# An Internet System to Self-monitoring and Assess Feeding in Young Mexicans

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Abstract. Obesity and metabolic syndrome pave the way to type 2 diabetes and cardiovascular disease. Obesity and metabolic syndrome prevalence are high (39% and 13%, respectively) in young Mexican population where feeding habits are one of the main factors leading to these maladies. So, a plausible strategy to address the problem is to suggest young to review and control their feeding habits. We present an internet system to register, self-monitoring, and assess feeding habits for young Mexican to review and control them. This system is organized in eight questionnaires, one of them about food frequencies. Also anthropometrics data such as weight, height, waist and hip circumference are registered to assess and follow-up weight condition, through body mass index, and waist/hip ratio. The user could generate a pdf report that automatically summarizes all the data captured in the questionnaires in two pages. A follow up charts of some parameters are also available for monthly data collection once the user fills the system. More than 2,000 young students have used this system since 2013 and is open universally (www.misalud.abacoac.org) to all young people wanting to self-monitoring her/his feeding habits, and obtaining general health recommendations.

Keywords: Nutrition  $\cdot$  Mexican young  $\cdot$  Obesity  $\cdot$  Weight control  $\cdot$  Metabolic syndrome

#### 1 Introduction

It is known that obesity is a worldwide epidemic [1,2], and that this health problem not only affects adults, but also young and even children. In this regard, Mexico is among the countries with high obesity prevalence [3], and among young Mexican (17–24 years old) obesity is also a problem: it was estimated that 39% of young Mexicans are pre-obese or obese (body mass index >25) [4]. Our research group (GMISARA: Multidisciplinary Research Group on Health and Academic Performance; www.gmisara.abacoac.org) has been investigated the physical health of first grade undergraduate students of Mexico City at the Facultad de Estudios Superiores Iztacala of UNAM, mainly focused on metabolic disorders such as metabolic syndrome and its components (obesity, blood pressure, levels of blood glucose, triglycerides, HDL cholesterol, insulin resistance, among others parameters).

# 2 Metabolic Syndrome and Obesity Among Young Mexican

Mexican young present a metabolic syndrome prevalence of 13.4% [5], disaggregating by its components and by sex, the prevalences are: low HDL-cholesterol (55% women; 29% men), high waist circumference (49%; 28%; central obesity is the second parameter with highest prevalence), high triglycerides (15%; 22%), high blood glucose (7%; 13%), and high blood pressure (6%; 19%). Only 29% of the young have none parameter altered, thus 70% present one or more alterations of the metabolic syndrome. Insulin resistance among young Mexican has been estimated that ranged from 14% up to 30% depending on the sex and region [6].

The high values of obesity, metabolic syndrome and alterations of its components show that young Mexican are prone to develop, in one or two decades, type 2 diabetes and cardiovascular disease, as can be heart attack and atherosclerosis, among others diseases [7].

### 3 Promoting Health Among Young

As part of our research protocol, university students are invited to participate in an evaluation of its physical health annually, where blood samples and anthropometrics are taken by the physicians of the team. The project has two main objectives: (a) conduct scientific research on metabolic syndrome, and (b) to promote the physical health among students. Since year 2008, our research group has evaluated near to 7,000 university students, making blood and urine laboratory analysis [8]. Since year 2012 we implemented an internet system to collect medical history previous to the blood sample, we then gave to the students a report evaluating its physical health, including some general recommendations [9]. The Internet system presented here is an evolution version of such version, given that the process for recording medical history represents an opportunity to give the participant some general recommendations on her/his feeding habits and weight condition, among other issues.

The MiSalud internet system takes the advantage to make recommendations on self-reporting anthropometrics data and feeding habits to all young that want to use the system, and not only to those that decide to participate in a more deeply study where blood and urine samples are needed.

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Fig. 1. MiSalud system showing the 'Food frequency' questionnaire.

