Achievement of the ABC target among Canadians with type 2 diabetes: data from the CHMS

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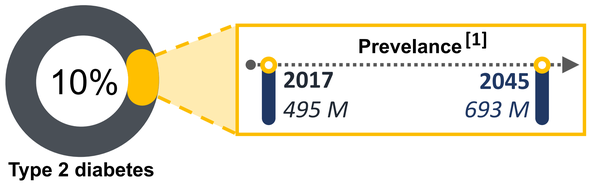
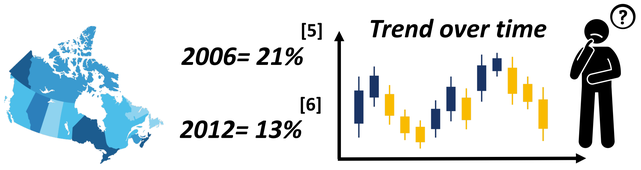
Introduction



Triple target: ABC

[4]



[7]

Methods

Canadian Health Measures Survey
(96-97%)

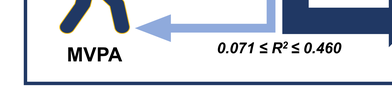
Adults ≥ 18 years of age

Excluding criteria
Pregnant female
Living in the Canadian territories
Living in Indigenous reserves
Members of the Canadian Forces

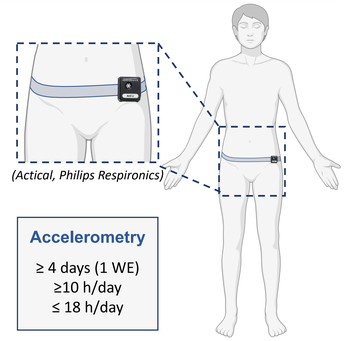
2007 — 2017

n= 17 582

ABC target



T2D prevalence



Accelerometry

≥ 4 days (1 WE)
≥10 h/day
≤ 18 h/day

Results

	Non-T2D N= 24 126 785 (93.7%)	T2D N= 1 603 472 (6.3%)
Age (years)	44.4 ± 15.9	60.2 ± 11.1 †
Sex (men; %)	49.4 [49.4 - 49.5]	57.6 [57.5 - 57.7] †
BMI (kg/m²)	27.1 ± 5.6	31.4 ± 7.1 †
Non hispanic white (%)	80.5 [80.5-80.5]	80.3 [80.2-80.3]
Regular smoker (%)	20.3 [20.3-20.4]	19.5 [19.4-19.6]
Regular drinker (%)	69.5 [69.5-69.6]	48.9 [48.8-48.9] †
A1c (%)	5.44 ± 0.46	7.39 ± 1.56 †
Fasting glucose (mmol/L)	5.03 ± 0.68	8.45 ± 3.34 †
Fasting insulin (mmol/L)	74.7 ± 63.4	144.5 ± 156.0 †
HDL cholesterol (mmol/L)	1.41 ± 0.41	1.19 ± 0.35 †
LDL cholesterol (mmol/L)	2.85 ± 0.90	2.31 ± 1.00 †
SBP (mmHg)	112.0 ± 15.3	120.7 ± 16.7 †
DBP (mmHg)	72.0 ± 9.6	72.2 ± 9.8
Medication		
Hypoglycemic (%)	0.80 [0.80-0.81]	78.64 [78.57-78.70] †
Antihypertensive (%)	19.32 [19.30-19.34]	69.8 [69.73-69.89] †
Hypolipidemic (%)	12.50 [12.48-12.51]	63.19 [63.09-63.26]†
*ABC (%)	0.385 [0.382-0.389]	42.9 [42.86-43.03] †

Table 1. Participant's characteristics.

Data are presented mean ± SD or in percentage (%). T2D= type 2 diabetes; BMI= body mass index; A1c= glycated hemoglobin; HDL= high-density lipoprotein; LDL= low-density lipoprotein; SBP= systolic blood pressure; DBP= diastolic blood pressure. † significant difference between T2D and non-T2D (p= 0.01).

	T2D diagnostic	T2D A1c/Glucose	T2D overall
Cycle 1 (2007-2009)	3.72 %	1.08 %	4.80 %
Cycle 2 (2010-2011)	4.94 %	1.58 %	6.52 %
Cycle 3 (2012-2013)	5.11 %	0.32 %*	5.43 %
Cycle 4 (2014-2015)	4.92 %	0.74 %*	5.66 %
Cycle 5 (2016-2017)	6.38 %	2.00 %	8.38 %
Cycle 1-5 (2007-2017)	5.06 %	1.18 %	6.23 %

Table 2. Prevalence of T2D in Canada from 2007-2009 to 2016-2017 in the adult population.

