Association of Dietary Habits with Cardiometabolic Status and Quadriceps Strength of College Football Linemen

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BACKGROUND AND PURPOSE

- NFL linemen have a 52% higher risk of cardiovascular disease mortality compared to the general population[1]
  - Heart disease mortality is 3.7X more likely among offensive and defensive linemen than other players
- Previous studies focusing on the cardiometabolic risk of linemen have not addressed dietary habits[1-4]
  - Documentation of poor dietary habits may identify linemen who possess elevated cardiometabolic risk
- Quadriceps strength to body weight ratio has been associated with both knee injury risk and cardiometabolic status[4]
- The purposes of this study were to determine whether or not associations exist between dietary intake of empty calories, quadriceps strength to body weight ratio, and cardiometabolic status among college football linemen
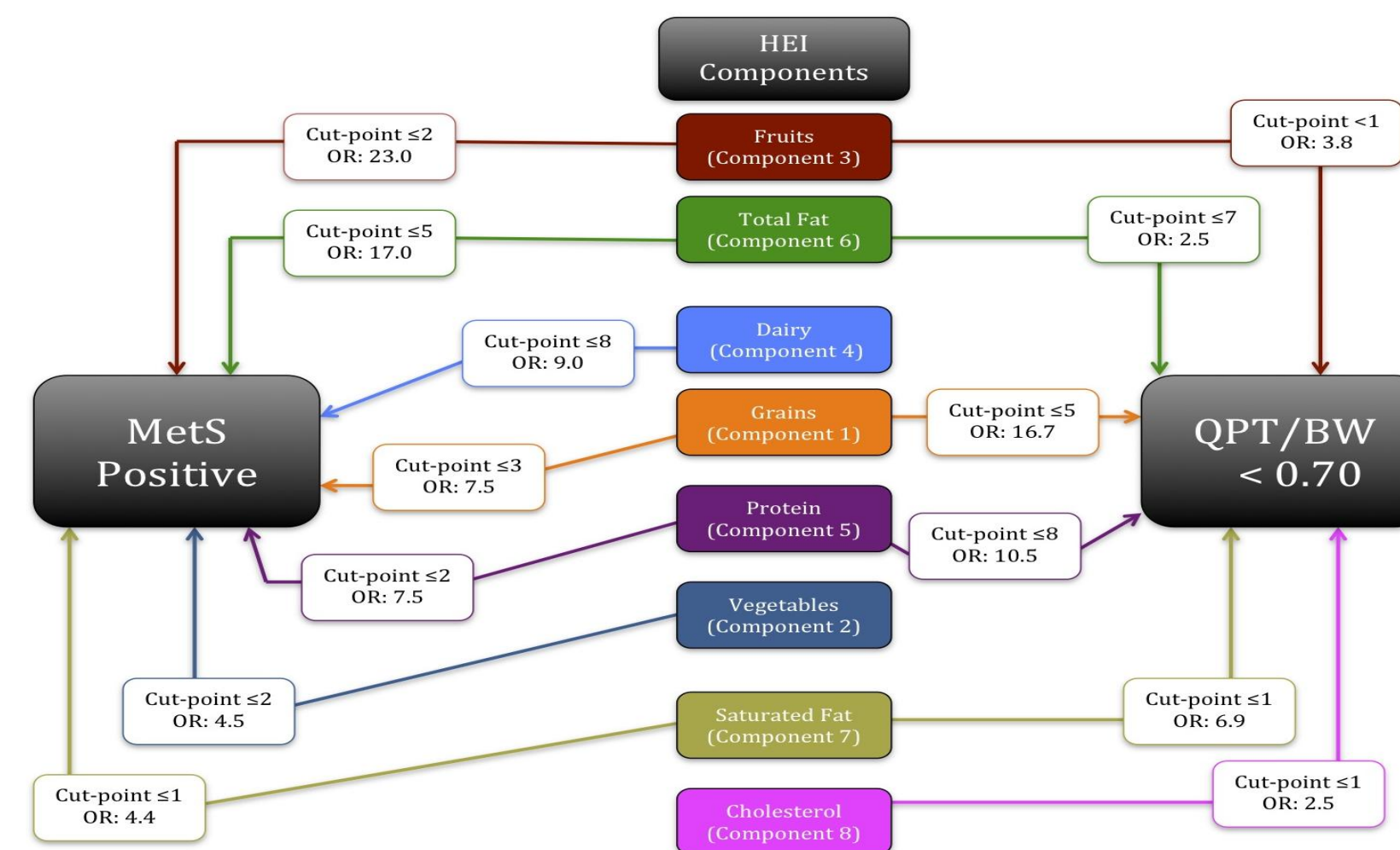
PARTICIPANTS AND PROCEDURES