### 4 Internet System for Self-monitoring

The system is organized in eight questionnaires (Table 1; www.misalud.abacoac. org), and the interface is based on a selectable list and ratio-buttons (Fig. 1). The user should register in the system to assign a password; in the register section the user specifies his/her name, birthdate, gender, among other general information. One of the questionnaires is about eating habits, where the user specifies the frequency of food consumption and portions (Figs. 1 and 2).

The system presents to the user the next sections, each one corresponding to one questionnaire:

- Register (*Datos de registro*).- Name, email, birthday, password, address, sex, phone, school registration number.
- Data set (Muestra).- Update questionnaires or select the data set (monthly).
- Anthropometrics measures (*Datos antropométricos*).- User self-measures of weight, height, waist circumference, and hip circumference.
- Family history (*Antecedentes heredo-familiares*).- Diseases of user, mother, father, and mothers and fathers grandmother and grandfather.
- Food and beverages (*Alimentos y Bebidas*).- Eating habits. Frequency, portion and type of food eating by the users.
- Physical activity (*Actividad física*).- Type, frequency and time of physical activity.

Section	Data	Content
Heading	Title, date, registration number	Includes the date (month) of data cap- ture, and date of report generation
General data	Name, email, gender, age	Update questionnaires or select the data set (monthly)
Anthropometrics	Weight, Height, Waist cir- cumference, Hip circumfer- ence	User self-measures of weight, height, waist circumference, and hip circumference
Weight Assessment	Body Mass Index	Classify BMI into one of the WHO classes: Underweight, Normal weight, Overweight, Obese.
	Waist Circumference	Classify into Normal or Altered, depending on cut off point for Latin American (<80 cm women; text- less90 cm men)
	Waist/Hip ratio	Classify into Normal or Altered, depending on cut off point ( $<0.85$ women; $<0.90$ men)
Physical activity assessment	Hours of exercise at week	Classify into Insufficient exercise, Adequate exercise, or Null exercise
Feeding Assessment	Fast food intake	Classify into Low or null consumption or High consumption
	Sweetened beverages	Classify into Low or null consumption or High consumption
	Fruits intake	Classify into Low or null consumption or Adequate consumption
	Vegetables intake	Classify into Low or null consumption or Adequate consumption
Footnote	Disclaimer and warning	Paragraph that warns that the reports is designed for young Mexicans

Table 1. Sections of the health report.

- Birthplace (*Lugar de nacimiento*).- Birthplace (Country, State, Municipality or County) of user, mother, father, and mothers and fathers grandmother and grandfather.
- Life habits (*Hábitos y estilo de vida*).- Whether the user works or not, has access to a computer/internet at home, has access to internet in her/his mobile phone, daily time dedicated to social networks, number of sleep hours.

The foods are classified in ten groups to facilitate user to find them, and taking into account Mexican food guides [10].

# 5 The Health Report

Once the user fill all questionnaires, she/he has access to generate an automatic report with weight valuation (body mass index, waist circumference, and waist/hip ratio) and general recommendation on her/his feeding habits, and

Lista de alimentos agregados							
Grupo de alimentos	Alimentos	Porción	Número de porción	Frecuencia	Editar B	Borrar	
HUEVO	HUEVO SOLO	PIEZA	1 PORCION	DIARIO (7 DIAS A LA SEMANA)	G	0	
BEBIDAS	JUGO DE FRUTAS NATURAL	250 ml (VASO CHICO)	1 PORCION	DIARIO (7 DIAS A LA SEMANA)	G	0	
BEBIDAS	CAFE	< 250 ml	3 PORCIONES	DIARIO (7 DIAS A LA SEMANA)	G	0	
BEBIDAS	AGUA NATURAL	600 ml (BOTELLA)	<b>1 PORCION</b>	6 DIAS A LA SEMANA	C	0	
BEBIDAS	ATOLE	250 ml (VASO CHICO)	<b>1 PORCION</b>	1 VEZ AL MES	G	0	
BEBIDAS	LECHE ENTERA	250 ml (VASO CHICO)	1 PORCION	4 DIAS A LA SEMANA	C	0	
BEBIDAS	CERVEZA	350 ml (VASO MEDIANO, LATA)	1 PORCION	2 DIAS A LA SEMANA	G	0	
BEBIDAS	VINO TINTO	250 ml (VASO CHICO)	1 PORCION	4 DIAS A LA SEMANA	C	0	
BEBIDAS	AGUA DE FRUTAS NATURAL	250 ml (VASO CHICO)	<b>1 PORCION</b>	1 DIA A LA SEMANA	C	0	
ANTOJITOS	TAMAL	PIEZA	2 PORCIONES	1 DIA A LA SEMANA	C	0	
CARNE BLANCA	PESCADO	PIEZA O FILETE	<b>1 PORCION</b>	1 DIA A LA SEMANA	C	0	
CARNE BLANCA	MARISCOS	VASO CHICO	1 PORCION	1 VEZ AL MES	C	0	
CARNE ROJA	RES	BISTEK GRANDE (> 100 gr)	1 PORCION	2 DIAS A LA SEMANA	9	0	

