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Associations between non-invasive upper- and lower-limb vascular function assessments: Extending the evidence to young women

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Short Title: Peripheral Vascular Function in Young Women

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ABSTRACT

Brachial artery (BA) flow-mediated dilation (FMD) is a well-established measure of peripheral vascular function prognostic of future cardiovascular events. The vasodilatory response to FMD (FMD%) reflects upper-limb conduit artery function, while reactive hyperemia (RH) following cuff-occlusion release reflects upper-limb resistance artery function. Comparatively, passive leg movement (PLM) is a newer, increasingly utilized assessment of lower-limb resistance artery function. To increase its clinical utility, PLM-induced leg blood flow (LBF) responses have been compared to hemodynamic responses to FMD, but only in men. Therefore, the purpose of this study was to retrospectively compare LBF responses to FMD% and RH responses in women. We hypothesized that LBF responses would be positively associated with both FMD% and RH, but to a greater extent with RH. FMD and PLM were performed on 72 women (23±4 years). Arterial diameter and blood velocity were assessed using Doppler ultrasound. Pearson correlation coefficients were used to evaluate associations. Measures of resistance artery function were weakly positively associated: change in BA blood flow ∆BABF and ∆LBF (r=0.33, p<0.01), BABF area under the curve (BABF AUC) and LBF AUC (r=0.33, p<0.01), and $BABF_{peak}$ and LBF_{peak} (r=0.37, p<0.01). However, FMD% was not associated with any index of PLM (all p>0.30). In women, indices of resistance artery function in the upper- and lower-limbs were positively associated. However, contrary to the previous work in men, upper-limb conduit artery function was not associated with lower-limb resistance artery function suggesting these assessments capture different aspects of vascular function and should not be used interchangeably in women.

Key words: flow-mediated dilation, passive leg movement, vascular function, conduit artery function, resistance artery function

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New and Noteworthy

Upper- and lower-limb indices of resistance artery function are positively associated in young women when assessed by reactive hyperemia following brachial artery flow-mediated dilation (FMD) cuff-occlusion release and leg blood flow responses to passive leg movement (PLM), respectively. However, despite previous data demonstrating a positive association between upper-limb conduit artery function assessed by FMD and lower-limb resistance artery function assessed by PLM in young men, these measures do not appear to be related in young women.

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INTRODUCTION

The vascular system plays a critical role in the delivery and control of blood flow via alterations in vascular tone. More specifically, the vascular endothelium is a single cell layer that lines the entire circulatory system and is responsible for the vasomotor properties of the vasculature via the controlled release of vasodilator and vasoconstrictor substances (1). Well-established, non-invasive laboratory methods are used to indirectly assess endothelial-mediated peripheral vascular function in both large conduit arteries and smaller resistance arteries. Importantly, these laboratory methods assessing vascular endothelial function can provide valuable insight into cardiovascular disease (CVD) risk and progression, even in young, otherwise healthy individuals.

Brachial artery flow-mediated dilation (FMD) is a non-invasive assessment of upper-limb conduit artery function. The vasodilatory response to FMD, expressed as the percent change in brachial artery diameter following cuff occlusion-release (FMD%), is traditionally used to evaluate peripheral macrovascular function and has been shown to predict future cardiovascular events in a variety of populations (2-5). Recently, FMD% performed following current guidelines (2, 6) was reported to be strongly positively associated with the more invasive assessment of coronary artery endothelial function with an *r* value of 0.77, highlighting the clinical relevance of FMD% (7). Although the FMD test is commonly utilized to assess macrovascular function, reactive hyperemia (RH) following FMD cuff-occlusion release can be quantified via Doppler ultrasound and be used as a proxy to assess downstream resistance artery, or microvascular, function (8, 9). Like FMD%, the RH response following FMD cuff-occlusion release has also been shown to predict future cardiovascular events in both apparently healthy and diseased populations (10, 11). Of note, disturbances in microvascular function generally precede that of the macrovasculature, therefore, microvascular assessments may be particularly useful in providing insight into CVD disease risk in younger populations free of CVD (11-13).

