

Effect of flywheel-based isoinertial exercise on markers of skeletal muscle adaptations

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The purpose of this study was to analyse the modulation of circulating and local molecular markers of muscle damage and growth/repair over 48h after an isoinertial exercise.

Eight male collegiate students (with at least 2 years of squatting experience) performed a session of isoinertial squat exercise (5 sets of 10 maximal reps; 3' rest in-between) on the D11 flywheel device (Desmotec, Italy). Circulating markers analyzed were: muscle creatine kinase (CKM), insulin-like growth factor-1 (IGF-1) and interleukin-6 (IL-6); measured before and 2, 24, 48h post-exercise. In addition, miRNAs (miR-1, -133b, -206, -146a, -126 and -423) encapsulated in circulating exosomes were quantified before and 2h after exercise. Local markers investigated were: mRNA levels of genes involved in myogenesis and cell cycle control such as IGF-1 isoforms (IGF-1Ea, IGF-1Eb, and IGF-1Ec), myogenin, myogenic regulator factor-4 (MRF-4) and cyclin D1; determined in *vastus lateralis* muscle using fine needle aspiration coupled with real-time PCR before and 2h post-exercise. Exercise-induced inflammatory response was also analyzed by quantification of mRNA encoding cytokines and chemokines (I κ B- α , MCP-1, TNF α , IL-6 and IL-6R) in muscle and in peripheral blood mononuclear cells (PBMC).

Circulating CKM increased significantly after 2h post-exercise, the maximum peak occurred within 24h restoring to baseline level within 48h. Isoinertial exercise significantly increased total serum IGF-1 24h post-exercise and IL-6 at 2, 24 and 48h post-exercise. Nanoparticle tracking assay revealed a 2-fold increase in circulating exosomes in response to acute exercise, which was paralleled by higher levels of the mir-146a and mir-126. Exercise increased muscle MCP-1, TNF- α and IL-6 and peripheral PBMC I κ B- α and MCP-1 mRNA levels 2h post-exercise. On the contrary, muscle IGF-1Ea, IGF-1Eb, IGF-1Ec myogenin and cyclin D1 mRNA content was down-regulated 2h after the exercise bout. Muscle I κ B- α , IL-6R and MRF-4 and PBMC TNF- α , IL-6 and IL-6R mRNA levels were unaffected.

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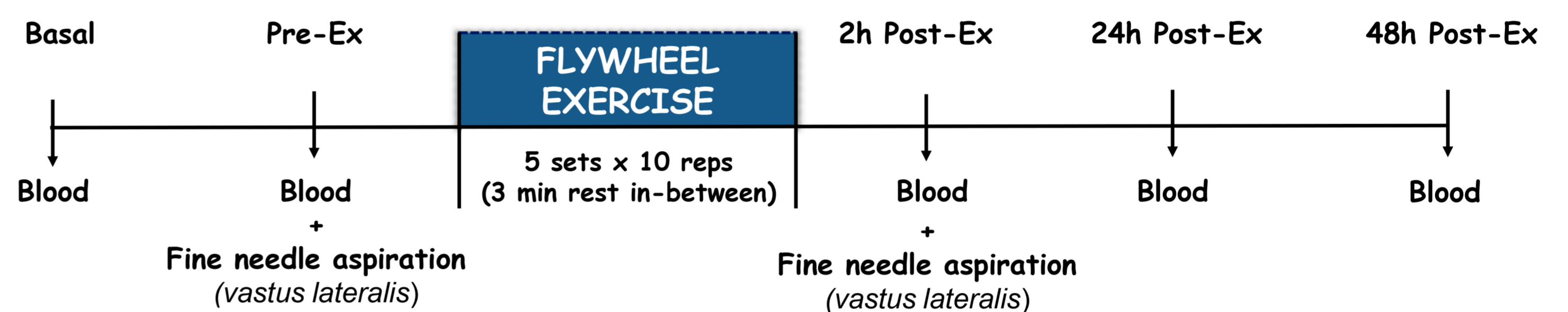


Fig. 1. Experimental design indicating Exercise intervention and sampling times. Basal (fasting), Pre-Exercise: 2h after breakfast (Carbohydrates 60%, Protein 20%, Fat 20%); both 24h and 48h post-exercise samplings were harvested in fasting condition.

