Cortisolo salivare ed holter cardiaco in dipendenti di call center

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Premessa

- La necessità di valutare lo stress lavoro correlato utilizzando metodi fisiologici-biologici

- L'utilità di studiare la relazione tra marcatori fisiologici di stress e risposte a questionari per la valutazione dello stress autopercepito

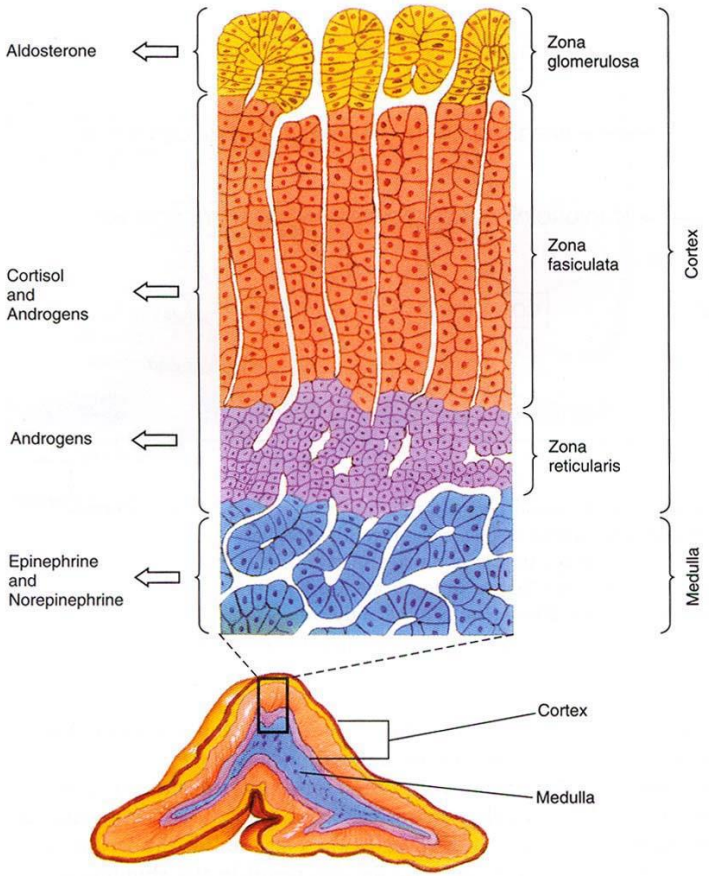
Operatori di call center

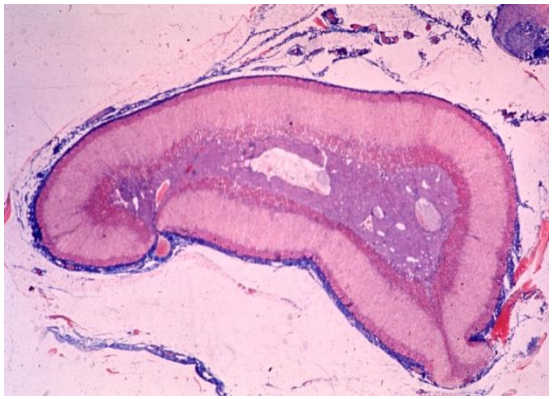
- Lavoro automatico e con ritmi imposti non controllabili (Norman et al 2004)
- Alto turnover e assenteismo a testimoniare elevati livelli di stress (Benninghoven, 2005, Holman, 2002)
- Durante il lavoro devono essere sempre “amichevoli” e questo causa elevato carico emozionale (Cox-Fuenzalida, 2007)

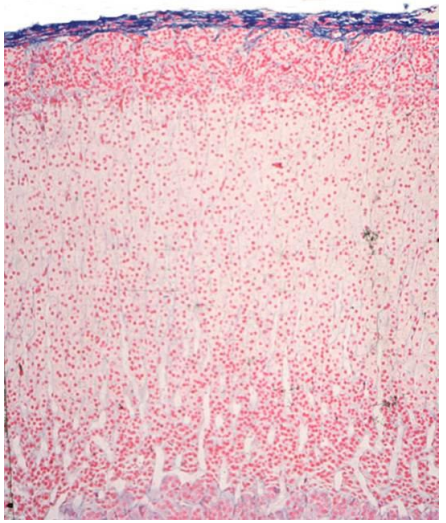
Cortisolo e stress

- Lo stress causa una disregolazione dell'asse ipotalamo-ipofisi-surrene (Mc Even 1998) con aumento o riduzione dei livelli di cortisolo ematico
- Può essere misurato facilmente nella saliva (Kirschbaum 1994)
- Conosciamo abbastanza bene le variazioni circadiane (Edwards et al 2001)

Surrene







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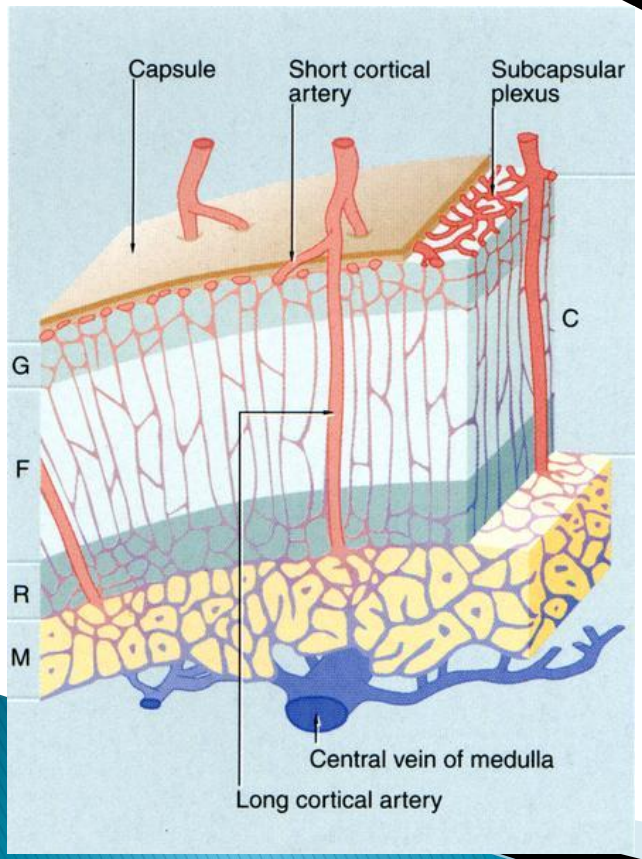
A MOST INTERESTING ASPECT OF ADRENAL BLOOD CIRCULATION

STRESS

CORTISOL

CATECHOLAMINES



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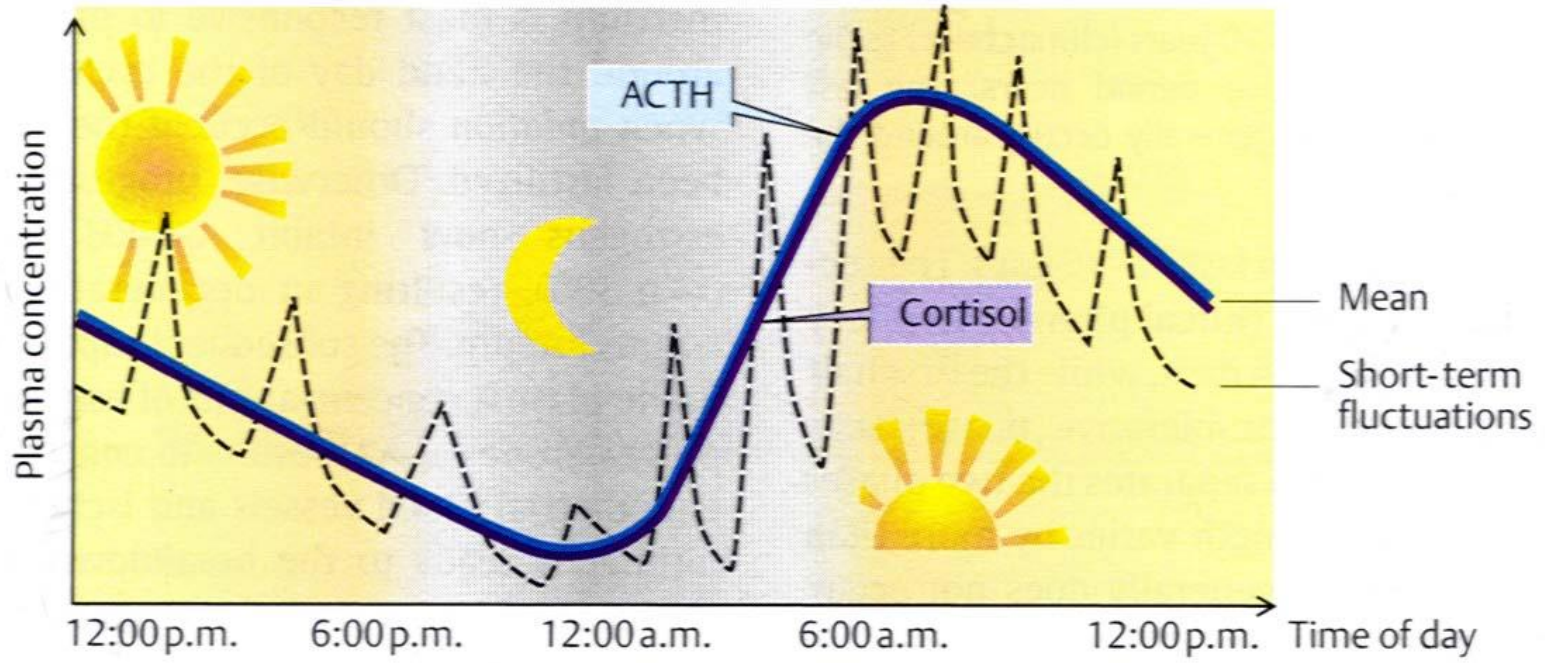
(WHEATER)

