# Nutrigenetik: Kişisel Beslenme Bilimini Uygulamak

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# Nutrigenetik: Kişisel Beslenme Bilimini Uygulamak

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# Önsöz



Beslenme hakkındaki düşüncelerimizi, besin öğelerinin genlerle nasıl etkileşime girdiğini inceleyen nutrigenetik alandan daha fazla hiçbir şey değiştiremez. Bu alanın önemi anlaşılmaya başlamadan önce, beslenme araştırmalarının sonuçları genellikle kafa karıştırıcıydı. Tüm insanların metabolik olarak benzer olduğunu düşündük ve bir besin öğesine tepkilerini incelediğimizde, yanıt verenleri ve yanıt vermeyenleri bulduğumuzda, bu varyasyonu çalışmanın bilimsel tasarımındaki zayıflıklara bağladık. Haber makaleleri, sırf bir araştırma çalışması sonraki hafta tam tersi bir sonuç bulsun diye, önceki haftadan yeni bir keşif duyuruyordu. Halkın, sağlığını iyileştirmek için bu bilgilere göre hareket etmesi zordu.

Şimdi, genetik ve epigenetik kodlamada farklılıklar olduğu için insanların metabolik olarak çok farklı olabileceğini biliyoruz ve araştırmacıların neden bazı insanların bir besin öğesine tepki verirken diğerlerine vermediğini gözlemlediğini açıklıyoruz. Modern genetik yöntemleri kullanarak, yanıt verenlerin kim olacağını doğru bir şekilde tahmin etmek çoğu zaman mümkündür. Bilim insanları şu anda besin öğelerine olan gereksinimleri ve tepkileri öngören kapsamlı bir gen-besin öğesi etkileşimleri kataloğu geliştiriyorlar. Bugün gen-besin öğesi etkileşimlerinin yüzlercesi biliniyor ama yakında on binlercesi tespit edilecek ve bu katalog optimal besin öğesi alımı için bireyselleştirilmiş tavsiyeler geliştirmenin temeli olacak. Beş ile on yıl içinde, doktorların, hemşirelerin ve diyetisyenlerin klinik uygulamalarını değiştirmek için bu nutrigenetik kataloğu kullanacaklarından eminim.

Genetik, epigenetik ve beslenme karmaşık bilimsel alanlardır ve özelleştirilmiş beslenme müdahaleleri geliştirmek için nutrigenetiği kullanmaya hazır olmak isteyen kişilerin çok sayıda yeni bilgiye hakim olmaları gerekir.

Dr. Kohlmeier'in kitabı bu öğrenme macerasına başlamak için mükemmel bir yer.

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# İçindekiler

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## GEN BİLGİSİ

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National Library of Medicine, gene information, http://www.ncbi.nlm.nih.gov/sites/entrez?db¼gene
Online Mendelian Inheritance in Man (OMIM), comprehensive gene information, http://www.omim.org/

## VERİTABANLARI

1000 Genomes Project, http://www.1000genomes.org
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HapMap, http://www.hapmap.org/
Micronutrient-related pathways, http://micronutrients.wikipathways.org
NHLBI Exome Sequencing Project (ESP) Exome Variant Server (accessed June 2012), http://evs.gs.washington.edu/EVS/
OpenSNP, http://opensnp.org/ searchable by rs number, gives position on chromosome and in gene
SNPedia for allele frequencies, http://www.snpedia.com

## VERİ MADENCİLİĞİ VE GÖRÜNTÜLEME ARAÇLARI

dbSNP, http://www.ncbi.nlm.nih.gov/projects/SNP/
Display linkage disequilibrium and recombination, https://statgen.sph.umich.edu/locuszoom/genform.php?type¼ourdata
Ensemble, http://www.ensembl.org
Entrez Gene, http://www.ncbi.nlm.nih.gov/sites/entrez?db¼gene
GEN2PHEN Project, http://www.gen2phen.org/
GenBank, http://www.ncbi.nlm.nih.gov/Genbank/
Genetic Association Database, http://geneticassociationdb.nih.gov/
HuGE Literature Finder, http://www.hugenavigator.net/HuGENavigator/startPagePubLit.do
HuGE Navigator GWAS Integrator, http://hugenavigator.net/HuGENavigator/gWAHitStartPage.do
Human Gene Coexpression Database, http://www.geneticsofgeneexpression.org/network/
Integrative Genomics Viewer, tool for displaying associations, http://www.ncbi.nlm.nih.gov/projects/gapplusprev/sgap_plus.htm
National Center for Biotechnology Information (NCBI), http://www.ncbi.nlm.nih.gov/
Phenotype-Genotype Integrator, http://www.ncbi.nlm.nih.gov/gap/PheGenI
PhenX Toolkit (consensus measures of Phenotypes and eXposures), http://www.phenxtoolkit.org
PolyPhen,tool for the exploration of the possible impact of amino acid variation on protein function, http://genetics.bwh.harvard.edu/pph/
PubMed, http://www.ncbi.nlm.nih.gov/sites/entrez/
Variant Name Mapper, http://www.hugenavigator.net/HuGENavigator/startPageMapper.do

