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Efficacy Of DNA-based Customised Diet and Exercise Plan for Weight Management

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Abstract

The change in the requirement of the nutrients is highlighted by gene-environment studies, depending upon changes in the genes of a person which influences metabolism and transport of different nutrients. Changes in weight of an individual throughout one's life are dependent on the interplay of various behavioral, genetic, and environmental factors. The present study will look into whether the inclusion of information of genes to personalise the diet of an individual and exercise plan would be fruitful or otherwise. The study analyses the nucleotide sequencing in various genes observed in preparing diet charts in group A and group B.

Aim: To determine the efficacy of DNA-based customised diet and exercise plan for weight management.

Material and methods: 30 subjects were included in the study and divided into 2 groups: Plan A – Number of subjects - 15 (n = 15) provided with DNA-based diet and exercise plan; Plan B – Number of subjects - 15 (n = 15) followed the conventional diet and exercise plan matched for age, gender, and BMI.

The study adopted moderate fat balanced nutrient, high protein and moderate carbohydrate diet as conventional therapy advocated by the hospital dietician. The study composed 1,500 kcal standard diet.

Results

1. ***Weight loss was observed in individuals both in plan A and plan B. The difference in the weight loss after 3 months in plan A and plan B was not significant. However, at 6 months, the subjects in plan A showed significant reduction in weight when compared with plan B.***
2. ***BMI of individuals of plan A at the end of 3 months was insignificant, but however, observations were statistically significant at the end of 6 months.***
3. ***The reduction in mean waist line of subjects at the end of 6 months was observed to be statistically significant in subjects of plan A in comparison to that of subjects of plan B (P = 0.042S).***

Conclusion: DNA test based customised diet and exercise plan helped to loose weight more effectively as compared to the conventional diet plan among obese subjects. Adding a genetic personalised component to the weight loss programme, improved motivation and compliance among the subjects.

Key words: Genomic diet, SNPs, exercise, weight management.

Introduction

Nutrition is considered as a basic human need and a pre-requisite for living a healthy life. Nutrigenomics is the science for studying the response of nutrition and diet on the physiological and genetic variations of one's body. Every individual has a unique set of genes that are attributable to variations in regards to different dietary components[1]. The variations in the genes of different individuals decide the metabolic traits such as response to diet and exercise plan which helps us to understand why some people can eat as much as they want but remain thin and why a certain type of exercise results in more weight reduction in one individual as compared to another. Testing one's genetic profile helps to determine which kind of food to be eaten and exercise to be done in ensuring a healthy lifestyle. The new field of nutrigenomics guides us to what specific foods you must consume, as per your genes. What you consume has a direct correlation to the genetic signals your body collects. These signals, one after the other, have the power to command all the molecules that add up to one's metabolism: the molecules that gives command to one's body either to burn calories or stockpile them. If the consumption of food is changed, it can even drastically change the manner in which the food interconnects with the body.

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The present study will look into whether the inclusion of information of genes to personalise the diet of an individual and exercise plan would be fruitful or otherwise.

Methods and material

In the present study we included 30 subjects (n = 30) and divided them into 2 groups as follows:-

- Plan A: Number of subjects – 15 (n = 15) who were provided with DNA-based diet and exercise plan.
- Plan B: Number of subjects – 15 (n = 15) following the conventional diet and exercise plan matched for age, gender, and BMI.

In the study we have adopted a moderate fat, balanced nutrient, high protein, and moderate carbohydrate diet as conventional therapy advocated by our hospital dietician for group B. A total of 1,500 kcal standard diet was prepared, out of which 20 - 30% energy was obtained from fats, 55 - 60% from carbohydrates and 15 - 20% from proteins. The diet restrictions were advocated along with suitable exercises.

Inclusion criteria

- Gender: both males and females.
- Ethnicity/food habits/economic background: no restrictions.
- Age (years): 18 - 60 years.
- BMI: between 25 to 38 kg/m^2.
- Ability to provide informed consent and complete health risk assessment prior to participation.

Exclusion criteria

- Individuals with diabetes mellitus, bariatric surgery, heart failure, cancer, liver, or renal disorders, HIV, and medical conditions that could affect body weight or ability to engage in structured physical activity of the study.
- Psychological or psychiatric medications within the previous twelve months.
- Reported pregnancy or cases of abortion/still birth in the last 6 months; or lactating mothers.

Study duration: 6 months follow-up.

Table I: List of genes under study with their physiological functions.