DAILY SECRETION: CORTISOL

Pulsatile signals from pituitary
Diurnal changes in the feedback SET POINT



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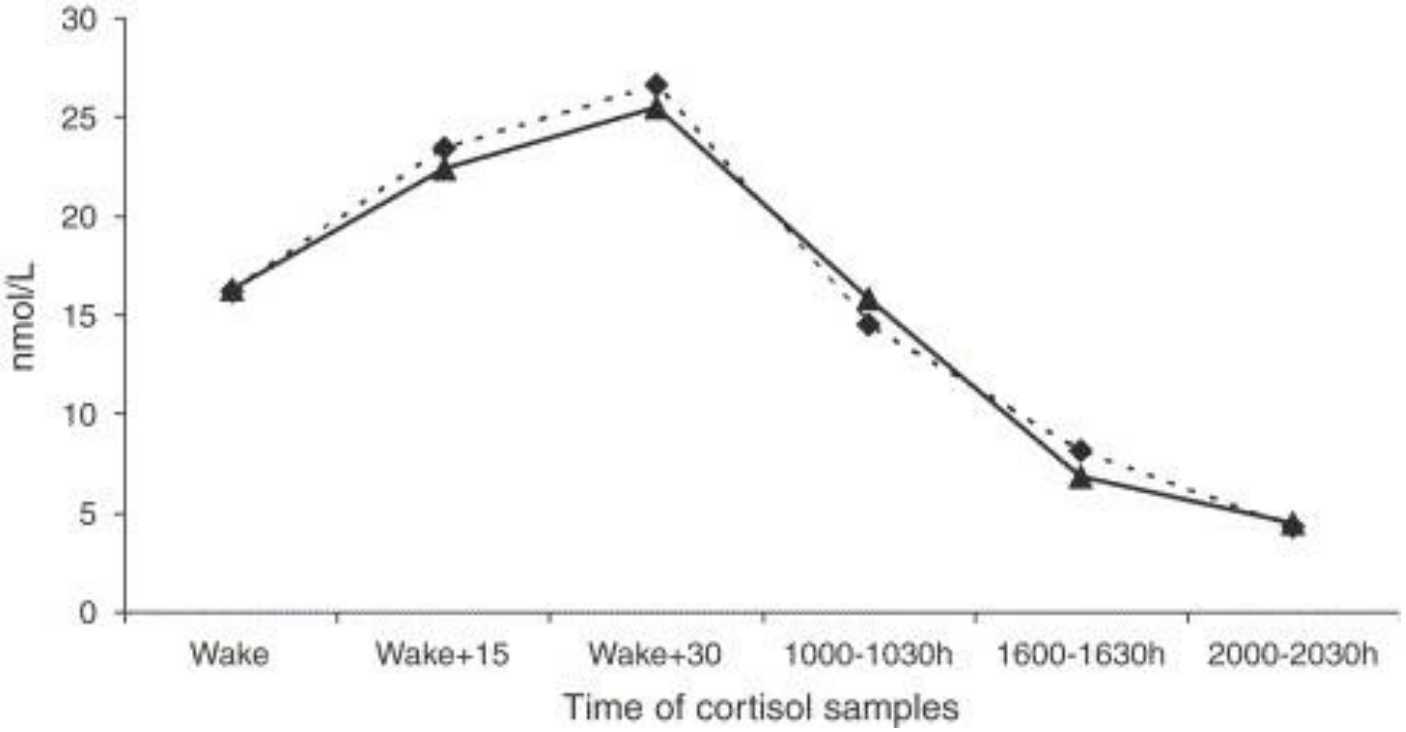


Mean salivary cortisol on waking (wake), 15 (wake+15) and 30 (wake+30) min later, and then at 1000–1030 h, 1600–1630 h and 2000–2030 h in men (solid line) and women (dashed line). (Steptoe, 2006)

Pressione arteriosa

- E’ nota la relazione fra job strain e ipertensione (Belkic et al, 2004. Scand J Work Environ Health, 30: 85-128)
- La relazione è migliore analizzando la pressione arteriosa in modo continuativo (Holter).
- Ci sono numerosi studi che hanno correlato elevati livelli di pressione arteriosa con alto job strain valutato con il metodo di Karasek

Job demand – control model and ambulatory blood pressure/1

AUTHOR	STUDY POPULATION	SAMPLING STRATEGY	RESULTS
Clays et al, 2007	case-control 178 healthy workers	1 workday (24h)	in both sex work SBP and DBP were higher in job-strains compared with other categories (6.5 mmHg SBP, 3.1 mmHg DBP)
Tobe et al, 2007	follow-up (1 year) 229 healthy workers (123 f, 106 m)	1 workday (24h)	job strain and marital cohesion were associated with SBP increase(+ 3 mm Hg) in both sex
Brown et al, 2006	cross-sectional 147 females (92 teachers, 55 nurses)	1 workday (24h)	in nurses (but no in teachers) low control and SBP and DBP were inversely related in both work and home settings
Riese et al, 2004	cross-sectional 159 nurses (f)	1 workday and 1 day off no sleep measures	high job demand predicted higher SBP in workday
Rau, 2004	cross-sectional 117 f and 124 m white collar	1 workday (24h)	employees exposed to high strain have higher SBP and DBP during work

Job demand – control model and ambulatory blood pressure/2

AUTHOR	STUDY POPULATION	SAMPLING STRATEGY	RESULTS
Steptoe, 2004	cross-sectional 227 subjects (106 f, 121 m)	1 workday no sleep measures	SBP and DBP were greater in low than high job control (125.7/81.5 versus 122.4/78.6 mmHg)
Brown et al, 2003	cross-sectional 59 nurses	1 workday (24h)	no association between job strain and ABP
Landsbergis et al, 2003	cross-sectional 283 white and bleu-collar men	1 workday (24h)	high strains with lower SES have SBP (2.7–11.8 mmHg) and DBP (1.9–6.1 mmHg)
Landsbergis et al, 2003	longitudinal study 213 employed men	1 workday (24h)	inconsistent evidence for hypothesis of rapid induction /recovery from job strain and BP
Fauvel et al, 2000	cross-sectional 70 chemical workers	1 workday (24h)	job strain associated with higher DBP during working hours (4.5 mmHg)

Job demand – control model and ambulatory blood pressure/3

AUTHOR	STUDY POPULATION	SAMPLING STRATEGY	RESULTS
Brown et al, 2000	cross-sectional 31 nurses	1 workday (24h)	no associations between Karasek's subscales and ABP
O' Connor et al, 2000	cross-sectional 27 general practitioners (10 f, 17 m)	1 workday and 1 dayoff (8 am – 10 pm)	high strain GPs' SBP and DBP was more elevated compared to low strains, particularly during non-work day
Brisson et al, 1999	cross-sectional 199 white collar women	1 workday (24h)	high educationed and high strain women have increased SBP and DBP (5.9/4.3 mmHg)
Laflamme at al, 1998	cross-sectional 210 white collar woman	1 workday (24h)	high strain women have higher work SBP (+ 8 mmHg) and DBP (+ 6.4 mmHg) than low strain
Schnall at al, 1998	prospective study 195 men	2 workday (24h)	"chronic" high strains have increased SBP and DBP at work and home (11/7 mmHg) compared to no job strains
Melamed et al, 1998	cross-sectional 79 non shift healthy men	1 workday (24h)	low controls have a higher SBP than high control group (+6.2 and 10.2 mmHg) during low and high workload period, respectively

Job demand – control model and ambulatory blood pressure/4

AUTHOR	STUDY POPULATION	SAMPLING STRATEGY	RESULTS
Cesana et al, 1996	cross-sectional 527 normotensive and mild hypertensive nonmedicated men	1 workday (24h)	among normotensive, SBP show the following trand: high strain > passive > active > low strain
Landsbergis et al, 1994	cross-sectional 262 men	1 workday (24h)	job strains have work SBP higher (+ 6,7 mmHg) and DBP (+ 2,7 mmHg) than other employees
Schnall et al, 1992	case-control 88 and 176 control men	1 workday (24h)	job strain was associated with increased SBP (+6.8 mmHg) and increased DBP (+2.8 mmHg) at work
Light at al, 1992	cross-sectional 129 healthy subjects (64 f, 65 m)	1 workday (8h)	high strain men have a greater increases in working hours than low strains (SBP: +9.9 ; DBP: +7.9 mHg)

Effort- reward imabalance model and ambulatory blood pressure

AUTHOR	STUDY POPULATION	SAMPLING STRATEGY	RESULTS
Steptoe et al, 2004	cross-sectional 197 subjects (105 m, 92 f)	1 workday during waking hours only	no associations in females work and home SBP higher in overcommited (132 mmHg) than control group (125 mmHg)
Vrijkotte et al,1999	cross-sectional 109 white collar men	2 workday and 1 day off during waking hours only	overcommitment not affects SBP and DBP work and home SBP higher in imbalanced men (mean 3.9 mmHg)

Summary of the studies

STUDY DESIGN	POSITIVE	MIXED POSITIVE and NULL	TOTAL
Case-control	2	--	2
Cross-sectional	8	9	17
Prospective	2	1	3
Total	12	10	**22**

Scopo del lavoro

- *Valutare l'associazione fra job strain, cortisolo salivare e monitoraggio continuo della pressione arteriosa*

METHODS (1)

- Study design:
  - *cross-sectional*
- Population:
  - *100 call-centres operators (2 call-centres)*
- In work site settings:
  - *medical examination: height (m) & weight (Kg): BMI (Kg/ m2)*
  - *self administered questionnaires:*
    - *job-content questionnaire (no.11 items): job demand no.5, job control no.6*
    - *effort-reward imbalance questionnaire (no.21 items): effort no.5, reward no.11, overcommitment no.5*
- Exclusion criteria:
  - *medication for hypertension*
  - *previous hospitalization for CHD*

METHODS (2)

- 24 HOUR-MONITORING:
  - ✓blood pressure measurements in 2 workdays (pleasant, unpleasant) using bp one OPCB ABP
  - ✓from 7 am till 10 pm: every ½hour
  - ✓from 10 pm till 6 am: every hour

