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Cardiovascular Disease Risk Profile of NCAA Division III Intercollegiate Football Athletes: A Pilot Study

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1 **Cardiovascular Disease Risk Profile of NCAA Division III**

2 **Intercollegiate Football Athletes: A Pilot Study**

3 **Abstract**

4 **Objectives**: Concerns about the long-term cardiovascular health implications of American

5 football participation have been investigated at the professional and Division I levels, but limited

6 research is available at the less resourced Division III level. Therefore, the objective was to

7 assess the cardiovascular disease risk profile of NCAA Division III intercollegiate football

8 athletes. **Methods**: Eighty-nine varsity football athletes (age=19.6±1.7 years,

9 height=1.81±0.07m, weight=92.7±16.2kg; n=21 linemen, n=68 non-linemen) at a private

10 Division III university volunteered to participate. During a preseason pre-participation physical

11 examination, all participants completed a health history screening form (to assess personal and

12 family history of cardiac related pathologies), and were assessed for height, weight, body mass

13 index (BMI), and blood pressure (BP). Linemen only additionally gave a blood sample for

14 fasting blood glucose and cholesterol analysis, and were assessed for waist and hip

15 circumference, metabolic syndrome, and percent body fat (%BF). These measures were reported

16 as averages and frequencies of elevated cardiovascular. Independent t-tests compared linemen to

17 non-linemen, all other data was presented descriptively. **Results**: On average, linemen were

18 significantly taller, heavier, had a higher BMI and higher systolic BP than non-linemen (all

19 P<0.05); there was no difference in diastolic BP between the groups (P=0.331). The average

20 anthropometric and cardiac risk characteristics for linemen were largely within normal ranges,

21 however analyzed individually, a substantial number of participants were at elevated risk (BMI

22 ≥30=85.7%, %BF ≥25=71.4%, waist circumference ≥1=42.9%, hypertension=9.5%, high density

23 lipoproteins <40mg/dL=42.9%, and triglycerides ≥150mg/dL=6.7%; metabolic syndrome

24   prevalence=19%). **Conclusions**: Similar to research in elite athletics, linemen at a single

25   Division III university have elevated cardiovascular disease risk. Physicians and other

26   healthcare providers should consider this elevated risk during pre-participation physical

27   examinations and in planning educational or dietary programming targeted to promoting

28   cardiovascular health.

29

Introduction

Football is one of the most popular sports in America at the high school, collegiate and professional levels, however, concerns have been raised about the long-term health implications of football participation. Of particular concern is how changes in body composition over the course of a football career may impact future cardiovascular health. In the early 1990's, these health concerns prompted the National Football League (NFL) Players Association to request an investigation into player morbidity and mortality [1]. This investigation found that, as a whole, retired players had decreased overall mortality compared to the general population. However, linemen and those with elevated playing-time body mass index (BMI) were at a significantly elevated risk for cardiovascular disease mortality compared to other retired players and to the general population [1].

Since this report, significant attention has been given to the body composition, cardiovascular disease risk, markers of metabolic syndrome, and dietary patterns of football athletes [2-6]. The health of offensive and defensive linemen is of particular concern due to correlations between body composition and cardiovascular disease risk factors in this subset of athletes [4, 6, 7]. In a study of retired NFL players, those with a playing-time BMI ≥ 30 kg/m^2 [8] were at an increased risk of cardiovascular disease risk factors and cardiovascular disease mortality compared to other retired players [9]. While research comparing football athlete's cardiovascular disease risk to the general population has reported mixed findings, the increase in risk for linemen compared to other positions is consistent in the literature [1, 2, 9]. Thus, there appears to be a clear link between body composition and cardiovascular health even in groups of current and former elite football athletes whose relatively high level of physical activity might be thought to mitigate risk.

