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Correlation Between HOMA-IR and eGFR Values

HOMA-IR ve eGFR Değerleri Arasındaki Korelasyon

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ÖZET

Amaç: Bu çalışmada amaç, bir eğitim ve araştırma hastanesinin farklı polikliniklerine farklı şikayetlerle başvuran bireylerin insülin direncinin homeostatik model değerlendirmesi (HOMA-IR) değerleri ile tahmini glomerüler filtrasyon hızı değerleri (eGFR) arasındaki korelasyonu belirlemektir. **Gereç ve Yöntem:** Çalışmada farklı polikliniklere başvuran 7815 (1740 erkek ve 6075 kadın) hastanın verileri analiz edildi. Çalışma kriterlerini karşılayan ve HOMA-IR ile eGFR talep eden yetişkin hastalar hastane bilgi yönetim sistemi tarafından belirlendi. Tüm hastaların yaş ve cinsiyetleri tespit edildi. Veriler istatistiksel olarak değerlendirildi. İnsülin direnci; homeostatik model değerlendirme yöntemi ile ölçüldü. **Bulgular:** Hastaların ortalama HOMA-IR ve eGFR değerleri sırasıyla 3.28±0.52 ve 111.35±22.91 olarak hesaplandı. 7815 hastanın %60'ının HOMA-IR değerleri normalden yüksek bulunurken, aynı hastaların eGFR değerleri normalden düşük olarak bulundu. HOMA-IR ile eGFR arasında negatif yönde korelasyon olduğu belirlendi (r = -0.48). **Sonuç:** HOMA-IR ve eGFR arasındaki korelasyon ($p<0.01$) istatistiksel olarak anlamlı bulundu. Ancak, bu bilgilerin daha kapsamlı bir çalışma ile klinisyenler tarafından kullanılabilir hale getirilmesi önem arz edecektir. İnsulin direnci ve böbrek rahatsızlıklarının gelişimi ve takibinde HOMO_IR ve eGFR seviyelerinin değerlendirilmesi erken teşhis bakımından yardımcı olabilir.

Anahtar Kelimeler: eGFR, HOMA-IR, Korelasyon

ABSTRACT

Objective: The aim of this study is to determine the correlation between the homeostatic model assessment of insulin resistance (HOMA-IR) values and the estimated glomerular filtration rate (eGFR) values of individuals who applied to different polyclinics of a training and research hospital with different complaints. **Materials and Methods:** In the study, the data of 7815 (1740 men and 6075 women) patients who applied to different polyclinics were analyzed. Adult patients who met the study criteria and requested HOMA-IR and eGFR were identified by the hospital information management system. Age and gender of all patients were determined. The data were evaluated statistically. Insulin resistance; was measured by the homeostatic model evaluation method. **Results:** The mean HOMA-IR and eGFR values of the patients were 3.28±0.52 and 111.35±22.91, respectively. While HOMA-IR values were found to be higher than normal in 60% of 7815 patients, the eGFR values of the same patients were found to be lower than normal. There was a moderate negative correlation between HOMA-IR and eGFR (r = -0.48). In other words, it was determined that patients with increased HOMA-IR values had a moderate decrease in eGFR values. **Conclusion:** There was a moderate negative correlation between HOMA-IR and eGFR However, it will be important to make this information available to clinicians with a more detailed study. Evaluation of HOMO-IR and eGFR levels can be utility for early diagnosis in the development and follow up of insulin resistance and kidney disorders.

Keywords: eGFR, HOMA-IR, Correlation

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INTRODUCTION

Insulin resistance (IR), especially obesity, diabetes mellitus (DM) and cancer etc. are the causes of diseases. IR is defined as an abnormal glucose response to exogenous and endogenous insulin. In large population studies, IR; fasting is measured in simple formulas using insulin and glucose values. HOMA-IR is one of the commonly used methods (Ascaso et al.,2003; Topsakal et al., 2012). IR and the resulting hyperinsulinemia are one of the basic mechanisms of various diseases such as DM and hypertension. Hyperinsulinemia also has a direct renal effect, such as the retention of sodium from renal tubules, which also leads to hypertension. IR and hyperinsulinemia are among the main mechanisms such as DM and hypertension (De Fronzo et al., 1976).

eGFR is one of the ideal tests to measure the level of kidney function and determine the stage of kidney disease. The measured eGFR remains the reference standard, but great advances in estimated eGFR have been seen over the past 20 years. The most important task of the kidneys is filtering the waste materials in our body to prevent them from entering the blood. Creatinine is a waste that is stored and disintegrated to provide energy. Like other wastes, it goes to the kidneys through the blood and is filtered out of the urine. The process by which the kidneys filter waste is called GFR or eGFR. The most important task of the kidneys, by filtering the waste materials in our body, to prevent them from entering the blood. The eGFR varies depending on age, gender, and weight. eGFR is equivalent to the sum of the filtration rate of all working nephrons. Early diagnosis of patients with reduced kidney function will prevent end-stage kidney disease and cardiovascular complications. The kidney filters about 180 liters of plasma per day. eGFR value; affected by age, sex, and body size, and is between 120-130 mL / min / 1.73m^2 (Stevens et al., 2006).

