interface and uncomplicated design which gives users the confidence and skill to log on, operate, and use the app. This makes the Nike® Training Club app a potential tool to keep individuals active particularly when at home and no one is monitoring their exercise activities. This allows them to take charge of their health, keeping their lifestyles active and consequently, allows them to optimize the benefits that they can acquire.

The Nike® Training Club app has potential to provide information that could lead to improvements in aerobic endurance. Although longer duration of use of the app may be necessary to cause significant physiologic changes.

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