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Research Article

Reliability of on-duty task simulation test for police officers

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Abstract:

On-duty task simulation (ODT-S) circuits or tests assess the physical ability to handle highly demanding situations arising from police officer activity. This study aims to evaluate the reliability of the on-duty task performance circuit for police officers. In this cross-sectional test-retest study design, a total of thirty (n = 30) Portuguese male police officers (age 25.7 ± 2.7 years; length of service, 3.1 ± 2.1 years; height, 1.77 ± 0.06 m; weight, 78.5 ± 7.2 kg) completed the ODT-S test in two moments (test; retest, R). The ODT-S test simulates (i) a chase/movement to the place of occurrence (1st stage) and (ii) the resolution of the incident (2nd stage). At each moment, the time taken to complete the tasks (T_{1st_stage}; T_{2nd_stage}; T_{1st_stage} + T_{2nd_stage} = T_{Total}), heart rate (HR_{1st_stage}; HR_{2nd_stage}), blood lactate (La_{2nd_stage} and $La_{Post\_5min.}$) and Borg's CR-10 Scale (RPE_{CR10}) were recorded. Results showed (i) significant improvements in ODT-S retest performance (T_{2nd_stage}R, -13.5 s; T_{Total}R, -15.1 s) and efficiency (La_{2nd_stage}, -2.9 mmol/l; La_{Post_5min}, -2.1 mmol/l); (ii) moderate and good reliability in the total time (ICC T_{Total} = 0.683) and heart rate at the end of 2nd stage (ICC HR_{2nd_stage} = 0.820), respectively. In conclusion, this ODT-S circuit for the police is highly demanding and physically demanding and performed as a reliable instrument for assessing suitability for police officer duties.

Keywords: Physical Fitness, Tactical Athlete, Police, Security.

Introduction

Police officers' health, physical ability, and safety[1] must be understood as critical and essential factors. For instance, communities depend on officers to protect them from crime. Agencies need healthy officers for retention to perform crime prevention duties at economically efficient levels. Further, healthy officers can continue to gain experience and effectively perform job duties over the long term.

One of the ways that security forces and services must monitor the physical ability for service on the part of their operatives is the implementation of specific tests that allow them to assess their competencies of this nature.[2] These tests can enhance the physical ability of police officers (PO). They can be used to establish minimum standards to be met by POs performing their duties (i.e., creating action protocols for situations in which non-compliance with the established parameters).

The physical fitness evaluation tests used in the security forces and services are distinguished by the nature of their constituent elements,[3] i.e., consisting of distinct fitness tests, on-duty task simulation circuits, and mixed or hybrid[4].

The literature presents a large number of on-duty task simulation (ODT-S) circuits or tests (e.g., Police Officers Physical Abilities Test – POPAT; Physical Abilities Requirement Evaluation – PARE; Physical Readiness Evaluation for Police – PREP; Physical Competence Test – PCT; Correctional Officers Physical Abilities Test – COPAT; Fitness Test for Correctional Officers – FITCO)[5] used to assess the physical ability for highly demanding situations arising from PO activity.[6]

The ODT-S circuits are used by many police forces, firefighter departments and military forces worldwide.[7] However, the work of Breci[8] shows that 22 out of 35 agencies presented fitness tests for access or approval in their Academies. Still, only 13 carried out validation or functional analysis studies to support the tests.

The identified fragility may result from the scientific dissemination of the circuits not being one of the objectives that motivated their construction. Nevertheless, the validity and reliability of ODT-S in current use for selecting new candidates and for initial training (widely known and cited countless times in scientific works) are paramount. This work aims to evaluate the reliability of the ODT-S presented by Teixeira et al.[9].

Methods

Participants

Thirty male police officers aged between 20 and 29 (n = 30; age, 25.7 ± 2.7 years; height, 1.77 ± 0.06 m; weight, 78.5 ± 7.2 kg) participated in this cross-sectional test-retest study. All participants received a clear explanation of the aims and procedures of the study and signed an informed consent form before the start of data collection. This study was authorised by the Ethics Commission of the Higher Institute of Police Sciences and Internal Security (Lisbon, Portugal, Europe) and complied with the standards of the Helsinki Declaration.