RESULTS

Circulating responses to isoinertial exercise

Circulating CKM increased 2h and 24h post-exercise: the maximum peak occurred within 24h restoring to baseline level 48h post-exercise (Fig 2). Isoinertial exercise significantly increased total serum IGF-1 at 24h post-exercise and IL-6 at 2, 24 and 48h post-exercise (Fig 2). PBMC IκBα, IL-6 and MCP-1 mRNA levels were up-regulated at 2h post-exercise. IGF-1 isoforms, IL-6R and TNF-α mRNA levels in PBMC were unchanged (Fig 3). Circulating exosomes, capable of transferring information between distant tissues - analyzed by nanoparticle tracking assay - revealed a 2-fold increase in response to acute exercise, which was paralleled by higher levels of the mir-146a and mir-206 (Fig 4).

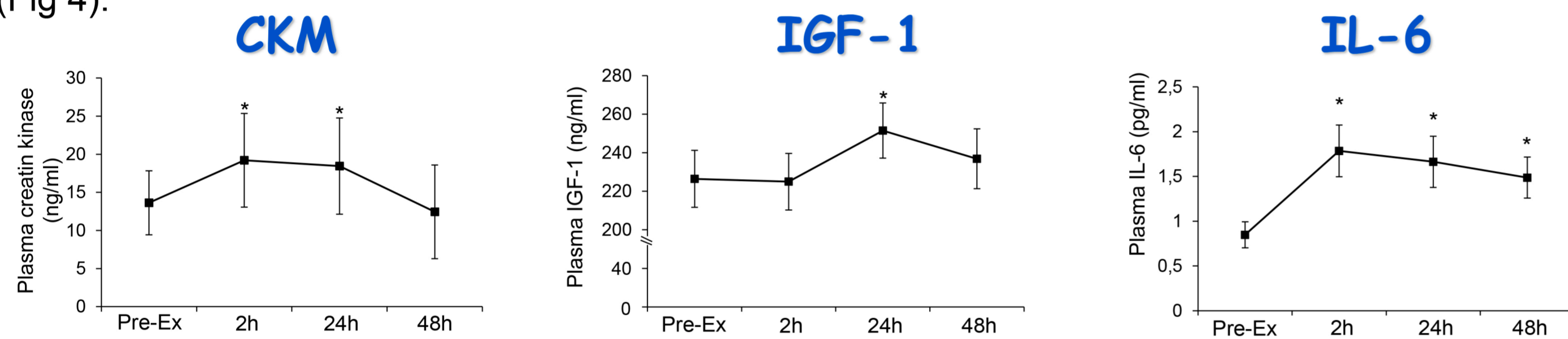


Fig. 2. Levels of circulating skeletal muscle creatine kinase (CKM); insulin-like growth factor-1 (IGF-1) and interleukin-6 (IL-6). * $P < 0.05$.

PBMC mRNA expression

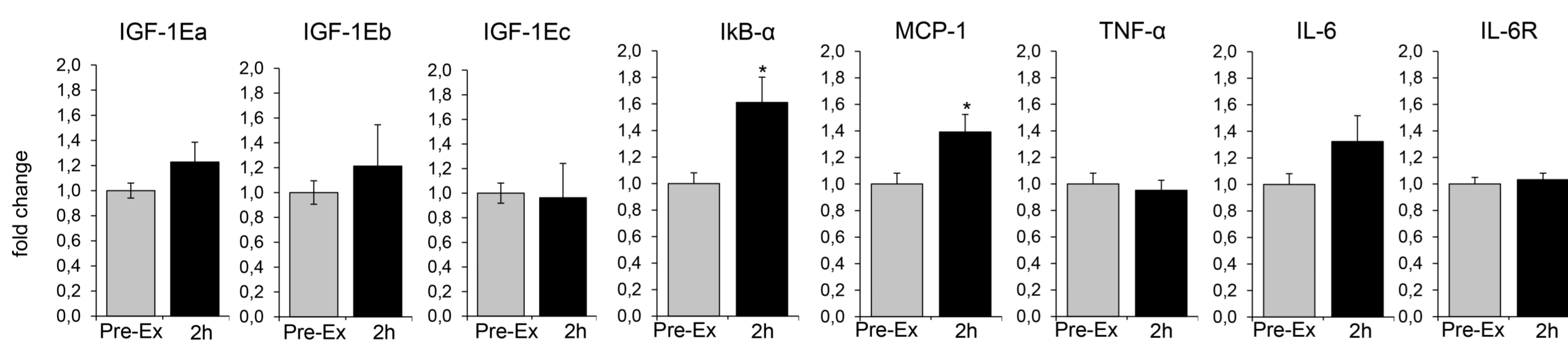


Fig. 3. Changes in the relative expression of IGF-1Ea/Eb/Ec isoforms, IκBα, IL-6, IL-6R, MCP-1 and TNF-α, obtained in PBMC pre- and 2h post-exercise. * $P < 0.05$.