53   The vast majority of research investigating the health and risk profile of football athletes

54   has been conducted on professional and National Collegiate Athletic Association (NCAA)

55   Division I athletes, perhaps due to the higher profile and resource-rich nature of these programs.

56   The risk profile of Division III football athletes, on the other hand, is sparsely documented. This

57   is despite the fact that 35% of all NCAA football athletes in 2014-15 participated at the Division

58   III level, a total of 25,609 athletes [10]. While their overall body size may be smaller, Division

59   III football players still undergo similar patterns of body compositional changes as Division I and

60   II athletes throughout their careers [11, 12]. Thus, healthcare professionals providing care for

61   these athletes should still be concerned about the potential short and long-term health risks of

62   sport-specific adaptations in body composition.

63   The majority of Division III research has consisted of performance and body composition

64   measures (e.g. BMI, body fat percentage, girth, 40-yard sprint) rather than chronic disease risk

65   factors [11, 13, 14]. To our knowledge, only Buell et al. [7] has reported a broader panel of

66   cardiovascular disease risk factors (specifically, those associated with metabolic syndrome) in

67   this population. Metabolic syndrome is a cluster of factors that increase risk for cardiovascular

68   disease and other metabolic disorders, commonly including abdominal obesity, dyslipidemia,

69   elevated blood pressure (BP), glucose intolerance, proinflammatory state and prothrombotic state

70   [15]. Buell et al. [7] sampled football athletes from all three NCAA divisions. Interestingly,

71   differences were found between divisions for several variables, but the presence of metabolic

72   syndrome was fairly consistent between divisions at 48.6% overall. Unfortunately, the authors

73   do not report descriptive data (means and standard deviations) for the majority of their variables,

74   thus Division III specific norms are still lacking.

75   These values would be of particular interest to healthcare professionals responsible for

76   both pre-participation cardiovascular screening and long-term health of athletes. It is

77   recommended that physicians conducting pre-participation screening utilize physical

78   examination findings, cardiac screening questions and known risk profiles to aid in the detection

79   of cardiovascular anomalies and decrease the risk of sudden death [16]. Additionally, since very

80   few Division III football players will continue to play competitively past their collegiate careers,

81   programs that address the long-term health of these individuals and help them transition out of

82   competitive athletics could have positive implications on their health for years to come.

83   However, before this can be done more information is needed on the cardiovascular disease risk

84   factors of this population.

85   Thus, the purpose of this research was to collect pre-season data of physical

86   characteristics (i.e. body composition and selected cardiovascular disease risk factors) of NCAA

87   Division III football players. Since similar information on a comprehensive cardiovascular

88   profile has not been collected in this population, we decided to utilize a single institution as a

89   pilot study to assess the feasibility and need for a larger trial.

90   **Methods**

91   **Participants**

92   A convenience sample of all football athletes at one NCAA Division III university was

93   recruited. From a roster of approximately 102 players, 89 athletes volunteered to participate

94   (n=21 linemen, n=68 other positions). All football athletes were invited to participate in the

95   main research study. Linemen were additionally recruited to participate in an additional branch

96   of the study which involved collection of additional variables, such as lipid profiles, body fat

97   percentage and glucose levels.

98   Returning athletes were recruited via an announcement made at a team meeting in the

99   spring of 2014, then sent a reminder email prior to their fall 2014 physical exam. New athletes

100   were recruited via an email introducing the study sent approximately one week before reporting

101   for fall sports, and a group announcement made prior to their scheduled physical exam. The

102   university Institutional Review Board approved this study. All participants gave informed

103   consent prior to participation.

104   **Data Collection Procedures**

105   Primary data collection occurred during regularly scheduled pre-season physical exams in

106   a university health center. Participants were given a packet of questionnaires to complete while

107   they waited to be called to the vitals station or doctors exam room. The questionnaires included

108   a Health History Screening Form, Food Frequency Questionnaire (FFQ), and Nutritional

109   Knowledge Questionnaire. Results from the FFQ and Nutrition Knowledge questionnaire are

110   reported elsewhere.[17] The Health History Screening Form asked participants to report a

111   family or personal history of various health issues that might indicate or affect cardiovascular

112   disease risk (e.g. a personal history of tobacco use, or a family history of stroke).