Morphological Evaluations

Height (cm) was measured to the nearest mm (0.1 cm) using a Siber-Hegner anthropometric kit (DKSH Ltd., Zurich, SW) according to the protocol described by Marfell-Jones et al.[10] and the norms established by the International Society for the Advancement of Kinanthropometry (ISAK). The same ISAK evaluators collected Individual measurements in all participants (intra-observer technical error of measurements: height, R≥0.98). A digital bioimpedance scale (Tanita® BC-601, Tokyo, Japan) was used to collect weight and relative Fat Mass (%FM) information. Complementarily, body mass index (BMI) was calculated from body size measurements, i.e., BMI = (weight) / (height²).

On-duty task evaluation

Each participant was required to attend one on-duty task simulation (ODT-S) test familiarisation session and two experimental testing sessions (with an interval of 72 hours, with the test and retest procedures being the same). Participants were instructed to avoid strenuous physical activity and substances containing caffeine or alcohol 24 hours before each testing session and perform the ODT-S test equipped with the operational gear (police-issued tactical garment and boots). A tactical utility belt holding a baton, handcuffs and a mock gun were given to be carried during the simulation. This equipment is essential for general POs and the gear that law enforcement agencies provide to their POs.[11] The total weight of the belt was 2.4 kg, with the mock gun weighing the same as the issued Glock 19 (Ferlach, Austria) with a fully loaded magazine (850 g).

The ODT-S test and retest were performed indoors and at the same facilities, and the investigators directly collected data (they are responsible for data collection and the correct execution of ODT-S tests). The preparation procedure includes placing a heart rate (HR) monitor and recording HR at rest – $HR_{Baseline}$ (Polar® RS400, Polar Electro Inc., Lake Success, NY, USA). Continuously, the blood lactate value ($La_{Baseline}$) is recorded using the Lactate Scout+® device (SensLab GmbH, Leipzig, Germany) and reactive strips (EKF-diagnostic GmbH, Leipzig, Germany). Once the first stage of the ODT-S test and retest have been completed, the time ($T_{1st\ stage}$; $T_{1st\ stage}R$) shown on the chronometer (TRTL 300, Geonaute, Francia),

La (La_{1st_stage}; $La_{1st\_stage}R$) and HR (HR_{1st_stage}; $HR_{1st\_stage}R$) were recorded. After the 30-s rest period, participants begin the second stage of the ODT-S test and retest (occurrence resolution), and with the transport of the victim (dummy) completed, the test ends, and the time (T_{2nd_stage}; $T_{2nd\_stage}R$), La (La_{2nd_stage}; $La_{2nd\_stage}R$) and HR (HR_{2nd_stage}; $HR_{2nd\_stage}R$) were recorded, and participants were asked to classify their effort according to Borg's CR-10 Scale (RPE_{CR10}; $RPE_{CR10}R$)[12]. Finally, La was collected 5 minutes after completing the ODT-S (La_{Post_5min}). The graphical representation of data collection is presented in Figure 1.