When IR develops, the body cannot use it effectively although it can produce enough insulin. Glucose cannot enter the cells, its glucose cannot be used, and glucose in the blood rises and prediabetes develops over time, resulting in Type 2 Diabetes. If IR is diagnosed early, diseases and disorders of many organs can be prevented. When IR develops, more insulin is needed because muscle, fat and liver cells cannot respond properly to insulin and blood glucose cannot be taken into the cell. The beta cells of the pancreas work harder and secrete more insulin to meet the increased need. If beta cells do their normal job, the sugar level in the blood stays at the required value. Over time, the beta cells become unable to meet the body's increasing insulin needs. High blood sugar can damage nerves and blood vessels causing heart disease, stroke, blindness, kidney failure and lower extremity amputation etc. can cause complications. The aim of this study was to investigate the relationship between eGFR and HOMA-IR in patients over 18 years and older age without malignancy and end-stage renal disease.

MATERIALS AND METHODS

Material

This study was carried out by examining the file data of 7815 patients who applied to hospital polyclinics between August-2014 and November-2018. Data of 7815 patients (1740 males, 6075 females) were taken from the hospital computer environment and evaluated. Hospital and polyclinics records of the patients were reviewed. Age and gender of the patients were recorded.

Patients under the age of 18 were not included in this study. The data of patients aged 18 years and older were taken into account in the study.

Method

eGFR and HOMA-IR tests of patients who applied to family medicine polyclinics were examined. Patients with end-stage renal disease and malignancy were not considered in this study.

Those with a HOMA-IR value above 2.7 mg/dL were considered predisposed to diabetes mellitus. Those with a HOMA-IR score of ≥ 2.7 were considered to have insulin resistance.

Adult patients who met the study criteria and requested HOMA-IR and eGFR were identified by the hospital information management system. Age and gender of all patients were determined. The data were evaluated statistically. Insulin resistance; was measured by the homeostatic model evaluation method.

Individuals with a HOMA-IR score ≥ 2.7 were considered as individuals with insulin resistance. 7815 patients were divided into two groups, HOMA-IR <2.7 and HOMA-IR ≥2.7, to evaluate relation with HOMA-IR and eGRF.

HOMA-IR value calculated as= Fasting Glucose (mg/dL) X Fasting Insulin (uIU/mL) /405 (Topsakal et al., 2012).

MDRD: GFR (mL / min / 1.73 m^2) = 175xSkr) $^{-1.154}$ x (Age) $^{-0.203}$ x (if 0.762 women) (Demir et al., 2010).

Glucose tests were performed on the BECKMAN COULTER AU5800 device and insulin tests on the ARCHITECT i2000 SR device.

Statistical Analyzes

Statistical analyzes were performed with the help of IBM SPSS for Windows 22.0 package program (IBM SPSS). The SSPS 26.0 package program was used to analyze the data and calculate the mean and standard errors. Correlations between the two variables were calculated. Ethical approval of the study was obtained Sakarya University Faculty of Medicine, (71522473/050.01.04/316).

RESULTS

In our study, insulin resistance parameters and eGFR levels were recorded by examining the data of 7815 patients who applied to different polyclinics of our hospital. A total of 7815 patients, including 1740 male (%22) patients and 6075 female (%78) patients, were treated. The mean age of the patients included in the study was calculated as 48.77±9.4 years. It was accepted that 40% of the patients who applied to outpatient clinics were insulin resistant.

Table 1. Descriptive statistics and correlation of HOMO-IR and eGFR

Variable	N	Mean	SE	Min	Max	Correlation
HOMA-IR	7815	3.28	0.52	0.03	164.71	-0.48**
eGFR	7815	111.35	22.91	4.89	1254.62	

**p<0.01

In Table 1, the mean HOMO-IR value of 7815 patients was calculated as 3.28±0.52, while the eGFR value was calculated as 111.35±22.91. The correlation between the two values was calculated as -0.48 ($p<0.01$).

Table 2. Descriptive statistics and correlation of HOMO-IR and eGFR in terms of gender

Variable	N	Mean	SE	Correlation
HOMO-IR(Men)	1740	4.15	0.77	-0.32 (NS)
eGFR (Men)	1740	106.93	33.59	
HOMO-IR(Women)	6075	3.03	0.44	-0.47**
eGFR (Women)	6075	112.61	18.59	

**p<0.01; NS: Not Significant

In Table 2, HOMO-IR and eGFR values were analyzed in terms of gender. The correlation between HOMO-IR and eGFR values was -0.32 in men and -0.47 in women.

