

Original Research Article

Is trunk hair density in nonobese Turkish men associated with insulin resistance?: A pilot study

Abstract

Aim: The association between insulin resistance and hirsutism in women is well studied. However there is no previous data about insulin resistance and male body hair density. Thus, the aim of the present study is to evaluate association between insulin resistance and trunk hair density in nonobese Turkish men.

Study design: This is a a cross-sectional, observational, pilot clinical study conducted with the approval of ethical review board.

Place and duration of Study: Department of Internal Medicine and Dermatology, Afyonkarahisar State Hospital, between July 2014 and October 2014.

Methodology: The study included 58 nonobese Turkish men with same ethnicity, without a systemic disorder. The body mass index (BMI) was calculated, and total trunk hair density was evaluated with a scoring method for each participant. Laboratory investigations, including fasting blood glucose, insulin, and serum lipid levels were performed. In each patient, insulin resistance was calculated as Homeostasis model assessment of insulin resistance (HOMA-IR).

Results: Mean age of the patients was 27.88 ± 8.14 (range: 17-58). Total trunk hair score was positively correlated with BMI ($P = 0.001$), fasting insulin levels ($P = 0.021$), HOMA-IR ($P = 0.019$) and insulin resistance ($P = 0.003$). Especially, abdominal hair score was correlated with insulin resistance ($P = 0.003$).

Conclusion: Total trunk hair score, especially abdominal hair score, was correlated positively with insulin resistance in nonobese Turkish men. Thus, evaluation of abdominal hair density may be a clinical method for risk assesment of insulin resistance in nonobese Turkish men.

Keywords: men; insulin resistance; trunk hair; hyperinsulinemia.

Introduction

The association between hyperandrogenemia induced hirsutismus and endocrine imbalance in women is a well known entity.^{1,2} Insulin resistance, hyperinsulinemia and obesity are closely asociated with polycystic ovary syndrome (PCOS), and insulin-sensitizer drugs are usually used to improve hirsutismus in PCOS patients.^{3,4} There are also some data about the association of insulin resistance with idopathic hirsutismus, which is characterized by normal serum androgen levels. Furthermore there is not previous study evaluating the association of male hair density with insulin resistance. The aim of this pilot study was to investigate the association of insulin resistance, and body mass index (BMI) with trunk hair density in a group of Turkish nonobese men.

Materials and Methods

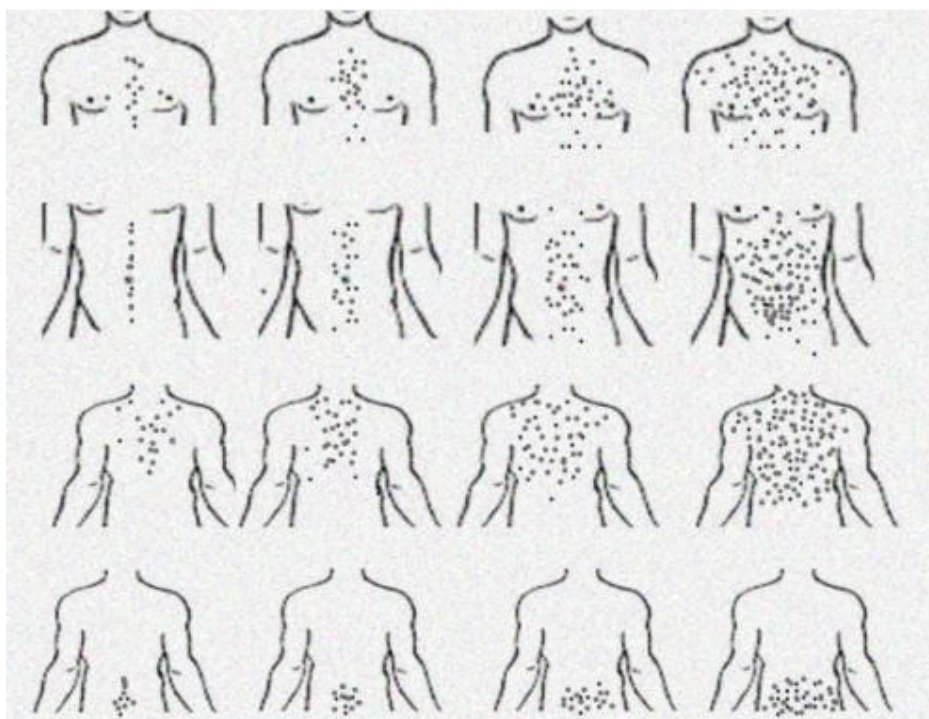
This cross-sectional observational pilot study included 58 nonobese (with BMI < 30) Turkish male patients with the same ethnicity. Exclusion criteria included prior history of any systemic, or skin disorder (including hyperlipidemia, insulin resistance, diabetes mellitus, hypoandrogenemia, and any disorder affecting hair density), history of body hair removal, and drug or cosmetic usage that may effect body hair density. Height, and weight were measured, and the BMI was calculated for each participant. Additionally, family history of diabetes mellitus was recorded. Venous blood samples were collected