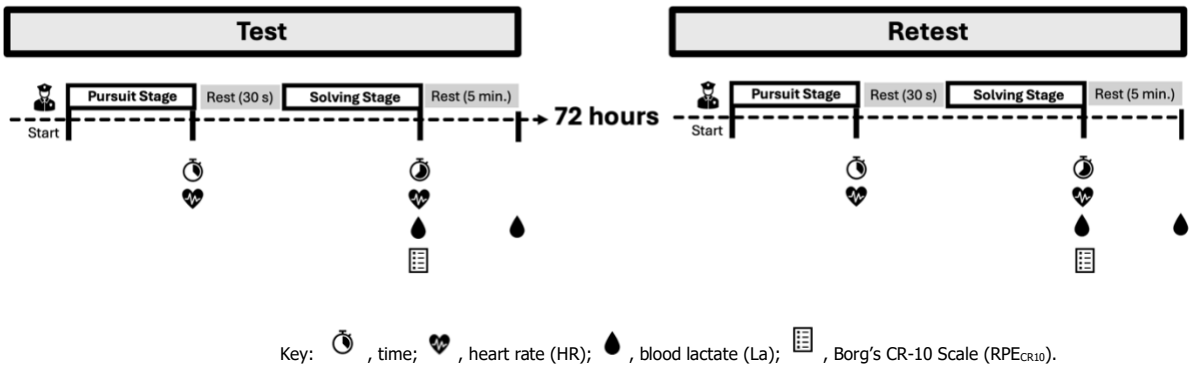
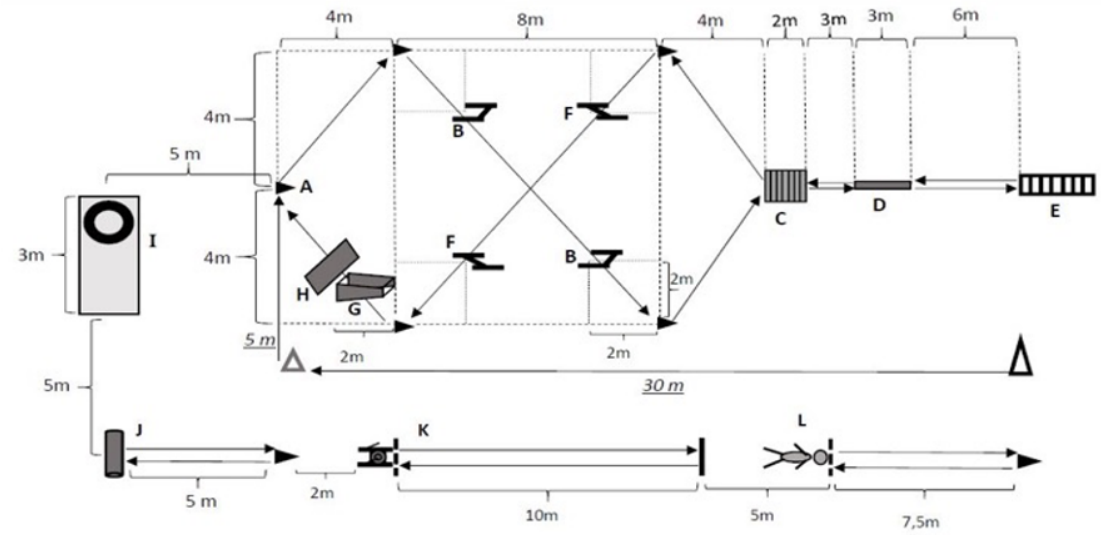


Figure 1: Graphical representation of study design.

The ODT-S test simulates a chase/movement to the place of occurrence (1st stage), and the resolution of the incident (2nd stage), and the total distance of the ODT-S test was 393 m (Figure 2). The 1st stage was supposed to mimic a foot pursuit during which the subject, in full tactical gear, would have to sprint for 35 m, enter an obstacle course enclosed with cones to go around, where he had two 0.75 m barriers to crawl under; a set of stair to go up and down, a 3 m beam to balance across, a gymnasium ladder to climb and reach a mark set at 3.2 m high, two 0.45 m barriers to jump over, a 1.5 m high plinth to go over, and a mat to perform one controlled fall on each lap (alternating between falling on his chest and his back). After completing four laps of this course, a 30-s rest period was granted. After that, participants would initiate the 2nd stage, simulating the solving of the problem, where the PO should: flip a 65 kg tyre four times, lift and carry a 25 kg bag for 10 m, push a 45 kg sled for 10 m and pull it on his way back another 10 m, and drag/carry a 48 kg dummy for 15 m.

The ODT-S test and retest 1st stage time and 2nd stage time were recorded and registered, and the total time in test and retest was calculated ($T_{Total} = T_{1st\_stage} + T_{2nd\_stage}$; $T_{Total}R = T_{1st\_stage}R + T_{2nd\_stage}R$).



EXECUTIVE DESCRIPTION:

1st Stage 1 - PURSUIT STAGE

- ▲ - Starting point, runs 30 m to get to △ right turn and run another 5 m.
- ▲ - Course indicating pylons (to go around the outside).
- A - Pylon indicating the start/end of the 4 laps to obstacle course.
- B – 0.75 m hurdles to go under.
- C – six-step staircase to go up and down.
- D – 3 m long, 0.3 m wide balance beam.
- E – Gym ladder to climb and reach a mark set at 3.2 m high.
- F – 0.45 m hurdles to go over (no support).
- G – 1.5 m high plinth to go over (using hands and feet).
- H – gym mat to perform controlled falls (alternating front and back in each of the 4 laps).

