Umeå universitet
Institutionen för kost- och måltidsvetenskap

KOD

Kunskapsprov för dietister

DELPROV 1

SKRIV DIN PERSONLIGA KOD I RUTAN PÅ VARJE SIDA!

Datum: 2025-05-22

Tid: 08.00-14.00

Hjälpmedel: Miniräknare och kladdpapper

Instruktioner

Provet består av 110 frågor där majoriteten av frågorna är flervalsfrågor. Vid flervalsfrågorna är ett svarsalternativ rätt. Läs frågorna noggrant.

Om ett eller flera svarsalternativ är felaktigt ikryssade eller om ett korrekt svar inte är ikryssat ges noll poäng på frågan.

Bilagor finns i separat dokument.

DEL 1 Medicinsk terminologi och magtarmkanalens fysiologi
DEL 2 Dietetik med sjukdomslära, kost och folkhälsa samt näringslära
DEL 3 Analys av vetenskaplig artikel

Kravgräns:

För godkänt på delprovet krävs att **87 av frågorna** är korrekt besvarade.

DEL 1

1. Enligt NNR2023 ska en märkning användas på livsmedelsförpackningar för vitaminer och mineraler, ange vilken märkning som avses?

_____

2. Patienten säger sig ofta äta ’charkuterier’ på helgen, vad menas med det?

- [ ] Bullar och kaffe
- [ ] Processat kött
- [ ] Veganska produkter

3. Vad är placenta?

- [ ] En graviditetsrelaterad hormonsjukdom
- [ ] Ett fosterhölje som skyddar barnet från infektioner
- [ ] Moderkakan, som förser fostret med näring och syre

4. Vilken av följande livsmedelskomponenter orsakar symtom vid histaminintolerans?

- [ ] Fenylalanin
- [ ] Biogena aminer
- [ ] Gluten

DEL 1

5. Vad står förkortningen BED för?

- [ ] Bulimic eating disorder
- [ ] Bolus elimination disorder
- [ ] Binge eating disorder

6. Vilken av följande faktorer har störst påverkan på energiförbrukningen?

- [ ] Kyla
- [ ] Vistelse på hög höjd
- [ ] Hög lufttemperatur

7. Vilket påstående om BMR/REE är korrekt?

- [ ] Kroppens värmeproduktion beräknas stå för ca 70% av kroppens variation i BMR/REE
- [ ] Fettfri kroppsmassa (FFM) bidrar med ca 80% av kroppens variation i BMR/REE
- [ ] För att enkelt uppskatta BMR/REE kan beräkningen 1-2kcal/kg x 24 tim användas

8. Vad är ett annat ord för metabolism

- [ ] Sjuklighet
- [ ] Nedbrytning
- [ ] Ämnesomsättning

DEL 1

9. Vilket är det latinska ordet för Matstrupe?

- [ ] Esofagus
- [ ] Ventrikel
- [ ] Jejunum

10. Vad är en annan beskrivning av Sepsis?

- [ ] Andnöd
- [ ] Blodförgiftning
- [ ] Tarmvred

11. Vad är en annan beskrivning av Anorexi?

- [ ] Sjukdomsutlöst aptitlöshet
- [ ] Sjukdomsutlöst trötthet
- [ ] Sjukdomsutlöst hunger

12. Vilken riskfaktor bedöms vara den viktigaste vid utvecklingen av metabolt syndrom?

- [ ] Högt HbA1c
- [ ] Lågt totalkolesterol
- [ ] Central obesitas

DEL 1

13. Vilken av följande kirurgisk metod används för att behandla obesitas?

- [ ] Appendektomi
- [ ] Gastrisk bypass
- [ ] Laparoskopi

14. Vad är ett annat ord för fragil?

- [ ] Lunginflammation
- [ ] Undernärd
- [ ] Skör

15. Vad av nedanstående beskriver aspiration?

- [ ] Processer där näringsämnen och läkemedel tas upp i kroppen och omsätts till energi
- [ ] Nedläggning av nasogastrisk sond
- [ ] Fast eller flytande föda hamnar i luftstrupen i stället för i matstrupen

16. Vad beskriver följande: klumpformad massa av föda och saliv?

- [ ] Analgetika
- [ ] Bolus
- [ ] Kasein

DEL 1

17. Vad är ett annat ord för Sårbildning?

- [ ] Tremor
- [ ] Mucosit
- [ ] Ulcus

18. Vilken av följande termer beskriver en förlust av elasticitet i lungvävnaden som är vanligt vid KOL?

- [ ] Kakexi
- [ ] Emfysem
- [ ] Fistel

19. Vad är en annan beskrivning av Anemi?

- [ ] Blodbrist
- [ ] Högt blodtryck
- [ ] Lågt blodsocker

20. Vad är ett annat ord för bukhinneinflammation?

- [ ] Gastrit
- [ ] Peritonit
- [ ] Dermatit

DEL 1

21. Vad är en annan beskrivning av Skov?

- [ ] Återanpassning efter sjukdom eller olycksfall
- [ ] Kortvarig eller tillfällig förbättring av sjukdomstillstånd
- [ ] Återfall i recidiverande eller kronisk sjukdom

22. Vad är ett annat ord för fettrik avföring?

- [ ] Steatorré
- [ ] Steatos
- [ ] Galla

23. Vilken av följande termer beskriver en del av pankreas som producerar hormoner?

- [ ] Glomeruli
- [ ] Alveoler
- [ ] Langerhanska öar

24. Vilken av nedanstående ord beskriver en stomi som används för att avleda urin?

- [ ] Jejunostomi
- [ ] Urostomi
- [ ] Ileostomi

DEL 1

25. Fyll i typ av bakterie nedan:

Bakterien är den främsta orsaken till gastrit.

26. Fyll i svaret nedan:

För att ta reda på om en persons insulinproduktion är normal tas ett blodprov som mäter:

27. Fyll i text nedan:

Vid diabetes typ 2 är det vanligt med insulinresistens. Förutom kost- och läkemedelsbehandling av insulinresistens, finns det ytterligare två viktiga faktorer som är centrala att motivera till, nämligen:

och

28. Vilken av följande termer beskriver en diagnostisk metod som används för att bekräfta celiaki?

- [ ] Kolecystektomi
- [ ] Koloskopi
- [ ] Gastroskopi

DEL 1

29. Vad innebär stunting?

- [ ] Tidig pubertet
- [ ] Tillväxthämning
- [ ] Kroppens förmåga att lagra fett

30. Vilket av följande alternativ är korrekt för de medfödda reflexer som hjälper ett barn att amma?

- [ ] Munvinkling, nappning, avrensning
- [ ] Ledreflex, svarsreflex, slutreflex
- [ ] Sökreflex, sugreflex, sväljreflex

31. Vad innebär neofobi?

- [ ] Kort tungband
- [ ] Rädsla eller skepsis mot ny mat
- [ ] Fobi mot kall mat

32. Vilken latinsk benämning för översta delen i magsäcken är korrekt?

- [ ] Fundus ventriculi
- [ ] Corpus ventriculi
- [ ] Antrum ventriculi

DEL 1

33. Vad är en annan beskrivning av Ödem?

- [ ] Återflöde av vätska mellan magsäck och matstrupe
- [ ] Sjuklig ansamling av vätska i kroppen
- [ ] Förlångsammad tömning av magsäcken

34. Vad är en annan beskrivning av Dysfagi?

- [ ] Sjukdomsutlöst aptitlöshet
- [ ] Sjukdomsrelaterad trötthet
- [ ] Svårighet att svälja

DEL 2

35. Utifrån de nordiska näringsrekommendationerna ges rådet att inta ca 25–30 g nötter per dag. Men vilken av nötterna har högst innehåll av omega-3?

- [ ] Cashewnöt
- [ ] Macadamianöt
- [ ] Valnöt

36. Nordiska näringsrekommendationer 2023: Ange rekommendationerna för totalt fettintag i energiprocent nedan:

_____

37. Vilket påstående gällande stärkelse är korrekt?

- [ ] Stärkelserika livsmedel har alltid lågt glykemiskt index
- [ ] Exempel på livsmedel med som innehåller resistent stärkelse är tex. havre, vita bönor och avokado
- [ ] Resistent stärkelse kan inte fermenteras av bakterier i tjocktarmen

38. Vilket av följande livsmedel innehåller mest mättade fettsyror per 100 g?

- [ ] Smör
- [ ] Hushållsmargarin
- [ ] Kokosfett

DEL 2

39. Vilket av följande livsmedel innehåller mest vitamin D per 100 gram?

- [ ] Lax
- [ ] Lättmjölk (berikad)
- [ ] Ägg

40. För att öka intaget av vitamin_____kan en lägga till en morot till maten.

41. Vilket påstående är korrekt för en vuxen frisk man under fastemånaden Ramadan som följer Islams matregler?

- [ ] Förbjuden att äta gluten
- [ ] Får inte äta baljväxter
- [ ] Får inte äta mat och dryck under dagtid

42. Vilket av nedanstående livsmedel bör en gravid kvinna avstå ifrån på grund av dess eventuella innehåll av skadliga bakterier?

