From physical activity to physical fitness: Implications in Pediatric Obesity

EGEA edition 8
International conference

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French National Observatory for Physical Activity & Sedentary Behavior (ONAPS)

European Childhood Obesity Group (ECOG)

Obesity Clinical and Research Group (CALORIS)

Clermont Auvergne UNIVERSITY

MAIN QUESTIONS

- ✓ Distinction between physical activity / fitness / abilities
- ✓ What about physical fitness in pediatric obesity ?
- ✓ What are the first steps for practitioners when it comes to PA and PF in obese children ?
- ✓ Physical activity… Is it all about energy expenditure?

Physical Activity

Body Movements generated by skeletal muscle contractions and favoring an increase of energy expenditure > to the Resting Metabolic Rate

70-75%	Resting Metabolic Rate
20-25%	Physical Activity EE
5-8%	Thermic Effect Food
100%	Total Energy Expenditure

Physical Activity

Body Movements generated by skeletal muscle contractions and favoring an increase of energy expenditure > to the Resting Metabolic Rate

Physical Inactivity

Not reaching Physical activity recommendations

Body Movements generated by skeletal muscle contractions and favoring an increase of energy expenditure > to the Resting Metabolic Rate

Physical Activity

Physical Inactivity

Not reaching Physical activity recommendations

Sedentary Behaviors

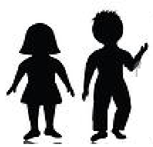
Behaviors with EE <1.5 Mets (SBRN)

Recommandations

< 6 ans	3 h		<1 h
5-18 ans	60min	>60%	<2 h

Age	Type	Frequency	Benefit
< 12 months	Supervised play Safe environments (e.g. tummy time, games with siblings to encourage reaching, grasping, pulling and pushing.)	**Daily** for 5-15 min sessions.	Supports brain development. Builds strong bones and muscles. Improves movement and co-ordination skills. Promotes social skills.
1-5 years	Supervised games promoting reaching, stretching, crawling, running, kicking, throwing and catching	**At least** 3hr/day (short bouts of 10-20 minutes)	Builds strong hearts, bones and muscles. Improves balance and co-ordination skills. Helps achieve and maintain a healthy weight. Encourage self-confidence and independence.

O'Malley G & Thivel D, 2016; ECOG EBook http://ebook.ecog-obesity.eu/

Age	Type	Frequency	Benefit
5-12 years 	MVPA With impacts to promote bone health (e.g. skipping, jumping, running & dancing).	**At least 60 min/day** **At least 3 days/week high impact**	Supports concentration and learning Builds strong bones and muscles. Improves movement and co-ordination skills Improves balance and co-ordination skills. Helps achieve and maintain a healthy weight. Encourage self-confidence and independence. Helps the child to make new friends and to Develop social skills.
13-17 years 	MVPA With impacts to promote bone health Active transportation Organised and non-organised sports games PE and other activities at home, school, work and in the community.	**At least 60 min/day** **At least 3 days/week high impact**	Supports concentration and learning Builds strong bones and muscles. Improves balance and co-ordination skills. Helps achieve and maintain a healthy weight. Encourage self-confidence and independence. Helps the child to make new friends and to develop social skills. Improve cardiometabolic health, Enhances mental health and wellbeing, Supports cardiorespiratory fitness

O'Malley G & Thivel D, 2016; ECOG EBook http://ebook.ecog-obesity.eu/

thebmj

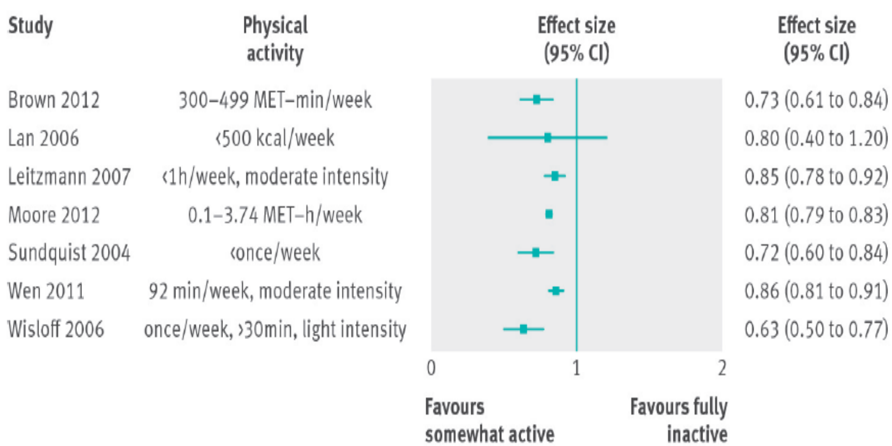
BMJ 2015;350:h23 doi: 10.1136/bmj.h23 (Published 21 January 2015)

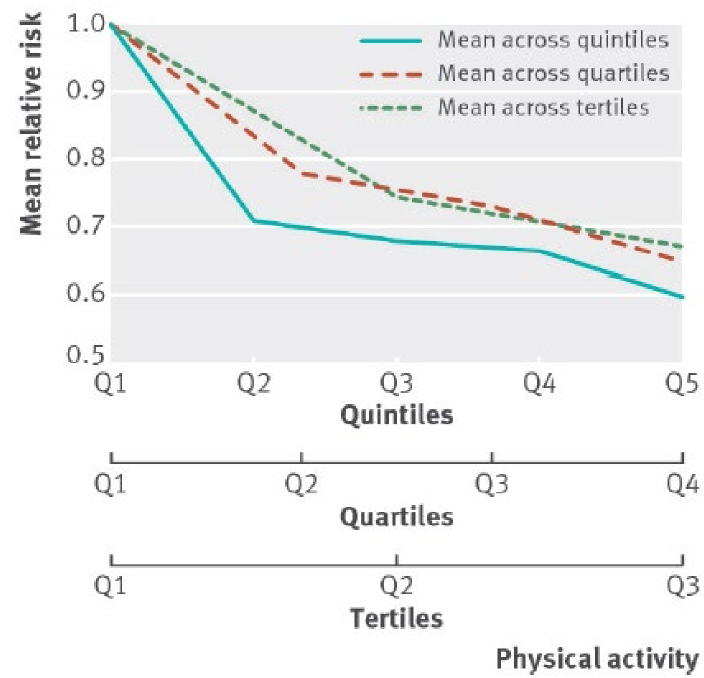
ANALYSIS

Global health agenda on non-communicable diseases: has WHO set a smart goal for physical activity?

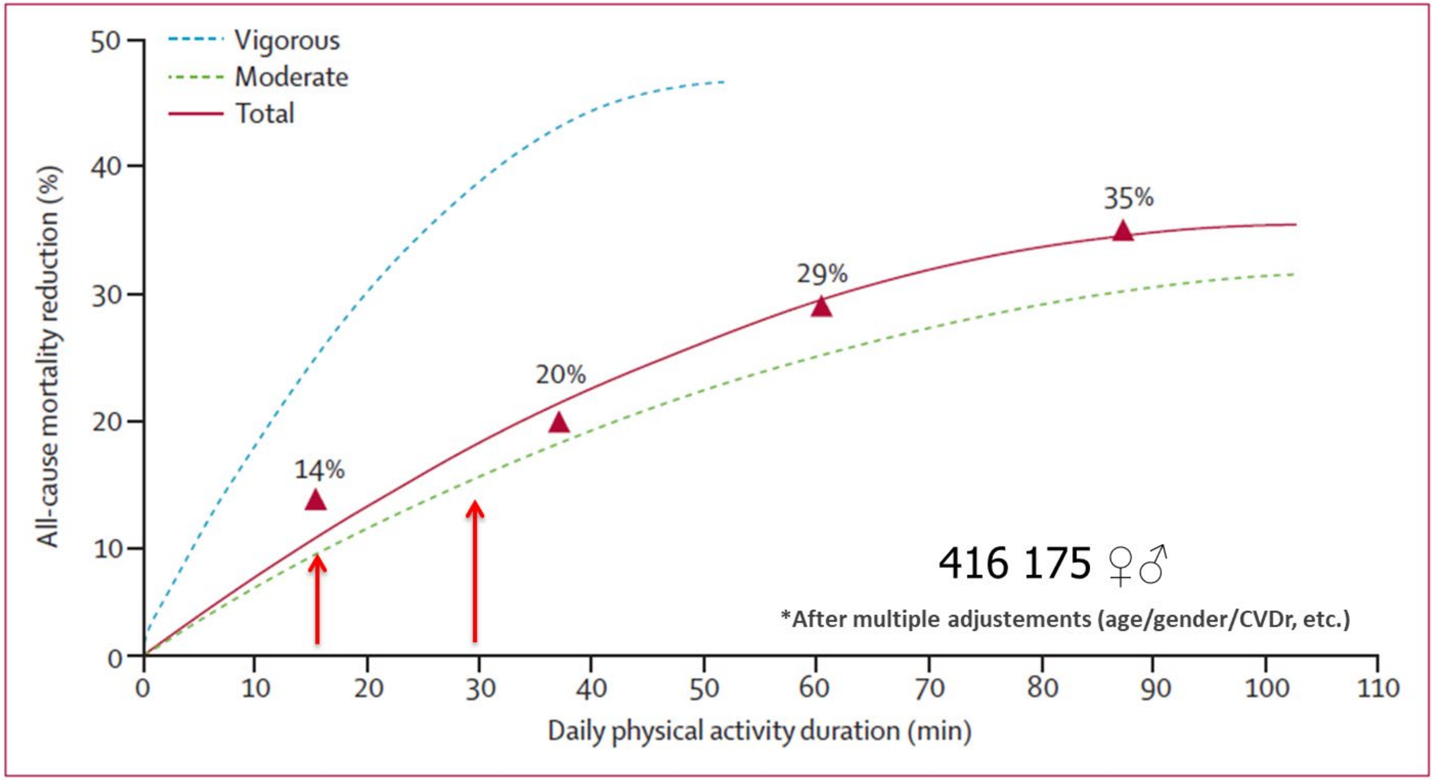
Philipe de Souto Barreto argues that, to reduce premature mortality, policies should focus on getting fully inactive people to do a little physical activity rather than strive for the entire population to meet current physical activity recommendations