## GENETİK YAZILIM PAKETLERİ

HAPSTAT: Statistical analysis of haplotype-disease associations, http://www.bios.unc.edu/~dlin/hapstat/
ISHAPE and SHAPEIT: Accelerated and verified haplotype analysis programs [1], http://www.griv.org/ishape/ and http://www.shapeit.fr/

PEDCHECK software: Examine variants for Mendelian inconsistencies [2], http://watson.hgen.pitt.edu/register/
PREST software: Pedigree RElationship Statistical Test [3], http://fisher.outstat.toronto.edu/sun/Software/Prest
S.A.G.E.: Statistical Analysis for Genetic Epidemiology, open source software for the genetic analysis of family, pedigree and individual data, http://darwin.cwru.edu/sage/
SOLAR software: Sequential Oligogenic Linkage Analysis Routines, for estimating residual heritability [4], http://www.txbiomed.org/departments/genetics/genetics-detail?p¼37

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# BÖLÜM 1
# Genotip Temelli Beslenme Kararları için Zaman Geldi mi?



"Tüm beslenme kalıtsaldır; genlerim bana bunu yaptırıyor."

**Martin Kohlmeier**

**TERİMLER**

- Nutrigenetik: Genetik yatkınlığa bağlı olarak değişen beslenme durumu
- OMIM: İnsanlarda Çevrimiçi Mendel Kalıtım, bilinen tüm genlerin ve genetik hastalıkların bir kataloğu.

## ÖZET

Beslenme birçok açıdan kişiseldir. Her birimizdeki farklı metabolik ve fonksiyonel değişen noktalar, bizim için en uygun besin çeşitlerini ve miktarlarını belirler. Bu kişisel beslenme değişenkenleri, geçmiş ve şimdiki yaşamımızın koşulları kadar genetik planımıza da bağlıdır. Bu plana karşı çıkmak bazen olumsuz sağlık sonuçlarına neden olabilir. Dahası, uygun olmayan alımdan kaynaklanan herhangi bir zarar daha az belirgin, ancak zaman içinde yine de önemli olacaktır. Yeni olan, genetik plan sayesinde, her bir birey için detaylı beslenme düzeninden hangisinin en iyi olduğunu tahmin etme yeteneğimizdir.

## 1.1 YAŞAM FESTİVAL DEĞİLDİR

### 1.1.1 Hepimiz Benzeriz Ama Aynı Değiliz

Son derece karmaşık ve ince ayarlanmış organizmalarız ve bedenlerimiz büyük özveriyi hak ediyor. Amerikalılar için Beslenme Rehberi [1] birçok harika ipucu sunmaktadır. Örneğin, 'rafine edilmiş tahılların yerine tam tahıllar konulmalıdır, böylece tüketilen tahılların en az yarısı tam tahıllardan oluşur'. Bu kesinlikle birçoğu için sağlıklı bir tavsiyedir, ama gerçekten hepimiz için geçerli mi? Başka bir vücut koruma kılavuzu (Diyet Referans Alımları) [2] bize folat alımını anlatıyor: 'Gebe kalabilen tüm kadınların, çeşitli diyetlerden besin folatı alımının yanı sıra takviyelerden veya takviye edilmiş besinlerden 400 mg tüketmesi önerilir'. Ama sonra bedenlerimizin aynı olmadığını hatırlıyoruz. Uzun veya kısa boylu, ağır kemikli veya minyon olmak, tek tek listelemek için çok fazla farklımız var

## ÖZET VE SONRAKİ BÖLÜME GEÇİŞ

Bu bölüm, insan genomunun mimarisinin yanı sıra transkripsiyon ve çeviri mekanizmaları da dahil olmak üzere kalıtımın biyolojik temelini yeniden gözden geçirmiştir. Aynı zamanda, genellikle maternal ve paternal kromozom kopyalarında bulunan alelleri sayarak takip edilebilen ortak genetik bulaşma modlarını da inceledik. Bazen, her bir ebeveynden farklı sayıda kopyanın mirası, bir ebeveyn gen kopyasının yokluğu, epigenetik mekanizmalar yoluyla bulaşma veya çok nadir durumlarda anne mtDNA'sı yoluyla kalıtım gibi durumlarla açıklanabilecek daha karmaşık bir kalıtım modeli buluruz.