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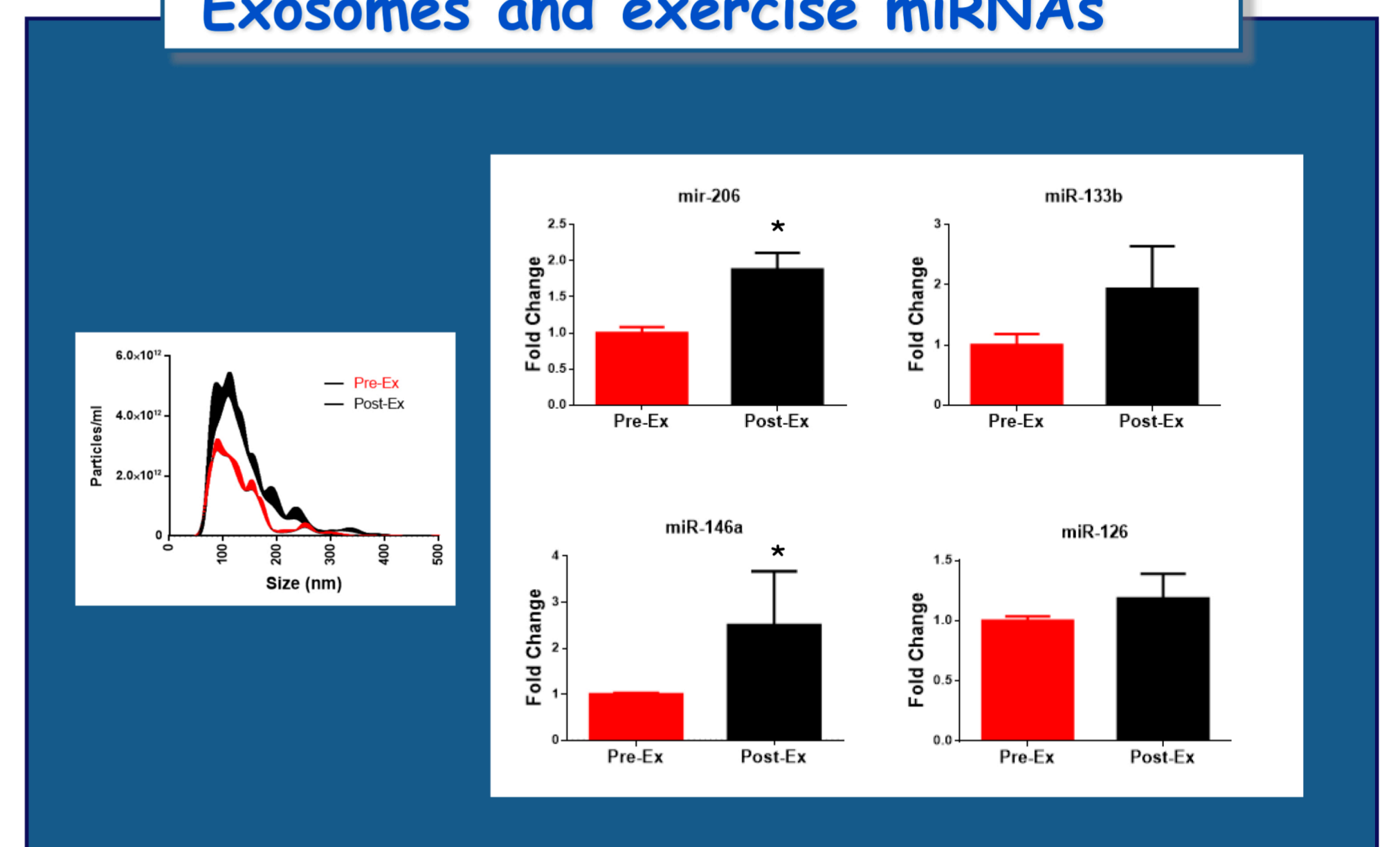


Fig. 4. Nanoparticle tracking assay of circulating exosomes and exercise specific miRNAs modulation in response to acute exercise. * $P < 0.05$.

Local responses to isoinertial exercise

The exercise increased muscle IκBα, IL-6, MCP-1, TNF-α and PGC-1α. Muscle IGF-1Ea, IGF1Eb, IGF1Ec expression was down-regulated 2h after the exercise bout (Fig 5).