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In comparison to FMD, passive leg movement (PLM) is a newer, methodologically simpler, non-invasive assessment indicative of lower-limb microvascular function measured at the femoral artery (14). PLM is similar to RH given that the leg blood flow (LBF) responses and brachial artery blood flow (BABF) responses respectively, are largely dependent on downstream resistance artery function (15). PLM has also been shown to be reliable and reproducible in both men and women (14, 16); however, the clinical utility of PLM in predicting future CVD risk remains to be determined. Therefore, in an effort to increase its clinical relevance, PLM has been previously compared to FMD in a population of men (17). Those findings suggest that PLM may provide a similar prognostic index of cardiovascular health as a strong positive correlation was found between upright seated PLM and brachial artery FMD (17), however, it is unknown if these findings are generalizable to women. Thus, elucidating the relations between FMD%, RH, and PLM in young women may expand the efficacy of PLM and allow for a better interpretation of each vascular measure in terms of whole-body vascular health.

Therefore, the purpose of this retrospective study was to compare LBF responses to PLM to both brachial artery FMD% and brachial artery RH in healthy young women. We hypothesized that LBF responses to PLM would be moderately positively associated with FMD% (r = 0.40 – 0.69) and strongly positively associated with RH responses (r > 0.70) in this population of healthy young women.

METHODS

Study Participants and Protocol

The data presented in this study are from a retrospective analysis of vascular function data collected between 2016 and 2021 within the same vascular research laboratory at the University of Delaware. Protocols were approved by the Institutional Review Board at the University of Delaware (IRB study #'s 941369 and 1288814) and were conducted in accordance with the Declaration of Helsinki. Written informed consent was obtained from all participants prior to participation. This study included apparently healthy premenopausal women between the ages of 18 and 35, recruited from the University of Delaware and the surrounding Newark, DE region. Participants were non-hypertensive (blood pressure <140/90 mmHg), non-obese (body mass index <30kg/m^2), non-tobacco users (<1 cigarette in the past month), free of any chronic diseases, and did not take any medications or supplements that might interfere with vascular function. Following consenting procedures, participants self-identified their race/ethnicity, completed a review of medical history, body mass index was calculated, and body fat percentage was assessed using bioelectrical impedance (Tanita TBF-300A, Arlington Heights, IL).

All participants completed the vascular assessments during the same visit and, when appropriate, during the early follicular phase of their menstrual cycle to control for the potential influence of sex hormones on our findings (18). Specifically, the vascular visit was scheduled within 7 days of the onset of menstruation for naturally cycling participants, during the placebo/no pill phase for participants taking oral contraceptives, and for participants using other forms of hormonal contraception, this visit was scheduled during menstruation, or at the participant's convenience if they did not menstruate as a result of their contraception (n=2). All assessments were performed during the morning hours (i.e., between 7-11 AM) in a temperature-controlled laboratory (~23°C). Participants were instructed to report to the laboratory fasted for ≥6 hours, without caffeine, alcohol, and exercise ≥24 hours, and without over-the-counter medications or supplements for ≥24 hours prior to the visit. Upon arrival to the laboratory, resting blood pressure was assessed (Omron 5 Series, BP7200) and participants underwent intravenous blood sampling for the clinical analysis of fasting blood glucose and a lipid panel (Quest Diagnostics, Inc., Philadelphia, PA). Participants rested quietly for a minimum of 20 minutes prior to FMD and a minimum of 10 minutes between the transition from supine FMD to upright-seated PLM.

Flow-Mediated Dilation Protocol

FMD was performed in accordance with current guidelines (6). In the supine position with the right arm fully extended, a narrow rapidly inflating cuff (E20 Rapid Cuff Inflation System, Hokanson, WA) was placed immediately proximal to the elbow and distal to the imaging site. Brachial artery diameter and blood velocity were recorded proximal to the cuff and distal to the shoulder joint via duplex ultrasound imaging (Logiq e, General Electric Medical Systems, Milwaukee, WI) using a linear array ultrasound probe (12 Hz) and a transducer with a Doppler frequency of 5 MHz, with the probe appropriately positioned to maintain an insonation angle of 60° or less. A 3-lead electrocardiogram (ECG100C, BIOPAC Systems Inc., CA) was used to record end diastolic R-wave gated images throughout baseline and post-cuff occlusion. Following 1-minute of baseline measures, the cuff was rapidly inflated to 250 mmHg for 5 minutes. Brachial artery diameter and blood velocity were measured continuously throughout baseline and 2 minutes immediately following cuff deflation. Images were collected from the video output of the Logiq e for offline analysis of brachial artery diameter conducted using an automated edge-detection software (Brachial Analyzer for Research, Medical Imaging Applications, Coralville, IA).