Şimdi beslenmeyi etkileyen genetik varyasyonun nereden geldiğini incelemeye devam edeceğiz. Bir sonraki bölüm, hangi besinlerin bizim için en iyi olduğunu etkileyen bazı genetik varyantların kökenlerini araştıracaktır. Paleolitik diyetlerin doğası, çoğu Çinlinin alkol almamaya ikna ettiği ve 800 yıl önce çoğu Paskalya Adalı'nın haptoglobin varyantı Hp1'e nasıl geldiğine dair hayati meselelere değineceğiz.

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## BÖLÜM 2

# Genetik Geçiş Nasıl Çalışır?



### TERİMLER

- Aleller: Bir lokusta alternatif DNA dizileri.
- Otozomal: Sayılı kromozomların birinin kalıtsallıkla ilişkisi.
- Cis: Aynı DNA zincirinden geliyor veya aynı DNA zincirinde bulunuyor.
- Diplotip: Bireyin iki haplotipine gönderme.
- Baskın: Özelliğin her zaman diğerini geçersiz kıldığı kalıtım modu heterozigot durumda (resesif) özellik.
- Epigenetik: Geni etkileyen kimyasal DNA değişikliklerine ilişkin ifadesi.
- Ekzon: Bir gen içindeki proteine çevrilen bir DNA segmenti.
- Genotip: Bir gen lokusunda kalıtsal varyantların kombinasyonu.
- Haplotip: Aynı iplikteki alellerin kombinasyonu.
- Hemizigot: İkinci bir kopya olmadığında bir aleli taşımak.
- Kalıtım derecesi: Bir özelliğin kalıtım yoluyla alındığı tahmini yüzde.
- Heteroplazmi: Bir baba atadan miras alınan mitokondri varlığı.
- Heterozigot: Bir kromozom çiftinde farklı aleller taşımak.
- Homozigot: Bir kromozom çifti üzerinde aynı varyant formları (aleller) taşımak.
- İntron: Eksonlar arasında bulunan çevrilmemiş DNA segmenti.
- Bağlantı dengesizliği: İki alelin istatistiksel ilişkisi.
- Odağı (pl. loci): Bir kromozom üzerindeki spesifik lokal sekans.
- LoD: İki loci arasındaki mesafeyi tahmin etmek için sıklıkla kullanılan oran logaritması.
- Memetik kalıtım: Yöntem ve davranışların bir kişiden bulaşması başka bir.
- Fenotip: Dış veya biyolojik görünüm.
- Polimorfizm: Bir popülasyonun en az %1'inde meydana gelen varyant.
- Resesif: Özelliğin her zaman diğeri tarafından geçersiz kılındığı kalıtım modu heterozigot durumda (baskın) özellik.
- Trans: Farklı bir DNA zincirinden geliyor veya farklı bir DNA şeridine yerleştiriliyor.
- Transkripsiyon: Nükleer DNA segmentlerinden haberci RNA sentezi.
- Çeviri: Haberci RNA şablonlarından protein sentezi.

## ÖZET VE SONRAKİ BÖLÜME GEÇİŞ

Bu bölüm, insan genomunun mimarisinin yanı sıra transkripsiyon ve çeviri mekanizmaları da dahil olmak üzere kalıtımın biyolojik temelini yeniden gözden geçirmiştir. Aynı zamanda, genellikle maternal ve paternal kromozom kopyalarında bulunan alelleri sayarak takip edilebilen ortak genetik bulaşma modlarını da inceledik. Bazen, her bir ebeveynden farklı sayıda kopyanın mirası, bir ebeveyn gen kopyasının yokluğu, epigenetik mekanizmalar yoluyla bulaşma veya çok nadir durumlarda anne mtDNA'sı yoluyla kalıtım gibi durumlarla açıklanabilecek daha karmaşık bir kalıtım modeli buluruz.