- [ ] Opastöriserade mjölkprodukter
- [ ] Kimchi
- [ ] Tonfisk från burk

DEL 2

43. Vilket av följande påstående är sant gällande laktosintolerans?

- [ ] Kroppen reagerar på ett protein
- [ ] Kroppen reagerar på en kolhydrat
- [ ] Kroppen reagerar på en fettsyra

44. Utifrån ingrediensförteckningen på bilden (se Bilaga 1), identifiera de ingredienser som en person med överkänslighet mot mjölk kan reagera på. Skriv nedan de ingredienser du identifierar som svar på frågan.

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45. Du (dietist) har fått en fråga huruvida en vegansk kost innehåller allt en person behöver. Vilket svar ger du:

- [ ] En välsammansatt vegansk kost innehåller allt som behövs förutom vitamin B12 och vit D som behöver intas som ett extra tillskott.
- [ ] En välsammansatt vegansk kost innehåller allt förutsatt den är tillräckligt energi- och variationsrik.
- [ ] En vegansk kost är inte att rekommendera eftersom det är svårt att äta tillräckligt för att få i sig alla vitaminer och mineraler som du behöver.

46. Vilka av följande kliniska symtom är vanligt förekommande vid anorexia nervosa?

- [ ] Ascites, svettningar, klåda
- [ ] Amenorré, mag-tarmproblem, elektrolytrubbningar
- [ ] Ikterus, feber, dyspné

DEL 2

47. För att klassificera en person som mycket aktiv ska värdet för PAL (Physical Acitity Level) vara minst:

- [ ] 1,6
- [ ] 1,8
- [ ] 2,0

48. Anna är 50 år, hennes TEE är 2500 kcal, hon väger 70 kg och är 1,65 m lång. Hon tar en rask promenad (MET-värde 6). Energiförbrukningen för Anna under 30 min promenad kan skattas till:

- [ ] 310 kcal
- [ ] 260 kcal
- [ ] 210 kcal

49. Respiratorisk kvot (RQ) = volym producerad CO_2/volym konsumerat O_2 (VCO_2/VO_2). Vid intag av en blandad kost är RQ=0,85. För vilken av makronutrienterna stämmer värdet RQ=1?

- [ ] Fett
- [ ] Protein
- [ ] Kolhydrater

DEL 2

50. Du träffar en patient där målet för nutritionsbehandlingen är BMI 20. Patienter är 1,60 lång och väger i dagsläget 46 kg.

Hur många kilo ska patienten öka för att nå önskat BMI?

- [ ] 4
- [ ] 6
- [ ] 8

51. Vilken av följande personer räknas som överviktig enligt BMI?

- [ ] 35 år, 64 kg, 165 cm
- [ ] 45 år, 102 kg, 180 cm
- [ ] 55 år, 82 kg, 175 cm

52. Du träffar en patient som för ett år sedan vägde 74 kg. Patientens väger idag 65 kg. Vilken är patientens viktförlust i %?

- [ ] 10%
- [ ] 12%
- [ ] 14%

DEL 2

53. Vad av följande är ett etiologiskt kriterium vid bedömning av undernäring med hjälp av GLIM?

- [ ] BMI
- [ ] Inflammation
- [ ] Obstipation

54. Vilken av följande infartsvägar är förstahandsalternativet när enteral näringstillförsel ska ske under en begränsad period (4–6 veckor)?

- [ ] Nasogastrisk sond
- [ ] RIG
- [ ] PEG

55. Vad av följande är korrekt när det gäller sondnäring?

- [ ] Vitaminer och mineraler behöver tillsättas sondnäringen innan administrering
- [ ] Sondnäring är vanligtvis en komplett näringslösning för de flesta patienter
- [ ] Sondnäring kan inte användas under längre tidsperiod

56. Vad är fördelen med att använda ett så kallat "slutet system" vid enteral näringstillförsel?

- [ ] Flödeshastigheten kan korrigeras på ett bättre sätt
- [ ] Underlättar för patient och anhöriga
- [ ] Skyddar mot kontaminering

DEL 2

57. Vilken av följande är *inte* en relevant åtgärd om diarré uppstått vid uppstart av enteral näringstillförsel?

- ☐ Sänk hastigheten
- ☐ Låt sondnäringen uppnå rumstemperatur
- ☐ Kontrollera sondspetsens läge

58. Du får en remiss från en barngastroenterolog som beskriver att en 12-årig pojke med Mb Crohns sjukdom ska behandlas med TEN i syfte att erhålla remission. Vad innebär detta?

- ☐ Pojken ska få kortison i kombination med intravenös näring
- ☐ Pojken ska endast nutrieras via flytande näringsprodukter (näringsdryck/sondnäring)
- ☐ Pojken ska få smärtlindring över mag-tarmkanalen som ska öka dess motilitet

59. Vilket av följande påståenden är *inte* korrekt gällande perifer infartsväg?

- ☐ Lösning med hög osmolaritet bör administreras
- ☐ Infart för kortare tids behandling med PN
- ☐ Glukosdropp kan ges via denna infart

60. Vilket av följande påståenden är *inte* korrekt avseende parenteral näringslösning (PN)?

- ☐ Tillsätt vitaminer, mineraler och spårelement i samband med PN
- ☐ Tillsätt extra elektrolyter vid behov i samband med PN
- ☐ Tillsätt extra fettemulsion vid behov i samband med PN

DEL 2

61. Vilket av följande kan vara ett symtom på refeeding syndrome/metabol överbelastning?

- [ ] Takykardi
- [ ] Hypogeusi
- [ ] Hypotermi

62. Patienten har metabolt syndrom. Vilken typ av fett rekommenderar du hen att använda till matlagning med hänsyn till patientens hälsotillstånd?

- [ ] Smör
- [ ] Kokosfett
- [ ] Flytande margarin

63. Vilket råd är viktigast att ge patienten med obesitas som önskar gå ner i vikt?

- [ ] Begränsa energiintaget
- [ ] Ät varierat
- [ ] Öka den fysiska aktiviteten

64. Vilket av följande näringsämnen rekommenderas personer över 75 år ett ökat intag av?

- [ ] D-vitamin
- [ ] K-vitamin
- [ ] Järn

DEL 2

65. Vad av följande har äldre individer med uttorkning (vätskebrist) ökad risk att drabbas av?

- [ ] Synnedsättning
- [ ] Trycksår
- [ ] Aversioner

66. Vilken kostbehandling kan användas för att minska dyskinesi vid Parkinsons sjukdom?

- [ ] Ketogen kost
- [ ] Fenylketonreducerad kost
- [ ] Proteinomfördelad kost

67. Vad av följande kan tyda på att en patient har dysfagi?

- [ ] Samlar mat i kinderna
- [ ] Diarré
- [ ] Buksmärtor

68. Vid ALS, vilket av följande alternativ är exempel på ett relevant råd när patienten börjar uppleva problem att äta och svälja?

- [ ] Använd framför allt tunna vätskor
- [ ] Påbörja total enteral näringstillförsel
- [ ] Undvik torra och smuliga livsmedel

DEL 2

69. Vad av följande är en nivå inom IDDSI?

- [ ] Total enteral näringstillförsel
- [ ] Svår undernäring
- [ ] Mycket lätt trögflytande

70. Du arbetar som dietist vid en HIV-mottagning. Vilken kostregim ska du utgå ifrån för en patient med nydiagnostiserad HIV utan undernäringsproblematik?

- [ ] NNR-kost
- [ ] Ketogen kost
- [ ] Proteinreducerad kost

71. Vilket av nedanstående råd är det mest lämpligt att dietisten ger till den ensamboende patienten (BMI 27 kg/m^2) som önskar kostråd för att förbättra eller bibehålla sitt hälsotillstånd.

Patienten har nyligen fått diagnosen kroniskt obstruktiv lungsjukdom (KOL) samt håller just på att återhämta sig från en luftvägsinfektion.

- [ ] Det vore bra om du gick ner lite i vikt
- [ ] Minst halva tallriken/portionen ska bestå av frukt och grönsaker
- [ ] Säkerställ att du har färdiga maträtter i frysen som lätt kan värmas i mikrovågsugnen de dagar du inte orkar laga mat

DEL 2

72. Vilket råd är *inte* relevant, eller mycket sällan, att ge under pågående cancerbehandling?

- ☐ Sträva efter en hälsosam vikt
- ☐ Uppmuntra fysisk aktivitet
- ☐ Välj lågproteinkost

73. Vilken typ av ämne antas ha skyddande effekt mot cancerutveckling?

- ☐ Lykopen
- ☐ Nitrosaminer
- ☐ Polycykliska aromatiska ämnen

74. Patienter som genomgått stamcellstransplantation kan drabbas av GVHD (eller GVH). Vad av följande är en anledning till att dietist är en viktig profession vid det tillståndet?