Fig. 2. List sample of foods added by the user in the 'Food frequency' questionnaire (Fig. 1).

hours of exercise at week (Fig. 3). The report has eight main sections (Table 1). The Feeding Assessment summarizes the frequency of consumption (Figs. 1 and 2) registered in the Food and beverages questionnaire. The recommendation are grouped in four subsections: Fast food intake, Sweetened beverages, Fruits intake, and Vegetables intake, because these four issues are among the main causes of a bad nutrition in young. We hypothesized that if the young are alerted in these points, they could be more conscious on the food they are consuming, and hence, on one hand, to improve their diets, and on the other and, to persist on their good habits.

One of the tables of the database contains the criteria to classify whether or not the frequency of each type of meal is adequate (Table 1). The system groups all the meals of the same type and then sum frequencies to obtain a final and general frequency of consumption. Based on this frequency the system gives a general recommendation, v.gr. acceptable frequency for vegetables seven days a week or higher.

Some statistical on these four points, based on users of the last year (Table 2), reveals that they are really key point to improve the feeding habits of young Mexican. Less than half of young drink daily natural water (40.4% women; 33.7% men), and not all young drink it at least once a week (58.6%; 56.8%); also less than half of young eat vegetables at least three times a week (44.7%; 33.7%); fish is not very popular among young (16.5%; 17.8%).