*Data are presented in percentage and weighted to represent the Canadian Population (individual and combine; 1-5).*One should be cautious when interpreting the undiagnosed prevalence of T2D in the cycle 3 and 4 considering the smaller sample size for fasting variable.*

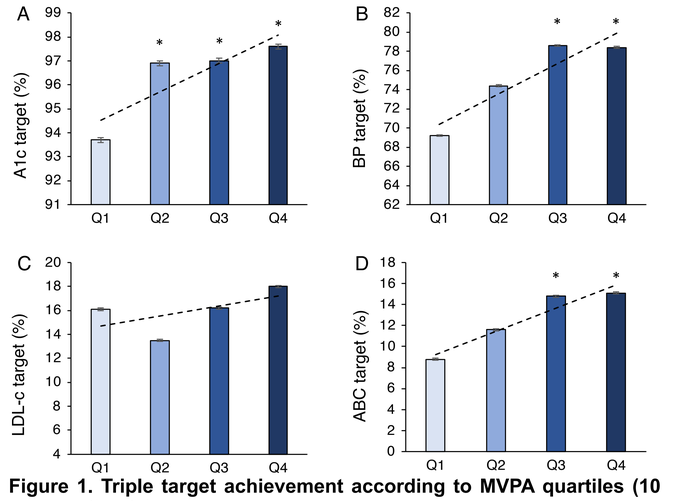


Figure 1. Triple target achievement according to MVPA quartiles (10 years estimate).

*Data are presented in percentage. A1c= glycated hemoglobin; LDL= low-density lipoprotein; BP= blood pressure; MVPA= moderate to vigorous physical activity; *Compared to Q1: p= 0.01.*

	A1c (<7%)	LDL-C (<2.0 mmol/L)	BP (<130/80 mmHg)	ABC
Non-T2D (%)	99.3	15.9	76.1	13.5
*Medication (%)	0.8	12.5	19.3	0.4
T2D (%)	51.3	42.0	64.4	14.1
*Medication (%)	78.6	63.2	69.8	42.9

Table 3. Prevalence of Canadians, with and without type 2 diabetes, achieving the ABC target (10-year estimate) .

Data are presented in percentage and weighted to represent the Canadian Population.

	A1c (<7%)	LDL (<2.0 mmol/L)	BP (<130/80 mmHg)	ABC total
Cycle 1 (2007-2009)	49.8 %	19.5 %	66.0 %	11.5 %
Cycle 2 (2010-2011)	46.9 %	32.0 %	63.8 %	11.3 %
Cycle 3 (2012-2013)	58.1 %	48.4 %	73.0 %	16.8 %
Cycle 4 (2014-2015)	56.1 %	51.1 %	56.2 %	14.9 %
Cycle 5 (2016-2017)	48.6 %	39.3 %	63.3 %	14.8 %

Table 4. Prevalence of type 2 diabetes individuals meeting the ABC target and its component in Canada from 2007 to 2017.

Data are presented in percentage and weighted to represent the Canadian Population.

Objectives

1) The main objective of this study was to update the prevalence trend of T2D in Canada from 2007 to 2017 and the proportion of individuals meeting the ABC during that period.

2) The secondary objective was to investigate how sedentary behaviors, physical activity duration and intensity may explain the achievement of ABC.

Conclusion

1) The prevalence of T2D has increased from 2007 to 2017 in the Canadian population, with a considerable number of undiagnosed patients. Only a small proportion of individuals with T2D meet the ABC recommendations, but fortunately, this prevalence has increased over the years

2) Active individuals who perform more than 142 min per week of MVPA are more likely to reach the ABC target. In addition to physical activity, other important factors such as BMI and the use of medication should also be considered as modifiable contributing factors.

References:

1- Cho et a. 2018
2- Diabetes Canada. 2020
3- Baena-Díez et al. 2016
4- Stone et al. 2018
5- Braga et al., 2010
6- Leither et al., 2013
7- Sigal et al., 2018