Passive Leg Movement Protocol

PLM was performed as previously described (15, 19-21) and in accordance with current guidelines (14). Briefly, in the upright seated position, the protocol consisted of 1 minute of baseline measurements immediately followed by a 1-minute bout of passive leg flexion and extension at the knee joint. Participants were instructed to remain passive and relaxed throughout the duration of the protocol. Femoral artery diameter and blood velocity were recorded in the right common femoral artery (CFA) distal to the inguinal crease and proximal to the femoral artery bifurcation via duplex ultrasound imaging (as described above). Passive movement was achieved by a member of the research team moving the participant's lower leg at the knee joint through a 90° to 180° range of motion at a frequency of 1 Hz, while movement cadence was maintained by a metronome. Femoral artery diameter was measured during baseline, while blood velocity was measured throughout the protocol. Throughout the duration of the protocol, the unaffected leg remained extended and fully supported.

Blood Flow Calculations and Analyses

Arterial blood velocity for both tests was evaluated using the Logiq e ultrasound system (as described above). The sample volume was maximized according to vessel size and centered within the vessel based on real-time ultrasound visualization. Arterial diameter was determined at a perpendicular angle along the central axis of the scanned area and mean velocity (V_{mean}) values [angle-corrected and intensity-weighted area under the curve (AUC)] were automatically calculated by the Doppler ultrasound system. Using arterial diameter and V_{mean}, arterial blood flow was mathematically calculated as follows: blood flow = $V_{mean}\ \pi$ (vessel diameter/2)^2 × 60, where blood flow is in milliliters per minute, in custom Excel spreadsheets designed for FMD or PLM analyses.

For FMD, end-diastolic ECG R-wave gated images were collected from the video output of the Logiq e for offline analysis of brachial artery diameter using automated edge-detection software (Brachial Analyzer for Research, Medical Imaging Applications, Coralville, IA). FMD%

was calculated as the maximal percent change in brachial artery diameter from baseline to post occlusion-cuff release. Indices of RH included ΔBABF, BABF AUC, and $BABF_{peak}$. ΔBABF was calculated as peak blood flow – baseline blood flow. BABF AUC was calculated as the sum of brachial artery blood flow above baseline for 2-minutes following cuff release, according to the trapezoidal rule and using the equation as follows: $\Sigma(y_i(x_{(i+1)} - x_i) + (1/2)(y_{(i+1)} - y_i)(x_{(i+1)} - x_i))$. $BABF_{peak}$ was identified as the highest blood flow achieved during the 2 minutes following occlusion-cuff release.

For PLM, V_{mean} was calculated as anterograde – retrograde blood velocities using continuous ultrasound Doppler imaging of the CFA. LBF was then calculated in ml/min as V_{mean} π (vessel diameter/2)^2) × 60. Baseline LBF was calculated as a 60-second average of V_{mean}, while second-by-second analysis of anterograde and retrograde blood velocities were used to determine V_{mean} and LBF flow during the movement phase of PLM, using the blood flow equation previously described. Indices of PLM included the overall change in LBF from baseline to peak (ΔLBF), LBF AUC, and LBF_{peak}. ΔLBF was calculated as LBF_{peak} – baseline LBF. LBF AUC was calculated as the sum of femoral artery blood flow above baseline for each second during the 60-second movement phase of PLM, according to the trapezoidal rule and using the equation as follows: $\Sigma(y_i(x_{(i+1)} - x_i) + (1/2)(y_{(i+1)} - y_i)(x_{(i+1)} - x_i))$. LBF_{peak} was calculated as the maximal blood flow achieved during the first 30-second movement phase of PLM.