- ☐ Patienten kan få svåra nutritionsproblem relaterat till mag-tarmkanalen
- ☐ Patienten har ökad risk för metabolt syndrom och viktuppgång
- ☐ Patienten behöver minska intaget av kolhydrater i kosten

DEL 2

75. Vilken av följande är exempel på en *icke-korrekt* nutritionsåtgärd för en patient med cancer och undernäring?

- [ ] Energi- och proteinberikad kost
- [ ] Fettreducerad kost
- [ ] Kosttillägg

76. Vilken av följande stadieindelning visar på bekräftad spridning av cancerceller till lymfnoder?

- [ ] N1
- [ ] NX
- [ ] N0

77. Följande remiss inkommer till dig, där nedanstående information finns:
Man, 70 år. Glomerular filtration rate GFR 7 ml/min. Planeras för peritonealdialys, tacksam för kostrådgivning. Vad mäter GFR?

- [ ] Nutritionsstatus
- [ ] Proteinintag per kg/dygn
- [ ] Njurfunktion

78. Av vilken anledning rekommenderas personer med kronisk njursjukdom ibland reducera intaget av torkad frukt?

- [ ] På grund av dess negativa inverkan på dialyseffekten
- [ ] På grund av dess kaliuminnehåll
- [ ] På grund dess påverkan på järnupptag

DEL 2

79. Vilket av nedanstående påstående stämmer överens med kostbehandling enligt FODMAP?

- [ ] FODMAPs påverkar inte gasproduktionen i tarmen
- [ ] FODMAPs ökar gasproduktionen i tarmen
- [ ] FODMAPs sänker gasproduktionen i tarmen

80. Inflammation vid Morbus Crohn kan engagera hela magtarmkanalen. Många patienter, ungefär hälften, har engagemang i en viss del av tarmen, vilken?

- [ ] Proximala ileum
- [ ] Distala ileum
- [ ] Laterala ileum

81. Patienter med IBD kan på grund av sjukdomen och behandlingen ha ökad risk att drabbas av ett annat medicinskt tillstånd, vilket?

- [ ] Osteoporos
- [ ] Divertikelkolit
- [ ] Gallsten

82. I relation till mag- och tarmsjukdomar, vad innebär SIBO?

- [ ] Överväxt av bakterier i tunntarmen
- [ ] Läckande tarm
- [ ] Gallsaltsmalabsorption

DEL 2

83. Vid levercirros, vilket av följande kostråd är relevant?

- [ ] Undvik laktos
- [ ] Undvik proteinrika livsmedel
- [ ] Undvik långa fasteperioder

84. Vilket näringsämne ses som fördelaktigt att supplementeras till patient med icke alkoholrelaterad fettlever?

- [ ] Vitamin E
- [ ] Kreatin
- [ ] Jod

85. Vilken typ av kost är mest fördelaktig för att minska belastningen på bukspottkörteln vid kronisk pankreatit när medicinsk behandling inte ger önskad effekt.

- [ ] Fettrik kost
- [ ] Fettreducerad kost
- [ ] Lågkolhydratkost

86. Vilka av dessa hormoner produceras i bukspottskörteln?

- [ ] Insulin och Glukagon
- [ ] Erytropein och Kortisol
- [ ] Renin och Ghrelin

DEL 2

87. Vilket av följande näringsämnen är viktigt att särskilt uppmärksamma och tillföra för att förhindra näringsbrist vid en ileostomi?

- [ ] Vitamin C
- [ ] Vitamin B12
- [ ] Järn

88. Vilket av följande kostråd är korrekt att ge till en patient med magsår?

- [ ] Öka intaget av fermenterade livsmedel.
- [ ] Minska intaget av omega-6 fettsyror.
- [ ] Intaget av kaffe eller koffein har ingen betydelse.

89. Ett tillstånd som kan förekomma efter bariatrisk kirurgi är dumping. Vilket av följande kostråd är korrekt?

- [ ] Välj livsmedel som är rika på olösliga fibrer.
- [ ] Undvik sockeralkoholer.
- [ ] Undvik extra fett till maten.

90. Fyll i det ord som saknas i slutet av meningen:

En person med diabetes typ 1 är beroende av exogent insulin för att förebygga framför allt

_____

DEL 2

91. Om du ska beräkna kolhydratkvoten enligt 500-regeln för en patient som har diabetes typ 1, vad behöver du då först ta reda på? (skriv ditt svar nedan)

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92. Vilket av följande livsmedel ska undvikas vid celiaki på grund av sitt gluteninnehåll?

- [ ] Bovete
- [ ] Durumvete
- [ ] Teff

93. Som dietist träffar du en 7-åring pojke som enligt tillväxtkurva växer -2 SD på längd och -2 SD på vikt. Enligt remiss ska barnet börja behandlas med tillväxthormon. Vilket av nedanstående hormon är det mest sannolikt att läkaren syftar på?

- [ ] Kortisol
- [ ] PTH
- [ ] GH

94. Utifrån analys av en tillväxtkurva – vilket av följande barn är det mest sannolikt att man utreder vidare med tanke på tillväxtavvikelse?

- [ ] Ett barn som vuxit +1 SD hela livet
- [ ] Ett barn som faller från +1 SD till -1 SD under ett års tid
- [ ] Ett barn som vuxit stabilt +1 SD på längd och -1 SD på vikt

DEL 2

95. Vilket av nedanstående påståenden är en riskfaktor för att ett barn ska utveckla en övervikt eller obesitas?

- [ ] Barnet har låg födelsevikt och låga APGAR-poäng
- [ ] Barnet har utebliven catch-up tillväxt
- [ ] Barnet har tidig adiposity rebound

96. Vilket av följande påstående är korrekt angående amning och modersmjölkersättning?

- [ ] Barn som ammas kan reglera sitt matintag i högre grad än barn som får modersmjölkersättning
- [ ] Barn som får modersmjölkersättning rekommenderas dubblerad dos vitamin D
- [ ] Näringen i modersmjölkersättning är känslig för temperaturförändring och får därför inte värmas

97. Som dietist träffar du ett 1,5 årigt barn med sin förälder. Via den kostanamnes du tar får du veta att barnet äter följande livsmedel (se Bilaga 2). Vilket av livsmedlen enligt anamnesen bör du informera föräldern om att begränsa? Motivera varför.

Livsmedel: _____

Motivering: _____

98. Spädbarn med Downs syndrom kan ha svårt att få i sig tillräckligt med näring. Vad är en vanlig orsak till detta?

- [ ] Förhöjt energibehov
- [ ] Svårighet att koordinera sugning, sväljning och andning
- [ ] Smärtor i svalg och matstrupe

DEL 2

99. Barn med autismspektrumtillstånd kan ha svårt att få i sig tillräckligt med näring. Vad är en vanlig orsak till detta?

- [ ] Sensorisk känslighet och undvikande av vissa livsmedel
- [ ] Förhöjt energibehov
- [ ] Gastroesofageal reflux och försenad magsäckstömning

100. Nutritionsproblematik är vanligt hos barn med diagnosen cerebral pares. Vad är en vanlig orsak till detta?

- [ ] Biverkningar av medicinering
- [ ] Smärtor i svalg och matstrupe
- [ ] Orofaryngeal dysfagi

DEL 3

I denna del (se Bilaga 3) ska du läsa en vetenskaplig artikel och sedan svara på ett antal frågor kring den. Det kan vara bra att läsa igenom frågorna innan du börjar läsa artikeln.

Artikel: Gortzi, O., Dimopoulou, M., Androutsos, O., Vraka, A., Gousia, H., & Bargiota, A. (2024). Effectiveness of a Nutrition Education Program for Patients with Type 2 Diabetes Mellitus. *Applied Sciences*, *14*(5), 2114.

