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Clinical Research

Heart Rate Response in Spectators of the Montreal Canadiens Hockey Team

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See editorial by Waters and Nattel, pages xxx–xxx of this issue.

ABSTRACT

Background: To our knowledge, heart rate responses have not previously been assessed in hockey fans. We quantified heart rate increases in spectators of the Montreal Canadiens, compared televised with live games, explored features associated with peak heart rates, and assessed whether increases correlate with a fan passion score.

Methods: Healthy adults were enrolled, with half attending live games and half viewing televised games. All subjects completed questionnaires and had continuous Holter monitoring. Intensity of the physical stress response was defined according to previously published heart rate index thresholds as mild (< 1.33), moderate (1.33–1.83), or vigorous (> 1.83).

Little is known about the effect of emotional and mental stress on the heart in sports spectators. The issue is relevant to public health considering that a higher rate of heart attacks and cardiac deaths has been observed during major soccer championships.^{1–4} One study on 10 Scottish soccer fans monitored heart rates and reported an increase by 23 beats per minute (bpm) after a goal was scored by the supported team.⁵ To our knowledge, no study has previously assessed heart rate responses in ice hockey spectators. The matter is of particular importance to Canadians considering that on May 12, 1994, ice hockey was recognized and declared by law to be Canada's national winter sport.⁶ Hockey is integrally linked to Canada's identity, with nearly 2500 rinks spread across the country, > 5000 full-time employees, and > 150,000 volunteers in

RÉSUMÉ

Contexte : Pour autant que nous sachions, les réactions de la fréquence cardiaque chez les amateurs de hockey n'ont pas encore été évaluées. Nous avons quantifié les augmentations de la fréquence cardiaque chez les spectateurs des Canadiens de Montréal, avons comparé les réactions aux matchs télévisés et aux matchs en direct, exploré les éléments associés aux fréquences cardiaques maximales, et évalué si les augmentations étaient corrélées à une cote de passion de l'amateur.

Méthode : Des adultes sains ont été recrutés; la moitié d'entre eux a assisté à des matchs en direct et l'autre moitié à des matchs télévisés. Tous les sujets ont rempli les questionnaires et ont été suivis en

coaching and administrative roles.⁷ Moreover, it has been conservatively estimated that the economic activity related to hockey in Canada exceeds \$11.2 billion per year.⁷

Our objectives were to: (1) quantify the heart rate response in spectators of the Montreal Canadiens; (2) determine whether viewing live games results in a greater increase in heart rate compared with televised games; (3) explore elements of the hockey game associated with peak heart rates; and (4) assess whether heart rate increases correlate with a fan passion score adapted from studies in soccer spectators.^{8,9}

Methods

Study population

The study population consisted of male or female adult (18 years of age or older) volunteers who live in Montreal, Canada, were willing to watch a live or televised Montreal Canadiens hockey game, and were capable of providing informed consent to participate. Subjects with known heart disease, a cardiac implantable electronic device, or pharmacological therapy with an antiarrhythmic agent or rate-slowing drug

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See page 6 for disclosure information.

Results: In 20 participants, 35% women, age 46 ± 10 years, the heart rate increased by a median of 92% during the hockey game, from 60 (interquartile range, 54-65) beats per minute at rest to 114 (interquartile range, 103-129) beats per minute ($P < 0.001$). The heart rate increased by 110% vs 75% during live vs televised games ($P < 0.001$). Heart rate index (2.16 ± 0.27 vs 1.73 ± 0.15 ; $P < 0.001$) and percent maximum predicted heart rate attained ($75\% \pm 8\%$ vs $58\% \pm 7\%$; $P < 0.001$) were significantly higher during live vs televised games. Number of premature beats was nonsignificantly higher during live games (5 vs 1; $P = 0.181$). The fan passion score was not predictive of the heart rate response ($P = 0.753$). Peak heart rates most commonly occurred during overtime (40%) and scoring opportunities for (25%) and against (15%).

Conclusions: It is exciting to watch the Montreal Canadiens! Viewing a live hockey game is associated with a heart rate response equivalent to vigorous physical stress and a televised game to moderate physical stress.

were excluded. The protocol was approved by the Quebec Provincial Technoscience Ethics Committee. All subjects provided written informed consent to participate.

Overview of study design and materials

Twenty subjects were recruited, with 10 attending live games and 10 viewing televised games in a home setting. After obtaining informed consent, a 5- to 10-minute questionnaire was administered to collect data on demographic variables, medical history, and a fan passion score. The fan passion score was adapted from 2 studies in 642 soccer fans that proposed and validated a scoring system to measure the degree to which a spectator is passionate about his or her team.^{8,9} It consisted of 16 questions that required responses on a scale of 0-3. Scores for each item were summed to arrive at a total score.

