

# HRV的應用

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## 源起

- 備戰2020-頂尖選手的長期壓力狀態
  - 提高自我覺察
  - 檢控壓力狀態，適時地去尋求協助

## 參考資料

- Marales, J., Alamo, J. M. and etc. (2014). Use of heart rate variability in monitoring stress and recovery in Judo Athletes. The Journal of Strength and Conditioning Research.
- Schmitt, L. Regnard, J. & Millet, G. P. (2015). Monitoring fatigue status with HRV measures in elite athletes: An avenue beyond RMSSD? Frontiers in Physiology.

## 用RMSSD測量疲勞

- 如何衡量壓力狀態
- 了解各數值的意義
  - Snap shot:RMSSD、LF/HF
  - Time domain vs frequency domain
    - SDNN、SDANN、NN50、pNN50
    - LH(0.04~0.15)(nLH):交感神經活性指標、HF(0.15~0.4):副交感神經活性指標
  - lnRMSSD 比較用(day to day difference)(0~6.5)
  - 長期:一周內任選三天的lnRMSSD平均值、一周的平均值、lnRMSSD/RR ratio
- 不同的疲勞狀態
  - 站著、躺著指標 (HRV profiles)
  - 建議閱讀:
    - Schmitt, L., Regnard, J., & etc. (2015). Typology of “fatigue” by heart rate variability analysis in elite Nordic-sikers. International Journal of Sports Medicine. (不同姿勢所測量的HRV 頻率資訊，分類不同的疲勞-耐力型項目)
    - prevention, diagnosis and treatment of the overtraining syndrome: joint consensus statement of the european college of sport science and the american college of sports medicine.

## 用HRV測量柔道選手的壓力與恢復

- 目的:HRV是否能夠反應不同的訓練強度。  
=> 如果可以的話，就可以用HRV來做為監控壓力與恢復的指標(柔道選手)
- 對象:14位國家等級的男性柔道選手(西班牙)

TABLE 1. Subject's characteristics.\*

	HTL ( <i>n</i> = 7)	MTL ( <i>n</i> = 7)
Age (y)	23.57 (0.3)	22.43 (0.87)
Height (m)	1.78 (2.09)	1.71 (2.49)
Weight (kg)	83.43 (6.54)	70.43 (3.27)

\*Data are expressed as the mean (*SEM*). HTL = high training load; MTL = moderate training load.

## 用HRV測量柔道選手的壓力與恢復

- 實驗設計(隨機分派):
  - 高強度組(HTL):每天技術訓練、每周兩次體能訓練
  - 中等強度(MTL):每周三次技術訓練

TABLE 2. Weekly training program for both groups.\*

	Monday	Thursday	Wednesday	Tuesday	Friday	Saturday	Sunday
MTL 10–12 AM 7–9 PM		Judo randori		Judo randori	Judo randori		
HTL 10–12 AM 7–9 PM	Strength training	Endurance training Judo randori	Judo technique	Endurance training Judo randori	Judo randori	Strength training	

\*HTL = high training load; MTL = moderate training load.

## 用HRV測量柔道選手的壓力與恢復

- 資料收集:HRV、問卷(選手壓力恢復問卷RESTQ-SPORT)、肌力
- 資料收集時間點:訓練前、後四周(訓練四周)
  - 前測:訓練季開始(九月)之前有一個月左右為調整期
  - 後測:訓練計畫執行後1個月  
(過程中執行訓練計畫的教練對於研究目的並不瞭解)
- HRV收集方式:
  - 48小時前禁用咖啡因飲料
  - 8 am，躺著10分鐘先適應，然後收10分鐘的資料。室溫20~22度

## HRV變異數分析的結果

TABLE 3. Intergroup and intragroup comparisons of heart rate variability variables.\*