Philipe de Souto Barreto *researcher*

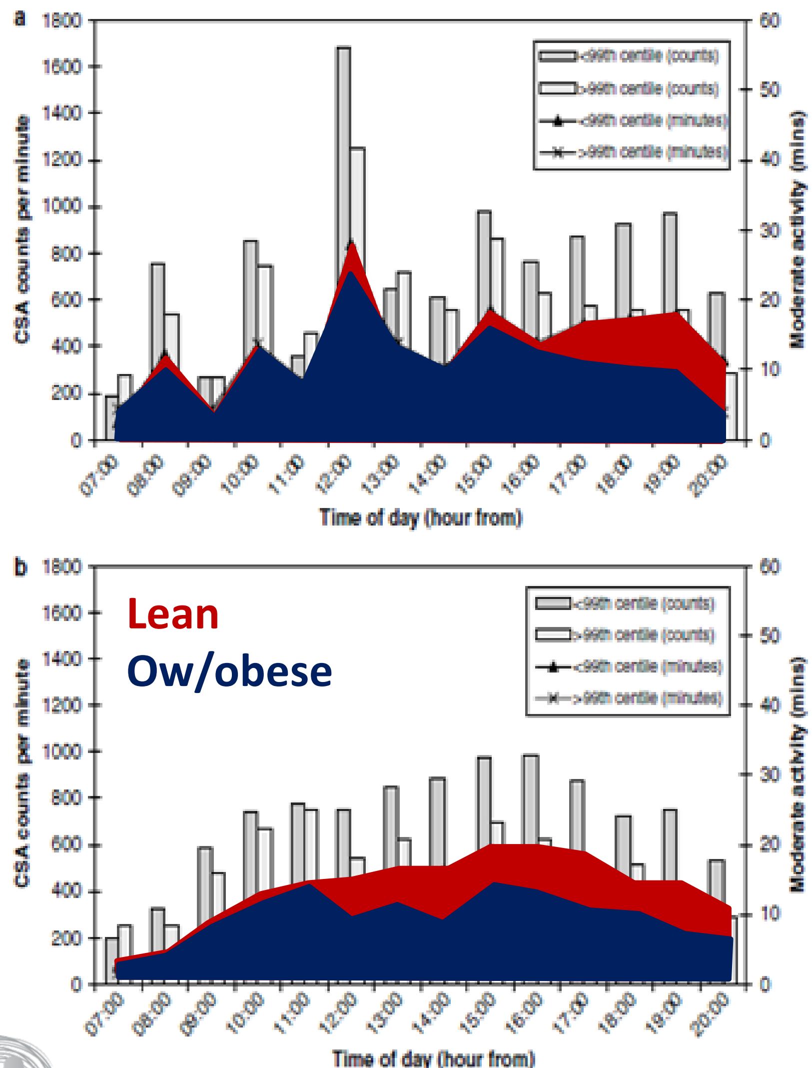


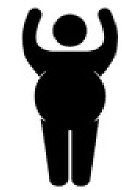


Minimum amount of physical activity for reduced mortality and extended life expectancy: a prospective cohort study



Pang wen *et al.* Lancet 378:1244-53, 2011





Lower PA level

Sedentariness
Physical Inactivity

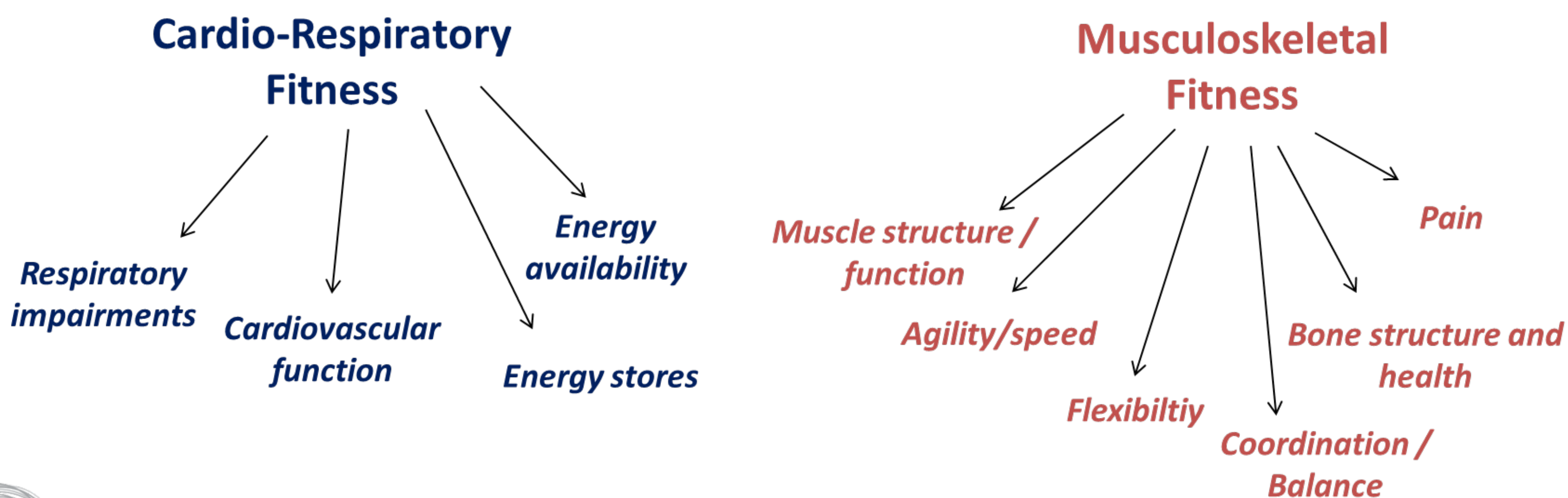
Lower Physical Fitness

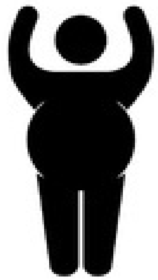
↑ Perceived Exertion / ↓ engagement / ↑ drop out

Page et al., 2005, IJO

Physical Fitness

Capacity to perform daily activities with no pain or excessive fatigue





Capacity to perform daily activities with no pain or excessive fatigue

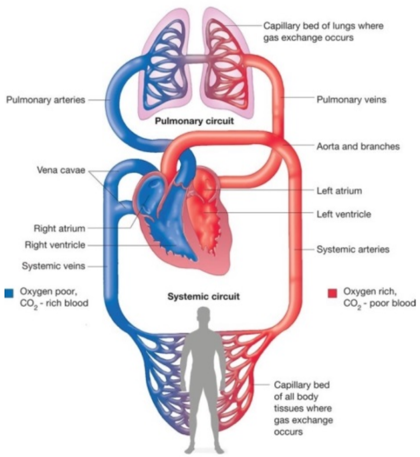
Physical Fitness

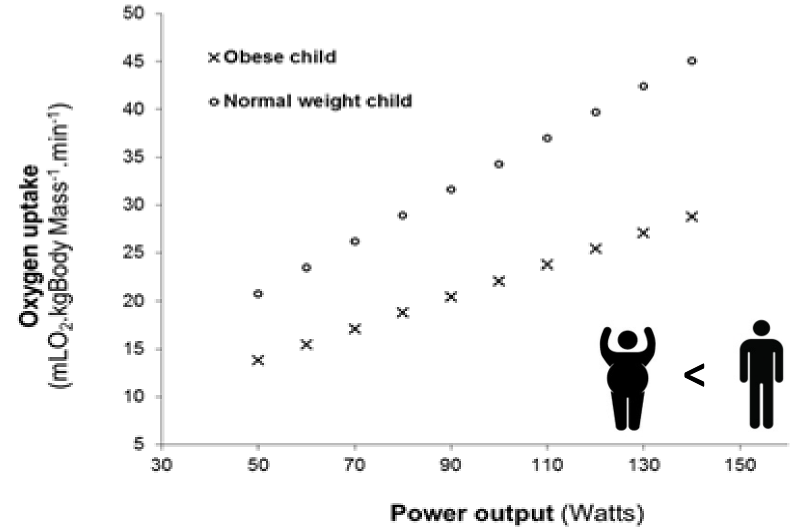
Cardio-Respiratory Fitness

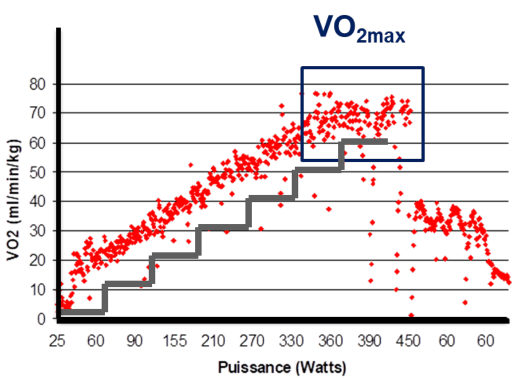
- *Respiratory impairments*
- *Cardiovascular function*
- *Energy stores*
- *Energy availability*

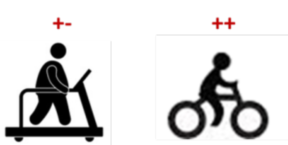
Musculoskeletal Fitness

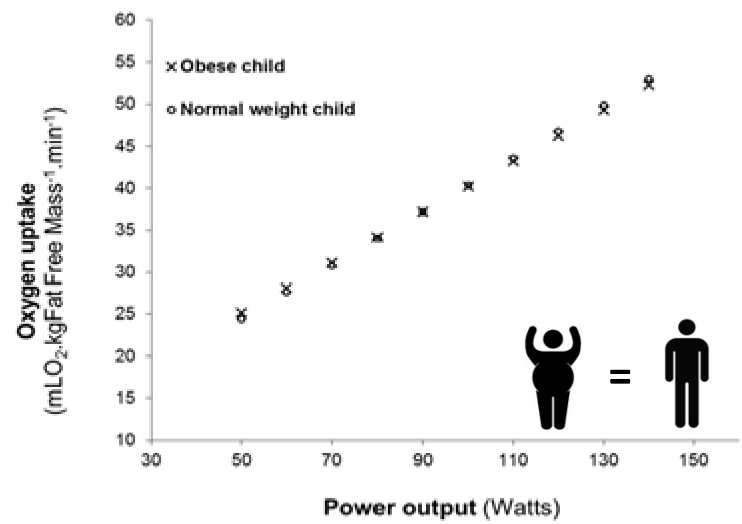
- *Muscle structure / function*
- *Agility/speed*
- *Flexibiltiy*
- *Coordination / Balance*
- *Bone structure and health*
- *Pain*











