

# Concurrent training for elite team sport athletes

av

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## Akademisk avhandling

Avhandling för doktorexamen i idrottsvetenskap  
vid Gymnastik- och idrottshögskolan,  
som enligt beslut av rektor kommer försvaras offentligt  
fredagen den 12 april 2024 klockan 9:00,  
i Aulan, vid Gymnastik- och idrottshögskolan, GIH, Stockholm.

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**Abstract:**

Most team sports consist of elements that require both a high level of strength and aerobic endurance. Because of these demands a combination of resistance and endurance training (concurrent training) is an integrated part of their weekly training program. Concurrent training can be defined as the implementation of resistance and endurance training in parallel within the same training program to develop both capacities simultaneously. Despite the wide range of benefits of concurrent training, there is evidence that adding endurance training to a resistance training protocol can compromise strength development. The underlying cause has recently started to be clarified, with substantial evidence suggesting that the design of the training program and inter-individual differences play a crucial role in determining the effect of concurrent training on strength performance. It has been suggested that the training status may have an independent influence on the results during concurrent training. Thus, it is important to acknowledge that the scientific literature on concurrent training for elite team sport athletes is very scarce, especially in females. The primary aim of this thesis was therefore to investigate the effect of concurrent training on elite team sport athletes with both sexes represented. This was done by performing one systematic review with meta-analysis and three experimental studies.

**Study I** is a review study addressing the effect of training status on strength development during concurrent training and the effect of same-session and different sessions of concurrent training. The result from this study suggests that adding endurance training to a resistance training protocol impairs lower-body maximal dynamic strength development in trained individuals but not in moderately trained or untrained. The data also show that the impairment appears to increase if concurrent training is performed within the same session. Given these findings, the focus of **study II** was to investigate the impact of intrasession exercise order during same-session concurrent training in elite team sport athletes. In this study, we show that high-intensity interval training before resistance training reduces power output during resistance training but does not impair maximal strength or power development during a 7-week training intervention. The focus of **study III** was to examine the reliability of isometric leg press and countermovement jump, two commonly used measurements when assessing strength- and power-related variables in elite team sport athletes. In this study, we demonstrate that isometric leg press and countermovement jump are highly reliable measurements when examining strength- and power-related variables.

The findings from **study II** showed that a reduction in resistance training performance (power output) during same-session concurrent training was visible only when high-intensity interval training was performed before resistance training (**study II**). The focus of **study IV** was therefore to investigate the effect of different recovery periods following high-intensity interval training on strength and explosive performance during a power training session in elite team sport athletes. Since isometric leg press and countermovement jump were shown in **study III** to be highly reliable measurements when assessing strength- and power-related variables in elite team sport athletes, these measurements were used in **study IV**. In **study IV**, we demonstrated that high-intensity interval training 10 min prior to power training impairs strength and explosive performance. However, the impairment was no longer present 6 and 24 hours after high-intensity interval training.

In conclusion, the present thesis shows that trained individuals are sensitive to concurrent training, and that adding high-intensity interval training prior to resistance training compromises strength and explosive performance during the resistance training session in elite team sport athletes. However, the reduction in training performance does not seem to translate to reduced strength or power development during shorter training periods (<7-weeks). The findings from the present thesis also show that the reduction in training performance can be reduced by performing the resistance training session first or by allowing at least a 6-hour recovery period between sessions. The findings from this thesis provide a foundation for an evidence-based approach when organizing training to enhance performance in elite team sport athletes, and for future work to further examine the effect of concurrent training on this population.

ISBN: 978-91-988127-5-6  
<http://urn.kb.se/resolve?urn=urn:nbn:se:gih:diva-8151>

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