Cortisolo

- Cortisolo salivare raccolto con Saliviette tubes (Sarstedt Ltd Leicester UK)
- 7 campioni per 3 giorni: 2 giorni di lavoro (turno gradito e turno sgradito) e 1 giorno di riposo
  - Al risveglio
  - Dopo 30 minuti
  - Dopo 60 minuti
  - E ogni 3 ore per 4 volte

  - TOTALE DI 1450 CAMPIONI

Analisi del cortisolo

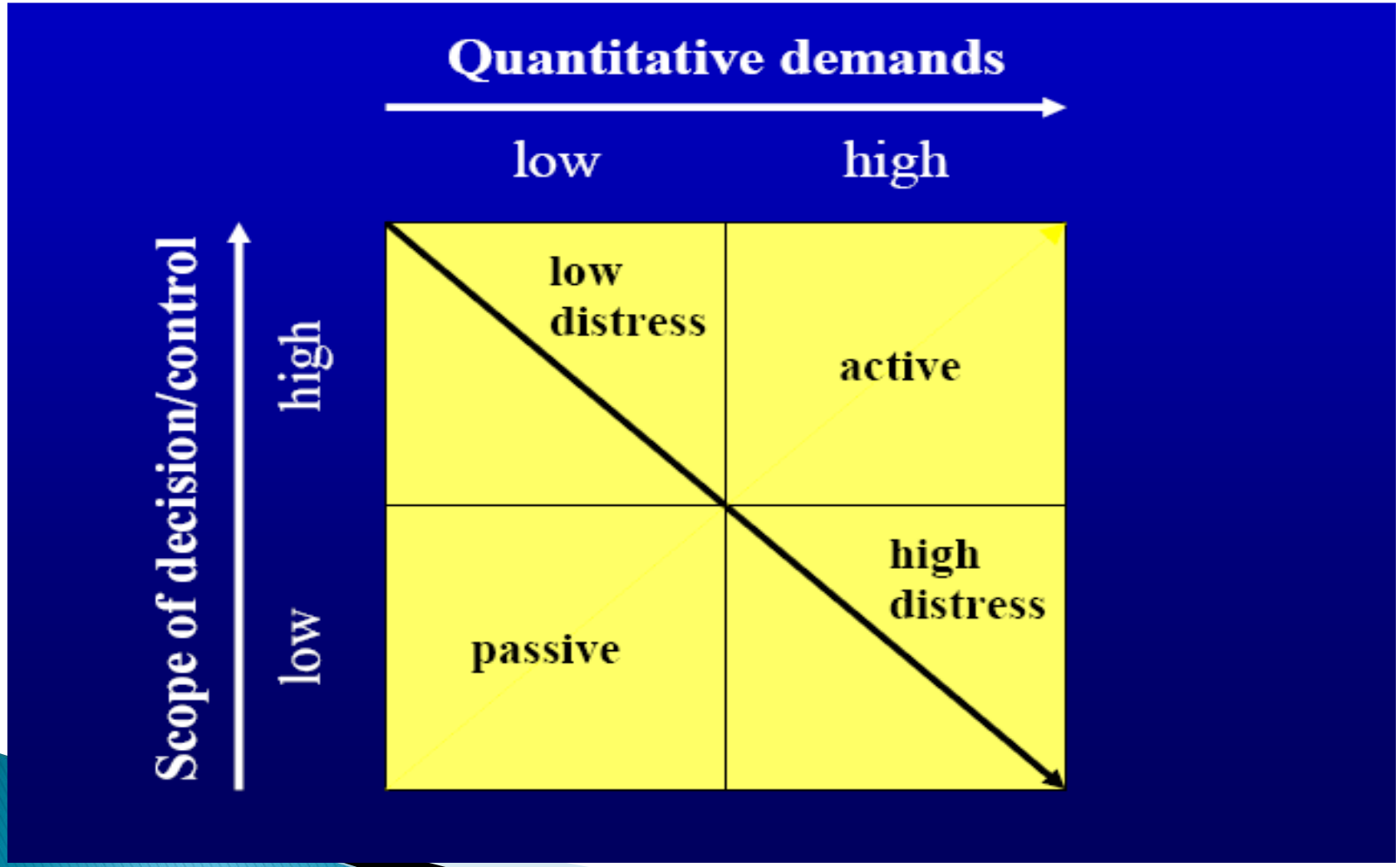
- CAR cortisol awakening response (cortisolo nei primi 60 minuti dal risveglio) calcolata in base all'area sotto la curva ponendo come 0 il risveglio (AUCt)
- AUCi area under the curve rispetto all'incremento (segno dell'attività basale dell'asse ipotalamo-ipofisi-surrene nella prima ora dopo il risveglio)
- Mean Increase incremento del valore (Pruessner 2003) Indica la reattività del sistema
- Escrezione di cortisolo durante il giorno (media dei campioni da 4 a 7)

METHODS (3)

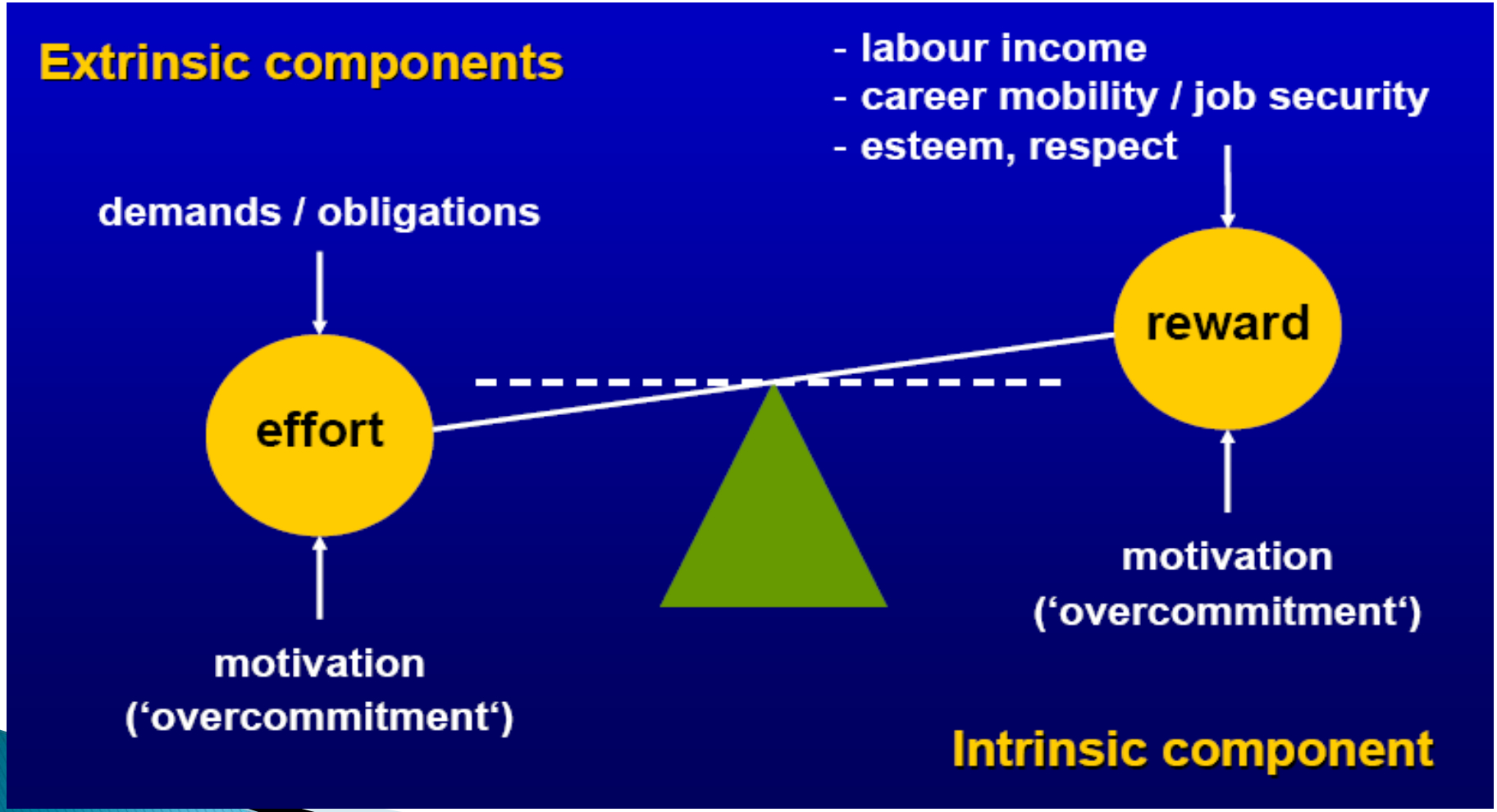
- DATA PROCESSING
  - Average ABP: night (no. 1550 obs), rest (no. 3361obs), work 8-14, work 14-20 (no. 2057 obs)

  (MAP: (SBP+2D)/3)
  - Statistical methods:
    - ✓ X^2
    - ✓ Spearman rank
    - ✓ Analyses of variance
    - ✓ *generalized estimating equations (GEE)*

THE DEMAND–CONTROL MODEL
(R. Karasek 1979; R. Karasek & T. Theorell 1990)



THE EFFORT– REWARD IMBALANCE MODEL
(J. Siegrist 1996)



AMERICAN JOURNAL OF INDUSTRIAL MEDICINE 52:251–260 (2009)

Salivary Cortisol and Psychosocial Hazards at Work

Giovanni Maina, MD,[1*] Antonio Palmas, MD,[1] Massimo Bovenzi, MD,[2] and Francesca Larese Filon, MD[2]

TABLE I. Characteristics of the Study Population

	Female (no. 20) Mean ± SD no. (%)	Males (no. 16) Mean ± SD no. (%)
Age (years)	41.6 ± 6.4	43.9 ± 7.8
Educational level		
Not graduate	19 (95)	14 (87.5)
Graduate	1 (5)	2 (12.5)
Marital status		
Not married	8 (40)	3 (31)
Married	12 (60)	13 (69)
Work schedule		
Full-time	15 (75)	12 (75)
Part-time	5 (25)	4 (25)
Job strain		
High strain	3 (15)	6 (37.4)
Active work	9 (45)	7 (43.8)
Passive work	4 (20)	3 (18.8)
Low strain	4 (20)	
Psychological demands		
High	13 (65)	7 (43.2)
Low	7 (35)	9 (56.8)
Decision latitude		
High	12 (60)	13 (81.3)
Low	8 (40)	3 (18.7)