101. Vilken var den vanligaste behandlingsformen innan interventionen?

- ☐ Kost och motion
- ☐ Insulinbehandling
- ☐ Enbart medicinering

102. Hur uppmuntrades fysisk aktivitet i interventionen?

- ☐ Genom gruppträningspass
- ☐ Genom rekommendation om lämplig träningsmängd/vecka
- ☐ Genom att förse deltagarna med aktivitetsarmband

103. Hur var nutritionsinterventionen upplagd?

- ☐ Fokus låg på stor viktnedgång
- ☐ En standardiserad diet för alla patienter
- ☐ Individanpassade rekommendationer

DEL 3

104. Vilken parameter förbättrades signifikant efter tre månader?

- [ ] LDL-kolesterol
- [ ] HDL-kolesterol
- [ ] Diastoliskt blodtryck

105. Vilken parameter förändrades *inte* signifikant efter interventionen?

- [ ] BMI
- [ ] HbA1c
- [ ] Midjemått

106. Vad visade resultaten gällande patienternas måltidsfrekvens?

- [ ] Lunch var ofta den mest bortglömda måltiden
- [ ] Tendensen att hoppa över frukost minskade under studiens gång
- [ ] Antalet måltider ökade drastiskt

107. Vad var en central anledning att patienter inte träffade dietist före studien?

- [ ] Brist på intresse från läkarens sida
- [ ] Uppfattningen att läkare räckte som stöd
- [ ] Låg tillgång till dietister

DEL 3

108. Vilken förändring av livsmedelskonsumtion var vanligast efter interventionen?

- [ ] Ökad konsumtion av processade livsmedel
- [ ] Ökad konsumtion av fiber
- [ ] Ökad konsumtion av omättat fett

109. Vad identifierades av forskarna som en fortsatt utmaning som hälso- och sjukvårdspersonal behöver fokusera extra på?

- [ ] Rökning och låg fysisk aktivitetsnivå
- [ ] Överdriven alkoholkonsumtion hos alla patienter
- [ ] Kraftiga ökningar i blodsocker

110. Hur beskriver artikeln majoriteten av patienternas ursprungliga kunskap om och förståelse för sjukdomens allvar?

- [ ] Hög kunskap men låg riskmedvetenhet
- [ ] Medelhög kunskap och låg riskmedvetenhet
- [ ] Låg kunskap och låg riskmedvetenhet

Bilaga 1.


coop
Gräddglass KOLASMAK OCH KOLASÅS
VOLYM/VIKT: 500 ml, motsvarar 260 g.
INGREDIENSER: Skummjölk, grädde 20 %, kolasås 15 % (glukossirap, kondenserad mjölk, socker, vatten, härdat vegetabiliskt fett (palm), salt, konserveringsmedel (E 202), arom), socker, vasslepulver, glukos-fruktossirap, emulgeringsmedel (E 471 vegetabiliskt), stabiliseringsmedel (E 410, E 412, E 407), arom, färgämne (E 150).

BILAGA 2.

Potatis

Havregrynsgröt

Banan

Kokta röda linser

Tomatsås

Messmör

Riskakor

Äpple

Morot

Köttfärs

Lax (frysta odlad)

Havredryck

Kavring

applied sciences

MDPI

Article

Effectiveness of a Nutrition Education Program for Patients with Type 2 Diabetes Mellitus

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Abstract: Diabetes is a metabolic disease that is a major health problem globally. Dietary interventions contribute to the management of the disease and the improvement in patients' quality of life. The aim of the present study was to assess the effects of a nutrition and lifestyle education intervention on a sample of patients with diabetes. The duration of the intervention was 3 months, and it focused on the promotion of the Mediterranean diet through information pamphlets, diet plans and healthy lifestyle guidelines, which were provided in addition to patients' standard medical treatment. Patients were enrolled in the outpatient clinic of the University Hospital of Larissa (Greece). Anthropometric and biochemical parameters were recorded at baseline and follow-up using standardized equipment and methods. The intervention improved patients' body mass index, body composition, fasting glucose, postprandial glucose, triglycerides, HDL/LDL cholesterol and cholesterol. For smoking status, alcohol consumption and physical activity categorization, physical activity improved but not the other two indices. The results of this study show that patient education should be provided according to the nutritional recommendations for T2DM plus a more individually structured intervention. It is therefore necessary to direct the attention of doctors to the need for continuous and detailed discussions with patients in relation to both the standards of a healthy diet and the benefits it brings. Patients, for their part, need to commit to following an appropriate, healthy diet.

Keywords: diabetes; nutrition; weight loss; education

Citation: Gortzi, O.; Dimopoulou, M.; Androutsos, O.; Vraka, A.; Gousia, H.; Bargiota, A. Effectiveness of a Nutrition Education Program for Patients with Type 2 Diabetes Mellitus. *Appl. Sci.* **2024**, *14*, 2114. https://doi.org/10.3390/app14052114

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1. Introduction

The prevalence of type 2 diabetes mellitus (T2DM) worldwide is increasing at epidemic proportions [1]. Chronic hyperglycemia is considered a major risk factor for cardiovascular and kidney disease, retinopathy and neuropathy [2]. The Center for Disease Control (CDC) estimates that almost 33% of adults in the U.S. have prediabetes; therefore, preventing or delaying T2DM is a public health imperative to help extend and improve the lives of millions of people [3].

The increase in the prevalence of T2DM is paralleled with the increase in overweight/obesity, and it has become particularly evident in the last decade [4]. Undoubtedly, as a person's body mass index (BMI) increases, the risk of developing T2DM increases in a "dose-dependent" manner. The prevalence of T2DM is 3–7 times higher in obese than in normal-weight adults [4], and people with a BMI > 35 kg/m^2 are 20 times more likely to develop T2DM than those with a BMI between 18.5 and 24.9 kg/m^2 [5]. Obesity also complicates the management of T2DM by increasing insulin resistance and blood

glucose concentrations [6]. Obesity is also an independent risk factor for dyslipidemia, hypertension and cardiovascular complications and cardiovascular mortality in patients with T2DM [2].

Attaining and maintaining a healthy body weight is a major therapeutic target in the management of T2DM. Governments are looking to identify the most effective services to support overweight/obese patients with T2DM to lose weight and improve their health status and quality of life [7]. Data from the Diabetes Prevention Program (DPP) showed that weight loss (7% of weight lost in the first year), increased physical activity (150 min of walking per week) and improvements in other lifestyle behaviors (e.g., dietary behavior) decreased the 4-year incidence of T2DM by 58% in men and women with glucose tolerance disorders [8].

Some strategies associated with successful long-term weight loss include lifestyle modification, specifically the adoption of low-caloric diets, frequent body weight monitoring, and participation in regular physical activity. Successful weight loss is accompanied by a reduction in the portion size of meals, foods and snacks, daily breakfast consumption, and 3 or less hours of screen-watching (television, computer, tablets/smartphone) per week on average [9,10]. The link between overweight and obesity and many non-communicable diseases is well known [11]. Weight loss has a major impact on improving glycemic control and reducing the risk of cardiovascular disease [12].

Dietary recommendations need to be based on personal choices, access to food and the patient's culture and ability to make behavioral changes [13]. Interventions in the patient's lifestyle to increase physical activity and reduce caloric intake aim to reduce body weight by 5%, as this can improve HbA1c and cholesterol and reduce cardiovascular risk [14]. The American Diabetes Association emphasizes the importance of educating the patient to make conscious food choices that take into account personal preferences, culture and religion and individualized metabolic goals. The diet patterns with the most beneficial effect on the metabolic profile have been mentioned as the Mediterranean diet and the vegetarian diet [15,16].

Long-term improvements to lifestyle, especially nutrition and physical activity, are challenging for most patients. The role of healthcare professionals working with diabetic patients is to encourage, monitor and support them in this effort [17]. Several techniques can be used to promote behavioral change. First, behaviors need to be screened, and personalized goals need to be set by the healthcare professional in agreement with the patient. Setting realistic and achievable goals allows patients to achieve success, which can be a starting point for further lifestyle change [18,19]. Strategies such as self-monitoring, avoidance of situations that trigger food intake and problem-solving (to the extent possible) may support self-regulation over time. Frequent communication and educational meetings (e.g., every fortnight) are associated with better long-term maintenance of weight loss [20].

The purpose of this study was to investigate the effectiveness of a nutrition and lifestyle education intervention in patients with T2DM for a patient-approach medicine. At the same time, the level of nutritional knowledge of the patients was assessed and their problems in adopting appropriate nutritional approaches were recorded with the ultimate aim of improving them. Some small studies promote nutritional supplementation [21] or a diet that may affect postprandial glucose or other metabolic biomarkers [22–24] or alter the metabolic profile through intermittent fasting [25], but only a few have examined the impact of behavioral [26] and patient-centric therapeutic approaches [27] for diabetes, so original research could close the gap. This study aims to present multifaceted strategies compared with the clinical studies conducted in the last years, with diet playing a pivotal role in T2DM management, with a special focus not only on the Mediterranean diet but also on personalized dietary recommendations for patients and shedding light on the efficacy of a multidisciplinary team of health professionals.

2. Participants and Methods

2.1. Study Designed

The study was approved by the competent Bioethics Committee of the University of Thessaly (approval numbers 49162/13-10-2017 and 49161/13-10-2017), and it was in line with the Declaration of Helsinki. All volunteers signed a written informed consent prior to their participation in the study. The study period was from October 2017 to January 2018.