Image are from Canva and Biorender

More information about this project

ACUTE NK CELLS RESPONSE TO DIFFERENT AEROBIC EXERCISE MODALITIES IN METASTATIC CANCER PATIENTS UNDERGOING CHEMOTHERAPY

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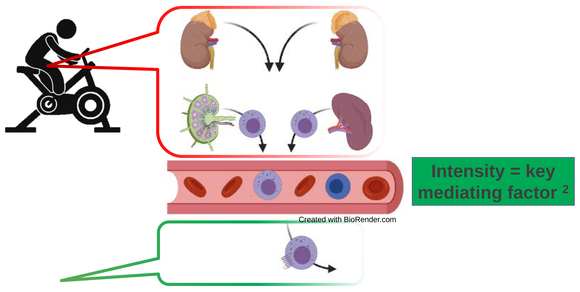
Aerobic exercise acutely elicits a lymphocytosis followed by a rapid decrease in lymphocyte blood counts in the subsequent hours, mainly reflecting their tissular redeployment. $CD56^{dim}CD16^{+}$ cytotoxic NK (cNK) cells strongly respond to this exercise-induced redeployment, which might promote their tumoral infiltration following each exercise session, and thus represent a potential adjuvant strategy to existing anticancer therapies. However, this promising immune response has not been studied in cancer patients currently undergoing chemotherapy, which elicits important immunosuppressive effects. **Purpose:** To characterize the acute cNK cells response following a moderate-intensity aerobic exercise (MOD) session and a work-matched high-intensity interval exercise (HIIE) session in cancer patients undergoing chemotherapy. **Methods:** Eleven patients (45-65 years) undergoing chemotherapy for a metastatic cancer performed a MOD and a work-matched HIIE in a block-randomized order, 24 hours before a chemotherapy treatment. Peripheral blood mononuclear cells were isolated before, immediately after and 1h after exercise. Flow cytometry and complete blood counts were used to enumerate NK cell subsets (CD56, CD16) and their surface expression of the following markers: NKG2D, CD158a, CD57, PD-1, TIM-3, CXCR3, CXCR4 and CCR2. **Results:** Immediately following MOD, cNK cells levels significantly increased relative to pre-exercise (+1.91±1.37-fold, p<0.001) and decreased 1h after exercise (-0.65±0.12-fold, p<0.001), back to pre-exercise values. The most strongly responsive cNK cells expressed CD57, NKG2D, the immune checkpoint TIM-3 and the chemokine receptor CXCR3 (all p<0.001). HIIE elicited an effect of similar magnitude on each of these subsets, with no difference between trials (all p≥0.38). However, strong correlations were found between the cNK cells fold-increase following HIIE and the percent of estimated heart rate reserve (r =0.87, p=0.001), and the cNK cells fold-decrease 1h-post HIIE and power output (r =0.86, p=0.002). **Conclusion:** both trials induced a redeployment of cNK cells exhibiting tumor migration and cytotoxic potential, supporting the idea that exercise could represent an adjuvant approach to existing therapies, with the effect of HIIE being potentially fitness-dependent.

Background

Could the cytotoxic NK (cNK) cells acute response to exercise promote anti-tumor immunity in cancer patients?

1) During exercise: Strong β_2-adrenergic induce blood mobilisation of cNK cells [1]

2) After exercise cessation: Rapid vascular egress, dependent upon catecholamines and cortisol, induce inflammatory chemokine receptors expression [2]



3) Post-exercise harvested cNK cells: ↑ cytotoxic activity against various cancer cell lines (*in vitro* cytotoxic assays) [3]

Could moderate continuous aerobic (MOD) or high-intensity intervals (HIIE) exercise mobilize cNK cells with tumor infiltration and cytolysis potential in cancer patients ? [4]

Objective

To characterise the acute cNK cell response to a MOD and a work-matched HIIE session in metastatic cancer patients currently being treated by chemotherapy

Methods

Study Design: Block-randomized, counterbalanced crossover trial (n = 12, 45-65 years old)

Each trial : 24h before a chemotherapy treatment

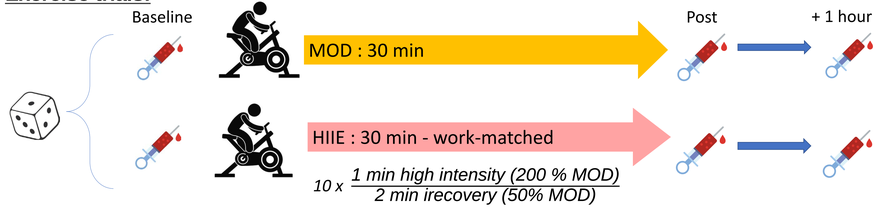
Inclusion

1. Metastatic cancer (prognosis ≥ 12 mo)
2. Undergoing chemotherapy
3. ECOG Status ≤ 1

Exclusion

1. Medical contraindication to vigorous exercise
2. Use of non-selective β-blockers

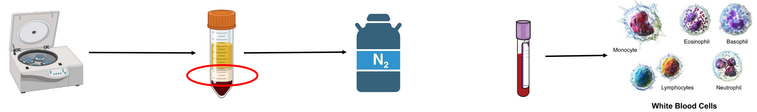
Exercise trials:



Samples processing :

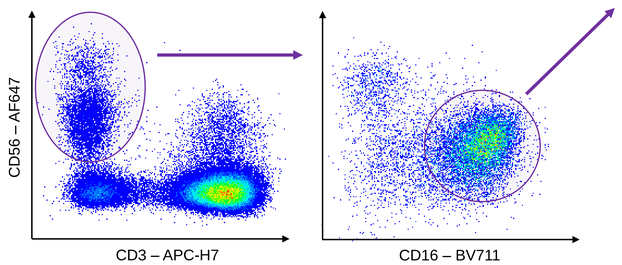
1) PBMCs were isolated using gradient centrifugation and kept in liquid nitrogen upon analysis

2) Differential leukocyte count (for blood count computation of each gated subset)



Flow cytometry analysis :

NK cells : $CD3^{-}CD56^{+}$ lymphocytes **Cytotoxic NK cells** : $CD56^{dim}CD16^{+}$



Evaluated for expression of the following markers:

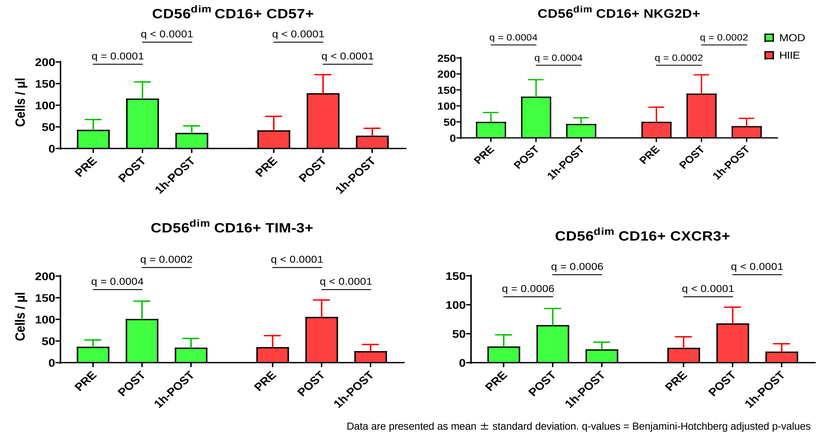
Differentiation markers: CD57, CD158a, NKG2D

Chemokine receptors : CXCR3, CXCR4, CCR2

Immune checkpoints : TIM-3, PD-1

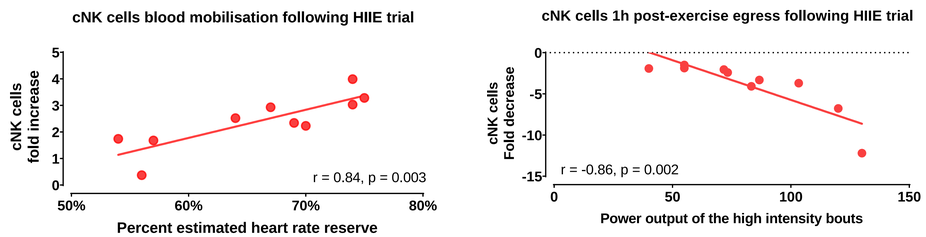
Results

1) cNK cells expressing CD57, NKG2D, the immune checkpoint TIM-3 and the chemokine receptor CXCR3 were the most exercise responsive subsets, with no difference between trials.



Data are presented as mean ± standard deviation. q-values = Benjamini-Hotchberg adjusted p-values

2) The acute cNK cell mobilisation and egress were strongly correlated with exercise intensity, but only following HIIE.



Discussion/Conclusion

1) Both MOD and HIIE session can mobilize highly differentiated cytotoxic NK cells with a phenotype suggestive of a good tumor homing potential in metastatic cancer patients undergoing chemotherapy.

2) The NK cells response to MOD and HIIE might be differently driven by exercise intensity.

3) These results will guide future longitudinal exercise trials to investigate the clinical benefits of different aerobic exercise training modalities in the cancer population.

References

1) Graff et al. (2018). *Brain. Behav. Immun.*, *74* (August), 143–153.; 2) Peake et al. (2017). *Journal of Applied Physiology*, *122*(5), 1077–1087.; 3) Bigley et al. (2014). *Brain, Behavior, and Immunity*, *39*, 160–171. ; 4) Idorn & Hojman (2016). *Trends in Molecular Medicine*, *22*(7), 565–577.

Funding: Sylain Poissant Foundation

HIGH-INTENSITY INTERVAL TRAINING AND AMBULATORY BLOOD PRESSURE IN WOMEN WITH HYPERTENSION AND TYPE 2 DIABETES

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INTRODUCTION

Aging

Type 2 diabetes (T2D)[1,2]
- Insulin resistance
- Hyperglycemia

Endothelial dysfunction[3]
- Atherosclerosis
- → Arterial stiffness

Hypertension

DIABETES CANADA

High intensity interval training (HIIT)[4]

VO_2 max

Low volume[5]: 6 x 1 min

High volume[6,7]: 4 x 4 min

OBJECTIVE

To compare the acute effect of two HIIT modalities on ambulatory blood pressure in aging women with T2D and hypertension.

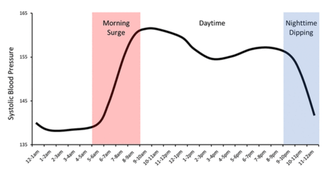
METHODS

Sample

- N = 15
- 60-85 years old
- T2D
- Hypertension (*controlled*)
- Physically inactives (> 60 min/week of structured physical activity)