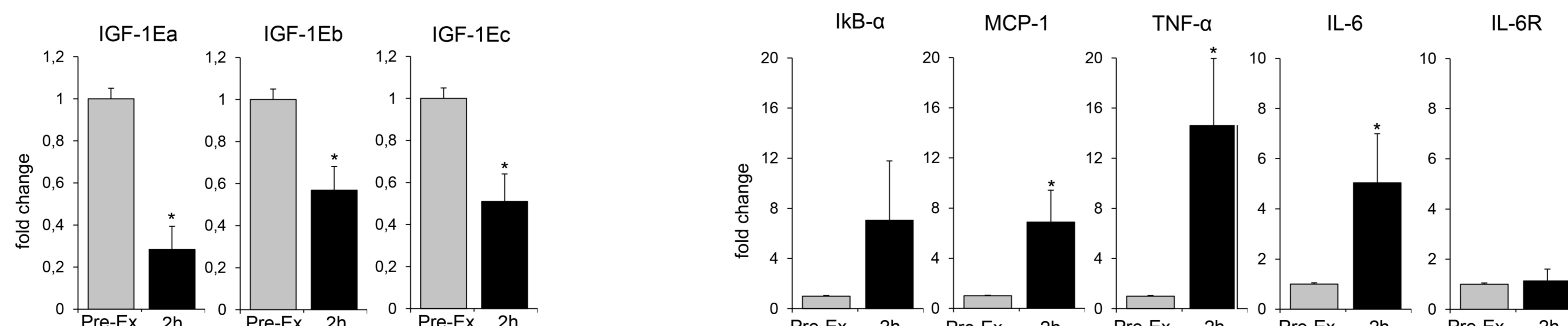


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CONCLUSIONS

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REFERENCES

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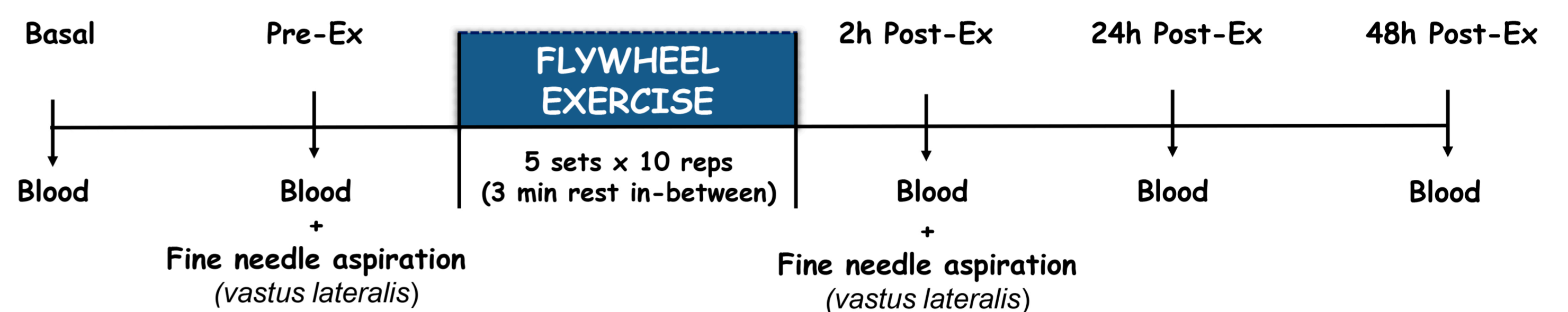


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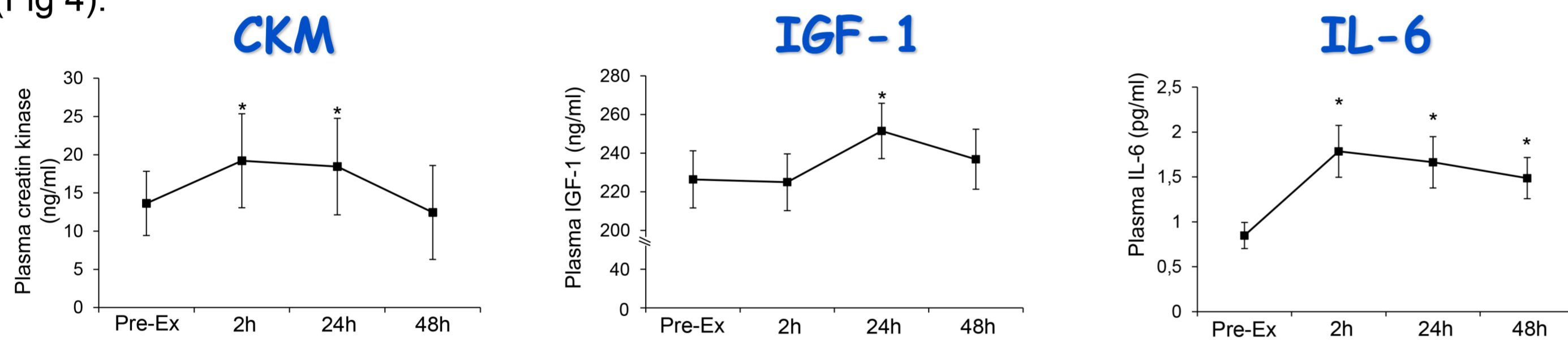