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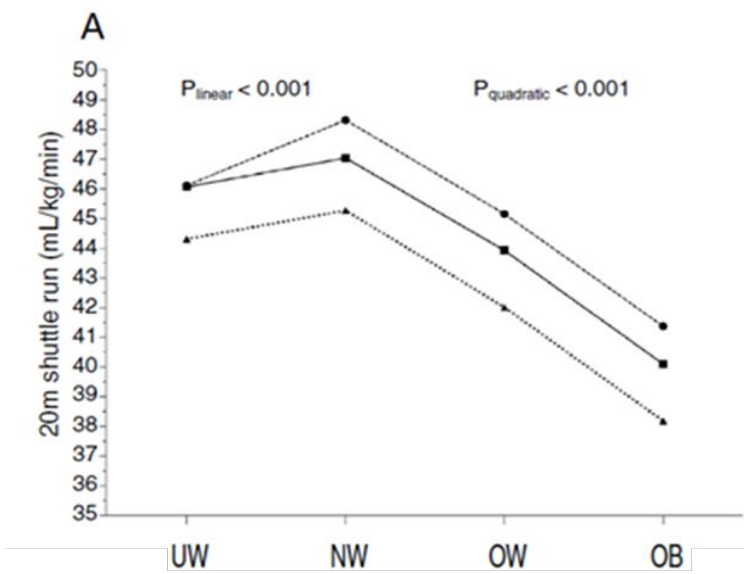
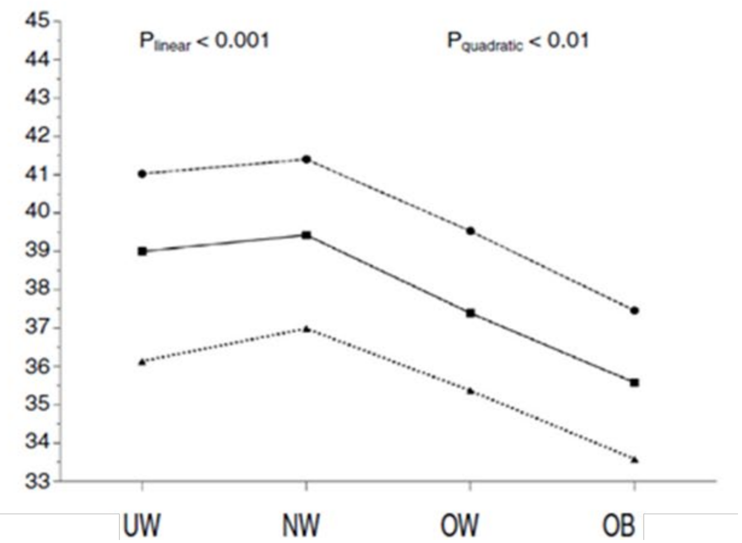
Thivel D & Aucouturier J, 2016; ECOG EBook http://ebook.ecog-obesity.eu/



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www.jped.com.br

ORIGINAL ARTICLE

Health-related physical fitness and weight status in 13- to 15-year-old Latino adolescents. A pooled analysis☆

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[b] Universidad del Rosario, Escuela de Medicina y Ciencias de la Salud, Centro de Estudios en Medición de la Actividad Física (CEMA), Bogotá, Colombia
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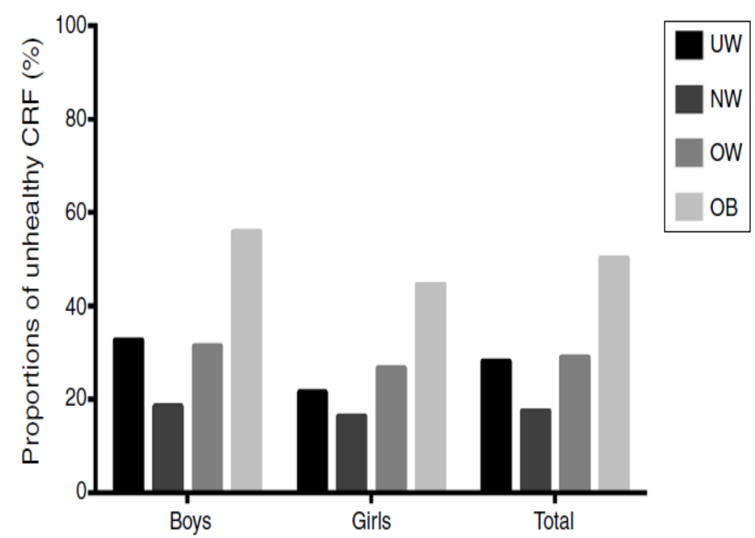
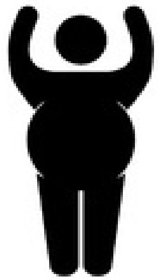
KEYWORDS
20-m shuttle run;
Muscular strength;
Aerobic fitness;
Weight status;
Body mass index

Abstract
Objective: The aim of this study was to investigate the relation between health-related physical fitness and weight status in 13- to 15-year-old Latino adolescents.
Method: The final sample consisted of 73,561 adolescents aged 13–15 years (35,175 girls) from Chile (n = 48,771) and Colombia (n = 24,790). Cardiorespiratory and musculoskeletal fitness were measured using 20-m shuttle run (relative peak oxygen uptake – VO_{2peak}) and standing broad jump test (lower body explosive strength), respectively. The International Obesity Task Force definition was used to define weight status (i.e., underweight, normal weight, overweight, and obese).
Results: The present study found an inverted J-shape relationship between body mass index, cardiorespiratory fitness, and musculoskeletal fitness in both genders and all age groups (p < 0.01). Results also suggest that underweight adolescents, and not just overweight and obese adolescents, have lower odds of having a healthy cardiorespiratory fitness (based on new international criterion-referenced standards) profile when compared with their normal weight peers, except in girls aged 14 (p = 0.268) and 15 years (p = 0.280).





Capacity to perform daily activities with no pain or excessive fatigue

Physical Fitness

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Knee extension strength in obese and nonobese male adolescents

Achref Abdelmoula, Vincent Martin, Antoine Bouchant, Stéphane Walrand, Cédric Lavet, Michel Taillardat, Nicola A. Maffiuletti, Nathalie Boisseau, Pascale Duché, and Sébastien Ratel

Abstract: The aim of the present study was to compare "absolute" and "relative" knee extension strength between obese and nonobese adolescents. Ten nonobese and 12 severely obese adolescent boys of similar chronological age, maturity status, and height were compared. Total body and regional soft tissue composition were determined using dual-energy X-ray absorptiometry (DXA). Knee extensors maximum voluntary contraction (MVC) torque was measured using an isometric dynamometer at a knee angle of 60° (0° is full extension). Absolute MVC torque was significantly higher in obese adolescents than in controls. However, although MVC torque expressed per unit of body mass was found to be significantly lower in obese adolescent boys, no significant difference in MVC torque was found between groups when normalized to fat-free mass. Conversely, when correcting for thigh lean mass and estimated thigh muscle mass, MVC torque was significantly higher in the obese group (17.9% and 22.2%, respectively; P <0.05). To conclude, our sample of obese adolescent boys had higher absolute and relative knee extension strength than our nonobese controls. However, further studies are required to ascertain whether or not relative strength, measured with more accurate in vivo methods such as magnetic resonance imaging, is higher in obese adolescents than in nonobese controls.

Key words: adolescence, knee extensors, maximal strength, muscle mass, obesity.

Résumé : Le but de la présente étude a été de comparer la force « absolue » et « relative » des extenseurs du genou entre des adolescents obèses et non-obèses. Nous avons comparés 10 adolescents non-obèses et 12 adolescents sévèrement obèses d'âge chronologique, de statut pubertaire et de taille similaires. La composition corporelle totale et régionale du corps a été déterminée à partir de l'absorptiométrie biphotonique à rayons-X (DEXA). La force de contraction volontaire maximale (FMV) des extenseurs du genou a été mesurée en utilisant un dynamomètre isométrique à un angle articulaire de 60° (0° = extension complète). FMV a été significativement plus élevée chez les adolescents obèses comparés au groupe contrôle. Néanmoins, alors que FMV rapportée à la masse corporelle a été significativement plus faible chez les adolescents obèses, aucune différence significative de FMV normalisée à la masse maigre totale n'a été observée entre les deux groupes d'adolescents. En revanche, lorsque FMV a été rapportée à la masse maigre ou à la masse musculaire estimée de la cuisse, les adolescents obèses ont présenté des valeurs significativement supérieures à celles des adolescents normo-pondérés (17,9 % and 22,2 %, respectivement; P < 0,05). Pour conclure, notre groupe d'adolescents obèses a produit une FMV absolue et relative des extenseurs du genou plus élevée que les adolescents normo-pondérés. Des études supplémentaires sont néanmoins nécessaires pour savoir si la FMV relative estimée à partir de méthodes de mesures in vivo plus précises (c.-à-d., imagerie par résonance magnétique) est plus élevée chez les adolescents obèses.

Mots-clés : adolescence, extenseurs du genou, force maximale, masse musculaire, obésité.