ADRB2[2]	Weakens the breaking-down of neutral fat (slower metabolism) causes needless energy accumulation in the body.
FABP2[3]	FABP plays a role in the transport of long-chain fatty acids and their acyl-CoA esters intracellularly. FABP2 plays a significant role in the synthesis of triglyceride-rich lipoprotein.
ADIPOQ[4]	The ADIPOQ gene comprises the instructions for production of the hormone adiponectin. This hormone is made solely by adipocytes (fat cells) and travels through the blood to reach the muscle and liver cells.
APOA2	Apolipoprotein A-II (APO-AII) is the second most frequently found protein in high density lipoproteins. APO-AII seems to damage the reverse cholesterol transport and antioxidant purpose of high-density lipoprotein.
PPARG[5]	PPARG plays an important physiological part as a regulator of central transcriptional adipogenic and lipogenic activity, insulin sensitivity and glucose homoeostasis.
TCF7L2[6]	TCF7L2 codes for a high mobility group (HMG). The protein plays an important role in blood glucose homoeostasis.
ACTN3[7]	Alpha-Actin binding protein is primarily expressed in skeletal muscle and functions as a structural component of sarcomere Z line. This protein helps in cross-linking actin for workout and athletic performance.
ADRB3	Beta-3 plays a part in the regulation of lipolysis and thermogenesis.

Table II: Events studied and their respective genes while prescribing DNA based genetic diet.

Metabolism of fat and glucose and risk of obesity	• ADRB2 • PPARG • FABP 2 • ADRB 3
Carbohydrate metabolism on fitness	• TCF7L2
Response to mono-unsaturated fats and poly-unsaturated fats (MUFA and PUFA)	• ADIPOQ • PPARG
Satiety behaviour: fat mass and obesity	• FTO
Type of sports, workouts, and exercises	• ACTN3
Response to exercise: metabolic efficiency, weight loss, and weight regain	• ADRB3

We consider for the genotype of the DNA sequence of a particular gene depending on the nucleotide sequences in the DNA and varied RNA formed; subsequent amino acids and the nature of the protein formed. Different proteins formed vary in their structure and function, catering to the different needs of the body (Table II).

Many studies have been done stressing upon the importance of the individual gene responsible in obesity management.

Ours is a unique study, incorporating all the genes as stated in Table I and II with their nucleotide sequences and single nucleotide polymorphisms affecting fats, carbohydrates, mono-saturated and poly-saturated fatty acids. Other parameters considered are satiety behaviour, types of sports, workouts, and response to exercises.

In the "DNA based genetic diet and exercise plan", we have studied SNP at ACTN3 gene, and depending upon the genotype workout, an exercise plan is prescribed.

Depending upon the genetic sequence of ACTN3 gene, following three types of variations in the SNPs have been noted.

Those with genotype CT were given endurance-based exercises and physical activity while those with CC and TT were given power-based exercises and aerobic exercises respectively.

Results

Table III: Gender of obese subjects in plan A and B in age group 20 - 50 years.

Gender	Plan A		Plan B		Total (Plan A + Plan B)
	No.	Percentage	No.	Percentage	
Male	11	73.33%	09	60.0%	20
Female	04	26.67%	06	40.0%	10
Total	15	100%	15	100%	30

Table IV: Comparison of mean weight of subjects in groups at baseline, after 3 months and 6 months of diet therapy.

Weight	Plan A Mean ± SD	Plan B Mean ± SD	t-value	P-value
Base line	91.67 ± 14.53	90.93 ± 14.80	0.137	P=0.892NS
After 3 Months	83.20 ± 12.72	86.73 ± 13.70	0.732	P=0.470NS
After 6 Months	75.07 ± 11.15	83.13 ± 14.18	1.94	P=0.04S

Table V: Comparison of mean waist line of subjects in groups at baseline, after 3 months and 6 months.

Waist Line	Plan A Mean ± SD	Plan B Mean ± SD	t-value	P-value
Base line	142.93 ± 19.96	147.07 ± 26.23	0.708	P=0.485NS
After 3 Months	131.33 ± 18.19	139.13 ± 19.82	1.12	P=0.271 NS
After 6 Months	120.06 ± 13.95	134.13 ± 21.42	2.13	P=0.042S

Table VI: Comparison of mean BMI of subjects in two studied groups at baseline, end of 3 months and 6 months of diet therapy.