- 21 NCAA Division I-FCS linemen: 13 offensive linemen (OL) and 8 defensive linemen (DL)
  - Age (20.1 ± 1.4 years), Height (187.2 ± 4.4 cm), Weight (123.5 ± 14.6 kg)
- Self-reported 5-day dietary log completed by each player for a Thursday – Monday period during season
  - Elizabeth Stewart Hands and Associates (ESHA®) Food Processor nutrition analysis system
    - Healthy Eating Index (HEI) – score derived from ESHA® output (10 dietary components)
- Metabolic syndrome (MetS) testing performed within a maximum of 10 weeks after completion of dietary analysis
  - Blood analyses: Piccolo® blood analyzer and Contour® digital glucometer
  - ATP-III definition: ≥ 3 positive factors[5]
    - 1) Waist circumference (WC) > 102 cm
    - 4) Triglycerides (TRG) ≥ 150 mg/dL
    - 2) Systolic and diastolic BP (SBP & DBP) ≥130/85
    - 5) Fasting blood glucose (FBG) ≥100 mg/dL
    - 3) High density lipoproteins (HDL) <40 mg/dL
- Isokinetic quadriceps muscle performance capability of dominant extremity assessed at conclusion of season
  - Quadriceps peak torque to bodyweight ratio (QPT/BW) at 60º per sec
- Data analysis procedures
  - Receiver operating characteristic (ROC) analysis used to identify cut-points for dichotomized associations

Table 1

Previous 4-Factor Model			New 5-Factor Model		
Predictor Cut-Point	Sensitivity	Specificity	Predictor Cut-Point	Sensitivity	Specificity
WC >90	100%	10%	WC >105	91%	60%
BP ≥130/≥85	100%	50%	BP ≥130/≥85	100%	50%
QPT/BW <0.98	100%	10%	QPT/BW <0.70	46%	60%
Ethnicity White	82%	60%	Ethnicity White	82%	60%
–	–	–	HEI Score <50	100%	50%
All 4 Factors Positive	82%	90%	≥4 Factors Positive	91%	90%

Figure 1

Figure 2 — 5-Factor Prediction of MetS (≥ 4)

Figure 3 — HEI 7-Component Prediction of MetS (≥ 3)

Figure 4 — HEI 6-Component Prediction of QPT/BW (≥ 5)

RESULTS

- Dietary habits quantified by HEI were associated with both MetS status and QPT/BW (Figure 1)
  - 52% (11/21) of linemen had MetS, which is associated with elevated cardiometabolic risk
    - 5-factor prediction model (without dietary analysis) found to be consistent with previous 4-factor model[4]
      - Previous model (4-factor) cut-points derived from cohort that included entire football team
        - 82% sensitivity and 90% specificity when applied to OL and DL cohort used for this study
      - New model (5-factor) incorporated position-specific cut-points for WC and QPT/BW (Table 1)
        - 91% sensitivity and 90% specificity (Figure 2)
  - 76% (16/21) of linemen had low HEI scores (≤ 50), which was associated with 22X greater likelihood of MetS
    - Some HEI components were found to provide substantial predictive value, whereas others did not
      - 7 of 10 HEI components were strong predictors of MetS
        - ≥ 3 of 7 positive (i.e., value below cut-point): 100% sensitivity; 90% specificity (Figure 3)
        - Total fruit and fat consumption components of HEI were strongest predictors
      - 6 of 10 HEI components were strong predictors of QPT/BW
        - ≥ 5 of 6 positive (i.e., value below the cut-point): 33% sensitivity; 100% specificity (Figure 4)
        - Saturated fat and grain components of HEI were strongest predictors
- Linemen with MetS were 4X more likely to have poor quadriceps performance capability (< 0.70 QPT/BW)
- Consistent with previous findings, White and Black athletes demonstrated important differences[4,6] (Table 2)
  - MetS is under-diagnosed in Black population[6]
    - TRG and HDL levels are often normal in Black athletes, even when insulin resistance may exist
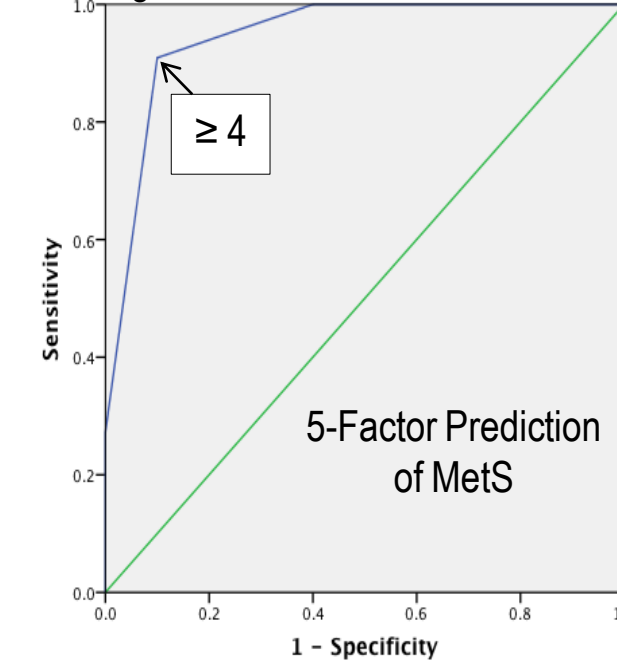   - Lipoprotein Lipase (LPL) higher in Black population (greater clearance of TRG)[6]