Introduction

Although the cardiovascular and metabolic consequences of obesity have been studied extensively, less attention has been paid to investigating the impact of obesity on functional muscle abilities (Tsiros et al. 2011). It is becoming increasingly apparent from the adult literature that obesity is associated with reduced physical function; however, paediatric literature in this area is extremely limited (Tsiros et al. 2011). In particular, the function of the knee extensor muscles, which are highly involved in ambulatory and functional activities, has received little attention in the paediatric population. The high body mass carried by severely obese children could act as a chronic training stimulus generating favourable adaptations of the knee extensor muscles. Alternatively, the extra load associated with severe obesity could also restrain children's spontaneous physical activity (Nantel et al. 2011; Trost et al. 2001) and hence alter the function of

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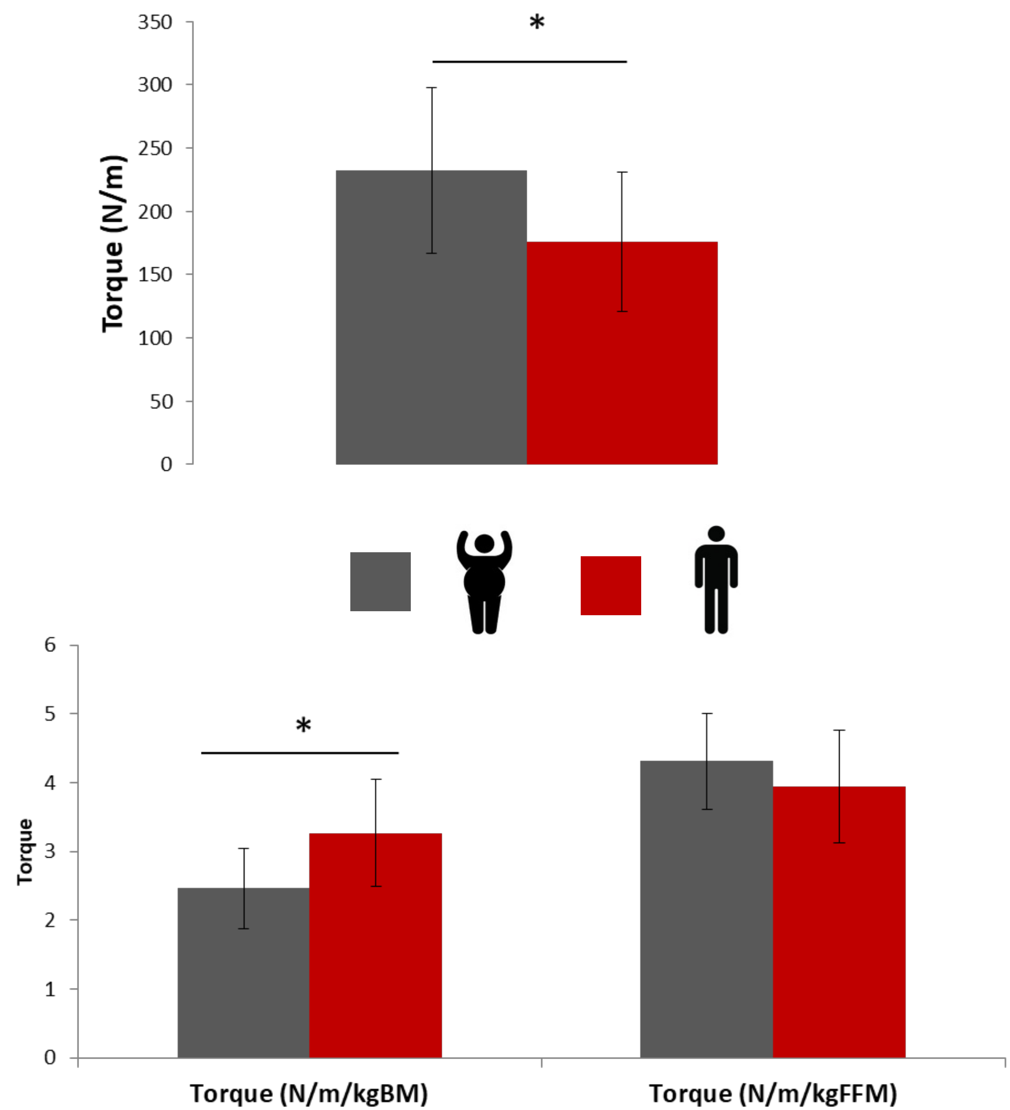

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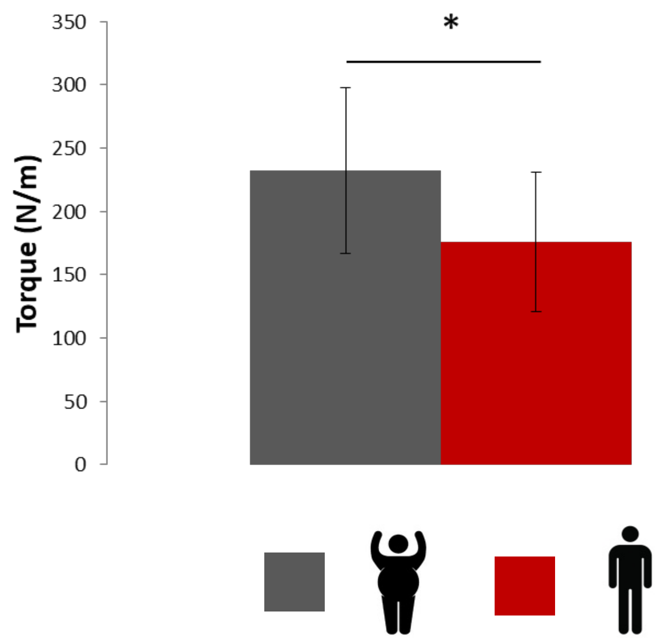
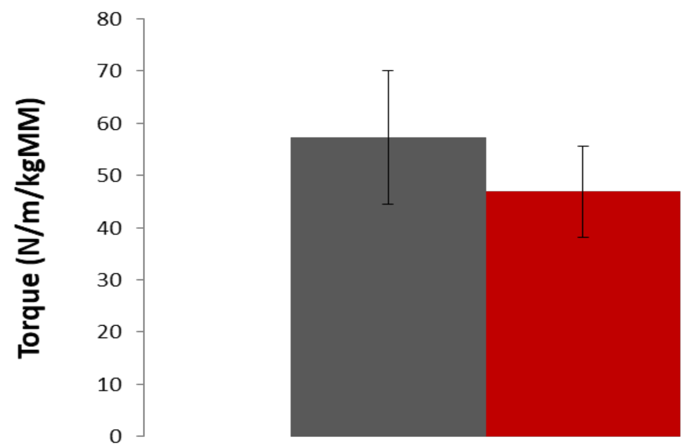
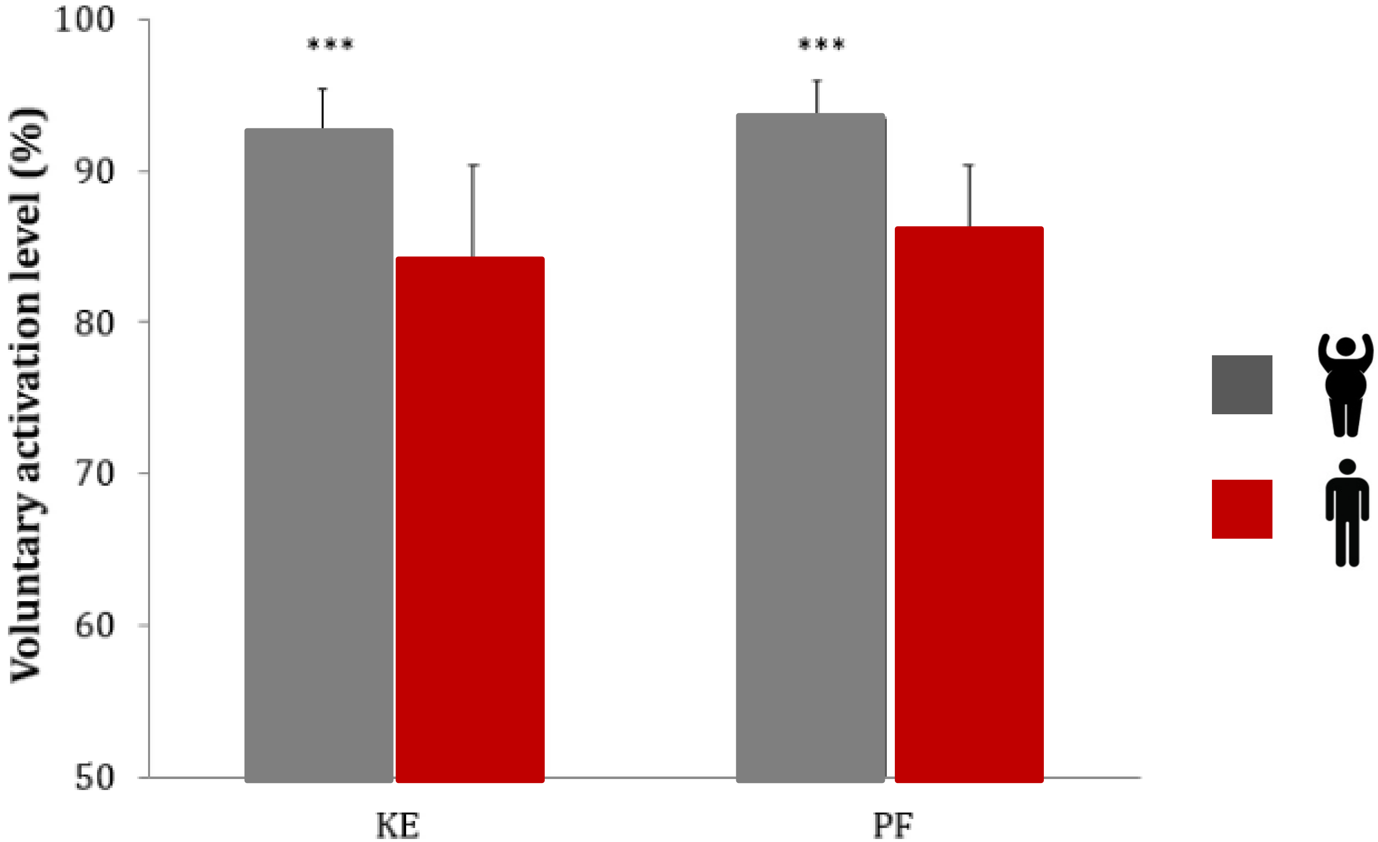
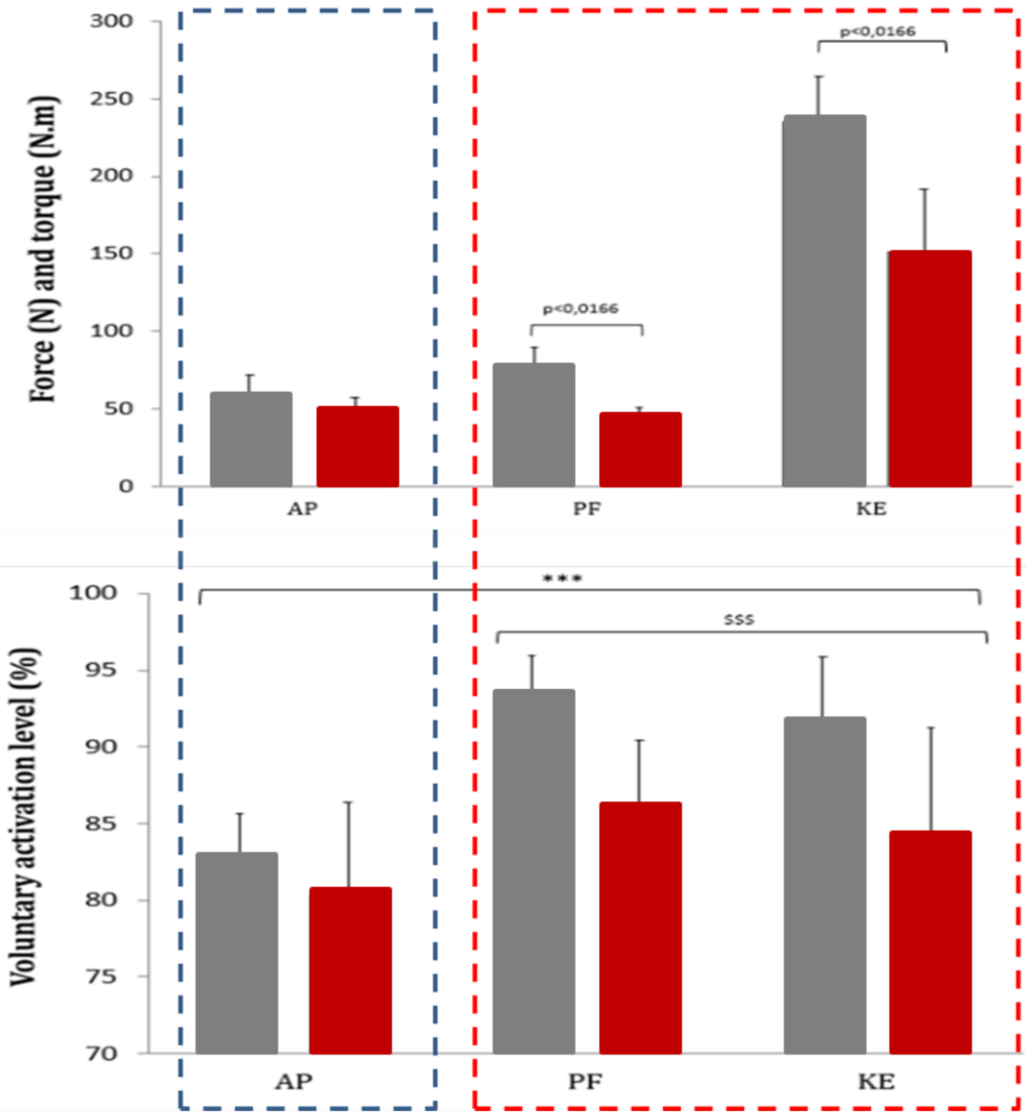