Variables of interest

- 24h ambulatory blood pressure
- Nocturnal dipping



Experimental conditions: 3 conditions achieved over 10 days

Rest
- Passive activities
- 35 min

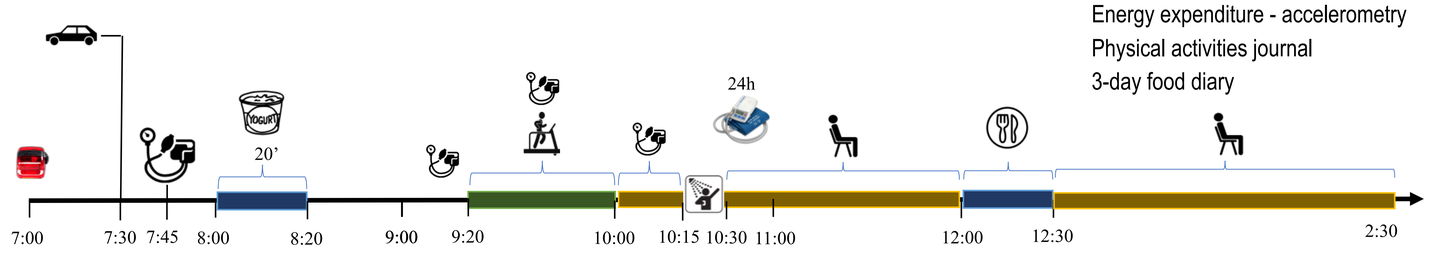
HIIT-4
- 4 x 4 min
- 90% of max HR
- 35 min

→ **HIIT-10**

HIIT-10
- 10 x 1 min
- 90% of max HR
- 38 min

→ **HIIT-4**

EXPERIMENTAL CONDITION HIIT



CONTROL VARIABLES

Energy expenditure - accelerometry
Physical activities journal
3-day food diary

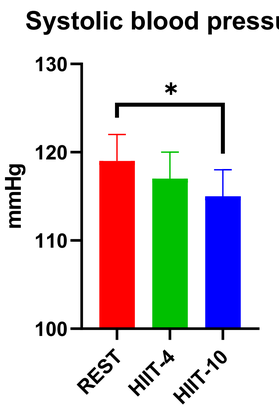
PRELIMINARY RESULTS

Descriptive characteristics

	(n=10/15)
Age (years)	69.8 ± 4.94
BMI (kg/m^2)	33.28 ± 5.96
Waist Circumference (cm)	108.42 ± 12.47
History of T2D (years)	13.1 ± 6.88
VO_2 peak (ml/kg/min)	17.48 ± 3.48
Fasting glucose (mmol/L)	6.7 ± 0.78
HbA1c (mmol/L)	6.5 ± 1.18
Systolic blood pressure (mmHg)	123 ± 9
Diastolic blood pressure (mmHg)	77 ± 5

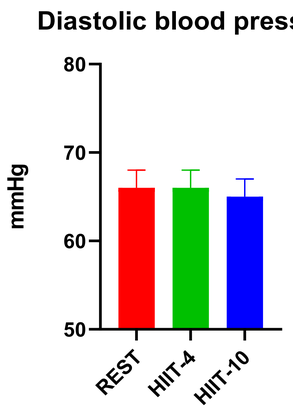
BMI: Body Mass Index; T2D: Type 2 Diabetes; HbA1c: Glycated Hemoglobin.

Systolic blood pressure



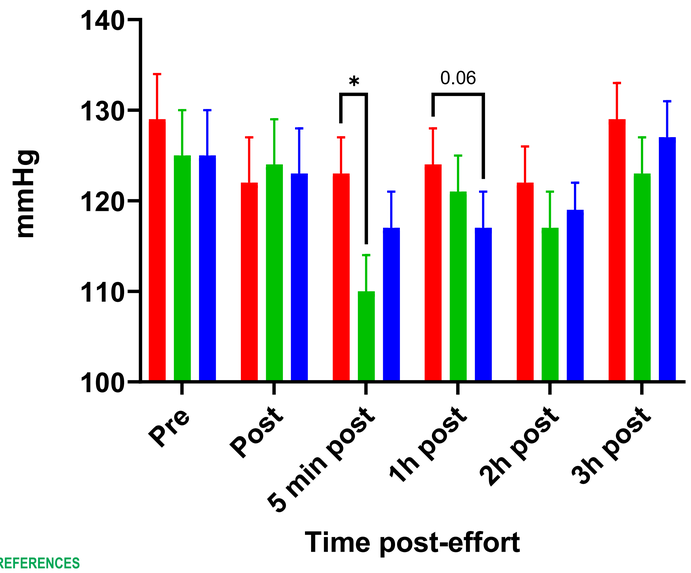
Ambulatory 24h period

Diastolic blood pressure



Ambulatory 24h period

Systolic blood pressure



CONCLUSION

- **HIIT-10 reduce 24h ambulatory blood pressure and also tended to reduce blood pressure 1h post-exercise.**
- **HIIT-4 produces a greater 5-min post-exercise hypotension.**
- **In treated hypertensive T2D older women, HIIT-10 seems to provide greater benefits with regards to blood pressure control**

REFERENCES

1) Zheng et al. (2018); **2)** Whitting et al. (2011); **3)** Lu J, et al. (2018); **4)** Diabetes Canada Clinical Practice Guidelines Expert Committee, et al. (2018); **5)** Marcotte Chénard, et al. (2021); **6)** Gillen, et al. (2012); **7)** RezkAllah, et al. (2019).