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KEPORTE DE HÁBITOS NUTRICIONALES Y EVALUACIÓN DE PESO* Proyecto Salad en Jórense Universitarios' Proyecto Salad en Jórense Universe Universe Universitarios' Proyecto Salad en Jórense Universe U	4-VALORACIÓN DE ACTIVIDAD FÍSICA  Horas de ejercicio a la semana: 2.5 Valoración: Insuficiente ejercicio Recomonciuto: La cantidad de baros a la semana que dedicas a rualizar actividad física en INSUFICIENTE. Es my importante que dediques 3 o 4 días a la semana (en total 4.6 baras como minimo) para haver ejercicio para que evites la aparición de alteraciones metabólicas. Te recomendamos que el ejercicio lo incorpors a tu estilo de vida.
Datos: Abril, 2014 Grupo: Reporte generado: 13 de Mayo de 2014 No. registro:	5 VALORACIÓN DE LA ALIMENTACIÓN
I- DATOS GENERALES Nombre: Sexo: MASCULINO Apellido putemo: Núm. cuenta: Composition (Composition Composition)	Antoptos y comica rapida Vuinco sa annenos a asemana en que os inclujes: Valoración: Bajo o nulo consumo de antojitos y comida rápida Haz reportado bajo o nulo recuencia en el consumo de antojitos y comida rápida (npitas, chicharrones, quesadillas, hambarguesas, pizzas, tacos al pastor, tumales,
Apellido materno: Edad (años): Edad (años):	Bebidas endulzadas Número de alimentos a la semana en que los incluyes: 0
	Valoración: Bajo o nulo consumo de bebidas endulzadas
2 DATOS ANTROPOMÉTRICOS           Poso (kg):         67.00           Circunferencia de cintura (em) por la matana:         54.00           Estaura (em):         171.00           Circunferencia de cantora (em);         91.60           Circunferencia de cantora (en);         91.60	Har reportado bajo o nula frecencia en el consumo de beblias endudadas articidas (refrecos, jugos embotellados, aguas endudadas,). Er econemisarios consumir beblias endudadas endudadas con fuectosa. Prutas Número de alimentos a la semana en que los incluyes: <u>6</u> Valoración: Bajo o nulo consumo de frutas
3 VALORACIÓN DE LA DELGADEZ-OBESIDAD	Haz reportado un bajo o nulo consumo en frutas, te recomendamos incluirlas en tu dieta diariamente.
Indice de mass corporal (IMC; kg/m2);         22.91         Valorición         Intervalos de normalidad           Circunferencia de cintura:         84.00         Normal         18.5 - 25           Relación (Immexadera:         0.92         Alterado         Alterado           Pre-diagnóstico Peso-Talla-Grasa abdominal         Normal - Pre-obeso         Seminore: 0.90 hombres	Vegetales Número de alimentos a la semana en que los incluyes: 8 Valención: Consumo de vegetales adecuado Har reportato una adocuda frecuencia en el consumo de venhara. Es muy importante que continúes consumiétodoles y que los incluyas por lo menos en un alimento diariamente, eso te ayudará a mantener tu salud elevando tus niveles de colesterol HDL (colesterol bueno).
Recomendación: Tiss medidas, antroponéricas sugieren que estás en riesgo de incrementor de peos (PRE-OBESIDA): En sugerimor que reviers an alterneticas hybrihos de cipricos para que virse la obseidad. Es importante corroborar este pre-diagnóstico con estudios de laboratorio (química sanguina, biomería hemática, insulina y examen general de orina). Mistalad. Sintena de rugitora, esguinismo y resuenciadores sobre hábitos anticionado y enfo de vida. ARACE, A.C SERES (precultandos - PES Janeda UNMA)	* Este reporte ha sido generado antontícicamente con base en los datos proporcionados por el estudiantes en el interna MiStada (harma el estudiante) en la sensa en la sensa el estudiante de la dimensión de la sensa el estudiante de la dimensión de la
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Fig. 3. Eating habits report. (A) Front page: Anthropometrics and weight evaluation and general recommendations; (B) Back page: Physical activity and eating evaluation and general recommendations.

The internet system has a double function: as a tool for self-monitoring on feeding habits, giving general recommendation, and as a research tool collecting massive data of young population. Additional to the health report, the system provides a follow-up charts (Fig. 4) that allows to the user self-monitoring her/his weight condition and feeding habits, among others.

#### 6 Users of the System

Up to date, 2057 users have been registered in the system; as it is open to be used universally, so many university students used it. Here we only report statistics of user participating in the project "Physical health assessment" in years 2013 and 2015, where an integral assessment was performed to each student including clinical analyses of blood and urine, blood pressure, and anthropometrics, that is, 1,335 students participating in the project. All of them were invited to fill up the questionnaires in MiSalud; 77.7% (1,037) of them did it. We classified the registers in 'reliable' and 'not reliable', according to the number of food that the user chose to add to the consuming list: at least one beverage, and at least eight different kinds of meals, resulting in 449 registers of users marked as 'reliable', that are the base of the statistics of feeding habit reported here.