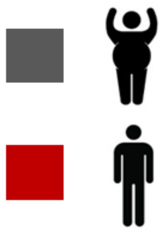




S. Garcia Vicencio, 2015

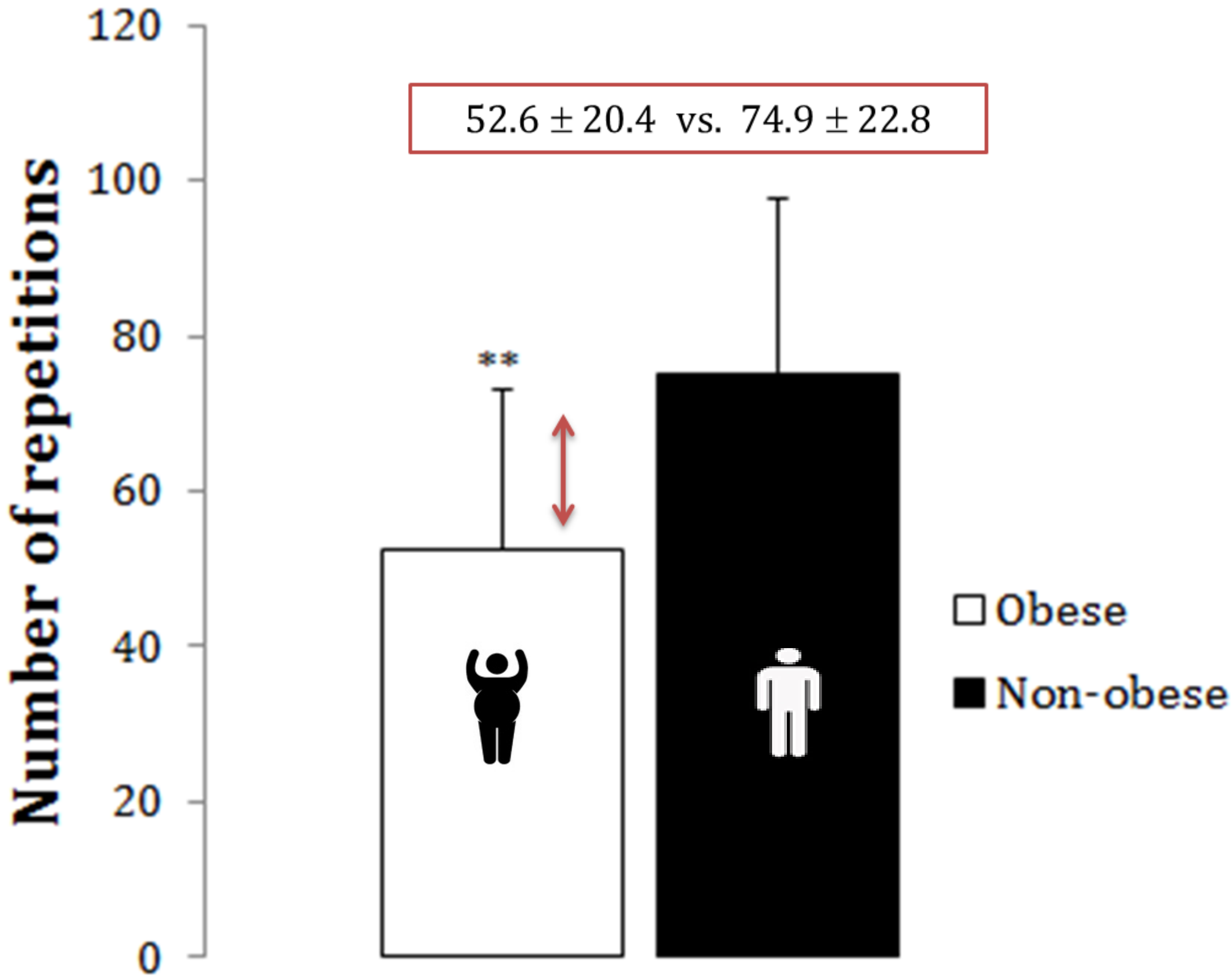


What about muscles that are not subject to body weight?



S. Garcia Vicencio, 2015

Peripheral fatigue OB>Lean



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S. Garcia Vicencio, 2015

Conclusion

The results of this systematic review demonstrate strong evidence that children and adolescents with obesity have reduced muscular fitness compared with their lean counterparts and that qualitative physical-activity based weight management interventions should be a key feature of weight management interventions.

Obesity Facts
The European Journal of Obesity
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www.karger.com/ofa

Review Article

Muscle Strength and Fitness in Pediatric Obesity: a Systematic Review from the European Childhood Obesity Group

David Thivel[a, b, c] Susanne Ring-Dimitriou[c, d] Daniel Weghuber[c, e, f] Marie-Laure Frelut[c, g] Grace O'Malley[c, h]

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to factors such as excessive body weight and increased inertia of the body. Our analysis also points out the lack of information regarding the role of age, maturation or sex in the current literature and reveals that routinely used field tests analysing overall daily muscular fitness in children with obesity provide satisfactory results when compared to laboratory-based data.

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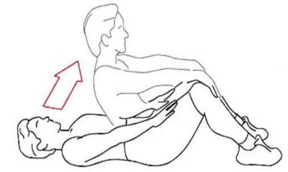
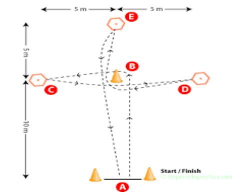
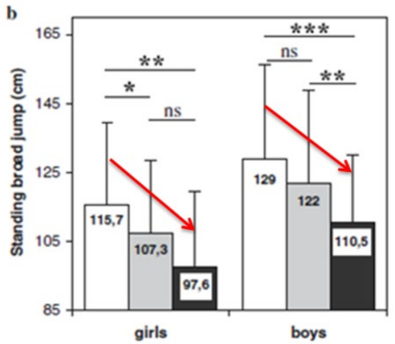
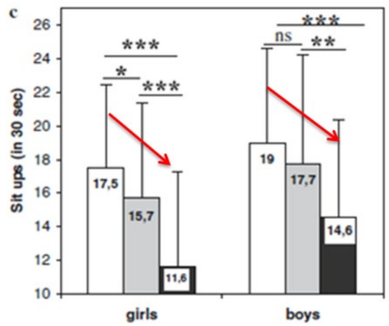
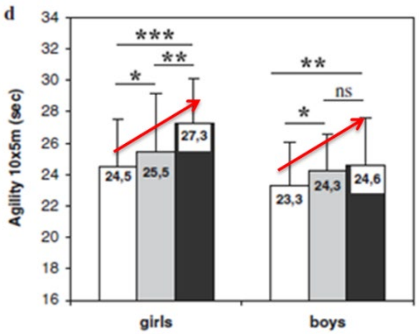
KARGER