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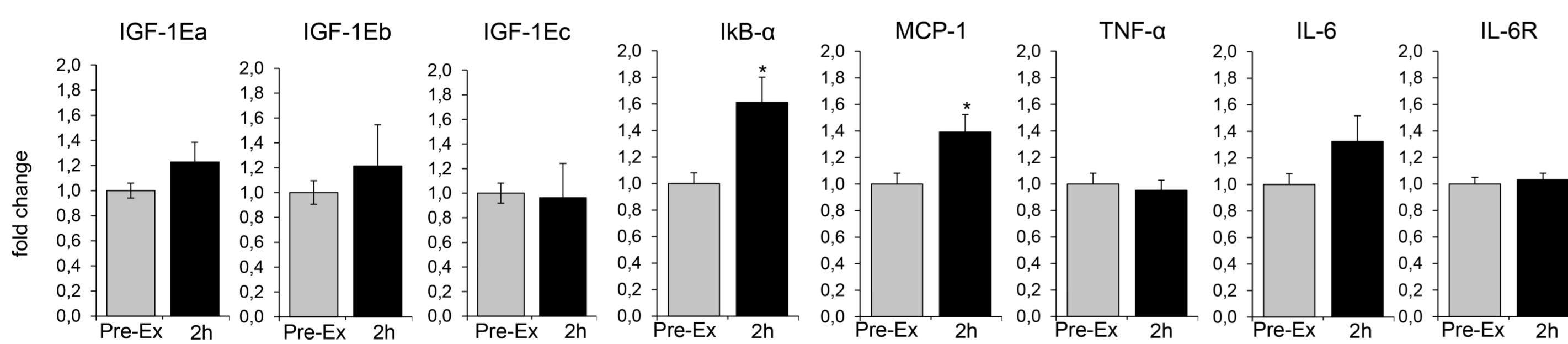


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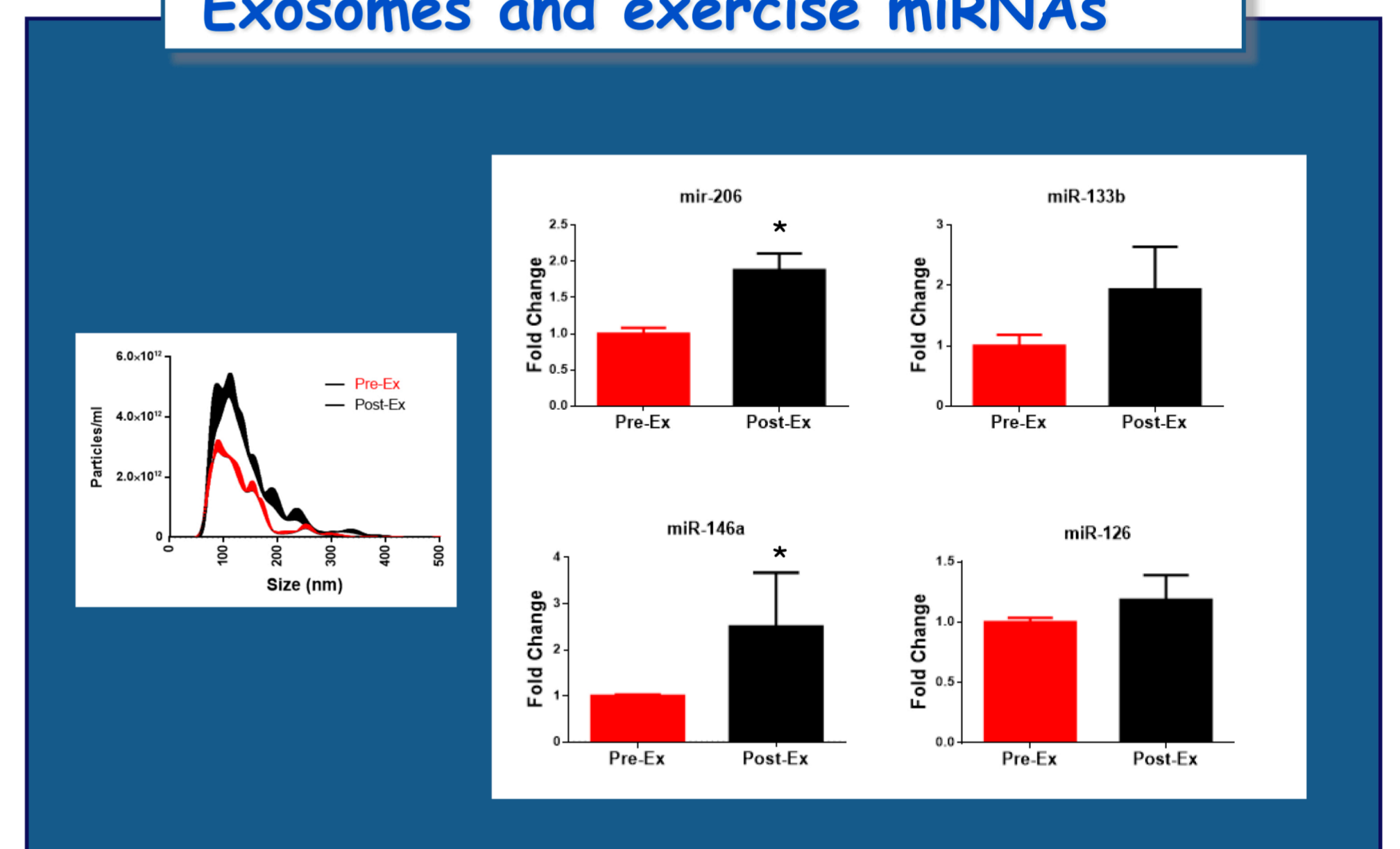