2.2. Participant Recruitment

Eighty-eight T2DM patients (forty males and forty-eight females, average age 51.4 years) were admitted to the Larissa General University Hospital, Greece, for 90.0 ± 3.3 days. Criteria for participation in the study were a diagnosis of diabetes established by hemoglobin A1C (HbA1c) or plasma glucose concentration. In addition, individuals with a recent diagnosis of T2DM (<3 months) and who were treatment-naive, 30–70 years of age, clinically and biochemically stable and without any acute metabolic complications of diabetes were also considered for the study. Individuals with history of recent alcohol use (<6 months), pregnant women and those in a severe comorbid state were excluded. The clinical samples for analysis were collected at the baseline (t = 0 months) and at the end (t = 3 months) of the study.

2.3. Data Collection and Measures

At baseline, patients filled out the questionnaire (demographic characteristics, personal information, complications of the disease), and data were recorded for biochemical indicators, including fasting glucose, blood glucose, HbA1c, total cholesterol, HDL cholesterol, LDL cholesterol and triglycerides, and also medications. Anthropometric data were also collected. Participants' weight was measured in light clothing and without shoes using a portable calibrated electronic weighing scale precision scale (TAN- ITA MC-780U Multi Frequency Segmental Body Composition Analyzer, Amsterdam, the Netherlands). Height was measured with portable measuring inflexible bars (Seca model 220, Seca, Hamburg, Germany). Waist (at umbilicus) and hip (at widest point) circumferences (WC and HC) were measured according to standard conditions using a measuring tape, and waist/hip circumference ratio (WHR) was calculated. Blood pressure was measured with a clever blood monitor (FYGB-869). All measurements were taken twice, and the average of the two values was reported, as suggested [28]. The follow-up was planned after 3 months and aimed to evaluate potential changes in the collected variables. Subjects recorded their physical activity using the International Physical Activity Questionnaire [29] and a validated diet recall Food Frequency Intake form [30].

Low-density lipoprotein cholesterol (LDL) was calculated according to the Friedewald formula [31]. Fasting glucose was calculated [32], and glycated hemoglobin (HbA1c) was measured by high-performance liquid chromatography (HPLC). All participants were evaluated for their changes in the collected variables.

2.4. Lifestyle and Nutritional Intervention

Each patient was allocated to one dietitian, a nutritionist, who was responsible for educating, measuring and adhering to the intervention. The intervention included one face-to-face meeting about nutrition under the direction of a dietician and the patient. During this visit, the patients were informed about the purpose of the study, answered the 24 h diet recall questionnaire [33] and were given an individualized nutritional plan (the energy requirements were calculated and personalized according to the preferences/needs of each patient) and detailed nutritional instructions, recommendations and advice, both for their diet and eating behavior. Patients were also educated regarding the choices of foods containing carbohydrates, with the aim of regulating sugar levels within normal limits as well as easily forming their daily diet. There were written specific nutritional recommendations: to have 5–6 meals per day, dividing the foods containing carbohydrates, to prefer foods rich in soluble fiber (legumes, fruits, vegetables, whole grains), to avoid the consumption of pure sugar and products containing it (sweets, cookies with sugar,

cakes, jelly, ice creams with sugar, candies, sugared drinks, etc.), to reduce salt consumption and to avoid the consumption of saturated fat contained mainly in red meat, cold meats, egg yolks (up to 3 times/week) and butter. Emphasis was given to the consumption of vegetable fats, mainly olive oil, and to replace red meat with fish as much as possible. All participants' diets were evaluated to assess their compliance with the Mediterranean diet and standards recommended by the American Diabetes Association [34] and the Hellenic Diabetes Association [35]. Some dietary recommendations were given by the dietician, such as reducing the intake of calories, total fat to <30% of daily energy intake and saturated fat (including trans fatty acids) to <10% of daily energy intake and increasing fiber intake (15g to 30g/day) [36]. The patients were given a form with the food categories mentioned above and an individualized nutritional plan (55% carbohydrate, 15% protein, and 30% fat) that they could follow for weight loss, as this was a key target of the intervention for those who were overweight or obese. They also received instructions for exercise. More precisely, participants were instructed to follow a Mediterranean-type diet and to perform at least 150 min of moderate-intensity exercise a week. Adherence to recommendations from dietitians was reported after the three-month intervention. Finally, the patients could communicate, either through calling, messaging or visiting the dietician during the three-month intervention, for questions or for support for their efforts.

2.5. Statistical Analyses

Statistical analysis was performed with the Statistical Package for the Social Sciences (SPSS 21). A frequency analysis was performed for each of the variables in the questionnaires. The Kolmogorov–Smirnov test was used to test the variables for a normal distribution. Data are presented as mean ± standard deviation (SD) or as median value (interquartile range). A paired *t*-test was used to compare parametric variables before and after three months of the nutrition education intervention; the Wilcoxon test was used for non-parametric data; and the chi-square test was used for categorical variables. *p*-values < 0.05 (two-tailed) were considered statistically significant.

3. Results

3.1. Study Population

Individuals with a history of recent alcohol use (<3 months) or in a severe comorbid state were excluded. The study population consisted of 48 females (mean age 50.1 ± 9.1 years) and 40 males (mean age 51.4 ± 6.8 years). The average interval between baseline and the end of the follow-up was 90.0 ± 3.3 days, and all participants completed the study. The study was explained to all the individuals initially considered. Only 88 of the initial 100 patients gave informed written consent and so participated in the intervention at the Hospital of Thessaly.

3.2. Socio-Economic Data, Nutritional Knowledge and Perception of T2DM Treatment

Although, risk factors for people with T2DM [3] are well known. it is therefore necessary to select socio-economic data and clinical characteristics of the T2DM patients.

More than half of the patients were treating diabetes with antidiabetic medication only (56.8%), with 3.4% injecting insulin and only 9.1% taking diabetic medications and eating a balanced diet (Table 1).

The amount patients spent on food each month was also checked for correlation with dietary guidelines. Most (52% of the sample) spent EUR 200–300, 32% spent EUR 300–400, 11% spent less than EUR 200 and just under 5% spent more than EUR 400.

As part of the interview, patients were questioned about their educational level. The results showed that almost half of the patients had a high school degree (42.5%), while only 4.6% had an elementary school degree. The rest of the patients had a university degree (Table 1).

No comorbidities were recorded in 25 patients; 57.5% had a family history of diabetes. The frequency of comorbidities for the remaining 63 patients is recorded in Figure 1.

Table 1. Socio-economic data and clinical characteristics of the T2DM patients (N = 88).

		%
Sex	Men	45.5
	Women	54.5
Education	Primary Education	4.6
	Secondary Education	42.5
	Higher Education	52.9
Financial budget per month for food	EUR < 201	11.4
	EUR 201–300	52.3
	EUR 301–400	31.8
	EUR > 400	4.5
Treatment of T2DM	Exercise and insulin	1.1
	Exercise. and medication	1.1
	Exercise and diet	1.1
	Diet, exercise and medication	6.8
	Diet and medication	9.1
	Insulin	3.4
	Medication	56.8
	Medication and insulin	20.5

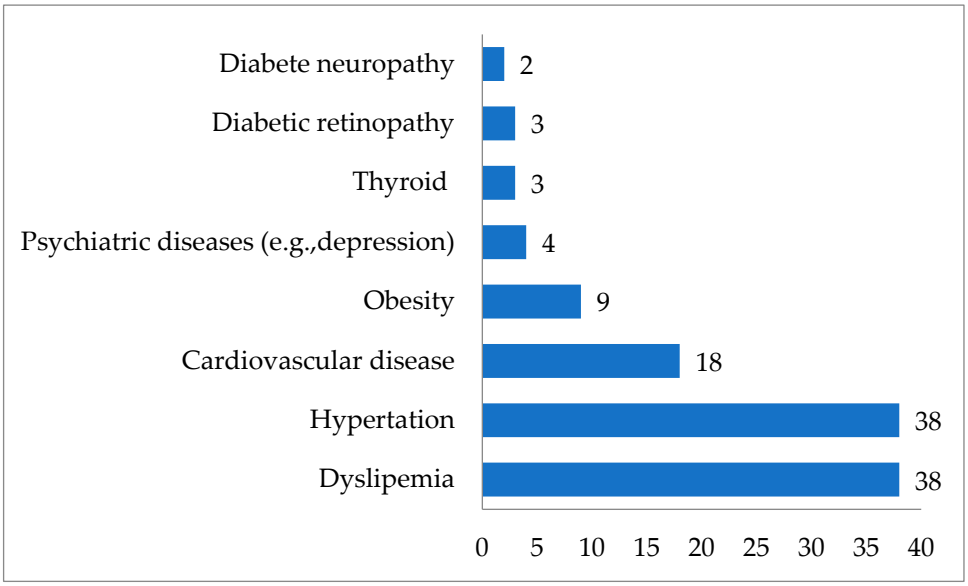

Figure 1. Comorbidity of the participants (%).