113   At the vitals station, participant height, weight and BP were recorded by pairs of trained

114   athletic training students utilizing the procedures described below. Participant height was

115   measured using a measuring tape mounted on a wall to ±0.5 in and converted to cm. Weight was

116   measured on a standard bathroom scale to ±0.5 lbs. and converted to kilograms (kg). Body mass

117   index (BMI) was calculated as body weight (kg) divided by height (m) squared. BMI of 18.5 –

118   24.9 kg/m^2, 25.0 – 29.9 kg/m^2, and ≥30 kg/m^2 was designated as normal weight, overweight, and

119   obese respectively [8]. Seated BP was recorded using a standard or extra-large adult cuff (sized

120   per manufacturer instructions) with a sphygmomanometer and stethoscope, resting time prior to

121   BP measurement was not controlled.

122   Linemen who opted into the additional data collection set up an appointment the morning

123   after their physical exam for additional data collection. Linemen were instructed to report to

124   their appointment having fasted for at least 8 hours and to be well-hydrated. Upon arrival,

125   participants completed the following measures: waist circumference, hip circumference, percent

126   body fat, and gave a blood sample.

127   Waist circumference was measured according to National Institute of Health (NIH)

128   guidelines [18]. In brief, it was measured to the nearest 0.1 cm using an anthropometric

129   measuring tape. Measurements were taken in a horizontal plane at the visible narrowing of the

130   waist after exhaling. If no narrowing was visualized, the measurement was taken at the level of

131   the 12th rib. The average of two measurements (agreement within ± 1.0 cm) was used. Hip (or

132   buttocks) circumference was measured according to methods described by Heyward [19], with

133   measurement taken at the level of the maximum extension of the buttocks to the nearest 0.1 cm.

134   The average of two measurements (agreement within ± 1.0 cm) was used. Waist to hip ratio was

135   calculated by dividing the average waist circumference by hip circumference. Percent body fat

136   was assessed using bioelectrical impedance analysis via a Tanita TBF-300A pedal to pedal

137   device (Tanita Co., Japan). A trained researcher (CJW or ELA) collected all waist

138   circumference, hip circumference and percent body fat measurements.

139   For the blood sample, the participant's finger was first cleaned using an alcohol wipe

140   then pricked with a disposable lancet. Approximately 40 µL was collected in a capillary tube,

141   then transferred onto a Cholestech LDX System Cassette (Alere, Inc., Waltham, MA) and

142   analyzed for blood lipids [low-density lipoprotein (LDL), high-density lipoprotein (HDL), total

143   cholesterol, and triglycerides] and blood glucose using the Cholestech LDX. A single trained

144   researcher (ELA) collected and analyzed all blood samples.

145   **Risk Category Definitions**

146   BMI $\geq$30 kg/m^2 [8], body fat $\geq$25% [8], waist $\geq$102cm [18], and waist to hip ratio $\geq$1 [19]

147   were considered elevated risk. According to the methods of Tucker et al. [5], prehypertension

148   was defined as systolic BP $\geq$120mmHg but <140mmHg, OR diastolic BP $\geq$80mmHg but less

149   than 90mmHg; hypertension was defined as both systolic BP $\geq$140mmHg and diastolic BP

150   $\geq$90mmHg. Fasting blood glucose $\geq$100 mg/dL was considered impaired, and $\geq$126 mg/dL was

151   considered glucose intolerance [5, 15]. From the blood sample analysis, HDL <40 mg/dL was

152   considered a marker of metabolic syndrome, high LDL was defined as $\geq$160 mg/dL,

153   triglycerides $\geq$150 mg/dL were considered dyslipidemia, total cholesterol >200 mg/dL was

154   defined as borderline high, and total cholesterol $\geq$240 mg/dL was defined as high [15, 20, 21].