TABLE V. Model 1: Marginal Linear Regression of Salivary Cortisol on Gender, Workshift, Adherence to Protocol, and Job Strain Categories in the Study Population

Factors	AUC_t coefficient (95%CI)	AUC_i coefficient (95%CI)	MnInc coefficient (95%CI)	$AUCG_{day}$ coefficient (95%CI)	DC coefficient (95%CI)
Gender[1]	−1.1 (−1.9 to −0.3)**	− 1.1 (−1.9 to −0.3)**	−1.0 (−1.7 to −0.4)**	−4.0 (−11.5 to 3.4)	−7.5 (−17.1 to 2.1)
Week day[2]					
Workday 1	1.0 (0.3 to 1.6)**	1.3 (0.4 to 2.2)**	1.1 (0.4 to 1.9)**	0.6 (−4.8 to 6.0)	−3.0 (−8.6 to 2.6)
Workday 2	0.6 (0.1 to 1.0)*	0.9 (−0.1 to 1.8)	0.8 (−0.1 to 1.7)	1.6 (−2.7 to 5.9)	1.3 (−3.9 to 6.5)
Job strain[3]					
High strain	1.1 (0.3 to 2.0)**	0.4 (−0.5 to 1.3)	0.2 (−0.6 to 1.0)	2.7 (−6.6 to 11.9)	5.6 (−5.4 to 16.6)
Active work	0.7 (−0.1 to 1.5)	−0.2 (−1.0 to 0.6)	−0.1 (−0.8 to 0.6)	3.5 (−5.0 to 11.9)	5.9 (−2.7 to 14.5)
Passive work	0.7 (−0.4 to 1.7)	−0.1 (−1.1 to 1.1)	−0.1 (−1.0 to 0.8)	2.3 (−6.0 to 10.6)	6.6 (−5.8 to 19.0)
Adherence to protocol[4]	0.4 (−0.1 to 0.9)	3.1 (2.5 to 3.8)**	4.9 (4.0 to 5.8)**	2.8 (−3.5 to 9.1)	−4.6 (−12.2 to 3.0)
Constant	6.1 (5.5 to 6.7)	−2.7 (−3.7 to −1.7)	−2.1 (−3.0 to −1.3)	68.4 (61.4 to 75.4)	91.7 (85.0 to 98.4)

Regression coefficients and robust 95% confidence intervals (95% CI) were estimated by means of the GEE method to account for correlation between repeated measures of salivary cortisol. See text for the definitions of AUCt, AUCi, MnInc, AUCGday, and DC. Square root transformation was used to normalize cortisol data.
Reference category: female[1], weekend day[2], low strain[3], non-adherence[4].
*$P < 0.05$.
**$P < 0.01$.

TABLE VI. Model 2: Marginal Linear Regression of Salivary Cortisol on Gender, Workshift, Adherence to Protocol, and Dimensions of the Job Strain Model in the Study Population

Factors	AUC_t coefficient (95%CI)	AUC_i coefficient (95%CI)	MnInc coefficient (95%CI)	$AUCG_{day}$ coefficient (95%CI)	DC coefficient (95%CI)
Gender[1]	−1.1 (−1.9 to −0.3)**	−1.1 (−1.9 to −0.4)**	−1.0 (−1.7 to −0.4)**	−3.8 (−11.4 to 3.7)	−7.0 (−16.5 to 2.4)
Week day[2]					
Workday 1	1.0 (0.3 to 1.6)**	1.3 (0.4 to 2.2)**	1.1 (0.4 to 1.9)**	0.6 (−4.8 to 6.0)	−3.0 (−8.6 to 2.6)
Workday 2	0.5 (0.1 to 1.0)*	0.8 (−0.1 to 1.8)	0.8 (−0.1 to 1.7)	1.6 (−2.7 to 5.9)	1.3 (−3.9 to 6.5)
High psychol demands[3]	0.5 (−0.2 to 1.2)	0.4 (−0.3 to 1.1)	0.2 (−0.4 to 0.9)	0.1 (−6.5 to 6.7)	1.7 (−7.0 to 10.5)
High decision latitude[4]	−0.5 (−1.2 to 0.1)	−0.1 (−0.8 to 0.5)	−0.1 (−0.7 to 0.5)	−1.8 (−7.8 to 4.2)	−2.2 (−10.3 to 5.9)
Adherence to protocol[5]	0.4 (−0.1 to 0.9)	6.3 (5.3 to 7.3)**	4.9 (4.0 to 5.7)**	2.7 (−3.6 to 9.1)	−4.7 (−12.4 to 3.0)
Constant	6.8 (6.2 to 7.4)	−2.8 (−3.6 to −2.1)	−2.2 (−2.9 to −1.5)	71.5 (64.1 to 78.9)	96.7 (88.1 to 105.4)

Regression coefficients and robust 95% confidence intervals (95% CI) were estimated by means of the GEE method to account for correlation between repeated measures of salivary cortisol. See text for the definitions of AUCt, AUCi, MnInc, AUCGday, and DC. Square root transformation was used to normalize cortisol data.
Reference category: female[1], weekend day[2], low psychological demands[3], low decision latitude[4], non-adherence[5].
*$P < 0.05$.
**$P < 0.01$.

Risultati complessivi

- Il job strain influenza l'increzione di cortisolo al risveglio in senso positivo (hi strain vs low strain)
- Le donne presentano valori di cortisolo più elevate e significativamente maggiori nei giorni di lavoro ripetto ai giorni di riposo

Conclusioni

- Il nostro lavoro ha dimostrato il coinvolgimento dell'asse ipotalamo surrene nello stress lavoro correlato
- La misura del CAR è un metodo sensibile per valutare la risposta fisiologica a fattori psicosociali

Int Arch Occup Environ Health
DOI 10.1007/s00420-009-0439-0

ORIGINAL ARTICLE

Associations between two job stress models and measures of salivary cortisol

Giovanni Maina · Massimo Bovenzi · Antonio Palmas · Francesca Larese Filon

Table 1 Description of the study population

Characteristics	Group 1	Group 2
Gender		
Male	12 (17.6)	16 (44.4)
Female	56 (82.4)	20 (55.6)[d]
Age (years)	31.6 (9.4)	42.6 (7.0)[b]
Education (years)		
<10	3 (4.4)	7 (19.4)
>10	65 (95.6)	29 (80.6)[c]
Marital status		
Single, separated, divorced or widowed	43 (63.2)	8 (22.2)
Married or cohabiting	25 (36.8)	28 (77.8)[c]
Work schedule		
Full time	34 (50.0)	29 (80.6)
Part time	34 (50.0)	7 (19.4)[d]
Adherence to protocol		
Not adherent	30 (44.1)	7 (19.4)
Adherent	38 (55.9)	29 (80.6)[c]
Morning waking time (hours)	8.03 (1.36)	6.40 (0.6)[b]
Sleep duration (hours)	7.5 (1.6)	6.8 (0.9)[a]
Sleep quality		
Good	45 (66.2)	26 (72.2)
Poor	23 (33.8)	10 (27.8)

Data are given as means and standard deviations or numbers and percentages

Student t test: [a]$P = 0.005$; [b]$P < 0.001$

χ^2 test: [c]$P < 0.05$; [d]$P < 0.005$; [e]$P < 0.001$

Table 4 Marginal linear regression of salivary cortisol index AUC_t on gender, age, marital status, weekday, adherence to protocol, and job strain categories in the study population

Factors	AUC_t coeff (95% CI)	
	Group 1	Group 2
Gender[1]	0.2 (−0.4 to 0.9)	−1.1 (−1.8 to −0.4)[a]
Age	0.01 (−0.02 to 0.04)	−0.04 (−0.08 to 0.01)
Marital status[2]	0.4 (−0.3 to 0.9)	0.3 (−0.3 to 0.9)
Day off[3]	−0.3 (−0.9 to 0.2)	−0.8 (−1.4 to −0.2)[a]
Adherence to protocol[4]	1.4 (0.8–2.0)[b]	0.5 (0.05–0.9)[a]
Job strain[5]		
Active work	−0.2 (−0.9 to 0.5)	−0.4 (−1.2 to 0.3)
Passive work	0.1. (−0.6 to 0.8)	−0.5 (−1.4 to 0.5)
Low strain	−0.4 (−1.1 to 0.3)	−1.4 (−2.4 to −0.3)[a]
Constant	6.6 (5.2–8.1)	9.9 (7.1–12.7)

Regression coefficients and robust 95% confidence intervals (95% CI), adjusted by work schedule, awakening time, sleep duration and quality, were estimated by means of the GEE method to account for the within-subject correlation between repeated measures of salivary cortisol. Square root transformation was used to normalize cortisol data. See text for the definition of AUC_t

Reference category: female[1], not married[2], workday[3], non-adherence[4], high strain[5]

[a] $P < 0.05$; [b] $P < 0.001$

Table 5 Marginal linear regression of salivary cortisol indices AUC_t and DC on gender, age, marital status, weekday, adherence to protocol, and effort in the study population