		Pretest	Posttest	$F_{1,12}$	$p$	$\eta_p^2$
RMSSD (milliseconds)	MTL	67.04 (19.28)	69.43 (18.43)	16.05	0.002	0.57
	HTL	84.98 (14.42)	38.83 (7.18)†			
VLF (square milliseconds)	MTL	3755.04 (1685.04)	3992.42 (1660.23)	6.08	0.03	0.34
	HTL	6258.23 (1593.06)	2567.57 (1050.91)†			
LF (square milliseconds)	MTL	3177.2 (1219.89)	2646.47 (962.57)	3.41	0.09	0.22
	HTL	2233.2 (421.06)	804.43 (217.35)			
HF (square milliseconds)	MTL	2474.06 (1075.17)	3199.1 (1465.87)	8.79	0.012	0.42
	HTL	3850.99 (1115.88)	736.91 (209.5)†			
LF/HF	MTL	2.24 (0.71)	1.61 (0.48)	4.64	0.05	0.28
	HTL	0.7 (0.1)	2.24 (0.78)†			
SD1 (milliseconds)	MTL	47.71 (13.56)	48.29 (12.27)	14.09	0.003	0.54
	HTL	62.39 (9.65)	31.54 (7.03)†			
SD2 (milliseconds)	MTL	100.53 (22.96)	102.8 (21.76)	0.5	0.49	0.04
	HTL	120.98 (15.40)	137.75 (15.29)			
$\alpha 1$	MTL	1.02 (0.08)	1.03 (0.04)‡	4.63	0.05	0.28
	HTL	0.94 (0.06)	0.75 (0.03)†			
$\alpha 2$	MTL	0.85 (0.05)	1.0 (0.03)‡	5.66	0.035	0.32
	HTL	1.09 (0.12)	0.85 (0.03)			

## 壓力問卷變異數分析結果

TABLE 4. Intergroup and intragroup comparisons of stress/recovery variables.\*

		Pretest	Posttest	$F_{1,12}$	$p$	$\eta_p^2$
General stress	MTL	2.01 (0.07)	1.99 (0.06)	20.51	0.001	0.63
	HTL	1.88 (0.07)	2.23 (0.07) <sup>†‡</sup>			
Sport-specific stress	MTL	2.24 (0.05)	2.15 (0.09)	1.81	0.2	0.13
	HTL	1.94 (0.08)	1.31 (0.4)			
General recovery	MTL	3.28 (0.05)	3.16 (0.04)	339.44	<0.001	0.97
	HTL	3.26 (0.07)	0.85 (0.12) <sup>†‡</sup>			
Sport-specific recovery	MTL	3.72 (0.08)	3.34 (0.14)	20.67	0.001	0.63
	HTL	3.52 (0.11)	1.73 (0.3) <sup>†‡</sup>			

\*Data are expressed as the mean (SEM). The column with the label  $F_{1,12}$  represents the  $F$  distribution value for the univariate interaction effect between testing time and group. The 2 next columns are the  $p$  value and partial eta squared ( $\eta_p^2$ ) associated with these contrasts. MTL = moderate training load; HTL = high training load.

<sup>†</sup>Significant pairwise difference ( $p \leq 0.05$ ) between the pretest and posttest values.

<sup>‡</sup>Significant pairwise difference ( $p \leq 0.05$ ) between groups.

## 肌力變異數分析結果

TABLE 5. Intergroup and intragroup comparisons of strength variables.\*

		Pretest	Posttest	$F_{1,12}$	$p$	$\eta_p^2$
Maximum strength (n.u.)	MTL	1 (0.1)	0.99 (0.09)	5.24	0.04	0.3
	HTL	0.95 (0.12)	0.9 (0.11) <sup>†</sup>			
Maximum power ( $W \cdot kg^{-1}$ )	MTL	6.29 (0.73)	6.23 (0.77)	15.89	0.002	0.57
	HTL	6.31 (0.84)	5.71 (0.81) <sup>†</sup>			
Right hand (n.u.)	MTL	0.64 (0.06)	0.64 (0.06)	1.06	0.32	0.08
	HTL	0.62 (0.06)	0.6 (0.07)			
Left Hand (n.u.)	MTL	0.62 (0.06)	0.64 (0.06)	0.63	0.44	0.05
	HTL	0.59 (0.06)	0.58 (0.06)			