46 from an antecubital vein between 8.30-9.30 a.m after an overnight (12 hours) fast.
 47 Laboratory investigations, including fasting blood glucose, fasting insulin, very low-
 48 density lipoprotein (VLDL), low-density lipoprotein (LDL), high-density lipoprotein
 49 (HDL), total cholesterol, and triglyceride were performed. Serum levels of fasting blood
 50 glucose were measured on the analyzer (Beckman Coulter AU2700®, CA, USA) using
 51 the glucose oxidase method. Fasting insulin concentrations were measured on a cobas e-
 52 601 analyzer (Hitachi High Technologies Corporation, Tokyo, Japan) with an
 53 electrochemiluminescence immunoassay kit. And serum levels of lipids were measured
 54 using commercial clinical diagnostic laboratory methods (Beckman Coulter AU2700®,
 55 CA, USA, CA). In each patient, insulin resistance was calculated as homeostasis model
 56 assessment of insulin resistance (HOMA-IR), using the following formula: fasting
 57 serum insulin ($\mu\text{U/ml}$) $\times$ fasting plasma glucose (mmol/l)/22.5.⁵ HOMA-IR value
 58 greater than 2.34, was accepted as the cut-off value for insulin resistance in the study
 59 population as previously reported.⁶ BMI was calculated as weight/height² (kg/m^2).
 60 Trunk hair density was evaluated with a scoring system (Table 1 and Figure 1). In this
 61 method, terminal hair density in 4 different body regions (chest, abdomen, lower back
 62 and upper back) is scored and is given a score of 1-4. And total sum of the grades for
 63 each region constitute the total trunk hair score, which ranges from 4 to 16. For all
 64 participants, same physician evaluated the total trunk hair density according to the
 65 scoring system in Figure 1.

66 **Table 1.** Scoring system of the trunk hair density in men. Total sum of the scores
 67 within each group gives the total trunk hair score, ranging from 4-16.

Body region	Description of terminal hair density
-------------	--------------------------------------

Chest	1: No hair, or involves < 25% of the chest 2: Involves 25-50% of the chest 3: Involves 50-75% of the chest 4: Involves > 75% of the chest
Abdomen	1: No hair, or hair only at midline 2: More in midline and also present laterally (< 50%) 3: Involves 50-75% of the abdomen 4: Involves > 75% of the abdomen
Upper back	1: No hair, or involves < 25% of the upper back 2: Involves 25-50% of the upper back 3: Involves 50-75% of the upper back 4: Involves > 75% of the upper back
Lower back	1: At sacral region, < 4cm 2: Both at sacral region and sides 3: Involves 50-75% of the lower back 4: Involves > 75% of the lower back



68

69 **Figure 1.** Scoring system of the trunk hair density in men. Each of 4 body regions
70 (chest, abdomen, lower back and upper back) is given a score of 1-4 according to the
71 criteria at Table 1. And these scores are summed to provide the total trunk hair score,
72 which ranged from 4 to 16.