BMI in Kg/m2	Plan A Mean ± SD	Plan B Mean ± SD	t-value	P-value
Base line	32.49 ± 2.37	32.93 ± 3.55	0.401	P=0.691NS
After 3 Months	29.35 ± 2.11	31.30 ± 3.39	1.89	P=0.069 NS
After 6 Months	27.05 ± 2.05	29.97 ±3.43	2.93	P=0.008S

Discussion

The present study has been undertaken using DNA amplification and nucleotide sequencing by Sanger's method. Reference genome has been utilised in the labs for sequencing purpose.

The basis of determination of amino acids are chiefly based on nucleotide studies. SNPs which are mapped with reference genomes, the resultant SNPs so observed could either be excitatory or inhibitory, or may have combined functioning. This perhaps is the reason why a particular kind of genetic diet so provided to an individual remains unsuitable for others despite having the same physique but the person is different genetically. This is possibly the precise reason that these SNPs decide the diet/edible oils in diet as PUFA and MUFA. These oils may be fruitful in one and unfruitful in others having same genomic nucleotide. Therefore, the suitability of the diet and the fruitful result could only be apparent after having genomic mapping of DNA-based chart for detecting SNPs. In the present study, we utilised the codon charts for mapping various DNA factors which have shown the presence of various combination of nucleotides in the gene/SNPs.

The study has analysed the nucleotides in various genes observed while preparing the diet charts of group A and B subjects. The combination of various nucleotide codon, contribute towards translation process, hydrophobic and hydrophilic region affinity, and the activation of base pairs, to normalise the pKa values towards normalcy. This normalised pKa value helps in proper functioning and cell metabolism of the obese person.

Different genes in the study as named are the sequence of nucleotides in DNA/RNA that encodes the different synthesis of gene products.

Our study has provided results that indicated statistically significant weight reduction in group A at the end of 6 months, as compared to group B.

The observations that the SNPs which are having appropriate functioning are based on the mapping results. The genetic diet provided on this basis, has given better results in the category of plan A (genetic diet subjects) than that of conventional diet, wherein also DNA-based profiling studies were undertaken.

Further, values observed for the reduction in weight in group A and group B at 3 months were statistically not significant. However, the reduction in weight at the end of 6 months is found statistically significant (Table IV). While validating the results with SNPs, one may draw the conclusion for results of group A and B noticed at 3 months that satisfactory outcome is evident in either groups, but is statistically insignificant. The satisfactory outcome noticed in group B, the SNPs, were still active and partly dormant. Those which were dormant did not activate for functioning in group B. We find the results noticed were significant statistically at the end of 6 months for genetic diet (Group A). Herein, the observation (Group A) signified that those SNPs functioning as dormant or were inactive at the end of 3 months might have resumed the activity towards normality at the end of 6 months, with statistically significant results. Perhaps, the genetic diet had helped to activate the dormant and the inactive SNPs towards better functioning and outcome at 6 months. Previous workers have done studies with individual SNPs and did not discuss the probable reasoning of reduction in weight with genomic diet. The late response in the reduction of weight beyond 3 months could be based on upgradation and down-gradation phenomenon of individual SNPs, activation of dormant non-functioning SNPs.

Summary

A comparative study was conducted to assess the efficacy of DNA based customised diet and exercise plan for weight management in obese individuals. 30 obese persons were selected and divided into two groups: Plan A (15 individuals following genetic diet) and Plan B(15 individuals following standard diet).

Strict diet charting and exercise plan was followed by the individuals in the study. The subjects were evaluated at 0, 3, and 6 months on the parameters of mean weight of individuals, percentage of weight loss, mean difference of weight loss over 3 and 6 months, comparison of BMI and mean waist circumference and mean difference of waist circumference at 3 and 6 months.

- Weight loss was observed in individuals both in plan A and plan B. However, the difference in the weight loss after 3 months in plan A and plan B was not significant. However, at 6 months observation of plan A showed significant reduction in weight in comparison to reductions observed in patients with plan B (Table IV).
- The reduction in mean waistline of subjects at the end of 6 months was observed to be statistically significant in subjects in plan A in comparison to that of subjects in plan B (Table V).
- BMI of individuals in plan A and B from baseline, decreased at the end of 3 months. The difference of BMI in plan A and B was not found to be significant at the end of three months. However, the results were statistically significant at the end of 6 months and more reduction was noticed with plan A genetic diet (Table VI).

Conclusion

DNA-based customised diet and exercise plan has helped in losing weight more effectively in comparison to the conventional diet and exercise plan amongst obese subjects. Adding a genetic personalised component to the weight loss programme, improved the motivation and compliance among the subjects.

Future prospects

Further studies can be undertaken via satellite RNA, protein structure analysis in obese persons for determining specific location on chromosome and genetic factor, besides identifying the SNPs.

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