Table 3. Descriptive statistics and correlation of HOMO-IR and eGFR in terms of HOMO-IR<2.7 score

Variable	N	Mean	SE	Correlation
HOMO-IR	4681	1.67	0.23	-0.02 (NS)
eGFR	4681	112.75	24.64	

NS: Not Significant

In Table 3, HOMO-IR and eGFR values were analyzed in terms of HOMO-IR<2.7 score. The correlation between HOMO-IR and eGFR values was -0.02.

Table 4. Descriptive statistics and correlation of HOMA-IR and GFR in terms of HOMA-IR≥2.7 score.

Variable	N	Mean	SE	Correlation
HOMO-IR	3134	5.68	0.68	-0.41 (NS)
eGFR	3134	109.25	19.86	

NS: Not Significant

In Table 4, HOMO-IR and eGFR values were analyzed in terms of HOMO-IR≥2.7 score. The correlation between HOMO-IR and eGFR values was -0.41.

DISCUSSION

IR is observed in many diseases, especially diabetes, cholesterol metabolism disorders and obesity. As a result, cardiovascular diseases are accepted as risk factors for hypertension,

hypertriglyceridemia, hyperinsulinemia, renal diseases and even cancer (Bilge et al., 2016). IR; peripheral tissues are defined as reduced physiological response despite normal insulin levels (Martin et al., 1992). Parvanova et al. (2006) found that IR was greater in patients with microalbuminuria than in patients with non-insulin dependent diabetes mellitus (NIDDM). A positive correlation was found between IR and microalbuminuria. Forsblom et al. (1995) found that patients with HOMA-IR had a higher risk of developing Type II DM compared to insulin-sensitive cases. In addition, in these cases, abdominal obesity, cardiovascular events and atherosclerosis causing some types of cancer (breast, colorectum, liver and pancreatic cancers) are reported to be associated with increased risk (Simmons et al., 2010; American Diabetes Association 2010; Arcidiacono et al., 2012; Bilge et al., 2015). Viswanathan et all found that as IR increased in diabetic patients, kidney damage increased further (Viswanathan et al., 2010). It is report that this damage, which mainly involves the glomeruli, results in endothelial dysfunction due to insulin resistance. There is also an increase in the release of systemic inflammatory mediators. As a result, increased vascular permeability, glomerular hyperfiltration and increased urinary albumin excretion because of increased intra-glomerular pressure (Gerstein et al., 2001; Parvanova et al. 2006; Premaratne et al., 2005; Shin et al., 2013). According to the results of the other studies, HOMA-IR values affect renal function (Bilge et al., 2015). In our study, we also found that HOMA-IR levels were high.

The most important task of the kidneys, by filtering the waste materials in our body, to prevent them from entering the blood. The eGFR test shows us the working performance of the kidneys and the extent to which the disease is present, and is an indicator used for the prediction of renal function (Ascaso et al., 2003). Approximately 65% of Type II DM patients have some decrease in renal function or have a risk in this regard (Castro et al., 2009; Coresh et al., 2005). People with Type II DM are at higher risk of increased mortality from cardiovascular diseases (Alan et al., 2004). This risk is approximately 3 times higher in Type II DM patients with decreased renal function (Ritz et al., 2004). Hypertension accompanies almost all congenital or acquired types of parenchymal kidney disease and is more common as GFR decreases (Brown et al., 1992). In our study, we also found that eGFR levels were low.

Can et al. (2020) investigated the relationship between GFR, HOMA-IR, C-reactive protein and neutrophil/lymphocyte ratio in patients with polycystic ovary syndrome. The researchers calculated the HOMA-IR value as 3.16 in the polycystic ovary syndrome group ($p>0.001$) and calculated the GFR value as 100.54 ($p>0.05$). The correlation between HOMA-IR and GFR was found to be -0.284 ($p>0.05$). Akwo et al. (2021), calculated the correlation between HOMA-IR and eGFR as -0.49. Park and Lee (2022), in their study, investigated the effects of metabolic syndrome on estimated glomerular filtration rate in middle-aged participants. The researchers used a total of 279 people, 153 men and 126 women, as material in this study. Again, the same researchers found the eGFR value to be 90.29 ± 15.33 in men and 95.16 ± 11.07 in women. The values in this study are in agreement with the work of the researchers.

CONCLUSION

In this study, a statistically significant correlation was found between eGFR and HOMA-IR values. However, these results; considering the relationship between eGFR and HOMA-IR with

systemic diseases, it should be searched in more comprehensive patient groups. In addition, we would like to express that; If this relationship is used by clinicians in treatment and follow-up, serious patient satisfaction will occur. It was concluded that it is necessary to use initial and confirmatory tests to determine the true value of eGFR. By doing much more research to further improve the accuracy of the assessment results, it was concluded that eGFR values could be improved.

Conflict of Interest

There is no conflict of interest between the authors.

Author Contributions

Research Idea/Concept: MÖ
Research Design: MÖ
Supervision/Consultancy: DM
Data Collection and/or Processing: MÖ, DM
Analysis and/or Interpretation of Data: DM
Literature Review: DM
Article Writing: DM
Critical Review: MÖ, DM

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