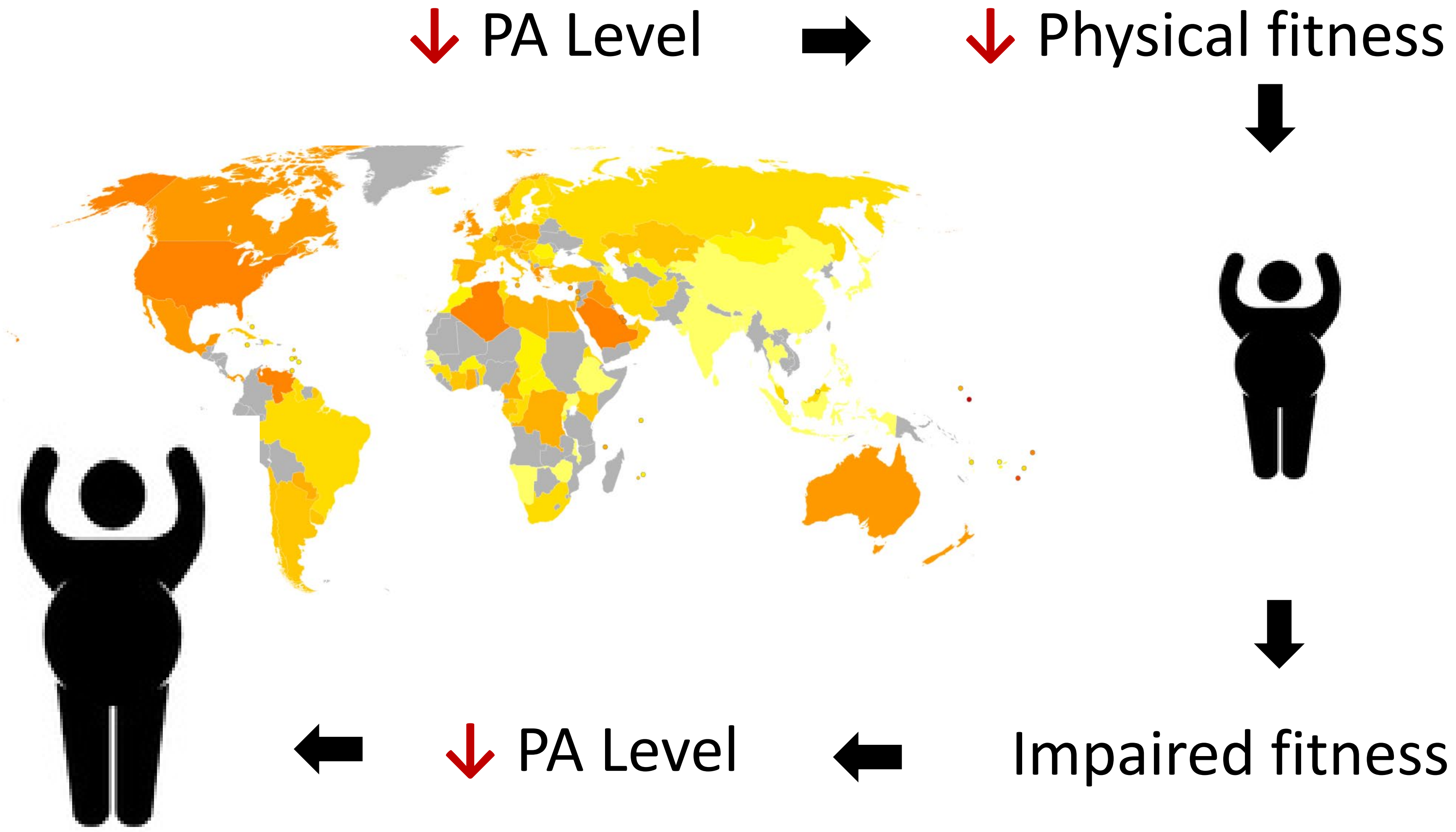


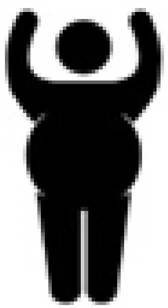




	Class of age I			
	UW (n: 68)	NW (n: 434)	OW (n: 85)	OB (n: 39)
Endurance (s)	108.9 ± 22.5	116.0 ± 21.2	126.5 ± 17.3	147.4 ± 15.0*
Speed (s)	4.5 ± 0.6	4.6 ± 0.5	4.7 ± 0.4	4.8 ± 0.2*
Agility time (s)	24.1 ± 5.0	23.1 ± 4.6	25.1 ± 4.7*	27.7 ± 2.7*
Agility errors (n)	0.4 ± 0.1	0.4 ± 0.2	0.5 ± 0.2	0.6 ± 0.1*
Long jump (m)	0.95 ± 0.17	0.92 ± 0.20	0.86 ± 0.19	0.75 ± 0.10*
P_{max} ($W \cdot kg^{-1}$)	29.2 ± 4.8	31.5 ± 6.3	26.1 ± 3.2	24.0 ± 4.0*
Balance errors (n)	1.1 ± 0.5	1.1 ± 0.4	1.6 ± 0.7	2.0 ± 0.5*
Handgrip (N)	104.8 ± 22.5	110.1 ± 21.3	113.3 ± 25.5	118.0 ± 22.0
Throw back ball (m)	3.58 ± 1.17	3.66 ± 1.15	3.66 ± 1.10	3.78 ± 0.81
Flexibility (cm)	1.76 ± 1.36	2.47 ± 1.32	2.30 ± 1.31	1.22 ± 1.13

Tokmakidis et al., 2006; Ceschia et al., 2015


↓ PA Level
↓ Physical fitness
Impaired fitness
↓ PA Level



Fitness impairments

↓

Barriers to PA ! **First objective**

↓

Effective evaluation (Eurofit, CPAFLA, CSEP…)

↓

Adapted PA-induced WL +++++

Role of Specialized practitioners as part of Obesity management

ECOG
European Childhood Obesity Group

European Childhood Obesity Group

International Journal of EXERCISE SCIENCE

Invited Editorial

Physical Activity and Physical Fitness in Pediatric Obesity: What are the First Steps for Clinicians? Expert Conclusion from the 2016 ECOG Workshop

GRACE O'MALLEY[1,2], SUSANNE RING-DIMITRIOU[2,3], PAULINA NOWICKA[2,11,12], ANDREA VANIA[2,13], MARIE-LAURE FRELUT[2,4], NATHALIE FARPOUR-LAMBERT[2,5], DANIEL WEGHUBER[2,6,7], and DAVID THIVEL[2,8,9,10]

First recommended clinical steps:

1. Estimate PA level
2. Identify barriers to PA and potential fitness impairments
3. Encourage the family to meet age-appropriate PA guidelines
4. **Refer the child for exercise-testing and physiotherapy as appropriate**

Multidisciplinary interventions based on ADAPTED Physical Activity

Fine prescriptions

modalities; frequency; intensities; durations; …chronobiology…

- ✓ Health-related quality of life (Fitness!!)
- ✓ Metabolic profile
- ✓ Body composition
- ✓ Physical fitness
- ✓ Academic achievement
- ✓ ***Appetite control***

British Journal of Nutrition (2011), **106**, 1768–1769

NS British Journal of Nutrition

Letter to the Editor

Is physical activity in weight management more about 'calories in' than 'calories out'?

(First published online 29 June 2011)

In the field of obesity research, physical activity has traditionally been considered a strategy to use energy. Most treadmills and exercise bikes display 'calories' and many people are obsessed about burning those extra 'calories', often only to eat or drink them right back. Although the results of exercise programmes designed to reduce body weight are generally considered disappointing, there is no doubt that some individuals can experience substantial weight loss with regular physical activity. In recent intervention studies, the same amount of supervised aerobic exercise has been shown to result in substantial weight loss in some individuals and even weight gain in others[1,2]. Thus, there appears to be almost no relationship between the amount of energy expended during exercise and changes in body weight. For example, a 10 lb (4·5 kg) weight loss within 10 weeks of taking up an exercise programme would require the burning of 35 000 kcal (146 440 kJ), which would correspond to about 1 h of intensive aerobic exercise daily. However, as recently reviewed[1], physical activity is more than simply a strategy to use energy. The stimulus of exercise provides a wide range of metabolic adaptations that improve overall health and can be associated with marked reductions in abdominal fat and increases in skeletal muscle mass[3].

In addition to the positive effects of exercise on energy expenditure and metabolism, the discussion about the benefits of exercise on weight management generally fails to acknowledge the substantial positive impact that physical activity can have on ingestive behaviour. We hypothesise that while the

might improve appetite control in short-duration sleepers. Given that contemporary society is generally characterised by high levels of mental stress and impaired sleep[9], regular physical activity might help buffering these stressors and breaking the stress-feeding habits. This concept is supported by studies showing that stress-relief activities (e.g. relaxation, yoga, meditation, etc.), which do not burn a large amount of energy *per se*, are generally effective in reducing emotional eating episodes and reducing body weight[10,11]. Thus, therapeutic processes that occur with stress-reduction interventions have the potential to promote weight loss in some individuals despite their minimal impact on energy expenditure.

We therefore propose that a substantial proportion of the variance in the contribution of exercise on body weight can be explained by positive effects of exercise on ingestive behaviour in individuals in whom overeating is primarily driven by stress, depression, poor self-esteem or unrestorative sleep, all of which can be improved with regular exercise. Accordingly, weight loss in these individuals is more likely to be explained by the impact of exercise on energy intake rather than energy expenditure. As a corollary, physical activity is probably less likely to produce weight loss in individuals not prone to overeat for the reasons mentioned above, because it does not help them reduce their energy intake.

Our hypothesis not only helps explain the remarkable inter-individual variation in exercise-induced weight loss but also readily explains why the amount of weight that some individ-

Physical Activity in Children and Youth May Have Greater Impact on Energy Intake Than Energy Expenditure

The management of energy balance requires addressing both energy intake and expenditure. Increasing physical activity, reducing sedentary behavior, and promoting a healthy and low-calorie diet are the main strategies used to limit and reduce childhood obesity.[1] Interventions that aim to reduce energy intake typically focus on diet, whereas those focused on energy expenditure tend to focus on physical activity and sedentary behavior. However, as published in a previous issue of this journal, physical activity and eating patterns are not independent and are closely related.[2] The available evidence even suggests that alterations in physical activity and sedentary behavior may not have the expected impact on daily energy expenditure but may instead have a strong impact on energy intake.

Concerning the impact of exercise on daily energy expenditure, it has been reported that total daily energy expenditure is not significantly changed by a bout of exercise in obese youth, as they tend to decrease their spontaneous physical activity after the session to compensate for the extra energy expended during exercise.[3,4] However, despite having no impact on daily energy expenditure, a bout of intense exercise does appear to reduce the positive energy balance in this population through a reduction in food intake.[4] In contrast to the impact of physical activity, sedentary behaviors such as seated video games, TV viewing, or waking bed rest are reported to have the opposite effect.[5,6] Although traditionally these activities were thought to contribute to the progression of weight gain and obesity through the very low level of energy expenditure they generate, they have also been shown to increase subsequent energy intake in lean or obese adolescents.[7] Interestingly, screen time use has been reported to substantially increase food intake in the absence of hunger, suggesting that caution must be exercised particularly for this type of sedentary behavior. Sadly, most kids and youth exceed the guidelines, which recommend no more than 2 hours of recreational screen time per day.