Statistical Analyses

Pearson correlation coefficients (Pearson's *r*) were used to evaluate associations between LBF responses to PLM and FMD% and RH variables and 95% confidence intervals were calculated. The strength of the associations were interpreted based on the following criteria: weak (r = 0.10 – 0.39), moderate (r = 0.40 – 0.69), or strong (r = 0.70 – 0.89) (22). ΔLBF was compared with ΔBABF, LBF AUC was compared with BABF AUC, LBF_{peak} was compared with $BABF_{peak}$, and all LBF variables were compared with FMD%. Analyses were

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performed using GraphPad Software (Version 9.3, San Diego, CA). An a priori power analysis was conducted using the software package G*Power 3.1.9.4 (23) for sample size estimation. To detect a medium effect with significance set at $\alpha \leq 0.05$ and power = 0.80, the minimum sample size needed is 69, thus our obtained sample size of 72 is adequate to test the study hypothesis. Statistical significance was accepted at $p \leq 0.05$ and participant characteristics and continuous data are presented as mean ± standard deviation (SD).

RESULTS

Participant characteristics are presented in **Table 1**. A total of 72 premenopausal women (41 White women, 15 Black women, 8 Hispanic women, and 8 Asian women; 23±4 years) completed both upper- and lower-limb vascular assessments. Fifty-eight (81%) women in the present study were not using any form of hormonal birth control, 8 were taking oral contraceptive pills, and 6 were using other forms of hormonal contraception including progestin intrauterine device (n=3), Nexplanon (n=2), and Depo Provera (n=1). All anthropometric variables, resting blood pressure, and basic clinical blood values fell within normal expected ranges for healthy young women. Group averages for FMD and PLM variables are displayed in **Table 2**.

Associations Between FMD and PLM

There were significant positive associations between indices of lower-limb resistance artery function assessed by LBF responses to PLM and indices of upper-limb resistance artery function assessed by RH following FMD cuff-occlusion release (**Figure 1**). Specifically, ∆LBF was positively associated with ∆BABF (**Figure 1A**), LBF AUC was positively associated with BABF AUC (**Figure 1B**), and $BABF_{peak}$ was positively associated with LBF_{peak} (**Figure 1C**). However, none of the indices of lower-limb resistance artery function as assessed by LBF responses to PLM were associated with upper-limb conduit artery function assessed by FMD% (**Table 3**).

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DISCUSSION

This study sought to compare the hyperemic responses to PLM to the hemodynamic responses to the FMD assessment in healthy young women. We found that upper-limb conduit artery (macrovascular) function assessed by FMD% was not associated with any measure of lower-limb resistance artery function as assessed by LBF responses to PLM. However, upper- and lower-limb resistance artery (microvascular) function assessed by brachial artery RH and PLM respectively, were weakly positively associated, suggesting some overlap between microvascular physiological responses in the upper and lower limbs in young women. Importantly, brachial artery RH following FMD cuff-occlusion release has been shown to be a strong predictor of future cardiovascular events in both healthy and diseased populations; therefore, findings from the present study help to advance the clinical utility of PLM, particularly in young women who represent a generally understudied population in vascular research.

FMD% is not associated with LBF responses to PLM

Studies comparing macrovascular and microvascular function in non-diseased populations are limited, despite the knowledge that impairments in microvascular function may be more readily detected than impairments in macrovascular function in young, otherwise healthy populations (24-26). Associations between FMD% and LBF responses to PLM have been previously studied in healthy young and older men and demonstrated a strong positive association between FMD% and LBF responses to PLM (17). For instance, FMD% was found to be significantly correlated with both ΔLBF and LBF AUC, with *r* values for young men reaching 0.73 and 0.55, respectively (17). Alternatively, the present study does not indicate any association between FMD% and LBF responses to PLM in young women and this discrepancy in findings may be explained by sex differences in macrovascular and microvascular function that have been identified across the lifespan.