Baseline heart rates were recorded in a seated position in a quiet environment after the participant had rested for 5 minutes. Three-channel digital cardiac Holter monitors (SEER MC, GE Healthcare, Little Chalfond, United Kingdom) were installed and maintained for the duration of the study. Holter data were stored on memory cards and uploaded to a hospital-based computerized system (Marquette; GE Healthcare) for analysis by a blinded technician (C.V.). All hockey games were digitally recorded on a high-definition terminal (Illico X8; Videotron, Montreal, Canada) and reviewed to determine the timing of relevant events.

Main study variables

The main study variables consisted of demographic data (ie, age, sex, height, weight, body mass index, medical history, medications), the fan passion score, game-related factors (eg,

continu au moyen d'un moniteur Holter. L'intensité des réactions de stress physique a été caractérisée, à l'aide des seuils d'un indice de coût cardiaque déjà publiés, comme étant légère ($< 1,33$), modérée (1,33-1,83) ou vigoureuse ($> 1,83$).

Résultats : Chez ces 20 participants de 46 ans \pm 10 ans, dont 35 % étaient des femmes, la fréquence cardiaque a augmenté de 92 % (valeur médiane) pendant le match de hockey, passant de 60 (intervalle interquartile : 54-65) battements par minute au repos à 114 (intervalle interquartile : 103-129) battements par minute ($p < 0,001$). La fréquence cardiaque a augmenté de 110 % pendant les matchs en direct et de 75 % pendant les matchs télévisés ($p < 0,001$). L'indice de coût cardiaque ($2,16 \pm 0,27$ vs $1,73 \pm 0,15$; $p < 0,001$) et le pourcentage de la fréquence cardiaque maximale théorique atteint ($75\% \pm 8\%$ vs $58\% \pm 7\%$; $p < 0,001$) ont été significativement plus élevés pendant les matchs en direct que pendant les matchs télévisés. Le nombre de battements prématurés a été plus élevé pendant les matchs en direct, mais pas de manière significative (5 vs 1; $p = 0,181$). La cote de passion de l'amateur ne s'est pas révélée être prédictive des réactions de la fréquence cardiaque ($p = 0,753$). Les fréquences cardiaques maximales ont été plus fréquentes pendant les prolongations (40 %) et lors des occasions de marquer des Canadiens (25 %) et de l'adversaire (15 %).

Conclusions : Regarder les Canadiens de Montréal est excitant! Regarder un match de hockey en direct est associé à une réaction de la fréquence cardiaque équivalente à un stress physique vigoureux quand le match est en direct et à un stress physique modéré quand il est télévisé.

live game at the Bell Centre vs televised game, ranking of opponent team, shots, goals, penalties, fights, injuries, overtime, shootout), and Holter-related variables.¹⁰ The latter included heart rate (resting, mean, maximum), heart rate index¹¹ (maximum heart rate/resting heart rate), percent maximum predicted heart rate¹² ($[\text{maximum heart rate}/(220 - \text{age})] \times 100$), and number of premature atrial and ventricular beats.¹³

Intensity of the physical stress response was categorized according to recommendations from the US Department of Health and Human Services and previously published heart rate index thresholds as mild (< 1.33), moderate (1.33-1.83), or vigorous (> 1.83).^{11,14} A heart index of 1.33-1.83 is equivalent to activity performed at 3.0-5.9 metabolic equivalent units (METs) and 40%-59% of aerobic capacity reserve, whereas a heart rate index > 1.83 correlates with activity performed at ≥ 6 METs and $\geq 60\%$ of aerobic capacity reserve.^{11,15}

Statistical analyses

Continuous variables are presented as mean \pm SD or median and interquartile range (IQR; 25th to 75th percentile) depending on normality of distribution. Categorical variables are summarized according to frequencies and percentages. Inpatient differences between baseline and maximum heart rates were assessed using nonparametric Wilcoxon signed rank tests. Two- and 3-group comparisons (ie, heart rate increase according to fan passion score categorized into tertiles) of continuous variables were performed using Mann-Whitney *U* and Kruskal-Wallis tests, respectively. Number of premature beats were compared using a Fisher exact test. Factors associated with an increase in heart rate were explored in univariable linear regression analyses from which β -coefficients and 95% confidence intervals (CIs) were derived.

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