Collectively, the available evidence suggests that in both lean and obese youths, physical activity and sedentary behavior mainly affect energy balance through their impact on energy intake. This finding leads us to reconsider the classical role of these behaviors in energy balance and suggests that these findings should be taken into consideration when making future recommendations for body weight control. Health care practitioners should be particularly aware of this interconnection between daily activities and food intake when prescribing physical activity or nutritional advice if they want to optimize the potential of their interventions.

Sincerely,

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The authors report no conflicts of interest.

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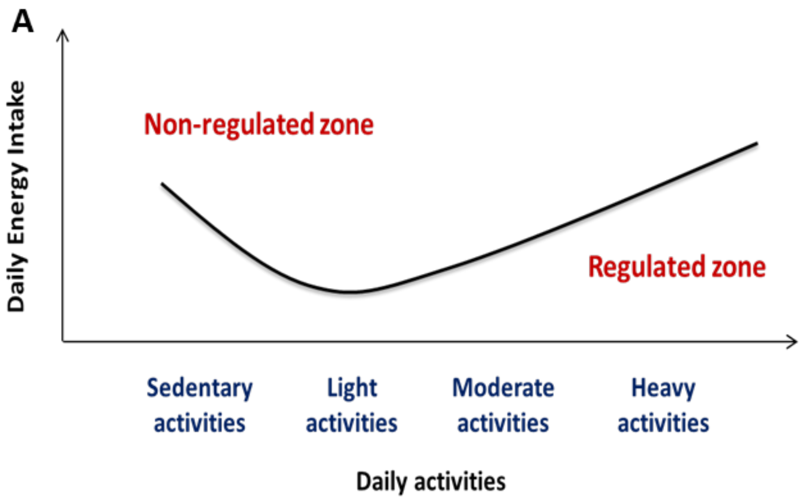
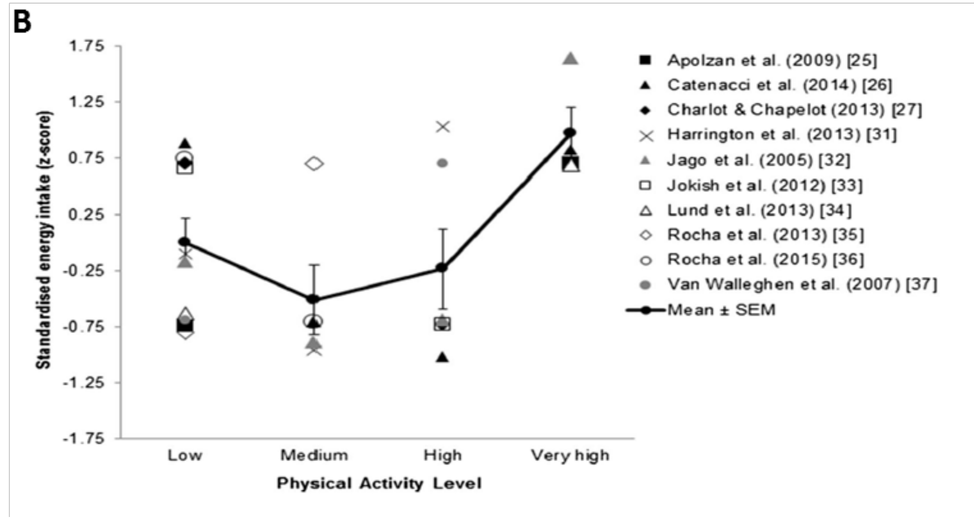
7. Thivel D, Isacco L, Aucouturier J, et al. Intensive exercise and physical inactivity have opposite effects on daily energy intake and energy balance in obese adolescents. *Obes Facts*. 2012;5(suppl 1):273.





Appetite control and energy balance: impact of exercise

obesity reviews (2015) 16 (Suppl. 1), 67–76

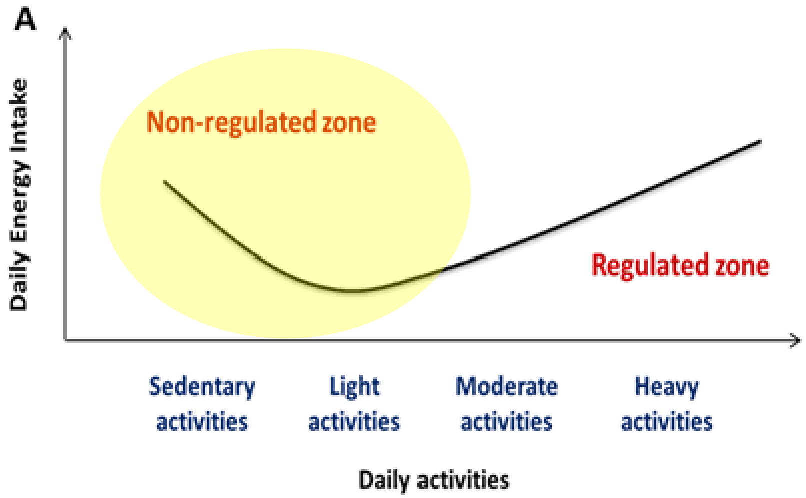
J. E. Blundell[1], C. Gibbons[1], P. Caudwell[2], G. Finlayson[1] and M. Hopkins[3]

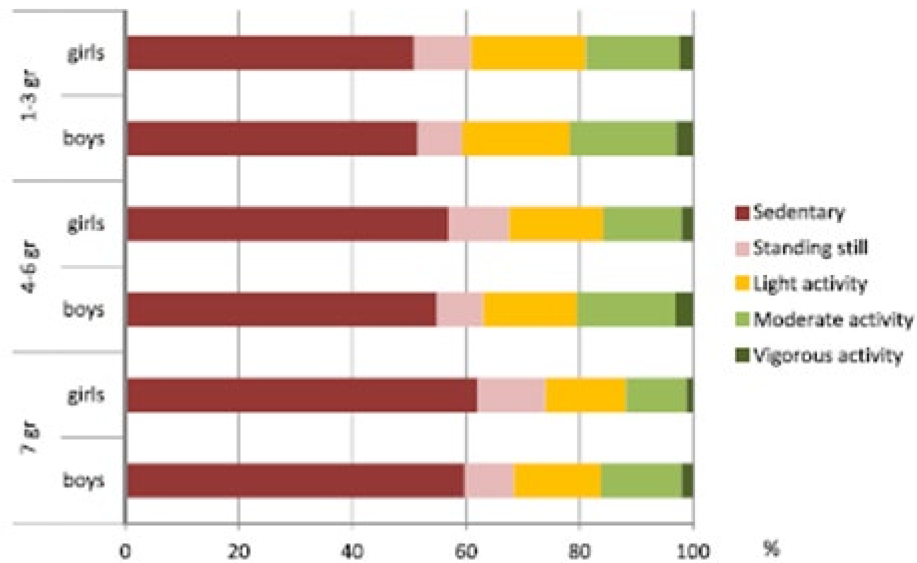
Sports Med
DOI 10.1007/s40279-016-0518-9

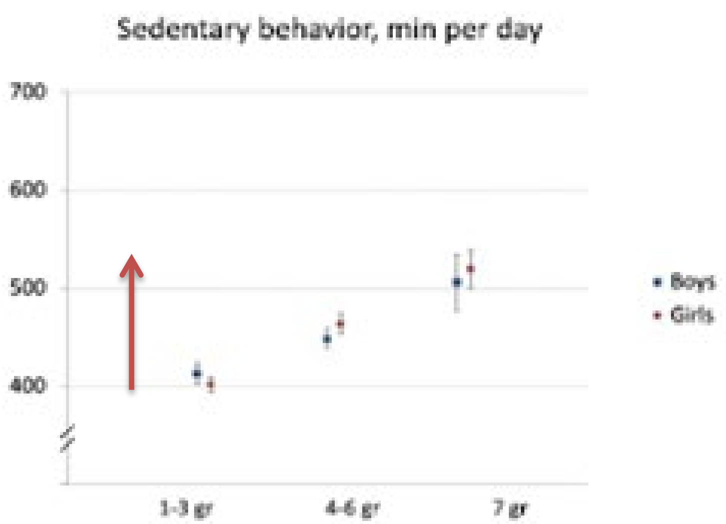
SYSTEMATIC REVIEW

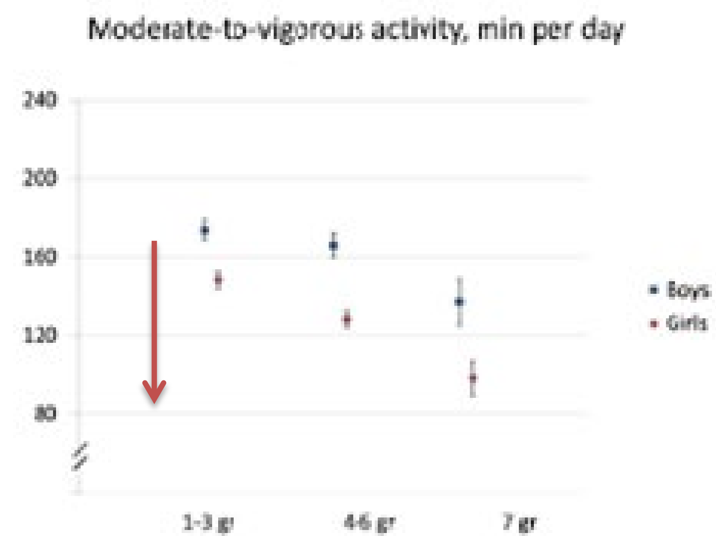
Does Habitual Physical Activity Increase the Sensitivity of the Appetite Control System? A Systematic Review

Kristine Beaulieu[1] · Mark Hopkins[1,2] · John Blundell[1] · Graham Finlayson[1]