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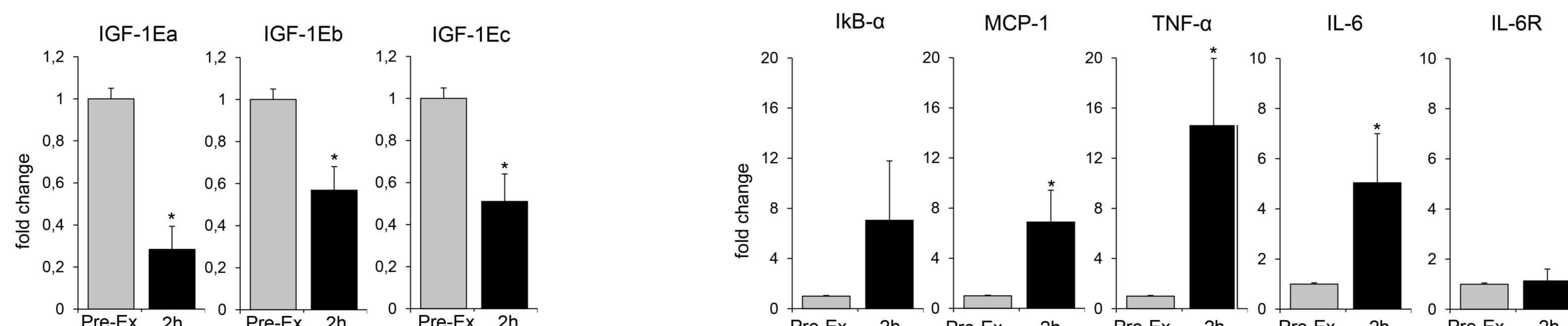


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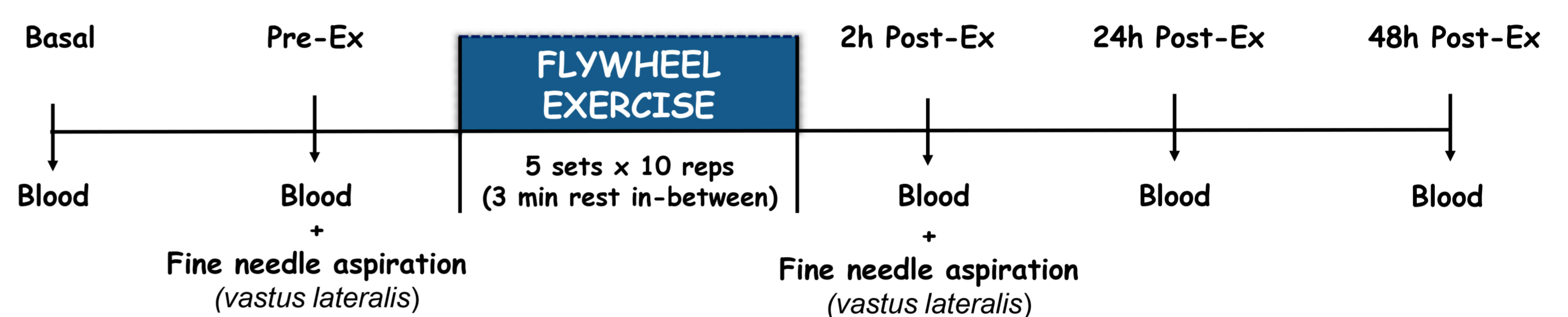