REST (30 seconds).

2nd Stage - SOLVING STAGE

- I – 65 kg tyre to flip 4 times.
- J – 25 kg bag to carry for 5 m, around the pylon and back.
- K – 45 kg sled (total) to push for 10 m, and to pull back another 10 m (using cable).
- L – 48 kg dummy to drag/carry for 7.5 m, around the pylon and back.

END OF TEST.

Figure 2: Layout and executive description of the Portuguese ODT-S test for Police Officers (adapted with authorisation from Teixeira et al.[13]).

Statistical Analysis

Descriptive statistics were analysed using mean values (M) and standard deviation (SD). The difference between the test and retest was analysed using the Paired *t*-test for paired samples.

To analyse the reliability of the ODT-S (test/retest), (i) the Intraclass Correlation Coefficient (ICC:2,1) and its 95% confidence interval (CI) were used, and (ii) the Bland and Altman plots were presented. ICC values above 0.90 were considered excellent, between 0.75 – 0.90 good, between 0.50 – 0.75 moderate, and below 0.50 poor.[14] Statistical data analysis was performed using the JASP.[15]

Results

Table 1 presents the characterization (M±SD) of the 30 elements that performed the ODT-S test/retest.

Table 1: Characterization of participants (police officers, n = 30).

	M±SD
Age (years)	25.7 ± 2.7
length of service (years)	3.1 ± 2.1
Morphological attributes	
Height (m)	1.77 ± 0.06
Weight (kg)	78.5 ± 7.2
Body mass index (m/kg^2)	24.9 ± 1.8
Fat mass (%)	13.9 ± 4.1