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Diabète Québec
CIHR IRSC Canadian Institutes of Health Research / Instituts de recherche en santé du Canada

IS *POST RESISTANCE EXERCISE GLUCOSE TOLERANCE* ASSOCIATED WITH EXERCISE PROTOCOL AND LOAD IN POSTMENOPAUSAL WOMEN?

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INTRODUCTION

- **Glucose tolerance**[1] (GT), **muscle mass**[2] (MM/FFM) and **strength**[2] are thought to decline in **postmenopausal women** (PMW)
- Exercise guidelines for healthy aging include **resistance training** (RT) with **heavy weights and moderate-to-low repetitions** (HWLR) with the aim of increasing MM[3]
- RT with **low weights and high repetitions** (LWHR), has also shown to be efficient for muscle adaptations[4]
- The magnitude of muscle acute response and adaptations to RT has been suggested to depend on **training load** (total weight lifted ; TWL)[5]

AIMS & HYPOTHESES

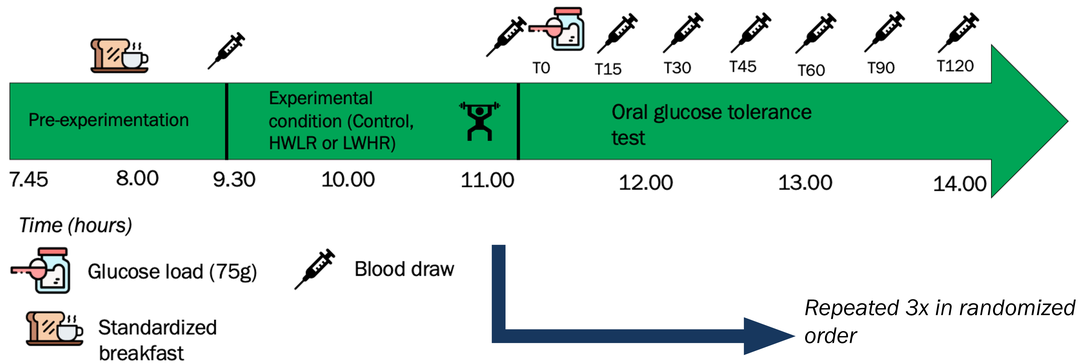
- The relationship between FFM and GT is unclear and has never been tested in response to acute RT in PMW.[6]
- It is unknown if acute RT can enhance acute GT and which RT protocol has the greatest potential in PMW.

METHODS

- 12 healthy PMW (50-72y)
- Non smoker, light alcohol drinker
- <75min structured exercice/week
- New to resistance training

Condition 1: No exercise	Condition 2: HWLR	Condition 3: LWHR
		
Rest for 60 minutes	3 x 10 reps 75-80% 1RM	2 x 25 reps 50-55% 1RM

FIG. 1. EXPERIMENTAL DESIGN



- FFM was measured with dual x-ray absoptiometry (iDXA, GE Healthcare)
- Blood glucose was determined in each blood sample with a hexokinase method (Dimension, Vista System). Glucose fold change was calculated as the difference between pre and post glucose/pre-exercise glucose
- VO_2peak was measured with a breath-by-breath technique using a metabolic cart (Medisoft Expair)

RESULTS

TABLE 1. PARTICIPANTS CHARACTERISTICS (n=12)

Age (years)	65.9 ± 5.6
Weight (kg)	64.3 ± 9.3
Waist circumference (cm)	92.4 ± 10.3
BMI (kg/m^2)	24.3 ± 3.5
Fat-free mass (kg)	37.9 ± 3.6
Fat mass (kg)	24.0 ± 7.4
Vo_2peak (ml/kg/min)	22.3 ± 6.5
Fasting glucose (mmol/L)	4.9 ± 0.2
2-h glucose (mmol/L)	7.4 ± 2.0
Glucose AUC (mmol/L*120min)	973.7 ± 183.7

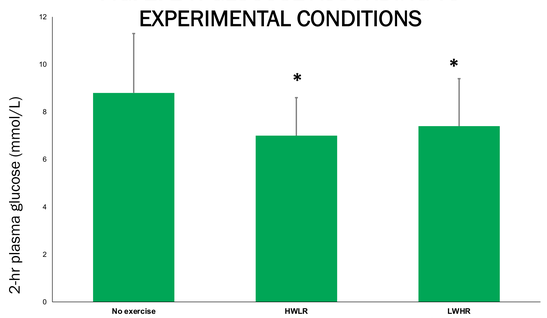
Results are presented as average ± SD

TABLE 2. TRAINING PARAMETERS

	HWLR (3 x 10 # 75-80% RM)	LWHR (2 x 25 reps @ 50-55% 1RM)
TWL (lb)	8573.2 ± 2297.9	9464.1 ± 2521.2*
sRPE (/10)	6,3 ± 2,4	5,5 ± 2,3