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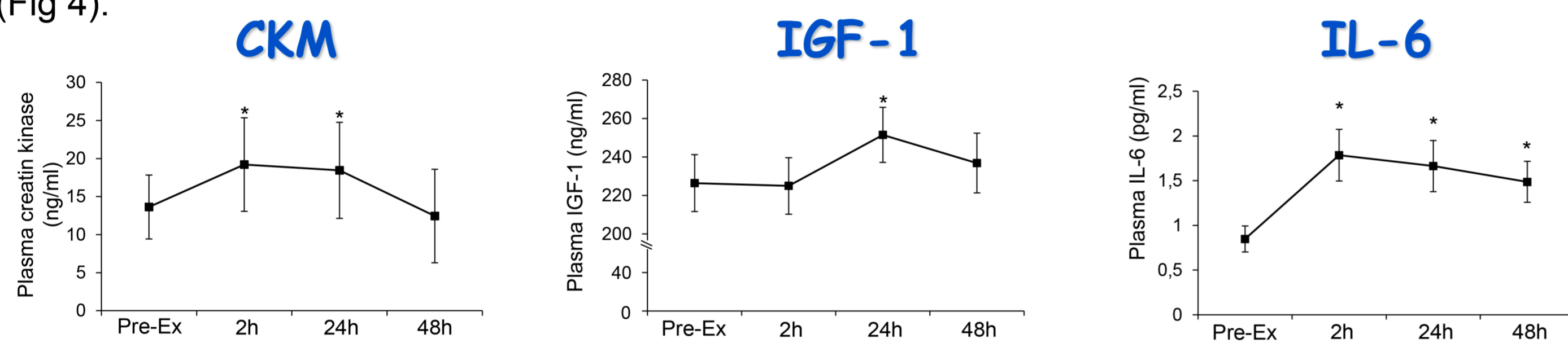


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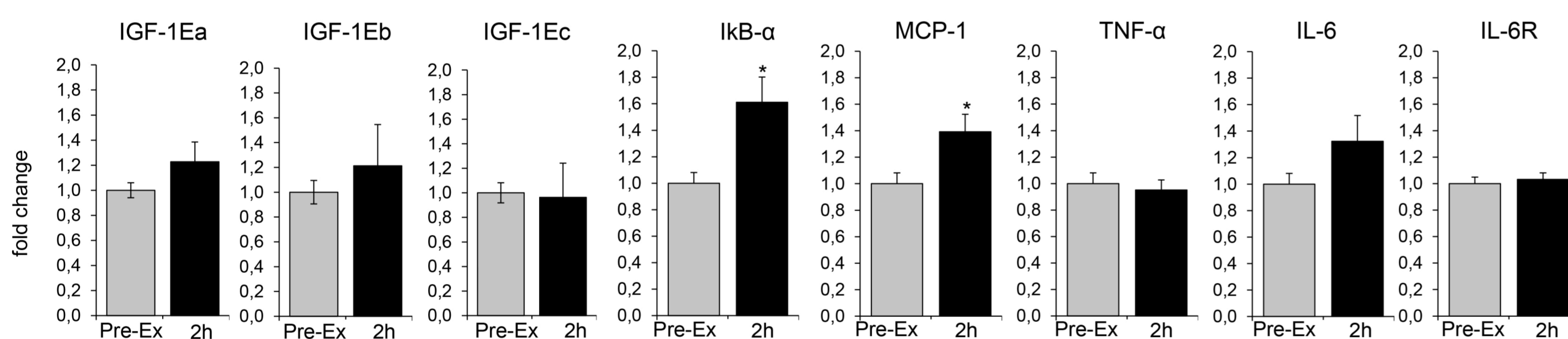