Şimdi beslenmeyi etkileyen genetik varyasyonun nereden geldiğini incelemeye devam edeceğiz. Bir sonraki bölüm, hangi besinlerin bizim için en iyi olduğunu etkileyen bazı genetik varyantların kökenlerini araştıracaktır. Paleolitik diyetlerin doğası, çoğu Çinlinin alkol almamaya ikna ettiği ve 800 yıl önce çoğu Paskalya Adalı'nın haptoglobin varyantı Hp1'e nasıl geldiğine dair hayati meselelere değineceğiz.

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# BÖLÜM 3
# Nutrigenetik Farklılıklar Nereden Gelmektedir?



**TERİMLER**

- Kurucu etki: Birkaç atadan gelen nüfus genişlemesi bazı yaygın varyantları açıklayabilir.
- Homininler: İnsan türleri (Homo sapiens, Homo ergaster ve Homo rudolfenis) ve yakın zamandaki ataları.
- Hominoidler: Homininler artı orangutanlar, goriller ve şempanzeler.
- Nutritope: Belirli bir besin öğesi bolluğu ve besin toksinleri içeren çevre.
- Pleiotropik: Farklı ve ilgisiz vücudu ilgilendiren bir etki tanımlamak fonksiyonlar.
- Psödojen: Fonksiyonel bir genden alçalma ile türetilmiş fonksiyonel olmayan genomik dizi

## ÖZET

İnsanların beslenme gereksinimleri, çağlar boyunca gelişmiştir. Erken primat ataları esas olarak meyve ve yaprak tüketerek yaşadılar. Daha sonraki bazı atalar nişastalı kökleri ve çim tohumlarını yemeyi öğrendi ve diğerleri av hayvan etleri ve balıklarla hayatta kaldılar. Tarım, mayalama, sığır sürüsü ve yemek pişirme yeni besin öğeleri kaynakları oluşturdular. Tüm bu gelişmeler izlerini genomumuza bıraktılar. Spesifik besin öğelerini sindirme ve metabolize etme konusundaki çeşitli yeteneklerimiz, çok farklı beslenme ortamlarının (nutritoplar) yankılarıdır. Besinlerden C vitamini bağımlılığımız, meyve ve yaprakların bol olduğu zamanlara geri döner, ancak bugün herkesin aynı miktarlara ihtiyacı yoktur. Bazı popülasyonlar, dünyanın diğer bölgelerindeki insanların hayatta kalabilmesi için düşük alım seviyelerine uyum sağlamıştır. Bazılarımız rahatsızlık duymadan çok süt içebiliriz; diğerleri karın ağrısı ve hafif miktarlarda bile şişkinlik çekerler. Birçok kişi alkollü içecekler içerken sarhoş olur ve ancak daha sonra akşamdan kalma olur. Diğerleri ise akşamdan kalma belirtilerini yüksek ruhlu sarhoşluk yolunda çok az hissediyor. Bu farklılıklar nereden geliyor ve nasıl çalışıyor? Bu bölüm genomumuzu şekillendiren beslenme

akşamdan kalma gibi bir şey yaşar. Belirli besin ve besin öğelerine farklı tepkilerin başka örnekleri çoktur. Kendi genetik varyant setimiz hepimizi benzersiz kılıyor ve bize kişisel bir beslenme dozu ve yapmama şekli veriyor.

Şimdi, bu örnekler anlatmak için ilginç olabilir, ama sadece birkaç fıkradan daha fazlası mı? Bir sonraki bölüm, bireysel genetik yatkınlığın birçok besin öğesinin metabolizmasını nasıl etkilediğini daha sistematik olarak gözden geçirecektir.

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## BÖLÜM 4

# Besin Öğeleri Genetikten Nasıl Etkilenir?



**TERİMLER**

- Alloenzim: Varyant alele karşılık gelen amino asit dizisi değiştirilmiş enzim.
- Ekspresivite: Belirli bir genotip ile ilişkili semptom ve sağlık sonuçlarının aralığı.
- Haployetersizlik: Normalde mevcut olan iki gen kopyasından birinin kaybı.
- Homolog: Farklı bir türdeki gene fonksiyonel ve yapısal olarak benzeyen gen.
- Doğuştan metabolizma hatası: Bir metabolitin ağır olarak defektif işlenmesine atfedilmektedir.
- Penetrans: Belirli bir genotipi taşıyan ve beklenen sağlık sonucunu gösteren kişilerin yüzdesi.