Deteriorations in macrovascular function that occur with aging have been shown to be significantly delayed in women compared to men (27). As such, investigating microvascular function in young women may be more sensitive and insightful regarding CVD risk, especially given that macrovascular function seems to be preserved in this population. For example, in response to prolonged sitting, a condition known to impair vascular function (28), young men experienced reductions in both lower-limb macrovascular and microvascular function as assessed by popliteal artery FMD and hyperemic blood flow AUC following popliteal artery FMD, respectively (29). In contrast, young women only experienced reductions in microvascular function, while macrovascular function remained unchanged in response to prolonged sitting (29). There are also data demonstrating that young adult women have similar vascular function compared to young adult men in the upper extremities as measured by brachial artery FMD% normalized for shear rate AUC, but appear to have reduced vascular function normalized for shear rate AUC in the lower extremities measured at the popliteal artery (30). Therefore, the absence of an association between our measures of microvascular and macrovascular function among young women in the present study may be driven by preserved macrovascular function, particularly in the upper limbs, and an earlier decline in microvascular function in women as compared to age-matched men (31). Indeed, the presence of the female sex hormone estrogen and its cardioprotective effects in young premenopausal women (32) likely help to explain, at least in part, the discrepancy between our findings and the prior FMD% and PLM comparison in young men (17).

Similar to findings from the present study, several previous studies have also reported no association between FMD% to other non-invasive assessments of vascular function. FMD% was not found to be associated with superficial femoral artery FMD nor popliteal artery FMD performed in the lower-limbs of young healthy adults (33), nor upper-limb microvascular function assessed by cutaneous reactive hyperemia following upper arm ischemia in adults aged 19 to 68 (34). It is important to consider that brachial artery FMD is performed in the upper-limb macrovasculature while PLM is performed in the lower-limb microvasculature, which may, in part, be responsible for the null findings in the present study limbs (30, 35, 36). Moreover, FMD% and PLM are governed by potentially different mechanisms; PLM is mostly NO-mediated (15) while FMD% is only partly mediated by shear stress-induced NO release when performed following current guidelines (2) and other contributing vasodilators have been identified including prostaglandins (PG) and endothelium-derived hyperpolarizing factor (EDHF) (37, 38). Therefore, findings from the present study are in agreement with previous work demonstrating that, despite its clinical importance and predictive abilities of overall cardiac disease incidence (4), FMD% may not reflect other measures of peripheral vascular function (e.g., it does not appear to be related to lower limb microvascular function in young women).

RH following cuff occlusion is positively associated with LBF responses to PLM

Both brachial artery RH and the LBF responses to PLM assess microvascular function, as the hyperemic responses to both tests are largely dependent on down-stream resistance artery vasodilation (14). In the present study, LBF responses to PLM were positively associated with RH in young women such that ΔLBF was positively associated with ΔBABF, LBF AUC was positively associated with BABF AUC, and LBF_{peak} was positively associated with $BABF_{peak}$ suggesting overlap in microvascular function in the upper and lower limbs. However, the associations between these parameters were relatively weak, which may be partly explained by the relative contributions of various vasodilators i.e., NO, PG, and EDHF, to each test. LBF responses to PLM are ~80% NO mediated (15), and it has been recently determined that PG and EDHF do not play a role in the hyperemic response to PLM in healthy young men (39). In contrast, the contribution of NO to BABF AUC is only ~30% (40) whereas the contribution of PG is far greater, especially in controlling the $BABF_{peak}$ response (41). Moreover, RH following FMD cuff release is also known to be mediated by combined activation of inwardly rectifying potassium channels (KIR) and Na(+)/K(+)-ATPase which function to hyperpolarize microvascular smooth muscle cells and induce resistance artery vasodilation (37, 42, 43). There are also clear limb-specific vasomotor responses to shear and vasoactive substances as demonstrated by distinct blood flow and vasodilatory responses to similar amounts of exercise-induced shear between the brachial artery, the common femoral artery, and the deep femoral artery (36). Therefore, although both assessments commonly evaluate resistance artery function, the heterogeneity of the vascular bed in which each test is performed (upper versus lower limb), the relative contribution of vasodilators, and the differing mechanisms of each test may be limiting the strength of this relation identified in these young women.

