DEVELOPMENT AND VALIDATION OF U15 FOOTBALL SIMULATION RUNNING PROTOCOL FOR YOUNG FOOTBALL PLAYERS

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DOCTOR OF PHILOSOPHY

UNIVERSITI PERTAHANAN NASIONAL MALAYSIA

2022

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Thesis submitted to the Centre for Graduate Studies, Universiti Pertahanan Nasional Malaysia, in fulfilment of the requirements for the Degree of Doctor of Philosophy (Sports Science)

2022

ABSTRACT

This thesis aim is to develop and validate a U15 Football Simulation Running Protocol (U15 FSRP). Twenty participants of a football academy and sports school volunteered to participate in the study, which utilised U15 match analysis data to develop the protocol. In the study, participant absolute total distance (TD) covered in a match was 6,981 ± 1,333 m, which was divided into various activities namely, 5 ± 15 m standing, 1,659 ± 349 m walking, 2,146 ± 502.4 m low intensity running (LIR), 2,280 ± 795.1 m medium intensity running (MIR), 574 ± 157.9 m high intensity running (HIR) and 318 ± 134.3 m sprinting. It was noted that participants performed 18.9 ± 6 number of sprints (NOS) (speed ≥ 19 $km.h^{-1}$) and the average distance per sprint was 16.6 ± 2.9 m. Taking into consideration the rolling substitution policy in youth football, the TD in relative values ($m.min^{-1}$) were used to represent individual player TD covered. These data provided the framework to develop a running protocol that mimicked U15 match play.

The protocol is thus 80 min of intermittent exercise divided by 4 x 20 min blocks of exercise with 3 x 5 min rest intervals similar to actual U15 match play duration. On every block, the running intensities were devised in a cyclical pattern required participants to run 10 repetitive cycles of LIR, MIR, HIR and walking. In every cycle, the participants alternate between Sprint and utility movements (sideways and backward running).

Following the development of the U15 FSRP, its reliability and validity was assessed. The protocol sought to simulate the physical distance covered by players, percentage of time spent in each type of running intensity and the associated physiological demands (heart rate) of match play in a controlled environment.

Test-retest (Trial 1 and Trial 2 separated by 7 days) was done to determine the reliability of the U15 FSRP. Variables measured were body weight (BW) loss, Borg Rating of Perceived Exertion (RPE), Felt Arousal Scale (FAS), Feeling Scale (FS), Countermovement jump (CMJ), peak sprint speed ($km.h^{-1}$) and heart rate ($beats.min^{-1}$). A paired-samples t-test was conducted to assess the mean differences between Trial 1 and Trial 2. There were no statistically significant differences found between both trials ($P < 0.05$). Reliability assessment: Pearson product movement correlation (r), Intraclass correlation (ICC) and Standard error of measurement (SEM), showed strong and good reliability (*r*: 0.78 to 0.97, $P < 0.05$, ICC: 0.84 to 0.98, $P < 0.05$ and SEM: ± 0.01 to ± 0.7).

Validation of the U15 FSRP was done through monitoring TD, distance in each running intensities, percentage of time spent in each match activity, NOS, average distance per sprint and heart rate (HR). The U15 match and U15 FSRP results were found to be similar, and this provides sufficient evidence that the protocol measured what it is supposed to measure. Further assessment on concurrent validity showed significant positive correlation between match play and the U15 FSRP (0.48 to 0.91, $P<0.05$). Nevertheless, the HR was found lower in the U15 FSRP (188 ± 6.3 $beats.min^{-1}$) compared to match play (207 ± 4.9 $beats.min^{-1}$) which could be from the lack of actual ball play and football skills such as attacking and defending movements. This study represents the reliable and valid football simulation designed specifically for U15 football players and from a practical perspective, it has great potential for use in investigating abilities and monitoring progress of young football players.

ABSTRAK

Tesis ini bertujuan untuk membina dan mengesahkan protokol larian simulasi bola sepak bawah 15 tahun (U15 FSRP). Dua puluh orang peserta dari akademi bola sepak dan sekolah sukan secara sukarela mengambil bahagian dalam kajian ini yang menggunakan data analisis perlawanan U15 untuk membangunkan protokol U15 FSRP. Jumlah jarak mutlak peserta (TD) yang diliputi ialah 6,981 ± 1,333 m yang terbahagi kepada beberapa aktiviti iaitu; 5 ± 15 m semasa berdiri, 1,659 ± 349 m semasa berjalan, 2,146 ± 502.4 m semasa larian berintensiti rendah (LIR), 2,280 ± 795.1 m, larian berintensiti sederhana (MIR), 574 ± 157.9, larian berintensiti tinggi (HIR) dan 318 ± 134.3 m semasa pecutan. Bilangan larian pecut peserta adalah 18.9 ± 6 (NOS) (kelajuan ≥ 19 km.h.$^{-1}$) dan jarak purata setiap pecutan ialah 16.6 ± 2.9 m. Dengan mengambil kira dasar penggantian pemain dalam bola sepak remaja, TD secara nilai relatif (m.min^{-1}) digunakan untuk mewakili TD pemain individu. Data-data ini menyediakan kerangka untuk membangunkan protokol larian yang menyerupai permainan bolasepak U15.