**Significantly different from HWLR (p≤0,001)*

FIG. 2. 2-H GLUCOSE ACCORDING TO EXPERIMENTAL CONDITIONS



**Significantly different from the no exercise condition (p≤0,05)*

FIGURE 3-5. RELATIONSHIP BETWEEN ABSOLUTE FFM (KG) AND GLUCOSE AUC IN CONTROL (A) AND AFTER HWLR (B) AND LWHR (C)

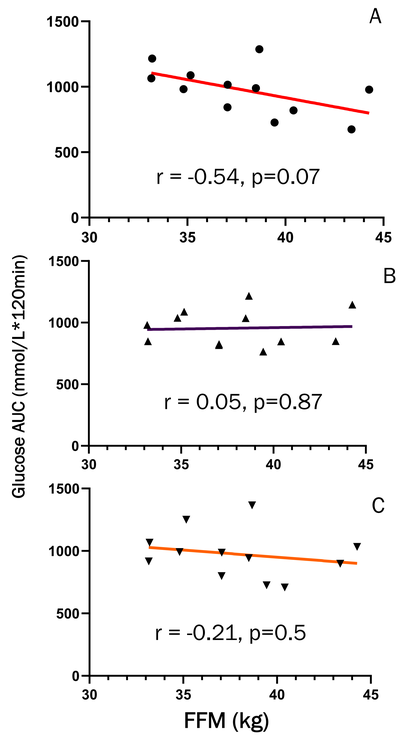


TABLE 3. CORRELATION MATRIX FOR SELECTED EXERCISE, BODY COMPOSITION AND GLUCOSE METABOLISM PARAMETERS

	Total MM	Lower body 1RM	TWL - HWLR	TWL - LWHR	Glucose foldchange - HWLR	Glucose foldchange - LWHR
Lower body 1RM	0,51‡					
TWL - HWLR	0,34	0,95*				
TWL - LWHR	0,46	0,94*	.			
Glucose foldchange - HWLR	0,47	0,16	-0,01	0,08		
Glucose foldchange - LWHR	0,16	0,68*	0,75*	0,63*	.	
Glucose AUC - Control	- 0,54‡	-0,04	-0,02	-0,08	-0,45	-0,26

*Statistically significant (*p≤0.05) and almost statistically significant result (‡p=0.07) are shown in bold.*

DISCUSSION & CONCLUSION

- Although glucose tolerance seems to be associated with total FFM in PMW, this relationship is blunted by prior RT.
- Although HWLR has produced a lower TWL than LWHR, both protocols had significant and similar effects on GT.
- Given the association between TWL and glucose fold change after LWHR, but not HWLR, the effect of each protocol on muscle glucose uptake and utilisation might be driven by different mechanisms.

ACKNOWLEDGMENTS

Fonds de recherche Santé Québec
CMDO Réseau de recherche en santé cardiométabolique, diabète et obésité
Centre de recherche sur le vieillissement
CENTRE DE RECHERCHE CHUS
Université de Sherbrooke
Fonds d'appui à l'engagement étudiant (FAEE) de l'Université de Sherbrooke

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IS HEART RATE A RELIABLE TEST TERMINATION CRITERION WITH INDIVIDUALS UNDERGOING CHEMOTHERAPY FOR METASTATIC CANCER?

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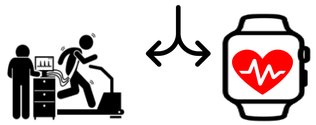
BACKGROUND: There are feasibility and acceptability issues in prescribing exercise intensity using cardiopulmonary exercise test or a predicted % of heart rate max (HRmax) in cancer patients undergoing chemotherapy. Therefore, submaximal testing is suggested, with predicted % HRmax or %HR reserve (HRR) and perceived exertion (PE) as stopping criteria. However, the HRmax prediction and the presence of autonomic dysfunction in cancer patients may increase the heterogeneity regarding the intensity at which the submaximal test is stopped, leading to suboptimal exercise prescription. **PURPOSE**: To assess if using a target HR (THR) as a stopping criterion during a submaximal test effectively translates into a proper intensity during subsequent exercise sessions in cancer patients undergoing chemotherapy. **METHODS**: Eleven individuals (57±7 years) undergoing treatments for metastatic cancer performed a modified YMCA (mYMCA) test. Participants were separated into two groups: REACH (n=5) who terminated the test because they reached the THR (±10 bpm) and No-REACH (n=6) who terminated the test without reaching the THR. The following measures were collected during the mYMCA and two different exercise sessions (high-intensity interval exercise [HIIE] and moderate-intensity exercise [MICE]): HR, PE (Borg CR10 scale), capillary lactate (La^-) and power output. **RESULTS**: During the last complete stage of the mYMCA, despite the difference in Δbpm from THR between groups (REACH: 6 [4] bpm, 74 [12] %HRR; No-REACH: 21 [13] bpm, 60 [14] %HRR; p=0.002), there was no group difference for PE (REACH: 7 [3], No-REACH: 8 [2]; p=0.08) and La^- (REACH: 5.5 [1.2], No-REACH: 5.5 [4.5]; p=0.92). Except for PE at the end of MICE (REACH: 3 [2] vs. No-REACH: 5 [1]; p=0.02), there was no difference between REACH and No-REACH for end-session La^- (HIIE: 4.9 [1.7] vs. 4.4 [3.2]; p=0.37; MICE: 2.8 [1.6] vs. 3.7 [2.1]; p=0.43) nor for PE at the end of HIIE (5 [4] vs. 6 [6]; p=0.27). **CONCLUSION**: These results suggest that using HR as the only stopping criterion for a submaximal test may lead some cancer patients to exceed the targeted submaximal threshold and perform a near-maximal test. These results raise the relevance of combining objective and subjective intensity measures to provide a personalized exercise prescription