Experimental Considerations

Brachial artery FMD% and RH have both been shown to be predictive of CVD risk, which justifies their widespread use as well as the clinical utility of these vascular assessments. In comparison, PLM is a newer non-invasive vascular function assessment and may present as a methodologically simpler test than the traditionally performed brachial artery FMD. However, the predictive ability of PLM in terms of CVD risk still remains largely unknown. Comparing PLM to FMD may provide insight into the clinical utility of PLM, however it is still important to consider various aspects of these tests that make them distinct from each other i.e., performed in an upper extremity versus a lower extremity (36), macrovascular (conduit artery function) assessment versus microvascular (resistance artery function) assessment (24, 34), the distinct mechanisms of each test, the observed sex differences in the vascular responses to each test (29, 30), as well as certain disease states that more strongly influence the outcomes of one test over another (44). In order to establish PLM as a clinically relevant assessment of vascular health, PLM should continue to be compared with other assessments of vascular function in a variety of populations (45). In addition, future research may consider quantifying the contribution of NO and/or other vasodilators to each test when comparing vascular assessments, as well as include both men and women across the lifespan.

Conclusions

Our main findings suggest that RH following FMD cuff-occlusion release and LBF responses to PLM reflect some of the same microvascular physiological responses in the upper and lower limbs in healthy premenopausal women. However, upper-limb conduit artery function and lower-limb resistance artery function, assessed by FMD% and PLM respectively, likely capture different aspects of vascular function and should not be used interchangeably. FMD% is a measure of upper-limb macrovascular function that is highly predictive of future cardiovascular events, while in contrast, PLM is a measure of lower-limb microvascular function that is methodologically quicker and easier to perform and is predominantly NO mediated. Therefore, performing both FMD% and PLM in combination may give the greatest insight into whole-body vascular health, as clearly demonstrated by the unique benefits of each test.

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DISCLOSURE STATEMENT

No conflicts of interest, financial or otherwise, are reported by the authors.

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Figure 1. Associations between indices of upper and lower limb resistance artery function as assessed by RH following FMD occlusion-cuff release and leg blood flow responses to PLM, respectively (n=72). The association between the change in brachial artery blood flow (ΔBABF) and the change in leg blood flow from baseline to peak (ΔLBF) (A). The association between brachial artery blood flow area under the curve (BABF AUC) and leg blood flow area under the curve (LBF AUC) (B). The association between peak brachial artery blood flow ($BABF_{peak}$) and peak leg blood flow (LBF_{peak}) (C). BABF, brachial artery blood flow; LBF, leg blood flow; AUC, area under the curve; *r*, Pearson correlation coefficient; CI, confidence interval. *P*-values in **bold** font indicate significance.