Protokol ini secara khususnya adalah 80 minit senaman berselang dibahagikan kepada 4 x 20 minit blok senaman dengan 3 x 5 minit selang rehat menyerupai dengan waktu permainan perlawanan U15 sebenar. Pada setiap blok, intensiti larian telah direka dalam corak kitaran yang memerlukan peserta berlari 10 kitaran berulang iaitu LIR, MIR, HIR dan berjalan. Dalam setiap kitaran, peserta berselang seli antara Pecutan dan pergerakan Utiliti (lari ke sisi dan ke belakang).

Berikutan pembangunan U15 FSRP, kebolehpercayaan dan kesahannya dinilai. Protokol ini bertujuan untuk simulasi jarak fizikal yang dilakukan pemain, peratusan masa yang dihabiskan dalam setiap jenis intensiti larian dan tuntutan fisiologi yang berkaitan (denyutan jantung) dalam suasana terkawal.

Protokol U15 FSRP diuji sebanyak dua kali (Ujian 1 dan Ujian 2 dipisahkan selang 7 hari) untuk menentukan kebolehpercayaan U15 FSRP. Pemboleh ubah yang diukur ialah kehilangan jisim badan (BM), *Borg Rating of Perceived Exertion (RPE), Felt Arousal Scale (FAS), Feeling Scale (FS), Countermovement jump (CMJ)*, kelajuan pecutan kemuncak ($km.h^{-1}$) dan denyutan jantung ($beats.min^{-1}$). Ujian-t sampel berpasangan telah dijalankan untuk menilai perbezaan purata antara Ujian 1 dan Ujian 2. Tiada perbezaan signifikan secara statistik antara kedua-dua percubaan ($P< 0.05$). Penilaian kebolehpercayaan; kolerasi pergerakan produk Pearson (r), Korelasi intrakelas (ICC) dan ralat pengukuran standard (SEM) menunjukkan kebolehpercayaan yang kukuh dan baik (*r*: 0.78 hingga 0.97, $P < 0.05$, ICC: 0.84 hingga 0.98, $P < 0.05$ dan SEM: ± 0.01 hingga ± 0.7).

Pengesahan U15 FSRP dilakukan melalui pemantauan TD, jarak pada setiap kategori intensiti larian, peratusan masa yang dihabiskan dalam setiap kategori larian, NOS, jarak purata setiap pecutan dan denyutan jantung (HR). Dapatan dari ukuran dari perlawanan U15 dan U15 FSRP didapati mirip antara satu sama lain, dan ini merupakan bukti yang mencukupi untuk menunjukkan bahawa protokol ini mengukur apa yang seharusnya diukur. Penilaian lebih lanjut mengenai kesahan persamaan menunjukkan korelasi positif yang signifikan di antara permainan dan U15 FSRP (0.48 hingga 0.91, $P < 0.05$). Walaupun begitu, nilai HR didapati lebih rendah dalam U15 FSRP (188 ± 6.3 $beats.min^{-1}$) berbanding permainan (207 ± 4.9 $beats.min^{-1}$) yang mungkin disebabkan oleh ketiadaan gerakan permainan menggunakan bola dan kemahiran bola sepak sebenar seperti pergerakan menyerang dan pertahanan. Kajian ini merupakan kaedah simulasi bola sepak yang mempunyai nilai kebolehpercayaan dan kesahan yang dibangunkan khusus untuk pemain bola sepak U15, dan dari

perspektif praktikal, ia berpotensi besar untuk digunakan dalam menyiasat kebolehan dan memantau kemajuan pemain bola sepak muda.

ACKNOWLEDGEMENT

In the name of Allah, the Most Gracious and the Most Merciful.

First and foremost, I would like to praise Allah and his blessings for the completion of this thesis.

Secondly, I would like to express my appreciation to my main supervisor Prof. Dr. Mohar bin Kassim for his support, guidance and knowledge regarding this topic. To my co- supervisor, Lt. Kol. Prof. Dr. Victor Feizal bin Knight Victor Ernest @ Abd Shatar (B) thank you for his support, guidance, helpful suggestions and ideas are greatly appreciated.

Sincere thanks goes to all Akademi Kecergasan Pertahanan staff for their kindness and moral support throughout this journey.