When asked about the frequency of blood glucose monitoring by the patients, 50% answered 1 time/day. After analyzing the patients' responses to the questionnaire, it was found that 90% of patients reported the frequency of their visits to the doctor for diabetes was every 3 months and 10% every year. A total of 89.8% of patients responded that they were not informed about the severity of the disease, while 10.2% of patients were informed. When asked if dietary instructions were given after the onset of the disease, the physician responded that it was the patient's responsibility. Almost half of the patients exercised every day. Finally, patients were asked if they smoked, and 25% of patients answered yes (Table 2).

Figure 2 shows the percentage of participants who adhered to the dietary guidelines prior to the intervention. Before the intervention, half the patients had not received clear dietary guidelines related to treating their diabetes. The others had been given some kind of dietary plan by the research dietician. For the majority of patients (56%), reducing carbohydrate intake was the most important dietary goal; 20% of patients tried to increase their intake of fruit and vegetables; 42% chose to include low-fat foods in their diet; 27% of patients did not follow any

dietary guidelines. In terms of sodium consumption, only 5% restricted the consumption of processed foods, and 35% refrained from eating particularly salty foods.

Table 2. Therapeutic approaches and treatment of T2DM (%).

		N %
Frequency of blood glucose measurement	Occasionally	3.4
	Weekly	8.0
	1 time/day	50.0
	2–3 times/day	34.1
	>3 times/day	4.5
Frequency of doctor visits for type 2 diabetes mellitus	Once a year	13.6
	Once per 6 months	28.4
	Once per 3 months	35.2
	1 time/month	17.0
	2 times/month	5.7
Update on disease severity/consequences of non-regulation	No	89.8
	Yes	10.2
With the onset of the disease, were dietary instructions given (immediately)? If so, by whom?	No	11.4
	From the doctor	52.3
	By the dietitian with guidance from the attending physician	36.4
	From the dietitian during a visit on individual initiative	0.0
Reason for not visiting a dietitian	No answer	20.5
	Negligence	31.8
	The doctor is enough	36.4
	Cost	8.0
	No time available	3.4
Participation in physical activity	No	27.3
	Housework	6.8
	Outside work	2.3
	Walking	53.4
	Jogging	2.3
	Sport	8.0
Frequency of exercise	No answer	27.3
	1 time/week	2.3
	2 times/week	4.5
	3 times/week	10.2
	4 times/week	3.4
	5 times/week	5.7
	Every day	46.6
Smoking	No	75.0
	Yes	25.0

When asked about their knowledge of the proper diet for someone with diabetes, the largest percentage (57.5%) rated this as moderate, while 37.9% felt they were adequately informed. A small percentage of 3.4% felt that they had very good knowledge and 1.1% felt that they had no knowledge in this area.

3.3. Efficacy of the Nutrition Education Intervention

At the end of the dietary intervention period, changes were seen in all anthropometric and biochemical variables measured. Body weight and body mass index (BMI) decreased significantly, as did systolic blood pressure, fasting and mean glucose, total and LDL cholesterol and triglycerides (TGs) (Table 3). The most important outcome was the change

in body composition (average body fat and vascular fat percentage averages) and waist circumference (Table 3).

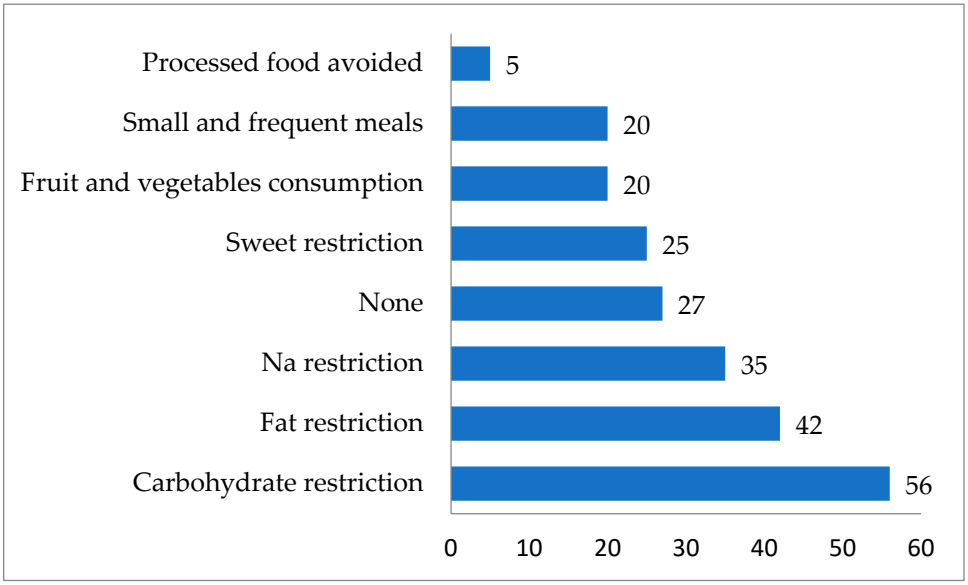

Figure 2. The participants who followed the nutritional guidelines before the intervention (%).

Table 3. Somatometric characteristics, biochemical variables and 24 h dietary recall results of the participants (N = 88) at baseline and after three months of the nutrition education intervention.

Characteristics *	At Baseline (t = 0 Months)	After Intervention (t = 3 Months)	*p*-Value
Body weight (Kg)	81.8 ± 17.2	77.8 ± 16.3	<0.001 *
BMI (kg/m^2)	28.8 ± 5.0	27.1 ± 5.4	<0.001 *
Waist circumference (cm)	107.4 ± 26.0	103.4 ± 25.5	<0.001 *
Hip circumference (cm)	96.8 ± 24.0	94.5 ± 23.6	<0.001 *
Waist–hip ratio	1.2 ± 0.1	1.1 ± 0.1	<0.001 *
HbA1c (%)	7.2 (6.4–8)	7.6 (6.7–7.7)	0.672 *
Postprandial blood glucose (mg/dL)	161.6 ± 36.0	131.9 ± 26.7	<0.001 *
Fasting glucose (mg/dL)	110.7 ± 19.5	99.5 ± 13.9	<0.001 *
Total cholesterol (mg/dL)	183.0 ± 41.1	165.8 ± 26.8	<0.001*
LDL-c (mg/dL)	96.2 ± 35.4	89.4 ± 20.0	0.002 *
HDL-c (mg/dL)	48.2 ± 15.5	47.1 ± 6.5	0.443 *
TG (mg/dL)	154.7 (150.7–154.7)	119.7 (69.7–120.7)	<0.001 **
SBP (mmHg)	14.2 ± 11.4	11.8 ± 0.9	0.056 *
DBP (mmHg)	8.8 ± 7.9	8.0 ± 0.4	0.342 *
Atherogenic index	4.1 ± 1.3	3.5 ± 0.5	<0.001 *
Uric acid (mg/dL)	6.5 ± 1.7	6.2 ± 1.4	0.0001 *
Body fat (%)	32.9 ± 7.8	29.2 ± 7.6	<0.001 *
Visceral fat (%)	11.8 ± 0.1	10.2 ± 0.1	<0.001 *
Muscle mass (%)	88.7 ± 4.3	83.1 ± 5.8	0.331 *
Daily calorie intake (kcal)	1659.7 ± 285.9	1631.4 ± 267.3	0.002 *

BW: body weight, BMI: body mass index, WC: waist circumference, HC: hip circumference, WHR: waist-to-hip ratio, HbA1c: glycated hemoglobin, BGP: blood glucose postprandial, FBG: fasting blood glucose, TC: total cholesterol, HDL: high-density lipoprotein cholesterol, LDL: low-density lipoprotein cholesterol, TG: triglycerides, SBP: systolic blood pressure, DBP: diastolic blood pressure, AI: atherogenic index, UA: uric acid, BF: body fat, VF: visceral fat, MM: muscle mass, DCI: daily calorie intake. Data are mean ± standard deviation (SD) or median value (interquartile range). * *p* values for the comparison with baseline by paired *t*-test. ** *p* values for the comparison with baseline by Wilcoxon test.

The atherosclerotic index and uric acid also decreased significantly at the end of the study period, while no significant changes occurred in HbA1c, HDL cholesterol, diastolic blood pressure and muscle mass (Table 3).

Based on the 24 h reminders at the beginning and end of the study, 73.4% of patients reduced their daily calorie intake and 5.9% increased their consumption of high-fiber foods by the third month, a large percentage (from 67.8% at the first visit to 59.8% in the third month) reduced their alcohol consumption, 5.9% opted for plant-based foods in place of meat, chicken and fish, while 5.2% made no changes to their dietary habits (Figure 3). Regarding patients' participation in physical activities, the percentage increased slightly by the third month, such as brisk walking, cycling or playing a friendly game of basketball or soccer (moderate to vigorous physical activity) (Figure 1). A significant percentage of patients skipped meals both at the beginning and at the end of the study (especially dinner (55.2%)) (Figure 4), although skipping breakfast and afternoon snacks was less frequent in the third month of the intervention and the differences were statistically significant ($p < 0.05$) (Figure 4). Lunch was the only meal that was not skipped by anyone.