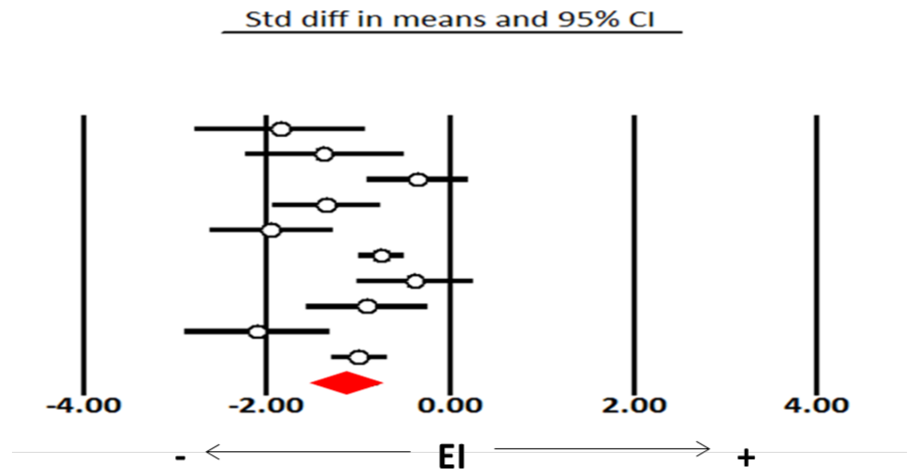

A
Daily Energy Intake
Non-regulated zone
Regulated zone
Sedentary activities
Light activities
Moderate activities
Heavy activities
Daily activities

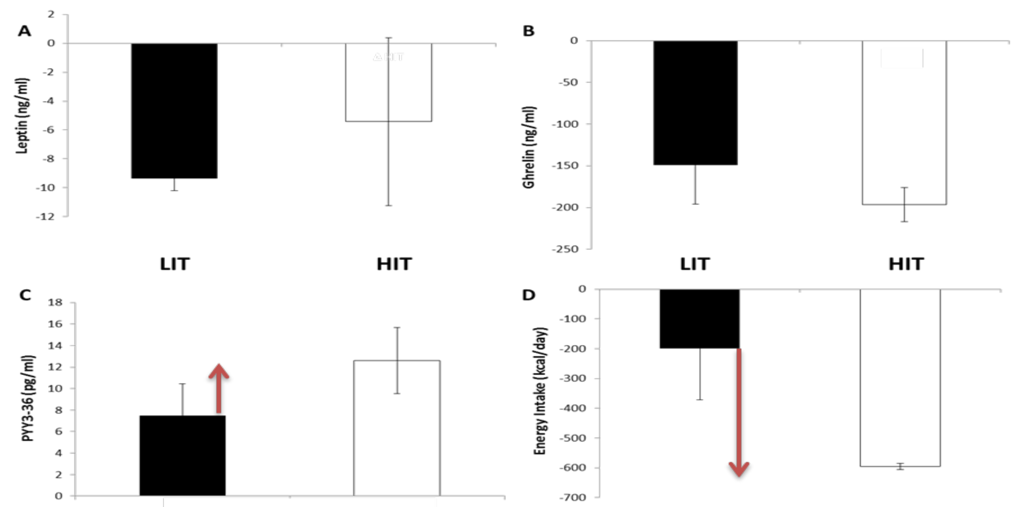

1-3 gr
girls
boys
4-6 gr
girls
boys
7 gr
girls
boys
0
20
40
60
80
100
%
Sedentary
Standing still
Light activity
Moderate activity
Vigorous activity


Sedentary behavior, min per day
700
600
500
400
1-3 gr
4-6 gr
7 gr
Boys
Girls


Moderate-to-vigorous activity, min per day
240
200
160
120
80
1-3 gr
4-6 gr
7 gr
Boys
Girls

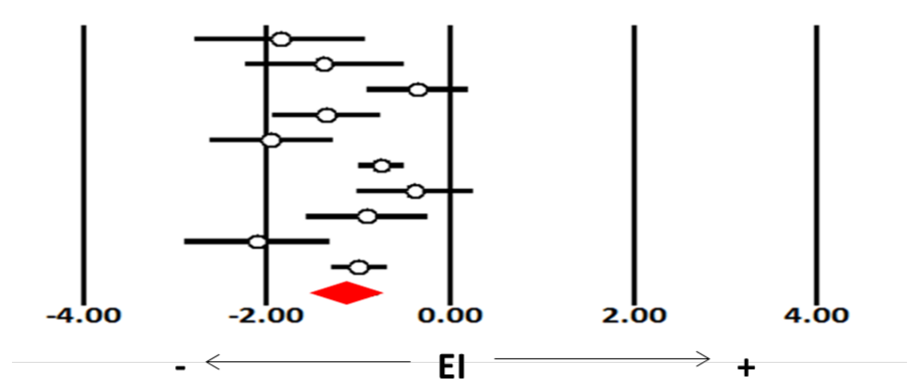
Multidisciplinary interventions based on ADAPTED Physical Activity

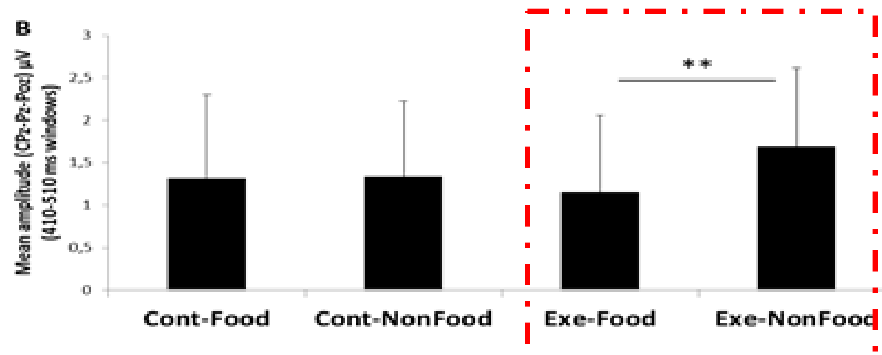


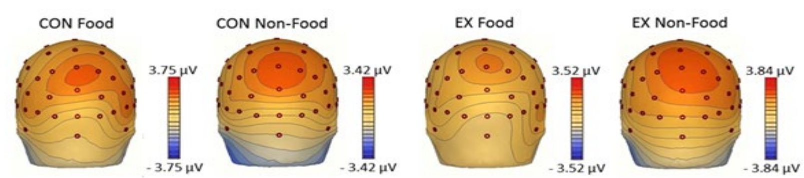


Schwartz et al., 2015; Prado et al., 2016

Multidisciplinary interventions based on ADAPTED Physical Activity







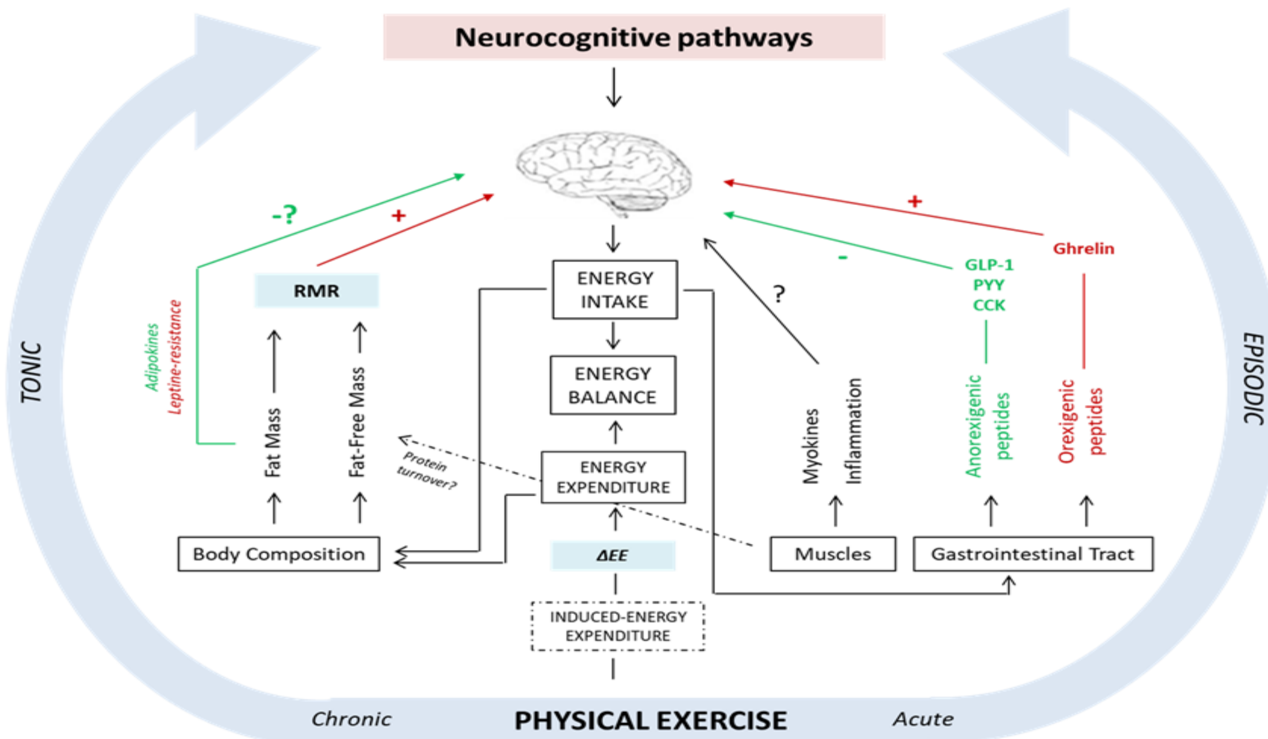
Schwartz et al., 2015; Fearnbach et al., 2017

Fine prescriptions

modalities; frequency; intensities; durations; …chronobiology…

✓ ***Appetite control*** (Poster 23/Miguet Maud)

Multidisciplinary interventions based on ADAPTED Physical Activity



Thivel, Finlayson & Blundell, 2018, Obesity Reviews

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Dr MORIO Béatrice
Pr COURTEIX Daniel
Pr KELLER Kathleen L
Pr BLUNDELL John E
Pr TREMBLAY Angelo
Dr PEREIRA Bruno
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PETIOT Nais
CHARIERRE Aurore
KHAMMASSI Marwa

Dr JULIAN Valérie
Dr MASURIER Julie
Dr TAILLARDAT Michel
Dr CARDENOUX Charlotte

Thanks for your attention

"It looks as though man should be regarded now, if not in the past, as a predominantly sedentary rather than an upright animal"

Edholm, Fletcher, Widdowson & McCance, *BJN*, 1955