My deepest gratitude goes to my family, Atan bin Yaacob, Zaiton Ibrahim, Khadijah Ibrahim, Mohammad Fazrul bin Jafar, El Xahra Amanda and El Xander Anaqy, your love and compassion keep me stronger every day. To the love of my life, gone but not forgotten Zainab Bt Ibrahim (1954 – 1991) and Siti Afizah Atan (1973 – 2014). This thesis is dedicated for both of you.

"The way I see it, if you want a rainbow, you got to put up with the rain"

May this journey end with a rainbow.

APPROVAL

The Examination Committee has met on **2 March 2022** to conduct the final examination of Siti Azilah Atan on his degree thesis entitled '**Development and Validation of U15 Football Simulation Running Protocol for Young Football Players'.**

The committee recommends that the student be awarded the **Doctor of Philosophy (Sports Science).**

Members of the Examination Committee were as follows.

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APPROVAL

This thesis was submitted to the Senate of Universiti Pertahanan Nasional Malaysia and has been accepted as fulfilment of the requirements for the degree of **Doctor of Philosophy (Sports Science)**. The members of the Supervisory Committee were as follows.

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DECLARATION OF THESIS

Student's full name : Siti Azilah Atan

Date of birth : 13 December 1979

Title : Development and validation of U15 football simulation running protocol for young football players'

Academic session : 2017/2018

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LIST OF ABBREVIATIONS

ACL	Anterior Cruciate Ligament
ACSM	American College of Sports Medicines
AMD	Akademi Mokhtar Dahari
AT	Artificial Turf
ATP	Adenosine Triphosphate
$BEAST_{90}$	Ball-Sport Endurance and Sprint Test
BJSAT	Basketball Jump Shooting Accuracy Test
BSFP	Basketball Specific Fatigue Protocol
BW	Body Weight
$Beats.min^{-1}$	Beats per minute
^{o}C	Celsius
cm	Centimetres
CHO	Carbohydrate
CHO-E	Carbohydrate-electrolyte
CI	Confidence Intervals
CMJ	Countermovement Jump
EbP	Elite Players at Beginning of Puberty
EKBLOM	Ekblom Soccer-Specific Endurance Test
EPL	English Premier League
FAM	Football Association of Malaysia
FAS	Felt Arousal Scale
FIFA	Fédération Internationale de Football Association

FS	Feeling Scale
FSRP	Football Simulation Running Protocol
GH	Growth Hormone
GPS	Global Positioning Unit
Hz	Hertz
HIA	High Intensity Activity
HIR	High Intensity Running
HIS	High Intensity Sprinting
HSR	High Speed Running
HR	Heart Rate
HR_{max}	Maximum Heart Rate
ICC	Intra-class Correlation Coefficients
kg	Kilogram
km	Kilometres
$Km.h^{-1}$	Kilometres per hour
LIR	Low Intensity Running
LIS	Low Intensity Sprinting
LIST	Loughborough Intermittent Shuttle Test
LSR	Low Speed Running
M	metres
MDS	Moderate Speed Running
min	Minutes
$m.min^{-1}$	Metres per minutes
$m \cdot s^{-1}$	Metres per second
$ml.kg^{-1}$	Millilitre per kilogram

MIR	Medium Intensity Running
MIS	Medium Intensity Sprinting
MSRT	Multistage Shuttle Run Test
MT	Motorised Treadmill
NATA	National Athletic Trainers Association
NBA	National Basketball Session
NFDP	National Football Development Programme of Malaysia
NbP	Non-elite players at Beginning of Puberty
NG	Natural grass
NMT	Non-motorised Treadmill
NOS	Number of Sprints
VO_{2max}	Maximum Oxygen Uptake
PFK	Phosphofructokinase
r	Pearson's correlation
$RPSA_{5COD}$	Reactived Repeated Sprint Test
RRST	Reactive repeated sprint test
RER	Respiratory Exchange Ratio
RPE	Borg Rating of Perceived Exertion
SBAFIT	Specific Battery Fitness Test
SEM	Standard Error of Measurement
SSEP	Sport-Specific Exercise Protocol
SSP	Soccer Simulation Protocol
SMS	Soccer Match Simulation

iSPT	Soccer-Specific Non-motorised Treadmill Simulation
TD	Total Distance
T-SAFT 90	Technical Soccer- Specific Aerobic Field Test
T-CAR	Carminatti Test
USG	Urine Specific Gravity
VHIR	Very High Intensity Run
VIFS	Vision Impaired Football Skills Test
VT_{2speed}	Second Ventilatory Threshold
VHSR	Very High Intensity Running
WANT	Wingate Anaerobic Test
YYIR1	Yo-Yo Intermittent Recovery Test Level 1