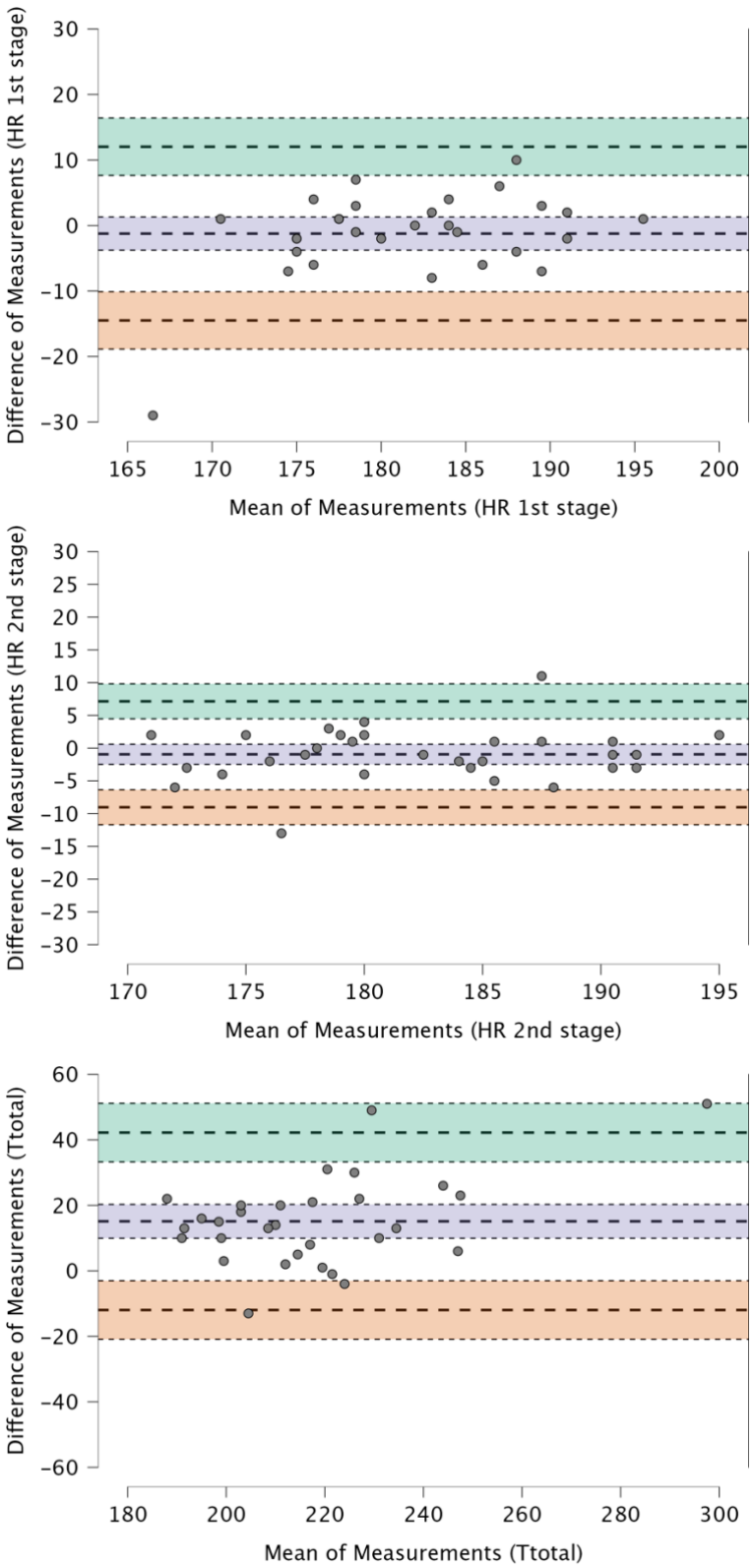
Regarding the characterisation of the effort of the ODT-S test, the results suggest that it is a high-intensity effort (HR_{2nd_stage} = 180-190 bpm, La_{2nd_stage} = 14-16 mmol/l and RPE_{CR10} = 8–9), with a significant cardiorespiratory component and an also relevant anaerobic (glycolytic) component. In the ODT-S retest, significant improvements were observed in performance ($T_{2nd\_stage}R$, -13.5 s; $T_{Total}R$, -15.1 s) and efficiency ($La_{2nd\_stage}R$, -2.9 mmol/l; $La_{Post\_5min}R$, -2.1 mmol/l). Considering the Intraclass Correlation Coefficient (ICC:2,1) was observed that reliability is: (i) good $HR_{2nd\ stage}$ (0.820); (ii) moderate in T_{Total} (α = 0.683) and HR_{1st_stage} (α = 0.598); and (iii) low in T_{1st_stage} (α = 0.456), T_{2nd_stage} (α = 0.148), La_{2nd_stage} (α = 0.158), La_{Post_5min} (α = 0.378), RPE_{CR10} (α = 0.473). Results are presented in Table 2, and in Figure 3, the graphical representations of the Bland–Altman test of the variables that presented good and moderate reliability.

Table 2: Descriptive statistics (M±SD) and Intraclass Correlation Coefficient (ICC:2,1) for the variables under study in the on-duty task simulation (ODT-S) test-retest.

	Mean ± SD		*t*-test			ICC	95% CI	
	Test	Retest	*t*(29)	*p*-value	Sig.		Lower	Upper
T_{1st_stage} (s)	153.20 ± 27.36	151.60 ± 15.35	-0.375	0.710		0.456	0.125	0.697
T_{2nd_stage} (s)	72.13 ± 24.00	58.60 ± 8.13	-3.241	0.003	**	0.148	-0.136	0.441

T_{Total} (s)	225.33 ± 26.12	210.2 ± 20.01	-5.997	<0.001	***	0.683	0.035	0.884
HR_{1st_stage} (bmp)	180.83 ± 8.67	182.07 ± 6.21	0.998	0.326		0.598	0.312	0.785
HR_{2nd_stage} (bpm)	181.83 ± 7.22	182.77 ± 6.63	1.239	0.225		0.820	0.659	0.910
La_{2nd_stage} (mmol/l)	15.08 ± 2.88	12.20 ± 2.96	-4.372	<0.001	***	0.158	-0.105	0.440
La_{Post_5min} (mmol/l)	15.02 ± 2.76	12.91 ± 2.33	-4.535	<0.001	***	0.378	-0.019	0.663
RPE_{CR10}	8.87 ± 0.94	8.53 ± 0.90	-1.980	0.057		0.473	0.155	0.705

Key: CI, confidence interval; HR, heart rate; ICC, Intraclass Correlation Coefficient (ICC:2,1); La, blood lactate; REP, Borg's CR-10 Scale; T, time; **, $p < 0.01$; ***, $p < 0.001$



Key 1: HR, heart rate; T, time.