Factors	AUC_t coeff (95% CI)		DC coeff (95% CI)	
	Group 1	Group 2	Group 1	Group 2
Gender[1]	0.2 (−0.4 to 0.7)	−0.9 (−1.4 to −0.3)[a]	13.5 (4.0–23.1)[a]	−6.6 (−13.6 to 0.4)
Age	0.01 (−0.02 to 0.04)	−0.04 (−0.1 to 0.01)	1.1 (0.6–1.5)[b]	−0.5 (−1.0 to 0.1)
Marital status[2]	0.3 (−0.4 to 0.9)	0.2 (−0.5 to 0.9)	−9.1(−17.9 to -0.2)[a]	−3.4 (−12.5 to 5.6)
Day off[3]	−0.3 (−0.8 to 0.2)	−0.8 (−1.4 to −0.2)[a]	−20.5 (−30.5 to −10.4)[b]	2.8 (−5.4 to 10.9)
Adherence to protocol[4]	1.4 (0.81–1.9)[b]	0.5 (0.1–0.9)[a]	−8.0 (−16.2 to 0.2)	−3.4 (−11.4 to 4.5)
Effort[5]				
2nd tertile	−0.5 (−1.1 to 0.02)	−0.9 (−1.5 to −0.3)[a]	−8.9 (−17.5 to −0.2)[a]	−7.8 (−15.3 to −0.3)[a]
3rd tertile	−0.4 (−1.0 to 0.3)	−0.8 (−1.6 to 0.02)[a]	−2.5 (−10.7 to 5.7)	−1.8 (−11.5 to 7.9)
Constant	6.9 (5.4–8.4)	9.9 (7.2–12.7)	101 (64.5–137)	124 (92.1–156)

Regression coefficients and robust 95% confidence intervals (95% CI), adjusted by work schedule, awakening time, sleep duration and quality were estimated by means of the GEE method to account for the within-subject correlation between repeated measures of salivary cortisol. Square root transformation was used to normalize cortisol data. See text for the definitions of AUC_t, and DC

Reference category: female[1], not married[2],workday[3], non-adherence[4], 1st tertile[5]

[a] $P < 0.05$; [b] $P < 0.001$

Regressione lineare del cortisolo AUC e DC

Table 6 Marginal linear regression of salivary cortisol indices AUC_t and DC on gender, age, civil status, weekday, adherence to protocol, and reward in the study population

Factors	AUC_t coeff (95% CI)		DC coeff (95% CI)	
	Group 1	Group 2	Group 1	Group 2
Gender[1]	0.2 (−0.4 to 0.8)	−0.8 (−1.4 to −0.2)[a]	14.2 (4.5–23.9)[a]	−4.9 (−11.5 to 1.8)
Age	0.01 (−0.02 to 0.04)	−0.03 (−0.1 to 0.03)	1.0 (0.6–1.4)[b]	−0.3 (−0.9 to 0.3)
Marital status[2]	0.4 (−0.2 to 1.1)	0.1 (−0.7 to 0.9)	−7.1 (−15.8 to 1.5)	−2.9 (−12.9 to 7.1)
Day off[3]	−0.3 (−0.9 to 0.2)	−0.8 (−1.5 to −0.2)[a]	−20.4 (−30.6 to −10.3)[b]	3.1 (−4.8 to 11.1)
Adherence[4] to protocol	1.4 (0.8–2.0)[b]	0.5 (0.01–0.9)[a]	−7.4 (−16.3 to 1.5)	−3.6 (−11.7 to 4.6)
Reward[5]				
2nd tertile	0.3 (−0.4 to 0.9)	−0.1 (−1.0 to 0.8)	2.6 (−7.8 to 12.9)	−0.3 (−10.1 to 9.4)
3rd tertile	0.7 (0.1–1.3)[a]	−0.1 (−1.0 to 0.8)	10.5 (2.9–18.2)[a]	3.5 (−6.3 to 13.2)
Constant	6.4 (5.0–7.8)	9.1 (6.0–12.2)	94.5 (60.7–128)	113 (78.1–148)

Regression coefficients and robust 95% (95% CI), adjusted by work schedule, awakening time, sleep duration and quality, were estimated by means of the GEE method to account for the within-subject correlation between repeated measures of salivary cortisol. Square root transformation was used to normalize cortisol data. See text for the definitions of AUC_t and DC

Reference category: female[1], not married[2], workday[3], non-adherence[4], first tertile[5]

[a] $P < 0.05$; [b] $P < 0.001$

Table 7 Marginal linear regression of salivary cortisol indices AUC_t and DC on gender, age, marital status, weekday, adherence to protocol, and effort reward imbalance in the study population

Factors	AUC_t coeff (95% CI)		DC coeff (95%CI)	
	Group 1	Group 2	Group 1	Group 2
Gender[1]	0.09 (−0.5 to 0.6)	−1.0 (−1.6 to −0.4)[a]	12.3 (2.8–21.8)[a]	−7.7 (−16.1 to 0.8)
Age	0.01 (−0.02 to 0.04)	−0.03 (−0.1 to 0.02)	1.0 (0.6–1.4)[b]	−0.4 (−0.9 to 0.1)
Marital status[2]	0.3 (−0.3 to 0.9)	0.2 (−0.6 to 0.9)	−9.1 (−17.6 to −0.5)[a]	−3.5 (−12.9 to 6.0)
Day off[3]	−0.3 (−0.9 to 0.2)	−0.8 (−1.5 to −0.2)[a]	−20.6 (−30.7 to −10.5)[b]	3.1 (−5.0 to 11.2)
Adherence to protocol[4]	1.4 (0.9–2.0)[b]	0.5 (0.1–0.9)[a]	−6.9 (−15.0 to 1.2)	−3.3 (−11.1 to 4.6)
Imbalance[5]				
2nd tertile	−0.7 (−1.2 to −0.2)[a]	−0.7 (−1.4 to 0.1)	−11.1 (−20.1 to 2.1)	−6.4 (−15.8 to 3.0)
3rd tertile	−0.7 (−1.3 to −0.2)[a]	−0.6 (−1.5 to 0.3)	−9.2 (−17.7 to −0.7)[a]	−1.6 (−12.1 to 8.9)
Constant	7.3 (5.8–8.7)	9.6 (6.9–12.4)	107 (69.8–143)	122 (90.0–155)

Regression coefficients and robust 95% (95% CI), adjusted by work schedule, awakening time, sleep duration and quality, were estimated by means of the GEE method to account for the within-subject correlation between repeated measures of salivary cortisol. Square root transformation was used to normalize cortisol data. See text for the definitions of AUC_t and DC

Reference category: female[1], not married[2], workday[3], non-adherence[4], first tertile[5]

[a] $P < 0.05$; [b] $P < 0.001$

Risultati

- Il cortisolo escreto nel periodo di risveglio è associato positivamente al job strain

- Il cortisolo escreto nel periodo di risveglio risulta più basso nei soggetti con alto sbilanciamento impegno/ricompensa secondo il modello di Siegrist

La valutazione della PA con Holter

	FEMALES (no. 74) mean ± SD no. (%)		MALES (no. 26) mean ± SD no. (%)	
Age (years)	34,9	± 1,1	36	± 2,1
< 33 yrs	37	(50%)	11	(42,3%)
≥ 33 yrs	37	(50%)	15	(57,7%)
*BMI**	21,1	± 0,3	22,5	± 0,5
Smoking				
Non-smokers	48	(64,9%)	19	(73,1%)
Smokers	26	(35,1%)	7	(26,9%)
Marital status				
Non-married	36	(48,7%)	15	(57,7%)
Married	38	(51,3%)	11	(42,3%)
Education				
< 13 yrs	66	(89,2%)	24	(92,3%)
> 13 yrs	8	(10,8%)	2	(7,7%)

*P< 0.01

Results (2): Job strain measures in the study population

	Females (no. 74) mean ± SD no. (%)		Males (no. 26) mean ± SD no. (%)	
Karasek classification				
High strain	21	(28,4%)	7	(26,9%)
Active	21	(28,4%)	9	(34,6%)
Passive	15	(20,3%)	5	(19,2%)
Low Strain	17	(23%)	5	(19,2%)
Job Control				
Low	41	(55,4%)	16	(61,5%)
High	33	(44,6%)	10	(38,5%)
Job Demand				
Low	48	(64,9%)	17	(65,4%)
High	26	(35,1%)	9	(34,6%)

Results (3): Effort-reward imbalance measures in the study population

	Females (no. 74) mean ± SD	no. (%)	Males (no. 26) mean ± SD	no. (%)
Effort				
Low	48	(64,9%)	17	(65,4%)
High	26	(35,1%)	9	(3,4%)
Reward				
Low	43	(58,1%)	14	(53,9%)
High	31	(41,9%)	12	(46,1%)
Imbalance				
Low	61	(82,4%)	19	(73,1%)
High	13	(17,6%)	7	(26,9%)
Overcomitment				
Low	39	(52,7%)	13	(50%)
High	35	(47,3%)	13	(50%)

Correlation matrix for the job stress measures Spearman rank correlation coefficient (rho)

	Job control	Effort	Reward	Overcommitment
Job demand	– 0,04	0,44**	– 0,41**	0,43**
Job control		0,10	0,16	– 0,04
Effort			–0,51**	0,63**
Reward				–0,46**

** P< 0,001

Results: HR, SBP, DBP and PAM in selected characteristics of the study population