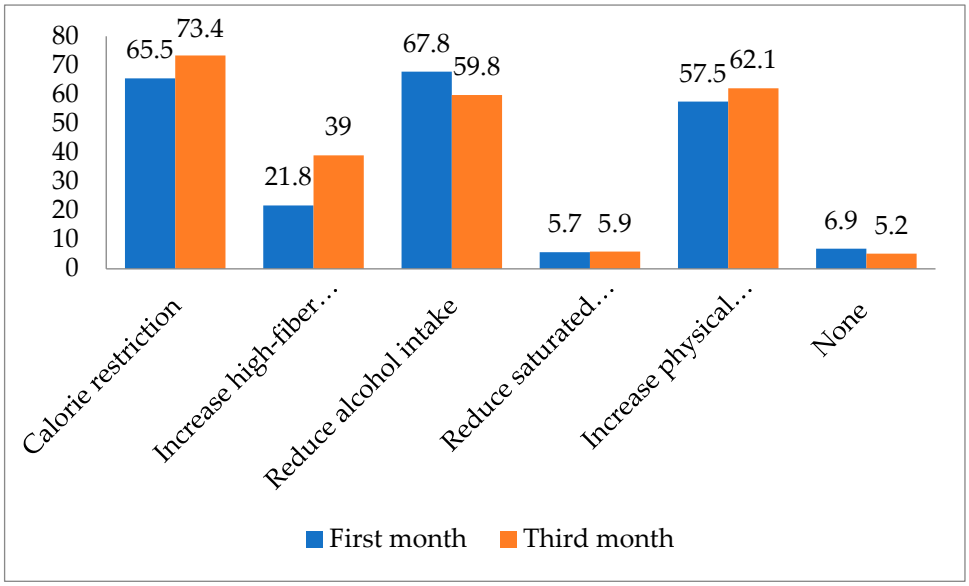

Figure 3. Percentage (%) of patients following the recommendations according to the ADA [22].

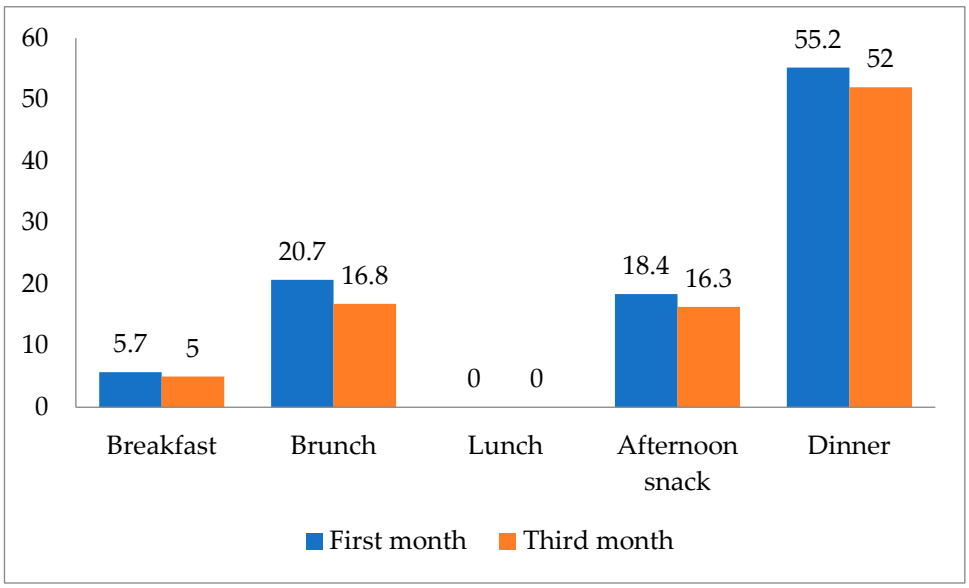

Figure 4. Percentage (%) of meal-skipping in participants.

Since dietitians should focus on individualized nutritional care to gain a holistic understanding of their patients, we recorded the frequency of patient communication with the dietitian during the three-month intervention and the results are shown in Figure 5.

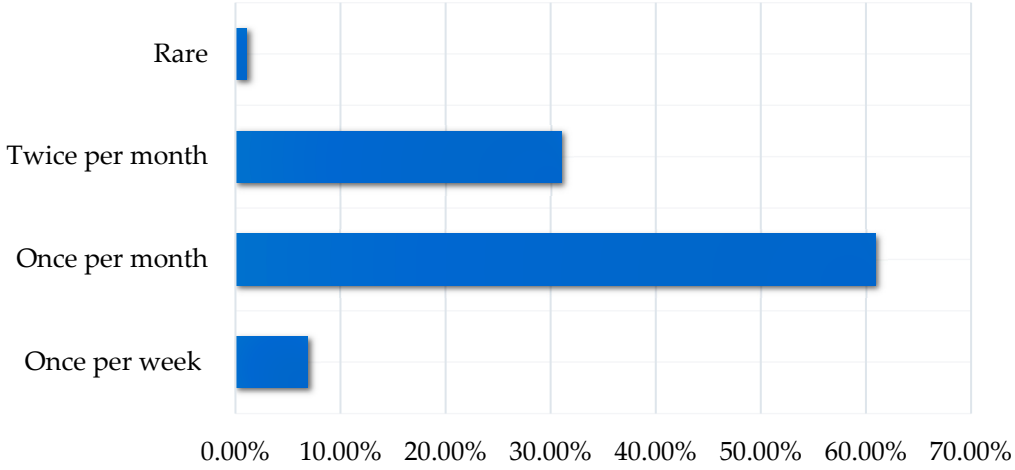

Figure 5. How often the patients communicated (either through calling, messaging or visiting) with the dietician during the three-month intervention.

4. Discussion

In this study, the nutritional and lifestyle recommendations given to diabetic patients appeared to cause significant changes in anthropometric characteristics and biochemical markers 3 months after a face-to-face meeting with a specialized dietitian. This is due to dietary instructions and changes in their physical activity (Tables 1 and 2). Main role in achieving and maintaining an appropriate body weight, preventing complications of the disease (Figure 1) and improving the overall clinical picture play also the appropriate dietary changes (Figure 2).

Other studies have also examined a similar research topic [37–39]. In most of them, a significant trend of a decrease in the recorded anthropometric characteristics and biochemical indices was observed [40]. In our study, body weight decreased from 81.8 to 77.8 kg after 3 months, and BMI also decreased from 28.8 to 27.1 kg/m^2. There was also a significant reduction in the average fasting blood glucose from 110.7 to 99.5 mg/dL and in the mean value of lipids (total cholesterol, LDL cholesterol, HDL cholesterol and triglycerides). The greatest change was observed in the mean total cholesterol and the mean triglyceride values. According to a recent study with a 3-month intervention to improve glucose control in individuals with type 2 diabetes through education, the HbA1c value was reduced by 1.1% [41]. In the ANODE study (2017), other secondary endpoints in the intention-to-treat analysis with web-based nutritional coaching were fasting blood glucose 1.46 mmol/L, total cholesterol 0.21 mg/dL, LDL-c 0.2 mg/dL, HDL-c 0.05 mg/dL, triglycerides 1.05 mg/dL and uric acid 45.45 μmol/L [42]. In our study, the changes in the other biomarkers were higher, with the exception of fasting blood glucose and uric acid, which were the same: fasting blood glucose 1.12 mmol/L, total cholesterol 17.2 mg/dL, LDL-c 6.8 mg/dL, HDL-c 1.1 mg/dL, triglycerides 35 mg/dL and uric acid 30 μmol/L. Other studies had positive results [41,42], as our study has. A possible explanation is the multi-layered strategies such as a personalized diet plan, written instructions with healthy food choices and personal contact with the dietician.

Some studies found varying effects of nutritional education [43–45]. For example, one study of 100 patients with type 2 diabetes found no significant effects on BMI or daily intake of fruit and vegetables, but there were positive changes in fasting blood glucose and HbA1c as well as weekly consumption of fruit and vegetables. Weekly moderate physical activity also improved [46]. Awareness about diabetes complications and consequent improvements in dietary knowledge, attitude and practices lead to better control of the

disease [47]. Different medications may also have different effects [48] and it is important to provide appropriate motivation for physical activity [49]. Our study did not find any significant change in HbA1c values, although significant changes occurred in fasting blood glucose levels. The biggest change was found in those who followed the dietitian's nutritional advice.

Our results agree with other studies that both dietary guidelines and nutritional interventions contribute to the reduction in anthropometric characteristics and biochemical indicators of people with type 2 diabetes. Following specific dietary interventions also gives better results for weight loss than are found in people who follow more general dietary recommendations [50].