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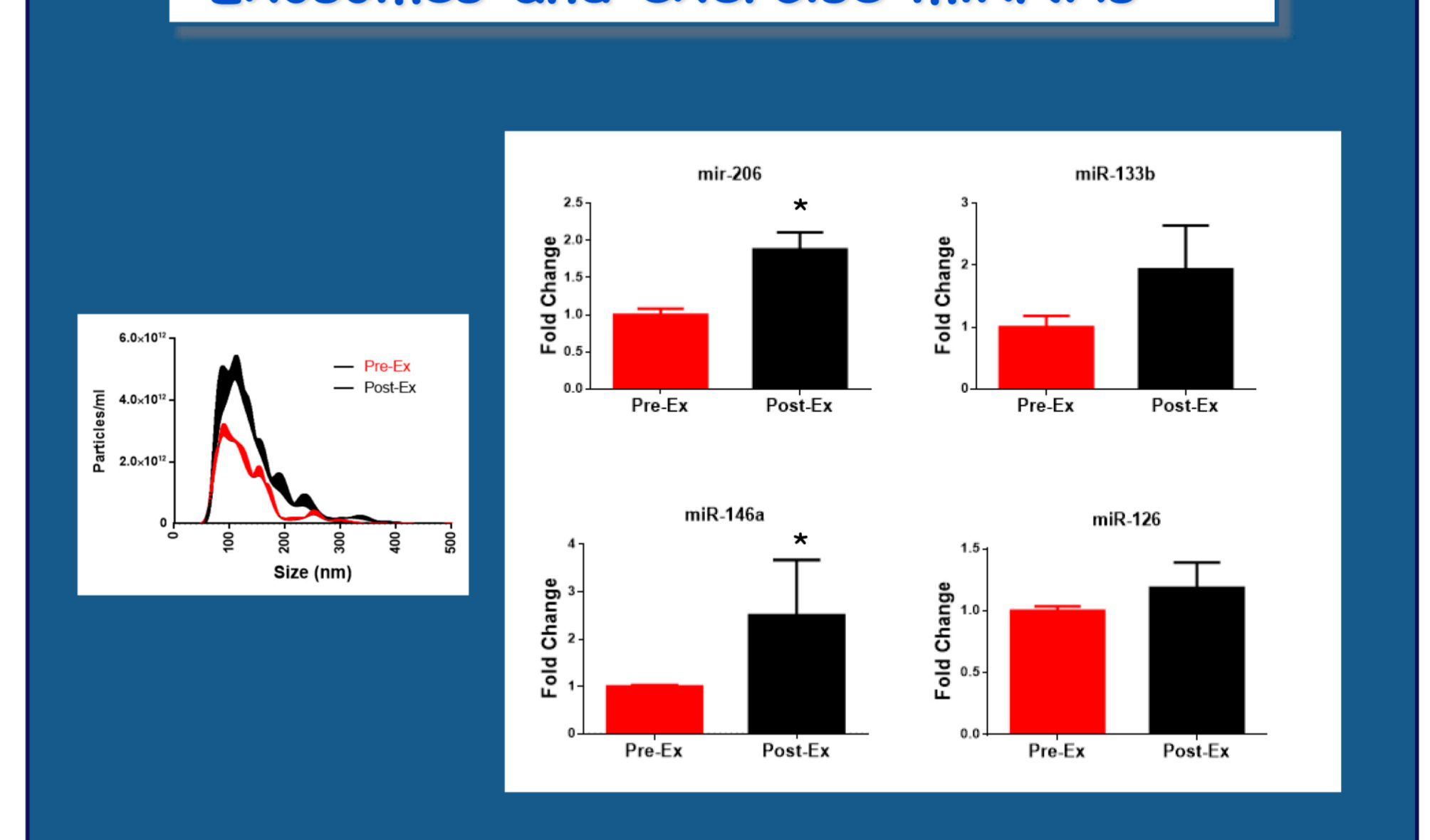


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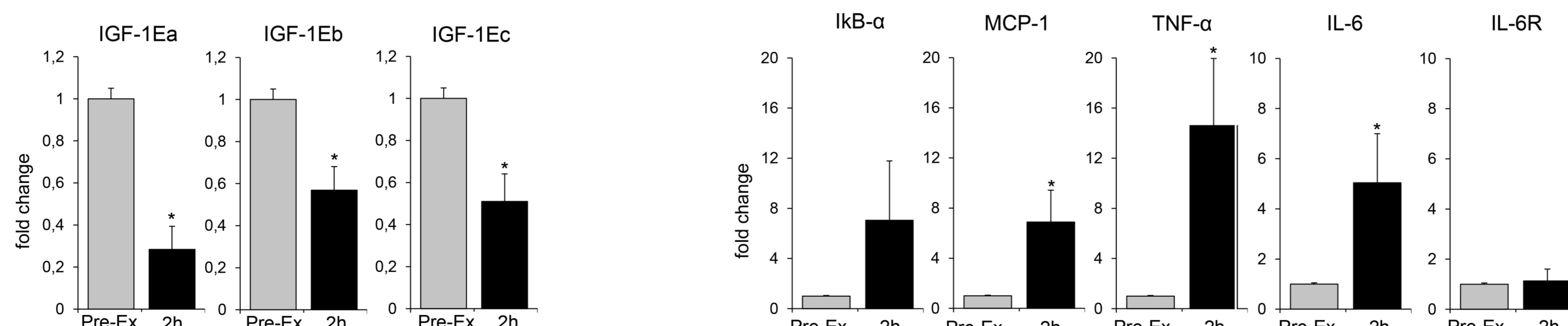


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