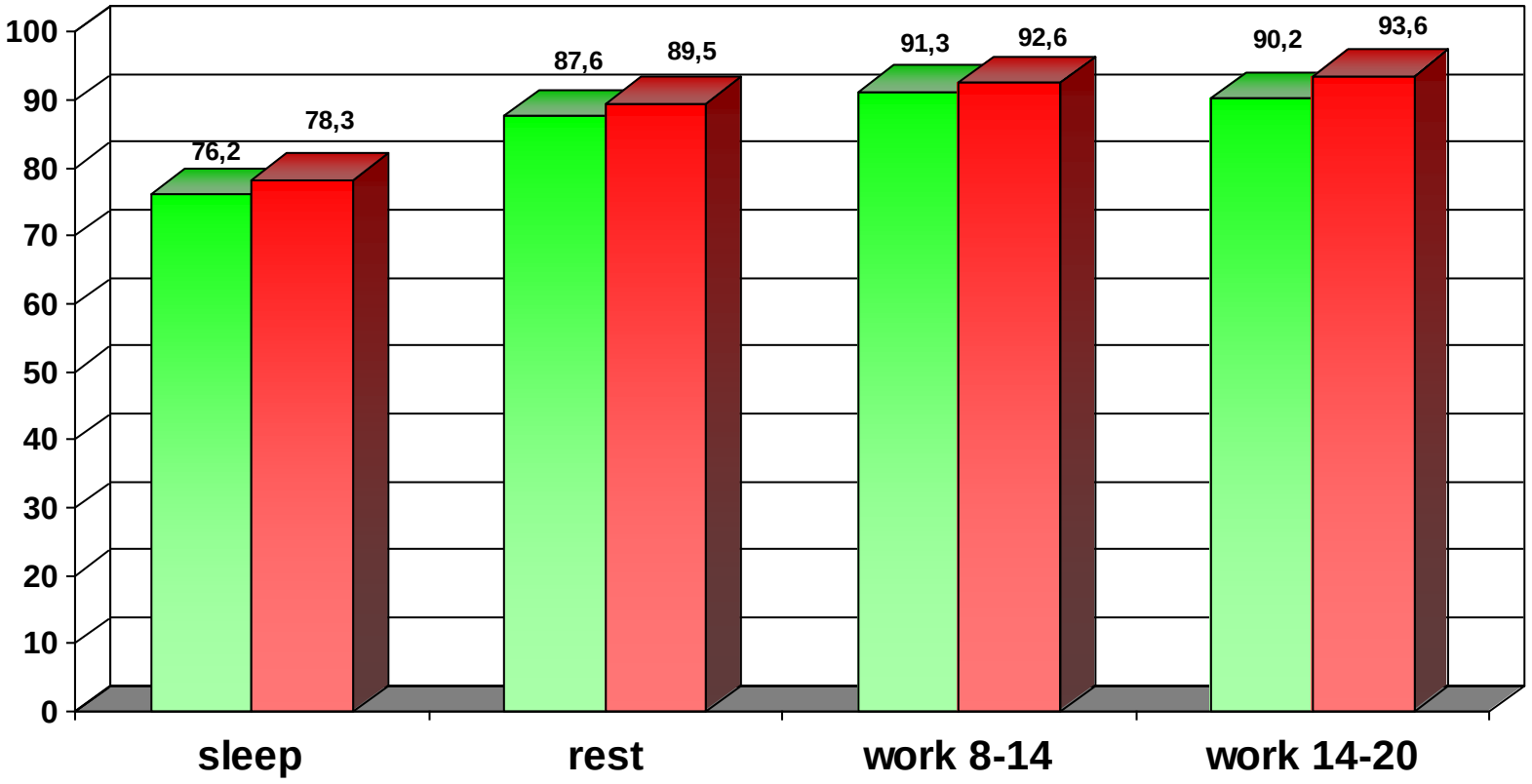
	HR		SBP (mmHg)		DBP (mmHg)		MAP (mmHg)	
	mean (SD)	*P*	*mean (SD)*	*P*	*mean (SD)*	*P*	*mean (SD)*	*P*
GENDER								
females	75.3 (15.3)	<0.001	112.9 (15.5)	= 0.06	74.7 (14.9)	= 0.014	87.5 (14.5)	=0.018
males	72.7 (15.5)		112.1 (14.1)		73.8 (13.5)		86.6 (13.2)	
BMI								
<21	75.6 (15.2)	<0.001	111.1 (15.2)	<0.001	73.7 (14.7)	<0.001	86.2 (14.3)	<0.001
>21	73.1 (14.2)		114.3 (14.5)		75.9 (13.9)		88.7 (13.6)	
WORKDAY								
pleasant	74.1 (15.3)	=0.11	110.6 (14.5)	<0.001	73.5 (14.0)	<0.001	86.2 (13.6)	<0.001
unpleasant	74.3 (15.4)		113.8 (15.6)		75.5 (15.0)		88.3 (14.7)	
ACTIVITY								
Sleep	63.2 (12.1)	<0.001	103.3 (13.5)	<0.001	64.2 (12.1)	<0.001	77.2 (12.1)	<0.001
Rest	78.4 (15.7)		114.1 (14.7)		75.8 (14.1)		88.6 (13.6)	
Work 8–14	73.6 (12.2)		117.0 (13.0)		79.4 (12.3)		91.9 (12.0)	
Work 14–20	77.7 (13.0)		117.0 (14.7)		79.6 (13.7)		92.1 (13.4)	