155   Additionally, the presence of metabolic syndrome (and number of symptoms) was determined

156   using previously established criteria [7, 15].

157   **Data Analysis**

158   Differences in demographic variables between positions were analyzed using

159   independent t-tests in IBM SPSS Statistics 20 (Armonk, New York). Alpha was set *a priori* at

160   p=0.05. Frequencies of "yes" and "no" responses on the Health History Form data were reported

161   for the whole sample. Cardiovascular disease risk factors of the lineman sub-sample are reported

162   alongside previously published norms for NFL linemen [5]. The variables and risk categories

163   were selected because they represent common cardiovascular disease risk factors and metabolic

164   syndrome characteristics, and have been previously tracked in similar research on elite athletes

165   [5]. Continuous variables are presented both descriptively and as frequencies after the data were

166   dichotomized into normal and elevated risk categories. Blood sample analysis for triglycerides

167   and LDL produced invalid test results in 7 participants, leading to a pre-season n=15.

Results

169   A total of 89 Division III football athletes from a single university participated in the

170   study. Twenty-one were classified as linemen and 68 were non-linemen. Demographic data is

171   reported in Table 1 and Table 2. There was no significant difference in age or diastolic BP

172   between linemen and non-linemen (P>0.05; Table 1). Linemen were significantly taller, heavier,

173   had a higher BMI and higher systolic BP than non-linemen (all P<0.05; Table 1).

174   The self-reported health history and behaviors for all participants are reported in Table 3.

175   Linemen anthropometric and cardiovascular characteristics are reported in Table 4, and

176   prevalence of cardiovascular disease risk factors in Table 5. The prevalence of metabolic

177   syndrome amongst linemen was 19% (n=4). Fourteen percent (n=3) had zero markers of

178   metabolic syndrome, 33% (n=7) had 1 marker, 33% (n=7) had 2 markers) and 19% (n=4) had 3

179   markers.

Discussion

181   The current study provides data on the cardiovascular disease risk profile of a single

182   Division III football team. Data were collected as a pilot study to assess the feasibility and need

183   for a larger multi-institution trial. This data highlights the general profile of the entire team,

184   which includes data that would be available during a standard pre-participation exam (e.g.

185   weight, BMI, BP, and self-reported health history). Additional variables, some of which are not

186   part of standard pre-participation exams, were collected on a subset of linemen. These variables

187   included important measures of metabolic syndrome and cardiovascular disease risk such as

188   body fat percentage, lipid profile, waist circumference, and fasting glucose.

189 **Self-reported health history and behaviors**

190   While a substantial number of participants reported a family history of pathologies

191 related to poor cardiovascular health and obesity, few participants reported a personal history of

192 these pathologies. As young, relatively healthy, physically active adults, this trend would be

193 expected. However, it is interesting to note that while only 9.5% of linemen indicated a personal

194 history of heart problems and 0% indicated abnormal cholesterol, this contrasts with actual

195 prevalence found in the linemen subgroup of 9.5% having hypertension, 42.9% having low

196 HDL, and 6.7% having high triglycerides. Thus, it appears that more individuals had

197 cardiovascular disease risk factors than were aware of their risk.

198 **Blood pressure and lipid profile of linemen**

199   Although values for Division III are largely absent, significant research into blood

200 measures such as lipids (e.g. total cholesterol, LDL, HDL, and triglycerides) have been done in

201 other football samples. Jonnalagadda, Rosenbloom, and Skinner [22] observed a trend for

202 increased total cholesterol in Division I linemen. After eight weeks of training, Kirwan et al. [6]

203 observed a significant increase in total cholesterol and LDL, but no change in triglycerides and

204 HDL among a group of redshirt freshmen. Conversely, Haskins, Bernhardt, and Koscik [23]

205 compared 30 collegiate football linemen to 10 age- and size-matched sedentary controls and

206 found similar total cholesterol, LDL, HDL and triglycerides between groups, though the athletes

207 had lower at-risk LDL than the controls. The current pilot study provides preliminary norms for

208 Division III football athletes. Future work should verify these values in a broader sample, and

209 investigate links between BP and lipid profiles, dietary habits, and access to nutritional support

210 services (e.g. registered dietitian nutritionist) as might be available in Division I or professional

211 athletics.