Our sample consisted of patients admitted to the hospital due to uncontrollable diabetes. It is possible that being admitted to the hospital and being given information about the possible complications that can occur if T2DM is not controlled contributed to their more positive attitude toward making changes in their behavior, both in terms of diet and physical activity (Figure 3). The intervention in the 88 adults with T2DM played an important role in their overall health.

Multiple supportive connections in community settings can also help people lose weight.

A study by Pellegrini and colleagues [47] aimed to evaluate the effectiveness of a technology-based system (TECH) on weight loss when used alone or in combination with a 6-month, in-person, behavioral weight loss intervention [47]. In another study of 212 patients [48], biomarkers such as fasting glucose, postprandial plasma glucose, triglyceride and HbA1c were lower at each follow-up meeting with the dietitian, which highlighted the improved patients' knowledge and behavior using the mobile interactive system as a helpful tool [49].

Nutrition is unquestionably important in the progression of T2DM, but most people rely more heavily on medication to manage their disease. In our study, the majority of the patients managed their diabetes by taking medicinal tablets (26.4%) or by combining antidiabetic drugs with appropriate nutrition/diet (27.6%). One review of 22 studies of overweight adults with type 2 diabetes [51] found that the most successful weight loss occurred with multicomponent interventions, including more intense physical activity and very low-calorie diets or low-calorie diets [51].

Programs delivered in primary care can produce meaningful weight loss. In our study, the average weight loss was 4 Kg. It is reported that a 5% to 10% weight loss is associated with health benefits, including lower systolic blood pressure along with reduced triglyceride and glucose levels, which may impact cardiac health [52]. In addition to weight control, the first goal is macronutrient and micronutrient intakes at the right amounts according to national dietary recommendations, i.e., a high-quality diet [34]. The proper dietary plan could be helpful for patients to follow the advice, as many do not realize that following the proper dietary rules prevents the occurrence of complications of the disease and improves the overall clinical picture of the patient [43]. In addition, more than half of the participants did not correctly identify alcohol as a factor that plays a role in the progression of the disease. Although abstaining from alcohol does not "reverse" diabetes per se, it significantly improves glycemic control and reduces the likelihood of complications [53]. Our study also showed that the consumption of breakfast is a factor in better metabolic biomarkers (Figure 4). This concurs with findings from a study of adults in families at high risk of T2DM in six European countries [54]. Another important finding of our study, as shown in the initial interviews of the patients with the dietitian, is that patients ignore the basic parameters of the disease. Although they know the importance of regulating blood glucose concentrations, they consider that reducing the calories they consume is enough to protect them from adverse situations. Observance of the frequency of meals by diabetic patients is of particular importance, but there was also a number of patients who skipped meals. Finally, the Mediterranean diet is considered a well-formed diet plan. However, with all dietary changes, we know that institutions and organizations

need behavioral scientists to assist consumers in becoming more aware of healthy eating habits, nutritional labeling and checking overall health [27].

According to the Academy of Nutrition and Dietetics and the Endocrine Society, another factor that affects the success of a nutrition education program and may minimize the frequency of visits to a dietitian is the cost [55]. A potential solution could be for primary care to support the recommendations from the organizations through consultations with health professionals [56].

Other factors, such as emotional support as well as fast and effective access to care, have been found to be important [57]. A greater number of contacts between patients and providers led to greater weight loss (Figure 5). The dietitian in all the studies followed some strategies for weight loss (>1 kg/month) such as dietary plans with detailed diet information or advice on cooking and minimizing the frequency of eating out and some other support tools like a food exchange list. Some specifically list replacement foods organized by food groups and guidelines on healthy food choices or even healthy recipes [58].

After the nutritional intervention, a change was observed in all biochemical indices and anthropometric characteristics studied. Therefore, the adoption of a careful dietary pattern based on the Mediterranean diet can lead to significant and long-term changes in metabolic profile due to minimizing ultra-processed foods, which are high in saturated fats and added sugars. Such changes protect against cardiovascular complications [59,60].

Diet advice via individual sessions as treatment has occurred in many studies [61]. A single dietary counseling session [62], as in our study and others, did not have the same results as can occur in more intensified interventions such as weekly [63], fortnightly [64] or monthly sessions [20].

Dietary patterns such as the Mediterranean diet as well as physical activity are crucial for improving the metabolic disturbances seen in patients with diabetes [65]. The primary goal is to reduce saturated and trans fatty acids. Dietary plans documented to reduce body weight at least by 5% in overweight and obese people should also reduce total fat to <30% of daily energy intake, reduce saturated fat (including trans fatty acids) to <10% of daily energy intake, increase fiber intake (14g/1000 Kcal) [66], minimize refined and processed foods [67] and increase omega-3 fatty acid intake [68]. Increasing the daily consumption of natural foods rich in dietary antioxidants (tocopherols, carotenoids, vitamin C, flavonoids, polyphenols), trace elements and vitamins by increasing vegetable and fruit intake to 400 g/day should be encouraged [69]. Educational meetings with the dietitian in primary care will possibly help patients better understand type 2 diabetes and show how they can control it with easy-to-apply lifestyle changes. The interaction and exchanges between different specialists, a friendly atmosphere of meetings, weight loss tips, including the latest research-backed strategies, healthy eating plans, smart nutritional secrets, meal-planning help and lifestyle strategies to help manage diabetes could help patients control diabetes. Moreover, effective social support with assistance and encouragement from family members, adequate self-management skills and self-efficacy (confidence) may reduce the risk of developing diabetes complications [70].

In our study, despite recommendations from health professionals to adopt a healthier lifestyle, many patients avoided exercising, while a high percentage of patients smoked. These practices are anything but helpful in controlling the disease. This finding should concern and activate health professionals to mobilize change in the behavior and habits of patients. Exercise seems to have a positive association not only with the regulation of systolic and diastolic blood pressure [71] but also with glycemic control [72] and variability, insulin sensitivity, lipid profile, oxidative stress/antioxidative capacity and/or chronic inflammation [73]. Although there is limited evidence, stopping smoking has been shown to have benefits in reducing or slowing the risk of cardiovascular morbidity and mortality in people with diabetes [74].

The nutritional intervention adopted by our patients was based on the principles of the Mediterranean diet [69]. The Mediterranean diet is considered to be a model of healthy eating. Its beneficial actions are generally accepted both in the general population and in

patients with T2DM [66]. It is a food pattern that satisfies all the conditions of a suitable diet for the regulation of the disease. It is therefore necessary to inform patients about the beneficial effects of this nutritional model in order to adopt it in their daily lives. Many people with diabetes initiate a conversation about diet with a health professional themselves [75]. The primary reason clinicians initiate a conversation about weight management is to avoid follow-on complications from T2DM [76]. A key strategic theme is to strengthen research-based understanding of T2DM and public health to improve the lives of young people and adults living with or at high risk of developing T2DM.

Therapeutic patient education for obesity or diabetes is a cost-effective intervention that improves patient outcomes [51]. The first step is to learn about the patient's circumstances and perspective, the second step is to help the patient identify their goals, the third step is to help the patient develop a plan (especially a dietary plan and oral health routine), the fourth step is to help the patient implement their plan and the fifth step is to review progress and adjust to changing circumstances. According to the most recently published WHO guidelines (2023), this review identified the factors that could be helpful for doctors, dietitians, nutritionists and other health professionals to promote health and prevent T2DM complications through education [27].

The main objective is to give health professionals better access to effective nutrition education for all people by identifying risk factors such as obesity, malnutrition, excessive sugar intake, weight, age, smoking, alcohol consumption and physical inactivity. A fundamentally different approach is then needed, one that emphasizes disease prevention and health management through a multidisciplinary, integrated and patient-centered approach to overall health [76].

The limitations of this study include the small sample size. The primary care physician was recommended and notified. Future research needs to be conducted using artificial intelligence and its applications to diabetes in order to detect and manage the disease and capture more data to be recorded for personalized healthcare with lower costs. A fully automated web-based program improves lifestyle habits and HbA1c in patients with type 2 diabetes and could be the next step for the researchers.

5. Conclusions

In conclusion, this study adds to the existing scientific evidence of the benefits of a nutrition education program for patients with type 2 diabetes mellitus by demonstrating relevant outcomes in both glycemic responses and dietary behaviors in a real-world setting. Overall, these data suggest that more frequent face-to-face contact with the dietitian may also be more helpful, and meal frequency and a daily breakfast followed by an afternoon snack of healthier foods may help to break down barriers and facilitate dietary self-management of diabetes. To achieve this, people with diabetes need education about their condition. They need to understand how to self-regulate their blood sugar not only in normal situations but also in stressful situations, such as intense physical activity, and when to seek early medical help. The earlier treatment begins, the better the prognosis.

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Data Availability Statement: The data presented in this study are available on request from the corresponding author. Data are unavailable due to privacy restrictions.

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