Heart rate, activity, workshift

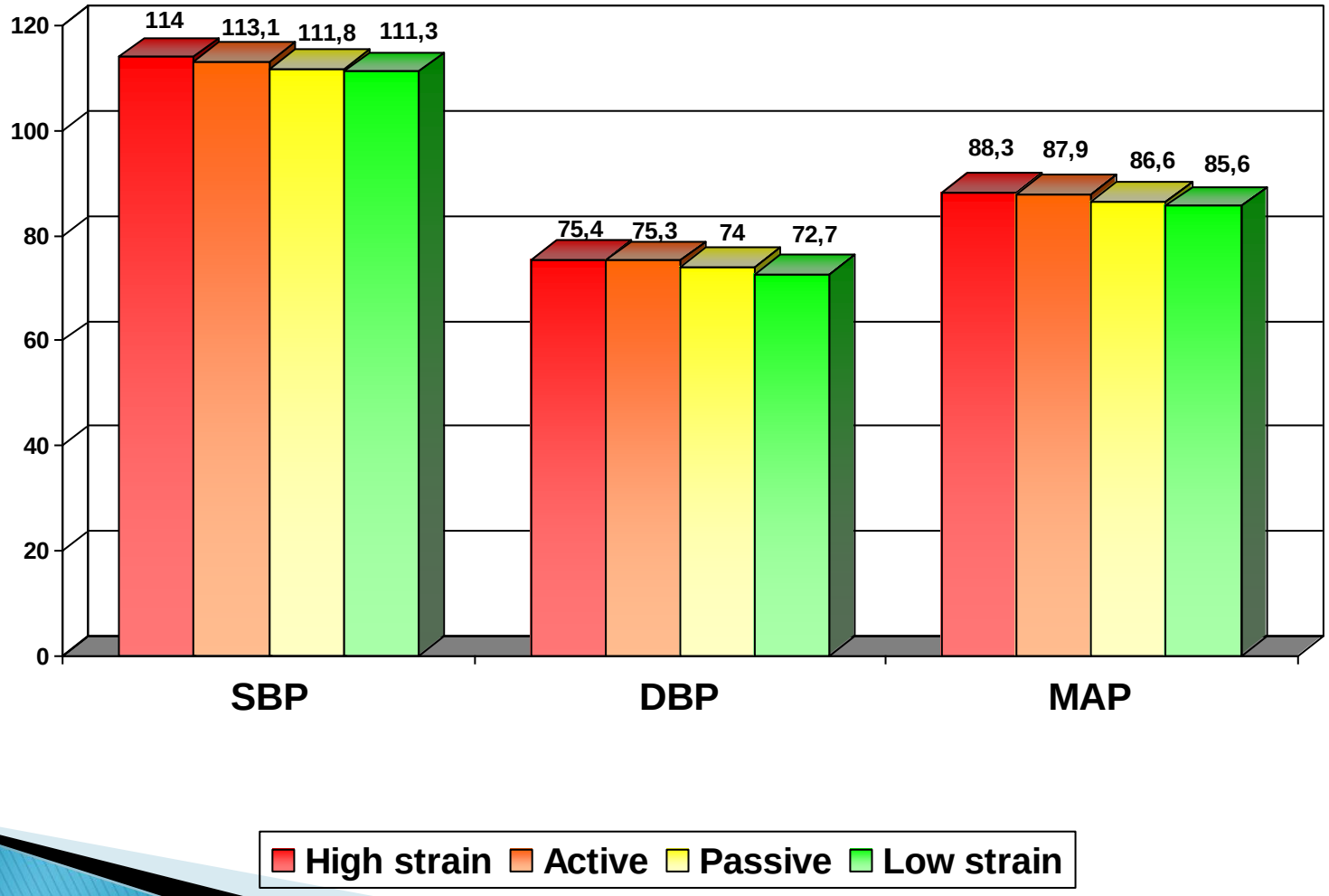
SBP, activity, workshift

DBP, activity, workshift

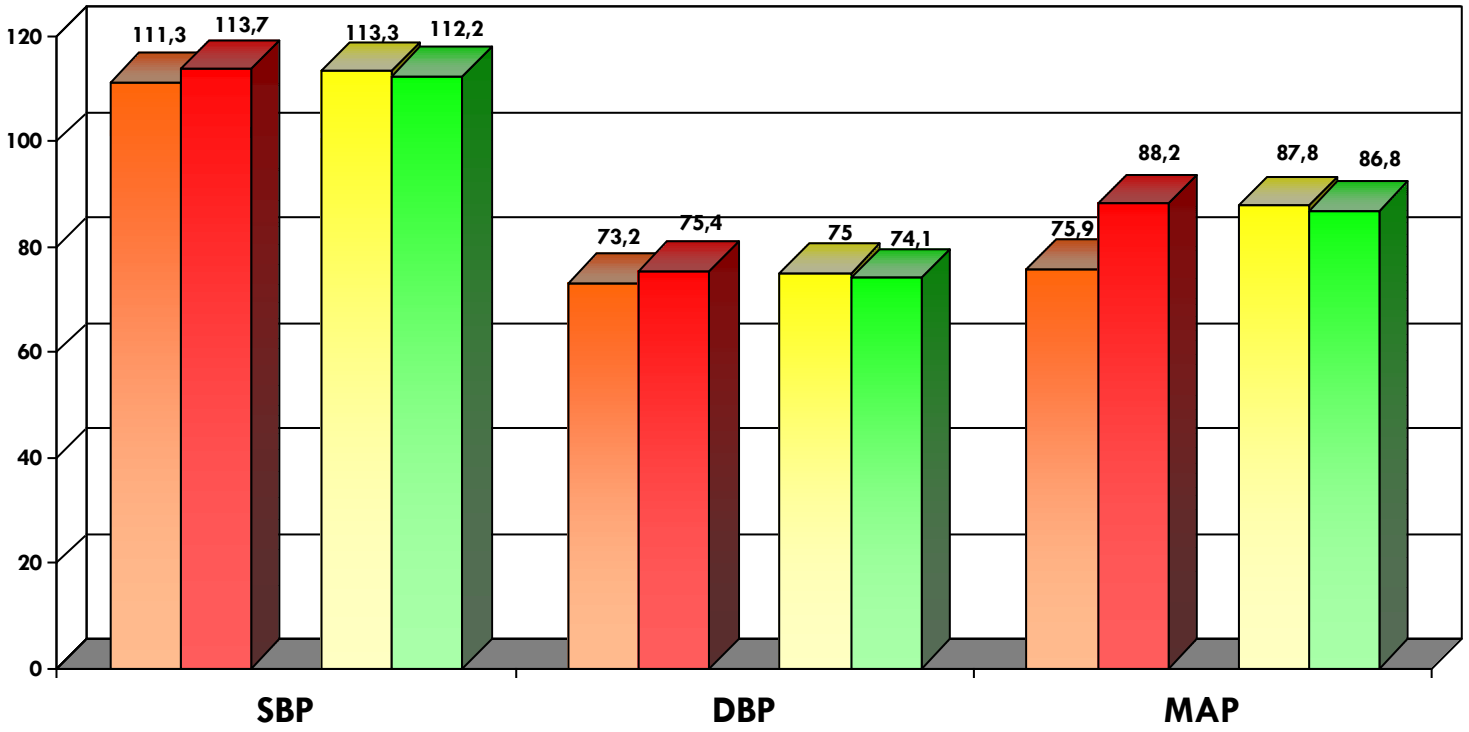
MAP, activity, workshift



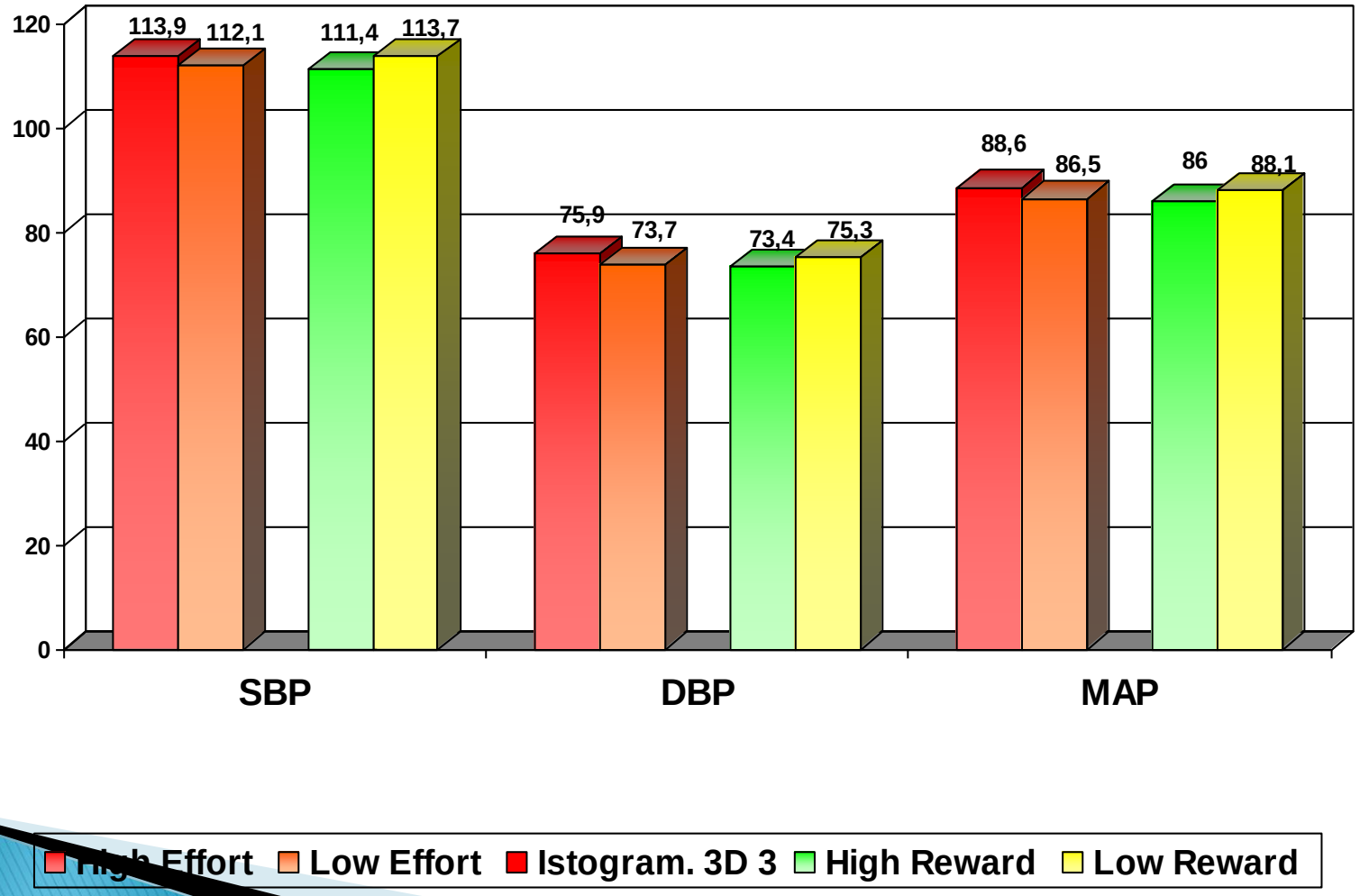
24 hours ABP and job strain categories



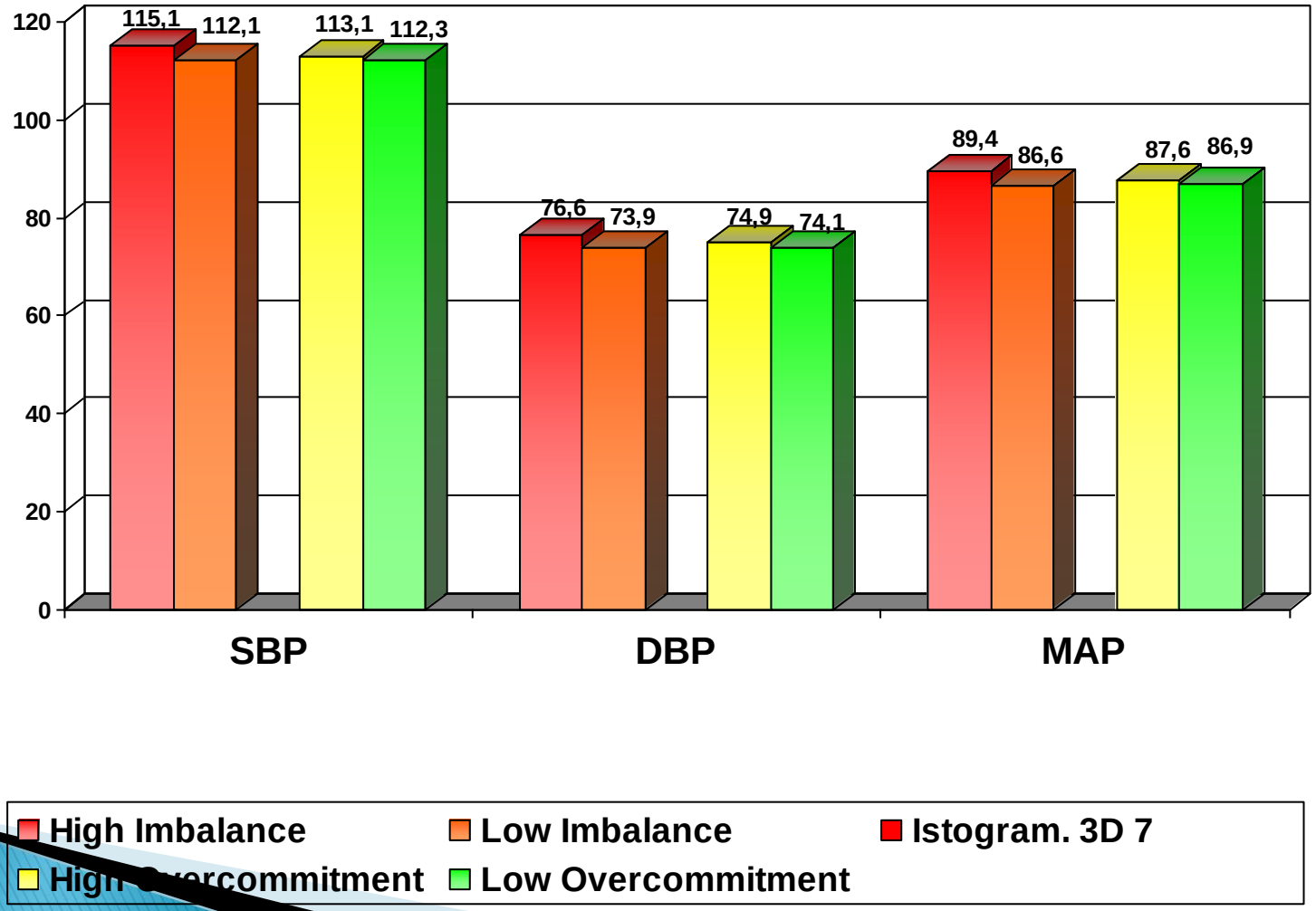
24 hours ABP and job strain dimensions



24 hours ABP and effort reward



24 hours ABP and imbalance, overcommitment



Il turno sgradito è associato con un incremento di 2 mmHg in MAP rispetto al turno gradito ($p=0.013$)

I turni di lavoro sono associati ad un incremento di 3-4 mmHg e 14 mmHg in MAP confrontati con il riposo fuori del lavoro e il periodo di sonno ($p<0.001$).