212   Lineman average BP, frequency of hypertension and prehypertension were similar when

213   descriptively compared to past research in NFL linemen [5]. Lineman had significantly higher

214   systolic BP than non-linemen, indicating that a slightly higher risk of hypertension, which may

215   merit physician attention during the pre-participation physical examination process. The

216   prevalence of metabolic syndrome in the linemen sample was found to be 19%, which is lower

217   than previously reported in the literature (48%) despite the use of identical criteria [7]. It is

218   unclear why lower prevalence was found in the current study; future research should investigate

219   the prevalence of metabolic syndrome in a larger, multi-institution sample.

220   **Anthropometric characteristics of linemen**

221   Similar to previous research, linemen in the current study were larger than non-linemen

222   [4, 5, 24]. As expected, the average size (height, weight and BMI) of the current sample of DIII

223   linemen is considerably smaller than previously reported norms in NFL linemen [5], and slightly

224   smaller than Division I and II athletes [4, 7]. Our linemen were similar in size to previous

225   reports at the DIII level [11], providing limited evidence that our linemen may be representative

226   to the larger DIII population. The average body fat percentage aligns with past research in

227   football populations (20.8-28.3%) [5, 7]. Interestingly, while not statistically compared, the

228   percentage of linemen with a body fat >25% appears higher in our sample (71.4%) than previous

229   research (14.1%) [5]. Clinically, this may indicate that elevated cardiovascular disease risk due

230   to excess body fat is more prevalent at the Division III level where conditioning and fitness

231   norms differ from more elite levels of football.

232   **Limitations and Considerations**

233   In this pilot study, data was collected from a single institution. While there is evidence

234   that football athletes at this institution follow previously published norms, results are not

235 necessarily representative of all Division III football programs. Additionally, due to data

236 collection at a single time-point, we cannot establish whether differences between lineman and

237 non-lineman might have existed prior to participation in football, or resulted from sport-specific

238 adaptation. We also asked participants to self-identify their ethnicity because of the potential for

239 increased cardiovascular risk in certain ethnic populations. Data is presented descriptively

240 (Table 2) but no subgroup analyses were conducted because this was not an aim of the current

241 study. Results should be interpreted in light of the ethnic characteristics of the current sample.

242 Future research should include a selection of programs across different geographical areas.

243   Additionally, there were limitations in the data collection protocol. Specifically, initial

244 anthropometric data (height, weight, and BP) was collected at four stations, each manned by

245 athletic training students. Although trained in the data collection task, some variability in

246 measurement could have been present, especially for BP which is known to have inter-rater

247 variability. While it would have been ideal research control to have one assessment station with

248 a single individual collecting all measures, this would have been practically unfeasible

249 considering the volume of athletes and time limitations. Additionally, it would not mimic

250 common practice in team pre-participation physicals, which commonly use multiple evaluators.

251 For the additional measures on linemen, body fat was analyzed using a bioelectrical-impedance

252 method, which is a less accurate measurement than plethysmography (e.g. BodPod) or DEXA

253 scanning. Unfortunately, these more accurate measures were not available at the time of the

254 study, and since skinfold measurements are known to vary greatly based on individual technique

255 and skill, we chose bioelectrical-impedance as the most consistent available option.

