Body Composition and Strength Profiles of Normal Weight Obese Females: A Hidden Risk Population

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Abstract

Body mass index (BMI) is the primary measure of obesity used in medical practice and fails to identify 50% of individuals who are genuinely obese. Consequently, there is a hidden population of individuals with high body fat who are misclassified as nonobese by BMI and described as 'normal weight obese' (NWO). This misclassification is particularly common in females in early adulthood, college, and childbearing years. Limited research exists on NWO in females with proper menstrual cycle phase study design. The purpose of this study was to identify health and fitness differences between NWO and normal weight lean (NWL) females. Participants completed three visits (1: 48-hr post menses; 2: 72-hr post ovulation; 3: 72-hr post visit 2). Participants performed a DXA scan (Horizon Hologic), bioelectrical impedance analysis assessment (BIA; InBody BWA2.0), and fitness tests. Thirty-eight participants completed all testing (NWL; N=24, NWO; N=14). Android, gynoid, and visceral adipose tissue were significantly greater in NWO compared to NWL ($p<0.05$), while lean mass was not different between groups. NWL lifted significantly more weight for bench press (NWL 89.5±22.3lbs, NWO 74.5±12.3lbs) and squat (NWL 159±35lbs, NWO 131±29lbs). Regardless of BMI and absolute lean mass, relative fat mass may impact muscle function and strength performance.

Introduction

BMI and the Differences Between Normal Weight Obese/Lean and Obese Individuals

- BMI reports demonstrate that Normal Weight Obese (NWO) and Normal Weight Lean (NWL) are similar, with only the Obese population reporting a different BMI (Thomas 2012)
- Body fat (%) range among all three groups (Bellissimo 2019)

Physical Effects NWO Individuals Face

- NWO poses for a higher cardiovascular risk in comparison to NWL (Romero-Corral, 2010)
- More susceptible to metabolic dysregulation similar to those categorized as obese (Wijayatunga, 2021)

Menstrual Cycle Hormones and Their Effects

- Estrogen and progesterone are lowest during the follicular phase of the menstrual cycle (Gould, 2021; Uhl, 2007)
- Ovarian hormones alter hydration of intra- and extracellular compartments, thus, altering the body composition (Benton, 2020; Mitchell, 1993; Suh, 2003; Van Pelt, 2015).

Purpose

Compare normal weight lean (NWL) and normal weight obese (NWO) absolute lean mass and relative fat mass and their effects on strength performance and muscle function.

Methods

Participants (*n*=38; NWO=14, NWL=24)

Inclusion

- Premenopausal, aged 18-42
- Normal BMI
- Either naturally menstruating or using hormonal contraceptives

Exclusion

- Irregular menstrual cycles
- Engage in <2 or >5 d/wk of aerobic or anaerobic exercise
- Smoking
- Taking medications that impacting lipid or muscle metabolism
- Diagnosed eating disorder or not weight stable