Frequency		Natural water	Sweetened drink	Fruits	Vegetables	Fish
Women (%)						
Dailly		159 (40.4)	16 (4.1)	48 (12.2)	22(5.6)	-
6 days a week		20 (5.1)	1 (0.3)	23(5.8)	17(4.3)	-
5 days a week		23 (5.8)	20 (5.1)	67 (17)	22(5.6)	1(0.3)
4 days a week		12 (3)	9 (2.3)	38 (9.6)	48 (12.2)	1(0.3)
3 days a week		13 (3.3)	21 (5.3)	48 (12.2)	67 (17)	3(0.8)
2 days a week		4 (1)	28 (7.1)	37 (9.4)	39(9.9)	10(2.5)
1 day a week		-	11 (2.8)	10(2.5)	15(3.8)	29(7.4)
1 day a month		-	5 (1.3)	1 (0.3)	4 (1)	15(3.8)
1 day every 2 momnths		-	1 (0.3)	-	-	6(1.5)
TOTAL women	394	231	112	272	234	65
(%)	(100)	(58.6)	(28.4)	(69)	(59.4)	(16.5)
Men (%)				,		
Dailly		57 (33.7)	3 (1.8)	12(7.1)	6(3.6)	-
6 days a week		10 (5.9)	1 (0.6)	7 (4.1)	4 (2.4)	-
5 days a week		19 (11.2)	10 (5.9)	27 (16)	13 (7.7)	-
4 days a week		6 (3.6)	15 (8.9)	13 (7.7)	11(6.5)	-
3 days a week		2 (1.2)	11 (6.5)	24 (14.2)	23(13.6)	1 (0.6)
2 days a week		2 (1.2)	10 (5.9)	14 (8.3)	17 (10.1)	6 (3.6)
1 day a week		-	9 (5.3)	7 (4.1)	6(3.6)	16(9.5)
1 day a month		-	1 (0.6)	1 (0.6)	-	7 (4.1)
1 day every 2 months		-	-	1(0.6)	-	-
TOTAL men	169	96	60	106	80	30
(%)	(100)	(56.8)	(35.5)	(62.7)	(47.3)	(17.8)

Table 2. Some statistics of the users of MiSalud system.

#### 7 Related Works

There are several internet systems to register and monitoring nutrition, one of them was developed by the Public Health School of the University of São Paulo for data collection, assessment and monitoring of the health and nutritional status of students by means of a structured 24–h recall method [11], the "NutriSim: System of health and nutrition monitoring - nutrition of school children".

A group of nutritional researches in Murcia, Spain, have developed the system GRUNUMUR a tool for human nutrition studies, including three types of questionnaires for dietary habits: 24 h recall, 7–days dietary record and Food Frequency Questionnaire, that also give reports of recommendations to young users, mainly university students [12].

Jung *et al.* developed the DES: Diet Evaluation System, a web based dietary survey program for Korean population, based on 24–h recall methodology [13], that gives recommendations on the total amount of nutrients given a list of food frequencies with their respective portions. The system contains a list of 4,222 common Korean foods each with information on 17 nutrients, so the system can calculate the total amount of nutrients intake for a given diet.



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Fig. 4. 'Results' interface of MiSalud Internet system, showing the follow-up graphs of Weight, and the related measures table.

Our goal was not to build a system to calculate nutrient amounts for the diet of the user, instead, to detect general pattern identified as good or bad feeding habits, and give general recommendations to both, encourage to continuing with good habits, as is to daily include vegetables in the diet, and to alert on bad habits, as is to drink with high frequency high sweetened beverages.

#### 8 System Evaluation

Several aspects can be evaluated of a system, one of them is the usability, and other is the effectiveness to modify positively feeding habits.

Furer et al. reported an evaluation on usability of a system to monitoring nutrition of school children by 17 Information technology professionals by means of a "Questionnaire for System Usability", containing 30 questions divided into six sections: easy to learn, easy to remember, error control, efficiency, efficacy, and satisfaction [11].

An evaluation on feeding habits improvement after an intervention in undergraduate students of US, using an online course system; components included e-mail messages, posted information, and behavior checklists with tailored feedback, showed a low efficacy [14]. Based on the cognitive theory, eight variables were evaluated: (1) Social cognitive theory variables, (2) Positive outcome expectations, (3) Negative outcome expectations, (4) Self-efficacy for low-fat dairy intake, (5) Self-efficacy for total dairy intake, (6) Self-regulation, (7) Social support for total dairy (family), and (8) Social support for total dairy (friends). They found that the intervention was effective in modifying only two cognitive theory constructs: Self-efficacy for total dairy intake and Self-regulation, but did not improve the remaining six constructs measured.