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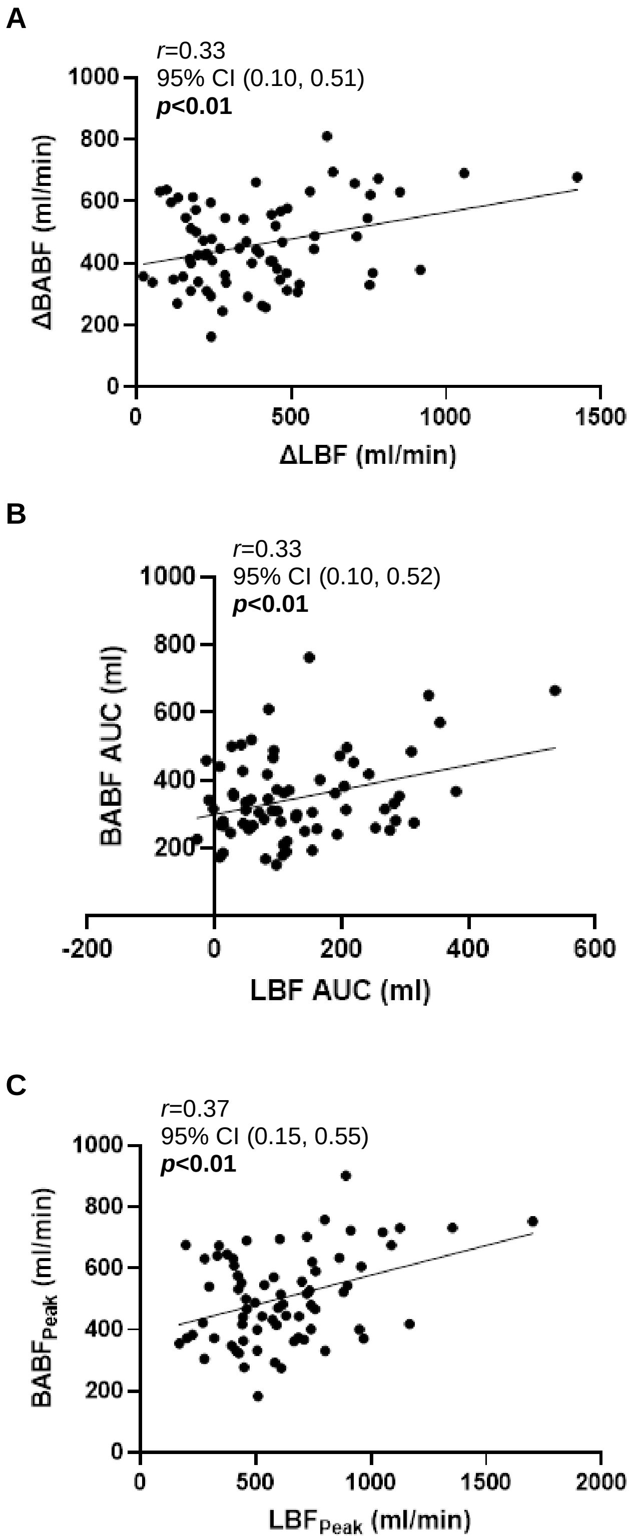

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Table 1. Participant Characteristics

N (W/B/H/A)	**72** (41/15/8/8)
Age (years)	23 ± 4
Body Mass Index (kg/m²)	23.6 ± 2.4
Body Fat (%)	28.1 ± 5.4
Systolic Blood Pressure (mmHg)	111 ± 7
Diastolic Blood Pressure (mmHg)	69 ± 6
†Total Cholesterol (mg/dL)	157 ± 26
†HDL Cholesterol (mg/dL)	62 ± 14
†LDL Cholesterol (mg/dL)	81 ± 20
†Triglycerides (mg/dL)	67 ± 29
†Fasting Glucose (mg/dL)	85 ± 6

†Clinical blood values obtained in a subset of participants (n=67). Data displayed as mean ± standard deviation. BMI, body mass index; BP, blood pressure; HDL, high density lipoprotein; LDL, low density lipoprotein; W, white women; B, black women; H, Hispanic women; A, Asian women.

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Table 2. FMD and PLM variables

Baseline BA diameter (mm)	3.35 ± 0.43
Baseline BABF (ml/min)	43 ± 19
ΔBABF (ml/min)	461 ± 135
BABF AUC (ml)	347 ± 125
$BABF_{peak}$ (ml/min)	504 ± 146
FMD (%)	7.3 ± 3.2
Baseline CFA diameter (cm)	0.78 ± 0.09
Baseline LBF (ml/min)	224 ± 70
ΔLBF (ml/min)	397 ± 257
LBF AUC (ml)	129 ± 111
LBF_{peak} (ml/min)	620 ± 283

Data displayed as mean ± standard deviation (n = 72). FMD, flow-mediated dilation; PLM, passive leg movement; BA, brachial artery; BABF, brachial artery blood flow; AUC, area under the curve; CFA, common femoral artery; LBF, leg blood flow.

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Table 3. Associations between upper limb conduit artery function and lower limb resistance artery function as assessed by FMD and PLM, respectively.

	FMD%		
	r	**95% CI**	***p***
ΔLBF (ml/min)	0.05	(-0.17, 0.29)	0.70
LBF AUC (ml)	0.11	(-0.11, 0.34)	0.36
LBF_{Peak} (ml/min)	0.05	(-0.16, 0.30)	0.65

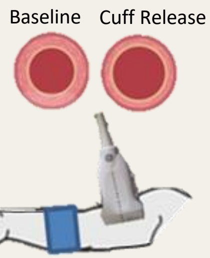
Pearson correlation coefficients were used to evaluate relations between FMD and PLM variables (n=72). FMD, flow-mediated dilation; PLM, passive leg movement; LBF, leg blood flow; AUC, area under the curve; *r*, Pearson's correlation coefficient; CI, confidence interval.