256 **Conclusions**

257   Similar to previous research in professional and Division I athletics, linemen at a single

258   Division III university have elevated cardiovascular disease risk compared with non-linemen.

259   While average linemen values were largely within target ranges, when analyzed at the individual

260   level, multiple participants fell into elevated risk categories. Physicians and other healthcare

261   providers should consider linemen's elevated risk when performing pre-participation physical

262   exams. In addition, football linemen may benefit from additional educational and dietary

263   programming targeted at decreasing modifiable cardiovascular disease risk factors.

264

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265

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325

326

Table 1. Demographic and Anthropometric Characteristics of NCAA Division III Football Athletes

Descriptor	Linemen, n=21		Non-Linemen, n=68		All Athletes, n=89		Independent t-test between positions	
	M	SD	M	SD	M	SD	Statistic[a]	P-value
Age, years	19.7	1.4	19.6	1.8	19.6	1.7	t=-0.236	0.814
Height, cm	183.9 [b]	5.5	179.6	6.6	180.6	6.5	t=-2.673	0.009
Weight, kg	114.6 [b]	13.1	86.0	9.9	92.7	16.2	t=-10.739	<0.001
BMI, kg/m^2	33.9 [b]	3.7	26.6	2.5	28.3	4.2	t=-10.357	<0.001
Systolic BP, mmHg	130.6 [b]	10.5	124.1	8.2	125.6	9.2	t=-2.944	0.004
Diastolic BP, mmHg	76.2	10.2	74.2	7.6	74.7	8.3	t=-0.977	0.331

Abbreviations: M = mean, SD = standard deviation, BMI = body mass index, BP = blood pressure
[a] Degrees of freedom = 87 for all analyses except age, where degrees of freedom = 86 due to 1 missing value
[b] Significant difference between linemen and non-linemen positions

Table 2. Sample Ethnicity and Year in College

	Linemen		Non-Linemen		All Athletes	
	N	%	N	%	N	%
Self-Identified Ethnicity						
Hispanic or Latino	0	0.0	3	4.5	3	3.4
Hawaiian	0	0.0	1	1.5	1	1.1
Black or African American	1	5.0	8	11.9	9	10.3
Asian	0	0.0	2	3.0	2	2.3
White	16	80.0	43	64.2	59	67.8
Mixed	3	15.0	10	14.9	13	14.9
Year in College						
1st year	10	50	28	42.4	38	44.0
2nd year	3	15	14	21.2	17	19.8
3rd year	5	25	11	16.7	16	18.6
4th year	1	5	10	15.2	11	12.8
5th year	1	5	3	4.5	4	4.7

Table 3. Self-Reported Health History and Behaviors of n=89 NCAA Division III Football Athletes

History Category	Linemen, n=21 Yes		No		Non-Linemen, n=68 Yes		No		All Athletes, n=89 Yes		No	
	N	%	N	%	N	%	N	%	N	%	N	%
Family[a] history of….												
Heart attack	4	19.0	17	81.0	13	19.1	55	80.9	17	19.1	72	80.9
Heart disease	2	9.5	19	90.5	5	7.4	63	92.6	7	7.9	82	92.1
High blood pressure	9	42.9	12	57.1	22	32.4	46	67.6	31	34.8	58	65.2
Stroke	5	23.8	16	76.2	10	14.7	58	85.3	15	16.9	74	83.1
Kidney disease	1	4.8	20	95.2	0	0.0	68	100.0	1	1.1	88	98.9
Diabetes	6	28.6	15	71.4	17	25.0	51	75.0	23	25.8	66	74.2
Personal History of…												
Tobacco Use	3	14.3	18	85.7	1	4.4	65	95.6	6	6.7	83	93.3
Heart disease or any heart problems	2	9.5	19	90.5	1	1.5	67	98.5	3	3.4	86	96.4
Circulation problems	0	0.0	21	100.0	0	0.0	68	100.0	0	0.0	89	100.0
Kidney disease or problems	0	0.0	21	100.0	0	0.0	68	100.0	0	0.0	89	100.0
High Cholesterol	0	0.0	21	100.0	2	2.9	66	97.1	2	2.2	87	97.8
Hypoglycemia (i.e. low blood sugar)	0	0.0	21	100.0	0	0.0	68	100.0	0	0.0	89	100.0

[a] Family history included parents, grandparents, aunts and/or uncles.