Key 2: The violet area represents the average difference between the number of repetitions of the fitness test and retest. The green and orange areas represent the upper and lower 95% confidence limits, respectively.

Figure 3: Bland–Altman test applied to the variables (n = 30): HR_{1st_stage}, HR_{2nd_stage} and T_{Total}.

Discussion

This work focused on evaluating the reliability of the Police on-duty task simulation (ODT-S) circuit, i.e., (i) analysing the differences between the ODT-S test and retest and (ii) evaluating the reliability and variation of the ODT-S circuit.

The results showed a statistically significant difference in the ODT-S execution times from the first to the second moment (test/retest). An average execution time was found to be close to 15 seconds (6.7%) faster in the retest (210.2 ± 20.0 s) than in the initial test (225.3 ± 26.1 s). However, it is essential to highlight that ODT-S has a high content and surface validity level as an added value. Although not very relevant in scientific rigour, the latter becomes vital due to the familiarity it establishes with those tested through the situations presented, making acceptance of the test more accessible and increasing the degree of agreement with its application.[16]

The ICC between the total time and the total retest time (ICC_{Ttotal} = 0.683; Table 2 and Figure 3) demonstrates that T_{Total} supports the moderate reliability of the ODT-S in the test/retest, presenting high reliability.[17] Considering that the ODT-S was designed to measure the effective and efficient execution (in less time) of tasks defined as critical and frequent in police activity,[18] we can conclude that a shorter execution time of the ODT-S in the second assessment moment (retest) may be the result of a participant learning effect. Based on the previous observation, prior familiarisation with the ODT-S is suggested before considering a final assessment based on cut points.

Both heart rates at the end of 1st stage and the end of 2nd stage present moderate (HR_{1st_stage} = 0.598) and good (HR_{2nd_stage} = 0.820) reliability (Table 2 and Figure 3). As heart rate is an essential parameter in controlling the intensity of effort in each task, the results suggest that the effort made by the participants is of almost maximum intensity, both in the first evaluation moment (test) and in the second (retest).

One of the parameters indicating a fundamentally anaerobic effort is the value of the lactate concentration in the blood (La), which is why this measure was also considered in the characterisation and control of the ODT-S effort. Although the moment of peak lactate accumulation is unknown,[19] according to Åstrand et al., blood samples should be taken to check the maximum lactate concentration between five and 10 minutes after exertion.[20] This study observed that blood lactate five minutes after ODT-S was higher in the retest than at the end of the test (Table 2). Nevertheless, ICC for this variable in the test/retest ($ICC_{La\ post\_5min}$ = 0.378) emphasizes the poor reliability of blood lactate five minutes after ODT-S to evaluate, in physiological terms, the anaerobic component of ODT-S.

As a form of subjective assessment and control of effort, the rate of perceived exertion (RPE) seems essential in characterising the intensity of effort in a physical task. The values recorded in the simplified CR10 Scale of Borg[21] indicate that (i) the operators who carried out the ODT-S considered it a high-

intensity effort (RPE_{CR10}, 8-9), and (iii) the ICC for the RPE_{CR10} presents poor to moderate (ICC_{RPE_CR10} = 0.473) reliability.[22]

Based on the results obtained in the test/retest, especially concerning total execution time and heart rate, it can be concluded that the ODT-S circuit presents itself as a moderate-good reliable instrument to assess the physical ability for highly demanding situations arising from PO activity.

Conclusion

In conclusion, it seems that (i) due to the high levels of metabolic acidosis it causes (high concentration of lactate in the blood after 5 minutes), this ODT-S circuit for the police is highly demanding and physically demanding, and (ii) based on the results obtained in the test/retest, the ODT-S performed as a reliable instrument for assessing suitability for police officer duties. Nevertheless, additional research involving greater sample sizes is needed to support these conclusions.

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