73 Statistical analyses were performed using SPSS v.18.0 for Windows (SPSS Inc.,
74 Chicago, IL, USA). Continuous variables are presented as mean $\pm$ standard deviation,
75 and categorical variables as frequencies and percentages. Associations between total
76 hair density score and HOMA-IR, insulin resistance and BMI were analyzed with
77 correlation analysis. Correlations between normally distributed parametric variables
78 were evaluated using Pearson's correlation coefficient, and nonparametric correlations
79 were evaluated using Spearman's correlation coefficient. Statistical significance was
80 considered as $P < 0.05$. The study protocol was approved by the Afyon Kocatepe

81 University Ethical Review Board, and all the participants were informed about the
82 procedures and provided written informed consent.

83 **Results**

84 The study included nonobese 58 male patients. Mean age of the patients was $27.88 \pm$
85 8.14 (17-58), and family history of diabetes mellitus was present in 19 (32.8%) patients.
86 Mean BMI of the patients was 23.65 ± 3.49 (range: 17.2-29.7). Mean HOMA-IR was
87 2.31 ± 1.59 (range: 0.71-9.78), and 19 (32.8%) patients had insulin resistance. Total
88 trunk hair score was positively correlated with BMI (correlation coefficient = 0.415, $P =$
89 0.001), fasting insulin levels (correlation coefficient = 0.302, $P = 0.021$), and HOMA-IR
90 (correlation coefficient = 0.307, $P = 0.019$). Mean total trunk hair score was 8.95 ± 2.37
91 in patients with insulin resistance, whereas 7.13 ± 1.64 in patients without insulin
92 resistance ($P = 0.001$), and there was a positive correlation between total trunk hair
93 density score and insulin resistance (correlation coefficient = 0.378, $P = 0.003$).
94 Furthermore, subgroup analysis showed positive correlation of abdominal hair score
95 with insulin resistance (correlation coefficient = 0.388, $P = 0.003$), and HOMA-IR
96 (correlation coefficient = 0.306, $P = 0.019$).

97 **Discussion**

98 Previous studies showing the association of insulin resistance with body hair density
99 especially focused on women with PCOS, however there is not previous data about the
100 link of body hair density and metabolic parameters such as insulin resistance and
101 increased BMI in men. Previous studies including hirsute women with PCOS, showed
102 association with metabolic irregularities such as obesity, metabolic syndrome, type 2
103 diabetes mellitus, and insulin resistance.⁷⁻⁹ Even lean women with PCOS, have been

104 shown to have insulin resistance.^{8,9,11,12} Furthermore, fasting insulin levels are found to
 105 be associated with severity of hirsutism.¹³ Although still controversial, some recent
 106 studies showed also association between insulin resistance and idiopathic hirsutism in
 107 nonobese women.^{10,14} In the present study we showed an association between increased
 108 trunk hair density and fasting insulin levels, HOMA-IR values, and insulin resistance in
 109 nonobese men.

110 The exact effect of hyperinsulinemia, and insulin resistance on hair follicles is unknown.
 111 Previously it has shown that insulin enhances insulin-like growth factor-1 (IGF-1)
 112 expression.¹³ In-vivo mouse studies¹⁵, and in-vitro culture studies¹⁶ showed that IGF-1
 113 is a significant regulator of cell proliferation and differentiation in hair follicle, and has
 114 a positive effect on hair growth. Furthermore, insulin resistance and hyperinsulinemia
 115 increase ovarian and adrenal androgen secretion and suppress sex-hormone binding
 116 globulin production, and affect the activity of 5- α reductase in hair follicles.^{13,17} The
 117 present study findings support the previously reported effects of hyperinsulinemia on
 118 hair follicles, however, underlying molecular etiopathogenesis needs to be further
 119 studied.