Visit 1 - Informed consent, familiarization and questionnaires

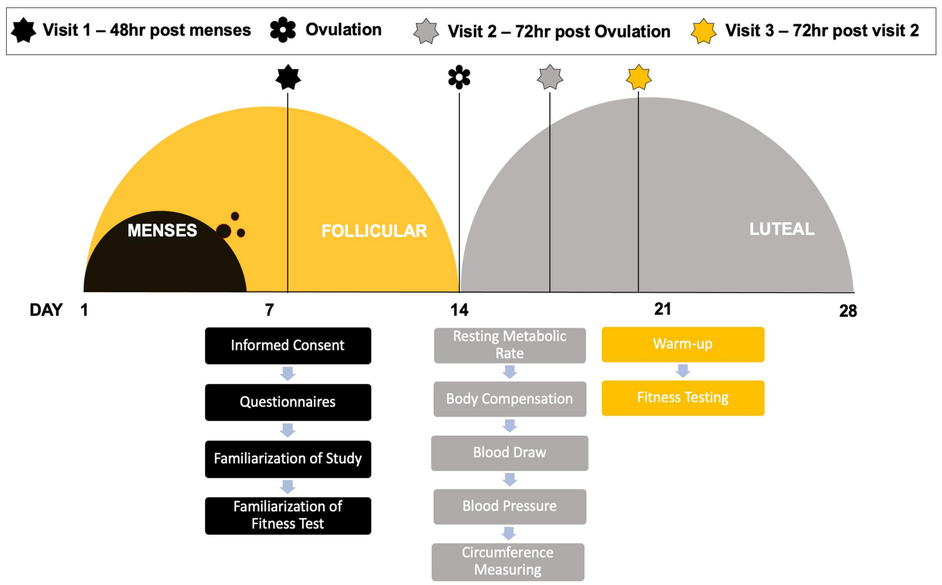
- 48 hours after their menstrual cycle
- Familiarized with the physical fitness tests including anaerobic and aerobic activities
- Participants were given a Clear Blue Fertility Monitor to test urine until positive test

Visit 2 - Physiological health profiles

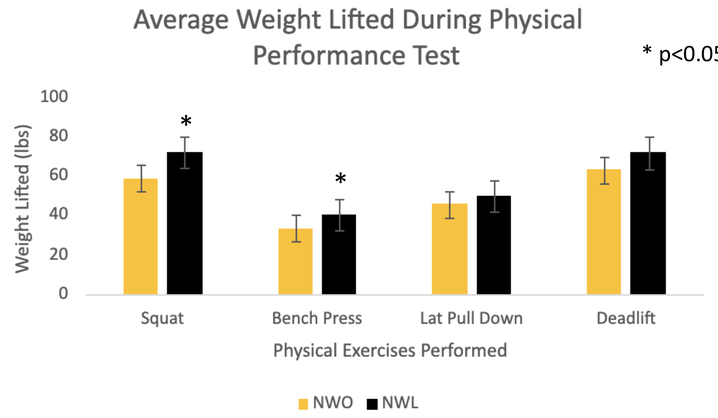
- 72 hours after testing LH positive and an 8-hr fast
- Whole-body resistance and reactance determined by bioelectrical impedance analysis (BIA; InBody BWA 2.0)
- Dual energy x-ray absorptiometry (DXA) scan (Hologic, Horizon)

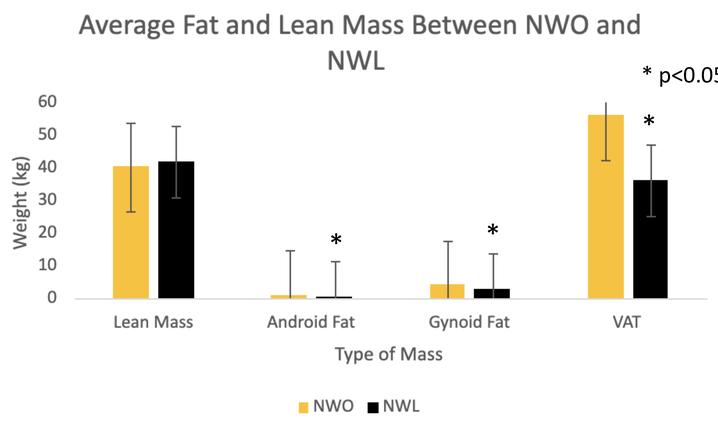
Visit 3 - Fitness testing

- 72 hours after visit 2 participants warmed-up for 5 minutes and performed handgrip dynamometer testing.
- 5-RM for bench press, squat, latissimus dorsi pull down and deadlift
- Participants were fitted with a heart rate monitor and performed a submaximal Bruce protocol (COSMED, K5) to predict VO_2 max.



Results





Conclusion

Females within the NWO category have demonstrated to obtain a significant difference in body fat percentage but comparable absolute lean mass in comparison to NWL. Physical fitness performance is also significantly reduced in NWO than NWL, which may be caused by relative fat mass.

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