

RINGKASAN

RESPONS KARDIOVASKULER SEGERA, INTENSITAS AKTIVITAS FISIK DAN TINGKAT KESENANGAN SELAMA BERMAIN *VIRTUAL REALITY EXERGAME*

Aktivitas fisik berasosiasi dengan perbaikan fungsi fisik, kesehatan mental, kognisi, kualitas tidur, kualitas hidup, serta menurunkan risiko penyakit, obesitas, depresi dan kecemasan, namun, populasi global tidak memenuhi rekomendasi aktivitas fisik yang ditetapkan. *Virtual reality exergaming* (VR EXG) dapat menjadi alternatif upaya peningkatan aktivitas fisik karena menyenangkan, teknologi yang diperlukan relatif mudah diakses dan dengan biaya terjangkau melalui alat komersial populer (Nintendo Wii™, Xbox® Kinect®, Nintendo Switch™).

Pemahaman mengenai respons fisiologis selama aktivitas fisik sangat penting untuk mendapatkan variabel latihan dan menghasilkan strategi yang dapat digunakan untuk menambah kepatuhan dan persepan program rehabilitasi, serta menjamin keamanan pasien. Studi ini bertujuan untuk mengevaluasi respons segera sistem kardiovaskular, kuantifikasi intensitas aktivitas fisik dan tingkat kesenangan selama bermain VR EXG "*Fitness Boxing*" Nintendo Switch™.

Subjek penelitian ini adalah 15 pria dewasa sehat berusia 21-39 tahun yang menjalani 3 jenis perlakuan, yaitu bermain VR EXG mode bermain sendiri tempo normal, tempo cepat dan mode bermain versus. Variabel yang dievaluasi antara lain perubahan frekuensi denyut jantung serta tekanan darah sistolik dan diastolik, persentase perkiraan frekuensi denyut jantung maksimal (%HR $_{max}$), Borg *Rating*

of *Perceived Exertion* (skala Borg), dan tingkat kesenangan yang diukur menggunakan *Visual Analog Scale* (VAS).

Hasil penelitian ini menunjukkan peningkatan frekuensi denyut jantung yang signifikan pada ketiga perlakuan ($p = 0,001$), dan perbedaan signifikan didapatkan saat bermain tempo normal dibandingkan mode versus pada variabel HR_{peak} ($159,33 \pm 19,12 - 148,47 \pm 22,43$, $p = 0,022$) dan ΔHR ($77,00 \pm 16,65 - 65,80 \pm 18,99$, $p = 0,019$). Terdapat perbedaan signifikan ($p = 0,001$) pada peningkatan tekanan darah sistolik ketiga perlakuan (tempo normal: $112,33 \pm 6,78 - 140,00 \pm 13,10$; tempo cepat $113,67 \pm 7,19 - 136 \pm 13,52$; mode versus $113,33 \pm 8,17 - 135,33 \pm 14,08$), sedangkan tekanan darah diastolik relatif konstan dan tidak ditemukan perbedaan yang signifikan. Peningkatan frekuensi denyut jantung dan tekanan darah sistolik didapatkan lebih tinggi pada tempo normal dibandingkan tempo cepat dan mode versus. Hal ini tidak sesuai dengan hipotesis penelitian yang memperkirakan bahwa tempo cepat akan memberikan peningkatan yang lebih tinggi dari pada tempo normal dan mode versus lebih tinggi dari pada mode bermain sendiri tempo normal.

Hasil penelitian menunjukkan bahwa tidak ada perbedaan bermakna ($p = 0,173$) dari *rating of perceived exertion* menggunakan skala Borg (berkisar 12-13), sedangkan terdapat perbedaan signifikan ($p = 0,034$) pada variabel $\%maxHR$ ketiga perlakuan, terutama antara tempo normal ($84,70 \pm 10,20$ %) dibandingkan mode versus ($78,95 \pm 12,07$ %) ($p = 0,022$). Data ini selaras dengan temuan hasil dari perubahan frekuensi denyut jantung dan peningkatan tekanan darah sistolik. Kategori intensitas aktivitas fisik berdasar skala Borg masuk dalam intensitas

sedang (*moderate*), sedangkan berdasarkan nilai %HR $_{max}$, masuk ke dalam kategori intensitas latihan berat (*vigorous*)

Visual analog scale tingkat kesenangan berkisar 72 – 81 mm dari skala 0 (tidak menyenangkan) hingga 100 (sangat menyenangkan). Mode bermain sendiri tempo cepat ($76,80 \pm 11,89$) lebih menyenangkan daripada tempo normal ($72,27 \pm 11,06$) ($p = 0,022$) dan mode bermain versus ($81,00 \pm 11,96$) lebih menyenangkan dibandingkan mode bermain sendiri tempo normal ($p = 0,002$). Hal ini sesuai dengan hipotesis bahwa mode bermain versus memberikan tingkat kesenangan lebih tinggi dibandingkan mode bermain sendiri tempo normal.