Table 2

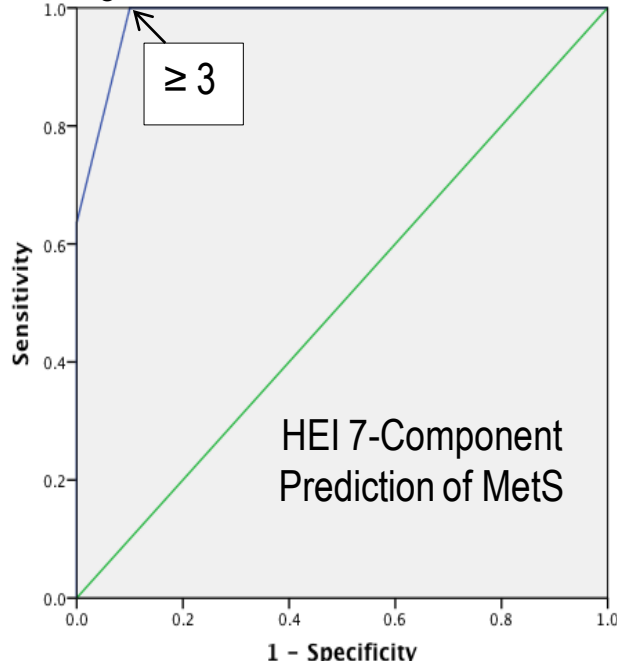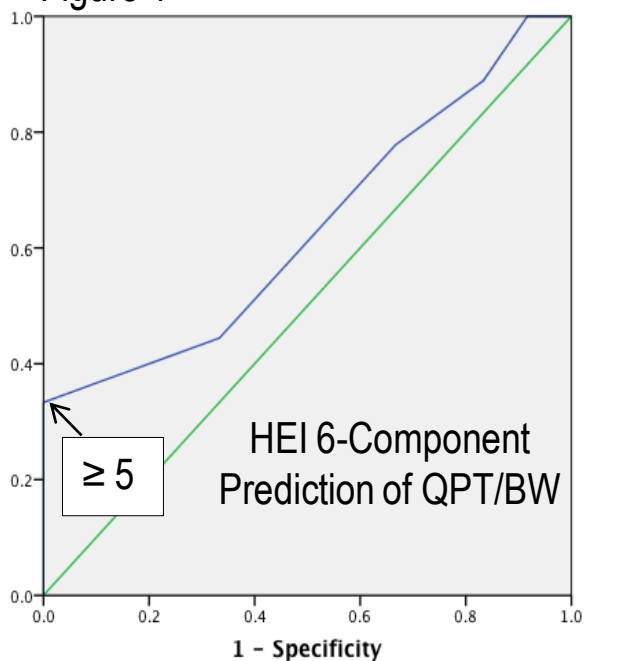| Variable	White (n=13)		Black (n=8)	
WC (cm)	109.39	± 12.87	110.70	± 12.87
SBP (mmHg)	130.54	± 10.24	127.50	± 10.24
DBP (mmHg)	81.15	± 12.07	77.75	± 12.07
HDL (mg/dL)	42.54	± 10.79	47.75	± 10.79
TRG (mg/dL)	136.08	± 38.10	86.63	± 38.10
FBG (mg/dL)	95.46	± 8.65	99.38	± 8.65
QPT/BW	0.77	± 0.07	0.67	± 0.07
HEI Score	44.00	± 10.62	44.88	± 10.62

CLINICAL RELEVANCE

- OL and DL position-specific cut-points, along with inclusion of HEI score as a factor, clearly improves the prediction model for identification of individual players with suboptimal metabolic status
- Analysis of HEI components that were strongest predictors of MetS yielded a 7-component prediction model, which provided remarkably strong discriminative power (≥ 3 positive components: 100% sensitivity and 90% specificity)
  - Further research is needed to confirm the greater predictive power of a model limited to the 7 strongest HEI components to that of models that include WC, BP, QPT/BW, ethnicity, and HEI score
  - Possible inaccuracy of self-reported dietary habits and variation in elapsed time between completion of dietary reporting period and MetS testing were limitations, but probably did not cause overestimation of associations
- Dietary habits appear to have a profound effect on metabolic status, which almost certainly has effects on both the long-term health risk and the performance capabilities of offensive and defensive linemen

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