Jung et al. performed an evaluation of a web based dietary survey program in Korean population, based on 24–h recall methodology [13]. The success rate was 63% (1–18 y) and 68% (19–49 y), i.e., the number of successful interviews out of all interviews, and was improved up to 92% and 78%, respectively, after include more devises. The average time of interviews was 14 min, and the daily nutrient intake calculated with the system was comparable to that calculated from national dietary survey. We have not evaluated the success interview of our system yet, but as it can be accessed by several types of devices, including cell phone, we will take advantage of its ubiquity to increase success on its use.

MiSalud has the double purpose of (a) register the feeding habits as survey to public health assessment, and (b) to give feedback to users on their feeding habits on monthly basis (Table 3). The success rate is 77.7%, i.e. of 1,335 students participating in the project (and who attended to our laboratory for a physical health evaluation, including anthropometrics and blood and urine laboratory analysis), 1,037 registered in the web page and filled the questionnaires. We classified the registers in 'reliable' and 'not reliable', according to the number of food that the user chose to add to the consuming list: at least one beverage, and at least eight different kinds of meals, resulting in 449 registers of users mark as 'reliable', that represent 43.3% of success.

To assess the usability perception we included the question: 'How easy is to use the system?' The percentages of answers obtained were: 1.4% Difficult, 14.9% Somehow difficult, 38.8% Easy, 44.9% Very easy. The percentages were similar if we included only of reliable users: 1.0%, 13.6%, 40.8%, and 44.7%, respectively.

To assess the perception of user on how useful is the system to improve their feeding habits we included the question: 'How important for improve your feeding habits the system is?' The percentages of answers obtained were: 0.3% Bad, 6.7% Somehow good, 53.8% Good, and 39.1% Very good.

#### 9 Discussion

The Internet provide the opportunity to distribute massively tools for health care, particularly here we presented a tool for self-monitoring of feeding habits and weight condition. The MiSalud system is universally available to all young that want to use it. This kind of system could help to address the obesity epidemic, particularly in Mexico, a country where the pre-obese and obese prevalence among young is one of the highest in the world.

No assessment has been made on the putative positive impact on the feeding habits of users. It is possible to obtain a statistical report on the frequent users, and compare them against users that have accessed only once, inviting them to a second assess.

The system is designed specifically for young Mexican, and thus, the food catalogue is constrained to foods mainly found in Mexico City area, and the

Table	e 3.	Da	itaba	se ta	able for	r reco	mmenda	ation	report	. The	ranges	reffe	r to	numb	er of
days a	a we	eek	that	$_{\rm the}$	partic	ipant	includes	s the	meal:	MIN	(inclusi	ve), a	and	MAX	(less
than).															

Group	Frequency: days a week MIN–MAX	Diagnostic_Text
Excercise	0-0	Do not do exercise
Excercise	1-3.5	Insufficient exercising
Excercise	3.5-8	Adequate excercising
Excercise	8-100	More than 8 h a week of exercising
Snacks	0–3	Low or zero consumption of snacks and fast food
Snacks	3-100	High consumption of snacks or fast food
Sweetened_beverages	0–3	Low or zero consumption of sweetened beverages
Sweetened_beverages	3-100	High consumption of snacks and fast food
Fruits	0-7	Low or zero consumption of fruits
Fruits	7-14	Adequate intake of fruits
Fruits	14-100	High consumption of fruit
Vegetables	0-0	Zero consumption of vegetables
Vegetables	1-7	Low consumption of vegetables
Vegetables	7-100	Suitable vegetable consumption

interface is in Spanish language, thus, adaptations are required if it is wanted its use for young of other regions.

# 10 Conclusions

MiSalud system is an internet system to assess health, mainly on feeding habits and weight condition available universally in internet (www.misalud.abacoac.org). More than 2,000 university young have been used the system obtaining the health report with general recommendations, and having access to the follow-up charts.

Nevertheless, the system is designed specifically for young Mexican, adaptations to other populations are possible, via replacing database catalogues, and translate the interface messages to other languages.

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