Penelitian ini menyimpulkan bahwa bermain VR EXG “Fitness Boxing” Nintendo Switch memberikan respon kardiovaskuler berupa peningkatan frekuensi denyut jantung dan tekanan darah sistolik yang signifikan, kuantifikasi intensitas aktivitas fisik masuk dalam kategori intensitas berat (*vigorous*), serta menimbulkan perasaan menyenangkan, sehingga memiliki potensi sebagai opsi sarana alternatif peningkatan aktivitas fisik, menghindari kebosanan, meningkatkan kepatuhan dan kontinuitas aktivitas fisik. Perlu ditekankan bahwa VR EXG dengan konsol *video game* komersial populer seperti Nintendo Switch™ ini tidak dapat menggantikan program latihan atau olahraga yang lebih intensif dan terstruktur.

SUMMARY

IMMEDIATE CARDIOVASCULAR RESPONSES, PHYSICAL ACTIVITY INTENSITY AND ENJOYMENT LEVEL WHILE PLAYING VIRTUAL REALITY EXERGAME

Physical activity is associated with improvement in physical functions, mental health, cognition, sleep quality, quality of life, as well as reducing the risk of disease, obesity, depression and anxiety, however, the global population does not meet the physical activity recommendations. Virtual reality exergaming (VR EXG) can be an alternative option to increase physical activity because it is fun, the technology needed is relatively easy to access and at affordable costs through popular commercial device (Nintendo Wii™, Xbox® Kinect, Nintendo Switch™).

An understanding of physiological responses during physical activity is important to obtain training variables and produce strategies that can be used to increase compliance, prescribe rehabilitation programs, and ensure patient safety. This study aims to evaluate the immediate response of the cardiovascular system, the quantification of the physical activity intensity and the level of enjoyment while playing VR EXG "Fitness Boxing" Nintendo Switch™.

The subjects of this study were 15 healthy men aged 21-39 years who underwent 3 types of playing conditions, namely playing VR EXG single player mode - normal tempo, fast tempo and versus mode. Variables evaluated included changes in heart rate, systolic and diastolic blood pressure, percentage of estimated maximal heart rate ($\% HR_{max}$), Borg Rating of Perceived Exertion (Borg scale), and enjoyment level measured using Visual Analog Scale (VAS).

The results of this study showed a significant increase in heart rate in all three playing conditions ($p = 0.001$), and significant differences were obtained when playing normal tempo compared to versus mode on HR_{peak} ($159.33 \pm 19.12 - 148.47 \pm 22.43$, $p = 0.022$) and ΔHR ($77.00 \pm 16.65 - 65.80 \pm 18.99$, $p = 0.019$). There was a significant difference ($p = 0.001$) on the increase in systolic blood pressure of the three playing conditions (normal tempo: $112.33 \pm 6.78 - 140.00 \pm 13.10$; fast tempo $113.67 \pm 7.19 - 136 \pm 13.52$; versus mode $113.33 \pm 8.17 - 135.33 \pm 14.08$), while diastolic blood pressure is relatively constant and found no significant difference. Increased heart rate and systolic blood pressure are found to be higher at normal tempo compared to fast tempo and versus mode. This is not in accordance with the research hypothesis which predicts that a fast tempo will provide a higher increase than the normal tempo and versus mode higher than the single player mode with normal tempo.

There was no significant difference ($p = 0.173$) of the rating of perceived exertion using the Borg scale (range 12-13), while there was a significant difference ($p = 0.034$) in the $\%HR_{max}$ of the three treatments, especially between normal tempo ($84.70 \pm 10.20\%$) and versus mode ($78.95 \pm 12.07\%$) ($p = 0.022$). These data are in line with findings from changes in heart rate and increased systolic blood pressure. The intensity category of physical activity based on the Borg scale is moderate, however, based on the $\% HR_{max}$ value, it is included in the vigorous intensity category.

Visual analog scale of enjoyment level ranges from 72 - 81 mm from scale 0 (unpleasant) to 100 (very pleasant). The fast tempo single player mode ($76.80 \pm$

11.89) is more fun than the normal tempo (72.27 ± 11.06) ($p = 0.022$) and versus mode (81.00 ± 11.96) is more fun than the normal tempo single player mode ($p = 0.002$). This is consistent with the hypothesis that the play mode versus provides a higher level of pleasure than the normal tempo play mode itself.

This research concludes that playing the VR EXG "Fitness Boxing" Nintendo Switch™ provides cardiovascular responses in the form of a significant increase in heart rate and systolic blood pressure, quantification of physical activity intensity included in the category of vigorous intensity, as well as causing pleasant feelings, so it has the potential as a alternative means of increasing physical activity, avoiding boredom, increasing compliance and physical activity continuity. It should be emphasized that VR EXG with popular commercial video game consoles such as Nintendo Switch™ cannot replace more intensive and structured exercise programs or sports.