Table 4. Anthropometric and Cardiovascular Disease Risk Characteristics of NCAA Division III Football Linemen

Characteristic	Division III Linemen			NFL offensive linemen[a]		NFL defensive linemen[a]	
	M	SD	Range	M	Range	M	Range
Height, cm	183.9	5.47	172.5-192	195	194-196	191	191-192
Weight, kg	114.6	13.11	91.4-135.5	143	142-145	131	128-134
BMI, kg/m^2	33.8	3.75	27.5-41.5	37.8	37.3-38.3	35.7	34.9-36.6
% Body Fat	29.9	6.35	19.5-39.5	25.8	24.9-26.6	20.8	19.3-22.2
Waist, cm	102.0	8.17	86.0-118.5	117	115-119	107	104-109
Waist:hip ratio	0.90	0.05	0.8-1.0	0.92	0.91-0.93	0.89	0.88-0.91
Systolic BP, mmHg	130.6	10.48	112-148	132	130-134	127	124-129
Diastolic BP, mmHg	76.2	10.22	60-98	79	78-81	75	73-77
Lipids, mg/dL							
HDL	39.9	8.51	24.0-54.0	43	41-46	47	44-49
LDL[b]	116.1	25.82	72.0-159.0	115	109-122	116	108-125
Total cholesterol	169.5	28.44	127.0-225.0	179	171-186	185	176-193
Triglycerides	93.9	42.34	53.0-217.0	119	103-135	111	93-128
Fasting glucose, mg/dL	81.7	6.07	74.0-98.0	87	84-89	86	83-90

Abbreviations: M = mean, SD = standard deviation, BMI = body mass index, BP = blood pressure; HDL = high density lipoproteins; LDL = low density lipoproteins
[a] As reported in Tucker et al. 2009
[b] pre-season n=15 due to invalid test results

Table 5. Prevalence of Cardiovascular Disease Risk Factors in NCAA Division III Football Linemen

Characteristic	Division III ↑ risk (%)	Division III nL risk (%)	NFL[a] ↑ risk (%)	NFL[a] nL risk (%)
BMI ≥30 kg/m^2	85.7	14.3	57.6	42.4
% Body fat ≥25	71.4	28.6	14.1	85.9
Waist, >102 cm	42.9	57.1	31.0	69.0
Waist:hip ratio ≥1	0.0	100.0	5.1	94.9
Prehypertension[b]	66.7	33.3	64.5	35.5
Hypertension [c]	9.5	90.5	13.8	86.2
HDL, <40 mg/dL	42.9	57.1	26.9	73.1
LDL, ≥160 mg/dL [d]	0.0	100.0	7.2	92.8
Triglycerides, ≥150 mg/dL [d]	6.7	93.3	13.7	86.3
Total cholesterol, ≥200 mg/dL	23.8	76.2	25.8	74.2
Total cholesterol, ≥240 mg/dL	0.0	100.0	4.7	95.3
Fasting glucose, 100-125 mg/dL	0.0	100.0	6.7	93.3
Glucose Intolerance, ≥126 mg/dL	0.0	100.0	0.3	99.7
Smoking	14.3	85.7	0.1	99.9

Abbreviations: nL = normal, BMI = body mass index, BP = blood pressure; HDL = high density lipoproteins; LDL = low density lipoproteins

[a] As reported in Tucker et al. 2009

[b] Prehypertension defined as systolic BP ≥120 mmHg & <140 mmHg, OR diastolic blood pressure ≥80 mmHg & <90 mmHg

[c] Hypertension defined as both systolic BP ≥140 mmHg and diastolic BP ≥90 mmHg

[d] pre-season n= 15 due to invalid test results