Associations between non-invasive upper- and lower-limb vascular function assessments: Extending the evidence to young women

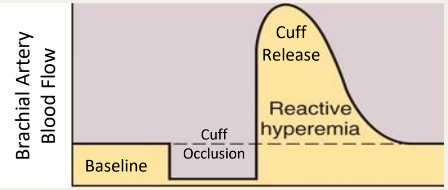
METHODS

Subjects: 72 premenopausal women (18-35 yrs)

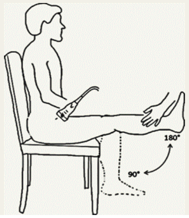
Brachial artery **flow-mediated dilation** (FMD): Upper-limb macrovascular assessment



Reactive hyperemia (RH) following FMD: Upper-limb microvascular assessment

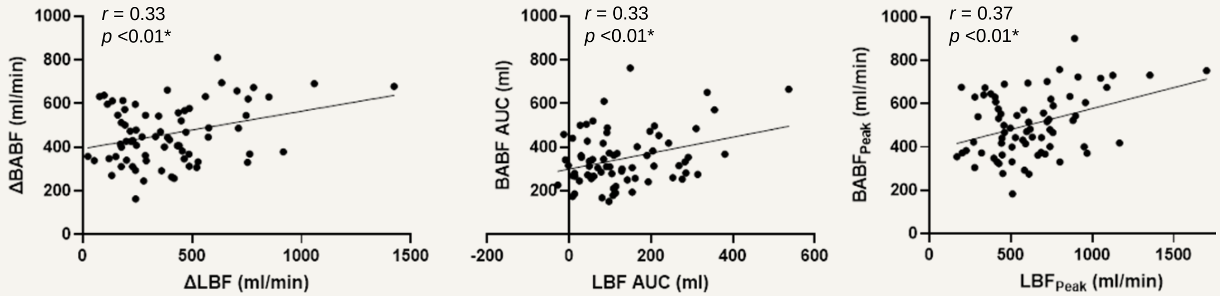


Passive leg movement (PLM): Lower-limb microvascular assessment

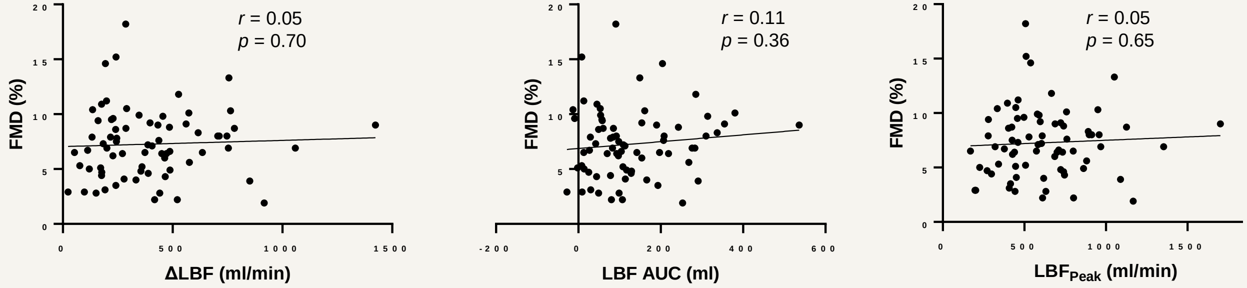


OUTCOMES

Reactive hyperemia following FMD cuff occlusion is positively associated with leg blood flow (LBF) responses to PLM.



FMD% is not associated with LBF responses to PLM



CONCLUSIONS Indices of resistance artery function in the upper- and lower-limbs were positively associated. However, upper-limb conduit artery function was not associated with lower-limb resistance artery function, suggesting these assessments capture different aspects of vascular function and should not be used interchangeably in women.