Introduction

Exercise prescription[1]



%HR (maximal [MHR], reserve [HRR])

Cancer patients (e.g., ANS dysfunctions)

Feasibility
Acceptability[2]

→ Alternative[3]

Submaximal

RPE

OR

MHR/ HRR

↑ heterogeneity[4] regarding the intensity at which test is stopped.

Objective

To assess if using a target HR as a stopping criterion during a submaximal test effectively translates into a proper intensity during subsequent exercise sessions in cancer patients undergoing chemotherapy.

Methods

Participants 11 individuals (57 ± 7 years) undergoing treatments for metastatic cancer (ECOG ≤ 1).

Submaximal test (mYMCA)

1st stage (3 min.) : 25 W					
HR (bpm)		**< 80**	**80-89**	**90-100**	**100**
2nd stage (3 min.)	♂	105 W	85 W	65 W	45 W
	♀	85 W	70 W	55 W	40 W
Subsequent stages: + 20 W ♂ / + 15 W ♀					
TEST TERMINATION CRITERIA: [La^-] > 4 mmol/l AND **A)** 80% estimated HRR ± 10 BPM or **B)** PE reached ≥ 8/10					

Measures collected (test & sessions)

Lactate [La^-], HR, perceived exertion (PE), power output (PO).

Exercise prescription

High-intensity exercise (HIIT): 10 x 1 min @ 100% end-stage PO, with 2 min rest @ 25%

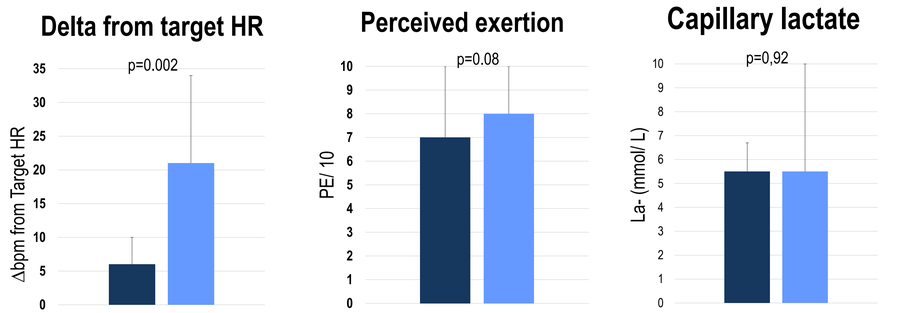
Moderate-intensity exercise (MICT): 1 x 30 min. @ 50% end-stage PO

Groups

1) **REACH** (n=5) having reached target HR
2) **No-REACH** (n=6) not having reached target HR

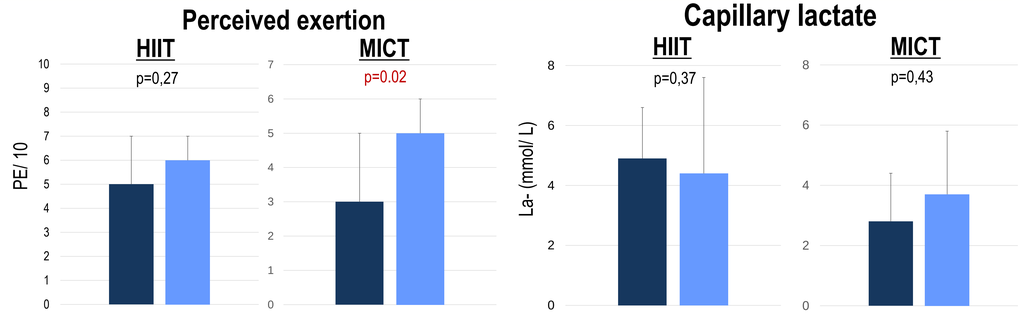
Results

Last completed stage of mYMCA



* Data: median [Interquartile range]

Exercise sessions: end-session values



Discussion & conclusion

Using HR as the **only** stopping criterion for a submaximal test with cancer patients may lead to **A)** exceed the targeted submaximal threshold and **B)** perform a near-maximal test.

These results raise the relevance of combining **objective** and **subjective** intensity measures to provide a personalized exercise prescription.

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Supported by the Sylvain Poissant Foundation.