## ÖZET

Nutrigenetik, tüm uygulama amaçları için, spesifik beslenme faktörlerine olan doğuştan duyarlılık bilimidir. Bu bölüm, besin ögesi ve diğer besin bileşenlerinin etkilerini değiştiren genetik varyantların örneklerini vurgulayacaktır. Kitabın sınırlı alanı ve okuyucunun uygun zamanı içinde, bildirilen tüm etkileşimlerin kapsamlı bir listesini sağlamak ne bir amaç olmuştur ne de mümkündür. Bu etkileşimlerden çok fazla bulunmaktadır ve liste her gün büyümektedir. Bunun yerine, genetik bir varyantı taşıyan kişilerin besin ögelerine ve besinlere, varyantı taşımayan kişilerin verdiği yanıttan farklı olarak, nasıl özel olarak yanıt verdiğini açıklayan seçilmiş yolakların ve mekanizmaların incelenmesi olacaktır. Basit bir temel kuralı hatırlamak isteyebilirsiniz: eğer bir varyant nadirse, bir şeyler muhtemelen ters gitmiştir ve varyant daha geniş çaplı yayılmamıştır. Eğer bir varyant yaygınsa, bir şeyler doğru gitmiştir ve bir çeşit avantaj varyantın yayılmasına yardımcı olmuştur. Bahsedilen besin ögelerine verilen genotipe özgü yanıtların bazılarının sadece bir çalışmada gözlemlendiğini ve daha fazla araştırmaya ihtiyaç duyulduğunu bilmek önemlidir.

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BÖLÜM 5

# Nutrigenetik Uzun Süreli Sağlığı Nasıl Etkiler?



**TERİMLER**

- Epistaz: Beslenme genetik etkileşiminin başka bir lokusta varyasyon ile modifikasyonu.
- Hemizigosit: Bir genin olağan iki kopyasından sadece birinin hücrelerde bulunduğu durum.
- Nöral tüp defektleri: Anensefali, spina bifida ve ilişkili doğum kusurları.

## ÖZET

Beslenme faktörleri, birçok yaygın durumların ve hastalıkların gelişiminde gelişen hastalıkların önlenmesinde ve tedavisinde eşit derecede önemli bir rol oynar. Genellikle beslenme faktörleri bazı bireylerde fark yaratırken diğer bireylerde fark yaratmaz. Beslenme metabolizmasında yer alan genlerin doğru bir şekilde anlaşılması ve beslenme durumlarının düzenlenmesi, sıklıkla ortak genetik varyantların önemli beslenme faktörlerine yanıtı nasıl değiştirdiğini anlamaya yardımcı olur. Bu bölüm, bu etkileşimlerin kaç tanesini bildiğimizi göstermek için karmaşık hastalıklar ve koşullar bağlamında nutrigenetik varyasyonu araştırmaktadır.

## 5.1 İYİ BESLENME FARKLI BİREYLER İÇİN FARKLI BESİNLER DEMEKTİR

Şimdi, beslenme seçimlerinin sağlık sonuçlarına etkisini ele alacağız. Tamamen aynı şeyleri tüketen iki bireyin sağlık sonuçları oldukça farklı olabilir. Bunun sebebi önceki bölümlerde açıkça belirtilmesi gerektiği gibi, her bireyin metabolizmasının genom tarafından farklı şekilde ayarlanmış olmasıdır. Sağlık koşullarının artmasıyla beslenme müdahelelerine bireylerin verdikleri cevapları tahmin edebilir ve bireysel tercihleri grafiklemek için genetik bilgileri kullanabiliriz. Bahsedilen gen-besin etkileşimlerinin çoğunun ek araştırmalarla

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# BÖLÜM 6
# Son Bulguların Ne Anlama Geldiğini Nasıl Bilebiliriz?



**TERİMLER**

- Alel: Bir lokusta bulunan DNA dizileri.
- Otozomal: Sayılı kromozomlarin birinin kalıtsallıkla ilişkisi.
- Kodominant: İki özelliğin aynı anda görülebildiği kalıtım durumu.
- Uyum: Kardeşler arasında bir özellik veya fenotipin benzerlik derecesi.
- Eş segregasyon: Kişisel özelliklerin veya lokusların birlikte kalıtsallık eğilimi.
- Baskın: Özelliğin her zaman heterozigot durumdaki diğer (çekinik) özelliği geçersiz kıldığı kalıtım durumu.
- Epistaz: Bir lokusun uzak bir lokusta özelliklerin görünümünü etkilediği yer.
- Genotip: Kalıtsal varyantların bir gen lokusunda kombinasyonu.
- Knock–in modeli: Hedeflenen genom dizisinin değiştirilmesiyle oluşan hayvanın suşu.
- Knockout modeli: Bir genin hedefe yönelik silinmesi ile oluşan hayvanın suşu.
- Bağlantı dengesizliği: İki alelin veya lokusun istatistiksel ilişkisi.
- LoD skoru: Olasılıkların logaritması; iki özellik veya lokus arasındaki mesafenin ölçüsü.
- Mendel randomizasyonu: Sonuçların genotip ile karşılaştırıldığı bir çalışma tasarımı.
- Monozigotik ikizler: Aynı döllenmiş yumurtadan yetiştirilen kardeşler.
- Fenotip: Dış veya biyolojik görünüm.
- QTL: Niceliksel özellik lokusu (çoğul lokus).
- Resesif: Özelliğin heterozigot durumdaki diğer (baskın) özellik tarafından daima geçersiz kılındığı kalıtım durumu.
- Segregasyon (Irk) analizi: Nesiller boyunca özellik oranlarının incelenmesi.