120 In the present study, we found that especially abdominal hair density was correlated
 121 with insulin resistance. Previously positive correlation between abdominal obesity and
 122 insulin resistance has been shown.¹⁷⁻¹⁹ As a result of this, waist circumference has been
 123 suggested to be a marker for risk assessment of insulin resistance, even in patients with
 124 normal BMI.^{18, 20} Although abdominal fat distribution has been associated with
 125 hyperandrogenism, and hyperinsulinemia, the exact underlying molecular events are
 126 unknown. Hyperinsulinemia, itself may effect fat distribution with its direct effects on
 127 adipocytes.¹⁹ Such as increase in abdominal fat, increased abdominal hair density may

128 be associated with local effects of hyperinsulinemia, which needs to be further
129 clarified. According to the present study findings, we suggest that evaluation of
130 abdominal hair density may give clue about underlying insulin resistance.

131 Since the present study included the patients admitted to the hospital, it may not
132 represent the general population, which may be regarded as a potential limitation.
133 Nevertheless, the present study may be accepted as a pilot study, and the study findings
134 need to be clarified with larger prospective studies.

135 In conclusion, the present study showed that increased BMI and insulin resistance was
136 associated with increased trunk hair density, especially abdominal hair density, in
137 nonobese Turkish men for the first time. And we suggest that evaluation of abdominal
138 hair density may be a clinical method for risk assesment of insulin resistance in Turkish
139 men. Association of insulin resistance with hair follicle functions in men needs to be
140 further studied in larger series.

141 **Ethical Approval**

142 All authors hereby declare that all experiments have been examined and approved by
143 the appropriate ethics committee and have therefore been performed in accordance with
144 the ethical standards laid down in the 1964 Declaration of Helsinki.

145 **References**

146 1.Talaei A, Adgi Z, Mohamadi Kelishadi M. Idiopathic hirsutism and insulin resistance.
147 Int J Endocrinol. 2013; 2013: 593197. doi: 10.1155/2013/593197.

- 148 2. Erkan M, Albayrak M, Karatas A, Keskin F, Aydin Y, Ak HY, et al. Are insulin
149 resistance and serum resistin levels increased in women with idiopathic hirsutism? *Eur*
150 *Rev Med Pharmacol Sci.* 2014; 18(13): 1889-95.
- 151 3. Amato MC, Galluzzo A, Merlino S, Mattina A, Richiusa P, Criscimanna A, et al.
152 Lower insulin sensitivity differentiates hirsute from non-hirsute Sicilian women with
153 polycystic ovary syndrome. *Eur J Endocrinol.* 2006; 155(6): 859-65.
- 154 4. Gambineri A, Pelusi C, Genghini S, Morselli-Labate AM, Cacciari M, Pagotto U, et
155 al. Effect of flutamide and metformin administered alone or in combination in dieting
156 obese women with polycystic ovary syndrome. *Clin Endocrinol (Oxf).* 2004; 60(2):
157 241-9.
- 158 5. Matthews DR, Hosker JP, Rudenski AS, Naylor BA, Treacher DF, Turner RC.
159 Homeostasis model assessment: insulin resistance and beta-cell function from fasting
160 plasma glucose and insulin concentrations in man. *Diabetologia.* 1985; 28(7): 412-9.
- 161 6. Uzunlulu M, Oğuz A, Aslan G, Karadağ F. Cut-off values for waist circumference in
162 Turkish population: Is there a threshold to predict insulin resistance? *Turk Kardiyol*
163 *Dern Ars.* 2009; 37 Suppl 6: 17-23.
- 164 7. Vrbikova J, Hainer V. Obesity and polycystic ovary syndrome. *Obes Facts.* 2009;
165 2(1): 26-35. doi: 10.1159/000194971.
- 166 8. Manco M, Castagneto-Gissey L, Arrighi E, Carnicelli A, Brufani C, Luciano R, et al.
167 Insulin dynamics in young women with polycystic ovary syndrome and normal glucose
168 tolerance across categories of body mass index. *PLoS One.* 2014; 9(4): e92995. doi:
169 10.1371/journal.pone.0092995.