Marginal linear regression of ambulatory blood pressure on gender, age, BMI, smoking, marital status, educational level, work schedule, activity, and Karasek classification

Factors	HR Coef (95% CI)	SBP Coef (95%CI)	DBP Coef (95%CI)	MAP Coef (95%CI)
Age[1]	0 (-0,2 to 0,2)	0,1 (-0,1 to 0,3)	0 (-0,1 to 0,2)	0,1 (-0,1 to 0,2)
Gender[2]	-1,9 (-5,5 to 1,8)	-2 (-5,1 to 1)	-1,7 (-4,1 to 0,7)	-1,8 (-4,4 to 0,8)
BMI[3]	-0,5 (-1,1 to 0,1)	0,8 (0,4 to 1,3)*	0,6 (0,1 to 1)*	0,7 (0,2 to 1,1)*
Smoking[4]	0,8 (-2,6 to 4,1)	1,8 (-1,2 to 4,8)	1,9 (-0,6 to 4,4)	1,9 (-0,7 to 4,5)
Marital status[5]	-2,4 (-6,1 to 1,3)	-1 (-5 to 3)	0,2 (-3,1 to 3,4)	-0,2 (-3,7 to 3,3)
Education Level[6]				
Diploma	0,5 (-3,7 to 4,7)	2,4 (-4,2 to 9)	2,2 (-1,9 to 6,4)	2,3 (-2,6 to 7,1)
Univ. Degree	-0,9 (-7 to 5,3)	2,3 (-6,8 to 11,4)	3,5 (-3,4 to 10,5)	3,1 (-4,4 to 10,6)
Workday[7]	-0,8 (-2,2 to 0,6)	2,2 (0,4 to 4)*	1,9 (0,4 to 3,4)*	2 (0,4 to 3,6)*
Activity[8]				
Rest	15,1 (13,9 to 16,4)**	10,8 (9,4 to 12,2)**	11,7 (10,3 to 13)**	11,4 (10,1 to 12,7)**
Work 8-14 h	12 (10,3 to 13,7)**	13,6 (11,5 to 15,6)**	14,8 (12,9 to 16,6)**	14,4 (12,5 to 16,3)**
Work 14-20 h	16,5 (14,5 to 18,5)**	13,2 (10,9 to 15,6)**	15,7 (13,6 to 17,7)**	14,9 (12,8 to 17)**
Karasek classification[9]				
Active	1,3 (-2,5 to 5,2)	-0,3 (-4,4 to 3,8)	0,9 (-2,6 to 4,4)	0,5 (-3,1 to 4,1)
Passive	3,5 (-0,5 to 7,6)	-1,2 (-5,2 to 2,8)	-0,4 (-3,5 to 2,7)	-0,6 (-3,9 to 2,7)
Low strain	1,1 (-3,9 to 6,2)	-1,5 (-6,3 to 3,3)	-1,1 (-5 to 2,8)	-1,2 (-5,4 to 2,9)
Constant	72,8 (59 to 86,5)**	80,9 (67,4 to 94,5)**	47,2 (36,6 to 57,8)**	58,4 (47,1 to 69,7)**

* P < 0,05 ** P = 0.000 Reference category: age <33 yrs[1], female[2], BMI < 21[3], non smokers[4], non married[5], primary school[6], pleasant[7], night[8], high strain[9]

Marginal linear regression of ambulatory blood pressure on gender, age, BMI, smoking, marital status, educational level, work schedule, activity and the two dimensions of Karasek's model

Factors	HR Coef (95% CI)	SBP Coef (95%CI)	DBP Coef (95%CI)	MAP Coef (95%CI)
Age[1]	0 (−0,2 to 0,2)	0 (−0,2 to 0,3)	0,1 (−0,1 to 0,2)	0,1 (−0,1 to 0,2)
Gender[2]	−1,8 (−5,4 to 1,8)	−2,1 (−5,1 to 1,0)	−1,7 (−4,1 to 0,7)	−1,8 (−4,3 to 0,7)
BMI[3]	−0,5 (−1,1 to 0,1)	0,8 (0,4 to 1,3)*	0,5 (0,1 to 1,0)*	0,6 (0,2 to 1,1)*
Smoking[4]	0,3 (−3,0 to 3,6)	1,7 (−1,4 to 4,8)	1,7 (−0,8 to 4,2)	1,7 (−0,9 to 4,4)
Marital status [5]	−2,4 (−6,2 to 1,4)	−1,0 (−4,9 to 2,9)	0,2 (−3,0 to 3,4)	−0,2 (−3,6 to 3,2)
Education Level[6]				
Diploma	−0,3 (−4,6 to 4,0)	2,3 (−4,3 to 8,8)	2,0 (−2,0 to 6,0)	2,1 (−2,6 to 6,8)
Univ. Degree	−1,9 (−8,2 to 4,4)	2,0 (−6,7 to 10,8)	3,2 (−3,3 to 9,8)	2,9 (−4,3 to 10,0)
Workday[7]	−0,8 (−2,2 to 0,6)	2,2 (0,4 to 4,0)*	1,9 (0,4 to 3,4)*	2,0 (0,4 to 3,6)*
Activity[8]				
Rest	15,2 (14,0 to 16,4)**	10,8 (9,4 to 12,1)**	11,7 (10,3 to 13,0)**	11,4 (10,1 to 12,7)**
Work 8–14 h	12,0 (10,3 to 13,7)**	13,6 (11,5 to 15,6)**	14,7 (12,9 to 16,6)**	14,4 (12,5 to 16,2)**
Work 14–20 h	16,4 (14,4 to 18,5)**	13,2 (10,8 to 15,5)**	15,6 (13,6 to 17,7)**	14,8 (12,7 to 17,0)**
Karasek dimensions				
Job control[9]	1,3 (−1,7 to 4,4)	−1,6 (−4,6 to 1,4)	−1,4 (−3,7 to 0,9)	−1,4 (−3,9 to 1,0)
Job demand[10]	1,0 (−2,2 to 4,3)	0,6 (−2,8 to 4,0)	−0,1 (−2,9 to 2,6)	0.1 (−2,8 to 3,0)
Constant	74,1 (61,0 to 87,3)**	81,4 (68,5 to 94,2)**	48,2 (37,8 to 58,5)**	59,1 (48,1 to 70.2)**

* P < 0,05 ** P = 0.000 Reference category: age <33 yrs[1], female[2], BMI < 21[3], non smokers[4], non married[5], primary school [6], pleasant[7], night[8], low control[9], low demand[10]

Marginal linear regression of ambulatory blood pressure on gender, age, BMI, smoking, marital status, educational level, work schedule, activity and ERI model.

Factors	HR Coef (95% CI)	SBP Coef (95%CI)	DBP Coef (95%CI)	MAP Coef (95%CI)
Age[1]	0 (−0,1 to 0,2)	0,1 (−0,1 to 0,3)	0,1 (−0,1 to 0,2)	0,1 (−0,1 to 0,2)
Gender[2]	−1,7 (−5,3 to 1,9)	−2,5 (−5,6 to 0,7)	−1,9 (−4,4 to 0,6)	−2,1 (−4,8 to 0,5)
BMI[3]	−0,5 (−1,1 to 0,1)	0,9 (0,4 to 1,4)*	0,6 (0,2 to 1,0)*	0,7 (0,3 to 1,2)*
Smoking[4]	0,3 (−2,8 to 3,4)	1,7 (−1,2 to 4,6)	1,6 (−0,7 to 4,0)	1,6 (−0,9 to 4,1)
Marital status[5]	−2,4 (−6,2 to 1,4)	−2,0 (−5,8 to 1,9)	−0,5 (−3,8 to 2,8)	−1,0 (−4,4 to 2,4)
Education Level[6]				
Diploma	0,3 (−3,4 to 4,1)	2,3 (−4,2 to 8,8)	1,6 (−2,9 to 6,1)	1,9 (−3,2 to 7,0)
Univ. Degree	−1,6 (−7,2 to 4,0)	1,7 (−6,9 to 10,2)	2,5 (−4,1 to 9,1)	2,2 (−4,9 to 9,3)
Workday[7]	−0,7 (−2,1 to 0,7)	2,2 (0,4 to 4,0)*	1,9 (0,4 to 3,4)*	2,0 (0,4 to 3,6)*
Activity[8]				
Rest	15,1 (13,9 to 16,4)**	10,8 (9,4 to 12,1)**	11,7 (10,4 to 13,0)**	11,4 (10,1 to 12,7)**
Work 8–14 h	12,0 (10,4 to 13,7)**	13,6 (11,5 to 15,6)**	14,8 (13,0 to 16,7)**	14,4 (12,6 to 16,2)**
Work 14–20 h	16,4 (14,4 to 18,4)**	13,2 (10,9 to 15,5)**	15,6 (13,6 to 17,,6)**	14,8 (12,8 to 16,8)**
ERI MODEL				
Effort[9]	2,7 (−0,7 to 6,1)	0,5 (−3,2 to 4,2)	1,3 (−1,9 to 4,6)	1,0 (−2,3 to 4,4)
Reward[10]	−1,9 (−5,0 to 1,2)	−0,6 (−3,6 to 2,5)	−0,3 (−2,9 to 2,4)	−0,4 (−3,1 to 2,4)
Imbalance[11]	−0,6 (−4,7 to 3,5)	3,3 (−1,7 to 8,3)	1,9 (−2,3 to 6,1)	2,4 (−2,1 to 6,7)
Overcommitment[12]	−2,4 (−5,7 to 0,8)	−1,5 (−4,8 to1,8)	−1,1 (−3,7 to 1,6)	−1,2 (−4,1 to 1,6)
Constant	76,1 (63,1 to 89,1)**	78,3 (65,2 to 91,5)**	45,7 (34,5 to 60,0)**	56,5(44,9 to 68,2)**

P < 0,05 ** P = 0.000 Reference category: age <33 yrs[1], female[2], BMI < 21[3], non smokers[4], non married[5] primary school[6], pleasant[7], night[8], low effort[9], low reward[10], low imbalance1[11], low overcommitment[12]

CONCLUSIONI-1

I nostri risultati suggeriscono che I fattori biologici e situazionali sono I principali determinanti della pressiona arteriosa ambulatoriale (Holter)

CONCLUSIONI-2

La varianza della pressione arteriosa non è significativamente associata alle classi di rischio valutate in base ai modelli di Karasek e Siegrist.

Conclusioni complessive

- L'uso di marcatori fisiologici dello stress è un'importante frontiera per lo sviluppo delle conoscenze su questo argomento e per cercare di dare oggettività ad un argomento così controverso

- Grazie per l’attenzione!