## ÖZET

Nutrigenetik bulguların, sonuçların ve hipotezlerin geçerliliğini ve uygunluğunu değerlendirmek için ilk ön koşul, yaygın olarak kullanılan araştırma yöntemlerini anlamaktır. İn vitro çalışmalar, hayvan deneyleri, popülasyon çalışmaları ve klinik araştırmalar hakkında bir rapor labirentinde ilerlemelisiniz. Genetikçiler, genetik olarak değiştirilmiş hüc-

ve yorumsal hatalar her zaman kafamızı karıştırmak için komplo kuruyor. Bu potansiyel sorunların farkında olmak, bildirilen bulguları perspektifte tutmamıza yardımcı olacaktır. En önemlisi, kritik kararlar almak için ilk bulgulara güvenilmesinden önce hastanın yeniden değerlendirilmesi ve tekrarlanmasıdır. Şimdi, kanıtların yeterince güçlü olduğunu varsayalım, ama pratikte öyle mi? Bir sonraki bölüm, gelecek vaat eden nutrigenetik kombinasyonların gerçek kullanım potansiyelini araştıracaktır.

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# BÖLÜM 7
# Nutrigenetiğin Pratik Kullanımları



**TERİMLER**

- DRI: Diyet Referans Alımları, sağlıklı insanlar için alım önerilerini özetler.
- EAR: Tahmini Ortalama Gereksinim, grupların yeterliliğinin değerlendirilmesi için kullanılan alım düzeyidir.
- Çok modlu dağılım: Farklı ortalamaları olan alt grupların oluşturduğu normal olmayan dağılımdır.
- RDA: Önerilen Diyet Alımı, çoğu insanın ihtiyaçlarını karşılayan alım seviyesidir.

## ÖZET

Nutrigenetik bilim ve uygulamanın birçok farklı kullanımı vardır. En çok önemli olan kavramları ise beslenmeye bireysel duyarlılığı düşündürmekte ve bu konseptlerle benzerlik göstermektedir. Nutrigenetik testler; beklenen sağlık yararı, gerekli performans, laboratuvar analizleri ve maliyetleri hesaba katılarak dikkatli bir şekilde seçilmelidir. Etik kaygılar genellikle özerklik ve gizlilik ile ilgilidir. Hastalar ve danışanlar başta kendilerini içine aldıkları durumu anlamalıdır. Tüm genetik testler açık ve net bir şekilde belgelenmiş onam bilgisi içermeli ve bireylerin rızasını gerektirmektedir. Sağlık hizmeti sunucularının, genetik analizlerin yanlış sonuçlar verebileceğini bilmesi gerekmektedir. Diğer laboratuvar testleri kadar sık olmasa da sonuçların yorumlanması yeni araştırmalarla birlikte değişebilmektedir.

Kişiselleştirilmiş beslenmenin pratik uygulamasına ilgi artmaya devam etmektedir. Genel tüketiciler, derinlemesine rehberlik olmadan beslenme profillerini değiştirememektedir. Bu durum, bireyselleştirilmiş metin mesajları veya daha kapsamlı bilgisayar tabanlı beslenme rehberliği ile yapılabilmektedir.

Popülasyon çapında kılavuzların ve tüm düzeylerdeki beslenme araştırmalarının geliştirilmesi için, bireylerin farklı beslenme ihtiyaçlarının daha iyi anlaşılması gerekmektedir. Artık çoğu insanın belirli bir beslenme faktörüne az ya da çok aynı şekilde yanıt verdiği varsayımı kabul görmemektedir. Beslenme kılavuzlarının geliştirilmesinde yeni analitik

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