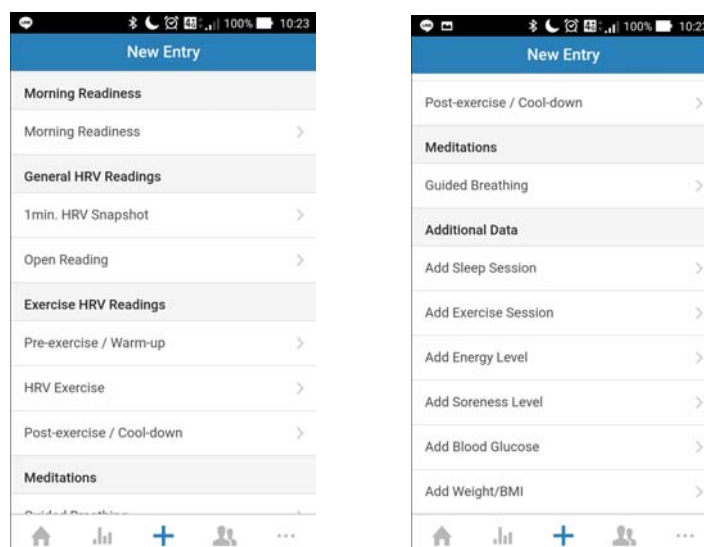
\*Data are expressed as the mean (SEM). The acronym n.u. means non units (the data were normalized by body weight). The column with the label  $F_{1,12}$  represents the  $F$  distribution value for the univariate interaction effect between testing time and group. The 2 next columns are the  $p$  value and partial eta squared ( $\eta_p^2$ ) associated with these contrasts. MTL = moderate training load; HTL = high training load.

<sup>†</sup>Significant pairwise difference ( $p \leq 0.05$ ) between the pretest and posttest values.

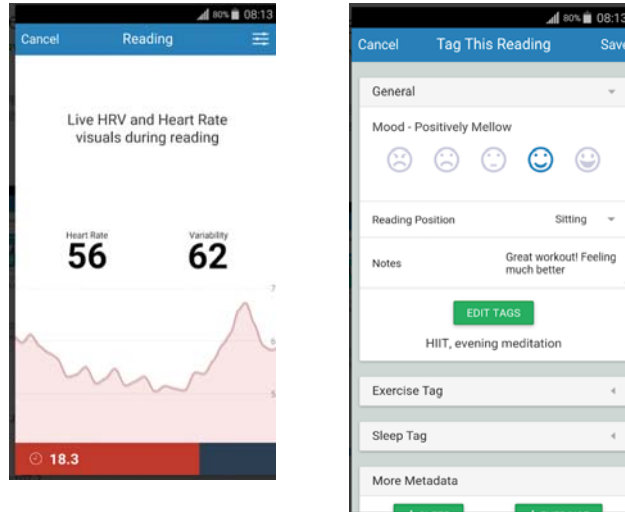
## 建議

- 每周進行一次HRV、心理壓力問卷測量，以了解訓練發展狀態
  - RMSSD，如果持續下降，配合心理問卷果看壓力狀態
- 針對特定的訓練，在訓練過後的隔天早上測量(自主神經的平衡)
  - HF是否下降(LF尚有爭議)
  - LF/HF 是否下降

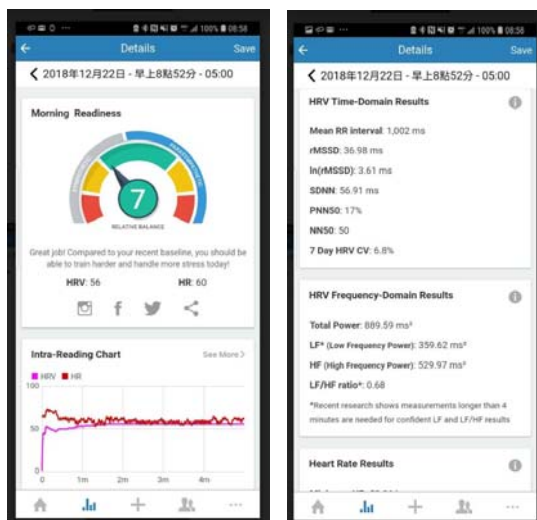
## Eilte HRV app 介紹



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## Eilte HRV app 介紹



## 接下來的行動

- 心理主要應用的方向:長期壓力RMSSD的變化
- 徵得教練、選手的認同，討論可能合作的方式
- 團隊合作的概念(資訊的揭露)
  - 教練
  - 生理、體能
  - 營養