

# STUDIE

*Zur Wirkung von Bekleidung, die Nanoplatinum und Nanodiamant enthält, auf die Regeneration von Fußballsportlern zwischen den Trainingseinheiten.*



**4th World Conference on Science and Soccer, University of Portland, OR, USA, 05.-07. Juni 2014**

Die vorliegende Studie erhebt erstmals Werte zur Beurteilung der Reaktion parasympathischer Aktivität und Herzfrequenzvariabilität auf mehrere Trainingseinheiten an einem Tag, und zur Wirkung einer speziellen, Nanomaterialien (DPV576-F) enthaltenden Bekleidung auf die Regeneration von Fußballsportlern während der Trainingsphase.

Die Ergebnisse zeigten, dass das Tragen dieser speziellen Bekleidung während der Trainingspausen eine verbesserte parasympathischen Aktivität und einen höheren Performancelevel erzielte.

## **Ergebnisse:**

Bekleidung, die Fasern mit DPV576-F enthält, kann helfen, eine schnellere Regeneration nach dem Training zu erreichen und Übertraining durch mehrere Trainingseinheiten an einem Tag zu verhindern.



# EFFECT OF GARMENT KNEADED WITH NANOPLATINUM AND NANODIAMOND ON RECOVERY FROM TRAINING IN SOCCER ATHLETES



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## Abstract

The present study is the first to evaluate the parasympathetic activity response using Heart Rate Variability to the multiple training session in a day and the effect of the special garment kneaded with nanomaterials(DPV576-F) on recovery from the training for soccer athletes. Results showed that the wearing of the special garment during the resting time induces enhanced parasympathetic activity and higher performance level. Garment made of the fiber kneaded with DPV576-F may help quick recovery for soccer athletes from the training session and prevent over-training caused by multiple training session in a day.

## INTRODUCTION

In order to plan multiple training sessions in a day, quick recovery from a training session is needed to maintain the performance level and prevent over-training. Recently, mixture of two nanomaterials, i.e. nanodiamond and nanoplatinum (DPV576-F), was introduced and studied for their immune modulatory effect. It was shown that resting on bed padding made of DPV576-F exhibit significant decrease of a psychological stress index, chromogranins A (CgA), after mental calculation load(1). However, there is no study to evaluate the effect of DPV576-F on physical training load. Several studies suggest that recovery status from physical training could be evaluated by analysis of heart rate variability (HRV). The purpose of this was to examine the effect of the garment with DPV576-F on recovery from the multiple training sessions on a day, judging from parasympathetic activity using HRV.

## METHODS

**Subject:** 12 men's collegiate soccer athletes (age 21.2 yrs.) executed two-hour training session in the morning and afternoon.

**Experimental Design:** Experimental group(EXP) wore the special garment made of the fiber kneaded with DPV576-F(VENEX recovery wear, Japan), on the contrary, control group(CON) wore normal leggings and T-shirts throughout resting time in a same lodging.

**HRV evaluation:** Four time five-minutes HRV data were recorded using Minicardio system (Hosand Recovery Variation, Italy).

1st: at the time of awakening in the morning, 2nd: after morning session, after twenty-minutes rest before the lunch, 3rd: at the time of awakening from two-hour afternoon sleep before the afternoon training session, and 4th: after afternoon session, after twenty-minutes rest before the dinner.

**Performance Test:** Athletes performed Short dribble test and Curved sprint test described by Bangsbo and Mohr (2) both in the morning and afternoon training session. Sprint time and dribble time were measured by Witty electric timing system (Microgate, Italy).



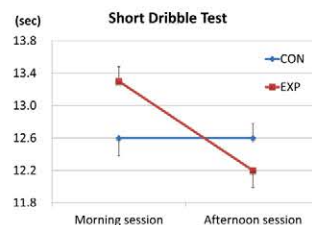
Short dribble test



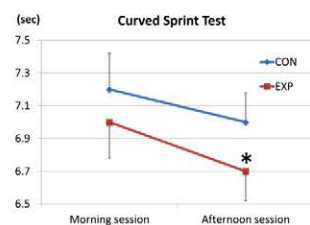
Curved sprint test

**Statistics:** A two way ANOVA (garment condition x HRV evaluation time) with Tukey's HSD post hoc test was used to examine the effects of the garment and their interaction of the testing time on the performance and HRV measures. The significance level was set at  $p \leq 0.05$ .

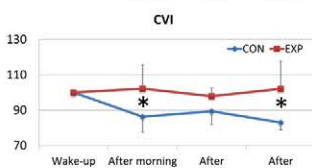
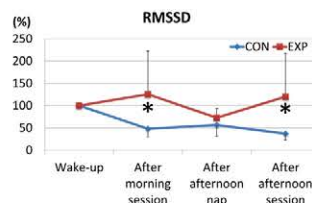
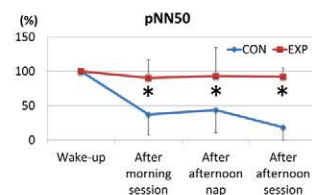
## RESULTS



Short dribble test time in EXP tended to decrease at the afternoon session compared to the morning session, however there was no statistically significant difference between the groups nor between the training sessions.



Although shorter Curved sprint test time was shown at the afternoon training session than the morning session for both group, EXP showed significantly ( $p < 0.05$ ) shorter time than CON at the afternoon session.



EXP showed significantly higher percentage of successive R-R intervals differences greater than 50ms over the entire recordings (pNN50) than CON, and maintain higher level (>90%) compared to reference value (Wake-up) throughout the day. pNN50 in CON, however, decreased in the second HRV recording and didn't recover afterward. EXP showed significantly higher value of the root mean square differences of successive R-R intervals (RMSSD) than CON in the second and forth HRV recording. Significantly higher percentage in the cardiac vagal index (CVI), which is calculated from Lorenz plot of HRV, was shown in the EXP at the second and forth HRV recording.

## DISCUSSION

The pNN50, RMSSD and CVI are well known as indices of parasympathetic nervous activity. The parasympathetic nervous activity is closely related to recovery mechanism from fatigue after training. The results that the value of these indices were higher in EXP than CON, and maintained relatively higher percentage compared to reference value recorded at the wake up in the morning suggest that post-exercise parasympathetic activity was activated and the recovery mechanism in EXP was enhanced by the garment with DPV576-F. As a result, higher performance for CST and SDT might be shown in EXP at the afternoon training session.

## CONCLUSION

Wearing of garment with DPV576-F during the resting time between the multiple training sessions in a day may induces enhanced parasympathetic activity and higher performance level for soccer athletes.

### References

- (1)Katano, H. et al. (2010) Med Biol 154, 86-91.
- (2)Bangsbo, J. & Mohr, M. (2012) Fitness testing in football.