- 170 9. Lim SS, Norman RJ, Davies MJ, Moran LJ. The effect of obesity on polycystic ovary
171 syndrome: a systematic review and meta-analysis. *Obes Rev.* 2013; 14(2): 95-109. doi:
172 10.1111/j.1467-789X.2012.01053.x.
- 173 10. Arduc A, Sarıcam O, Dogan BA, Tuna MM, Tutuncu YA, Isik S, et al. Should
174 insulin resistance be screened in lean hirsute women? *Gynecol Endocrinol.* 2015 Jan 5:
175 1-5.
- 176 11. Cebeci F, Onsun N, Mert M. Insulin resistance in women with hirsutism. *Arch Med*
177 *Sci.* 2012; 8(2): 342-6. doi: 10.5114/aoms.2012.28563.
- 178 12. Abdel Fattah NS, Darwish YW. Is there a role for insulin resistance in nonobese
179 patients with idiopathic hirsutism? *Br J Dermatol.* 2009; 160(5): 1011-5. doi:
180 10.1111/j.1365-2133.2009.09078.x.
- 181 13. Landay M1, Huang A, Azziz R. Degree of hyperinsulinemia, independent of
182 androgen levels, is an important determinant of the severity of hirsutism in PCOS. *Fertil*
183 *Steril.* 2009; 92(2): 643-7. doi: 10.1016/j.fertnstert.2008.06.021.
- 184 14. Ucak S, Basat O, Satir E, Altuntas Y. Evaluation of various insulin sensitivity
185 indices in lean idiopathic hirsutism patients. *Endocr J.* 2012; 59(4): 291-6.
- 186 15. Weger N, Schlake T. IGF-1 signaling controls the hair growth cycle and the
187 differentiation of hair shafts. *J Invest Dermatol.* 2005; 125(5): 873–82.
- 188 16. Ahn SY, Pi LQ, Hwang ST, Lee WS. Effect of IGF-I on Hair Growth Is Related to
189 the Anti-Apoptotic Effect of IGF-I and Up-Regulation of PDGF-A and PDGF-B. *Ann*
190 *Dermatol.* 2012; 24(1): 26-31. doi: 10.5021/ad.2012.24.1.26.
- 191 17. Ramezani Tehrani F, Behboudi-Gandevani S, Simbar M, Azizi F. A population-
192 based study of the relationship between idiopathic hirsutism and metabolic disturbances.
193 *J Endocrinol Invest.* 2014 Sep 9 [Epub ahead of print].

- 194 18. Toscani M, Migliavacca R, Sisson de Castro JA, Spritzer PM. Estimation of truncal
195 adiposity using waist circumference or the sum of trunk skinfolds: a pilot study for
196 insulin resistance screening in hirsute patients with or without polycystic ovary
197 syndrome. *Metabolism*. 2007; 56(7): 992-7.
- 198 19. Godoy-Matos AF, Vaisman F, Pedrosa AP, Farias ML, Mendonça LM, Pinheiro
199 MF. Central-to-peripheral fat ratio, but not peripheral body fat, is related to insulin
200 resistance and androgen markers in polycystic ovary syndrome. *Gynecol Endocrinol*.
201 2009; 25(12): 793-8. doi: 10.3109/09513590903015528.
- 202 20. Lebovitz HE, Banerji MA. Point: visceral adiposity is causally related to insulin
203 resistance. *Diabetes Care*. 2005; 28(9): 2322-5.