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Artículo original

Reintroducción del consumo regular de Quinoa en Riobamba, Ecuador: estudio piloto.*Reintroducción of regular consumptin of quinoa in Riobamba, Ecuador: a piloy study*Daniel **Halperin**^{1,2}, Paul **Jinez**¹, Danny **Castillo**¹, Myriam **Paredes**³, Verónica **Delgado**¹

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Resumen

En Ecuador la incidencia de obesidad, diabetes y otras afecciones crónicas de salud, que se han asociado parcialmente con cambios en los hábitos alimentarios, está aumentando y muchas veces se acentúa en los centros urbanos más pequeños. El consumo omnipresente de arroz blanco es probablemente una práctica alimentaria presente en esta transición nutricional, mientras que el consumo de alimentos tradicionales saludables como la quinoa permanece generalmente bajo. En nuestra encuesta realizada en 2013, el 67% de los 240 residentes encuestados en la pequeña ciudad andina de Riobamba informaron que preferirían comer "arroz de quinoa" (quinoa preparada como arroz) por lo menos dos veces por semana en lugar de arroz blanco. Con el objetivo de reintroducir el consumo regular de quinoa en los hogares de esta población, a finales de 2015 se inició una intervención para promover el consumo de arroz de quinoa 3 veces por semana, entre 131 adultos en Riobamba.

Entre la línea de base y los datos obtenidos al final de la intervención cuatro meses más tarde, no hubo cambios significativos en el IMC observado. Sin embargo, a los 2, 4 y 7 meses post-basal, el 52%, 40% y 47% de los encuestados, respectivamente, informaron haber disfrutado del consumo de arroz de quinua en lugar de arroz blanco, afirmando que les gustaba “mucho” o “en general”, y el 64%, 55% y 68% de los encuestados refirieron que “definitivamente” o “muy probablemente” continuarán consumiendo quinua en lugar de arroz, por lo menos a veces. Estos hallazgos sugieren una aceptación modesta de esta (re)introducción de un alimento tradicional y saludable, aunque otras investigaciones más amplias y extensas podrían evaluar con mayor precisión los posibles impactos en la salud de este

tipo de cambio reportado en los hábitos alimentarios de la población.

Palabras clave: Reintroducción, consumo, Quinua, hábitos, alimentación.

Abstract: In Ecuador the incidence of obesity, diabetes and other chronic health conditions -- which are partly due to changes in dietary behavior -- has been increasing, often most dramatically in smaller urban centers. The ubiquitous consumption of white rice is likely one important factor in this nutritional transition, while the consumption of traditional healthy foods such as quinoa remains generally low. In a 2013 survey we conducted, 67% of the 240 residents surveyed in the small Andean city of Riobamba reported they would prefer eating quinoa “rice” at least twice weekly instead of white rice. With the objective

of encouraging more normative household consumption of quinoa in this population, in late 2015 an intervention was begun to promote consumption of quinoa rice 3 times a week among 131 adults in Riobamba. Between the baseline and the termination of the intervention four months later, no significant change in BMI was observed. However, at 2, 4 and 7 months' post-baseline, 52%, 40% and 47% of respondents, respectively, reported enjoying consumption of quinoa rice instead of white rice either "very much" or "in general," and 64%, 55% and 68% of respondents "definitely" or "very likely" planned to continue doing so. Our findings suggest a modest acceptance of this (re)introduction of a traditional and healthy food, though further and more extensive research could assess with greater precision the potential health

impacts of such reported changes in dietary habits.

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Keywords: Reintroduction, consumption, Quinoa, habits, feeding.

Introduction: In Ecuador as in much of the developing world, the incidence of obesity, diabetes/metabolic syndrome and other chronic health conditions, which are considered to be associated in large part with changes in dietary and other lifestyle behaviors, has been increasing at an alarming rate [1-5]. The phenomenon of "nutritional transition," characterized by over- consumption -- often of unhealthy foods and drinks -- has clearly taken hold in the country [1-5]. In the most recent national survey, for the first time more overweight than underweight persons were found [1,5], with some 60% of adults, along with

26% of adolescents (29% in the urban Andean region) being identified as overweight or obese. In recent years, such shifts in Ecuador have often been occurring most dramatically in the small to medium-size urban centers [2-5].

In the Andean province of Chimborazo, culturally a more traditional region of the country, 53% of the population 19-60 years of age are now overweight or obese [5].

The staple national diet based on ubiquitous consumption of white rice has been identified as a likely key factor related to this type of nutritional transition [1-3]. Although the “super grain” of quinoa is a normative feature of Andean, including Ecuadorian, cultural life [6-10], the actual per-capita consumption of quinoa has been very low for many years [7,9,10]. (And overwhelmingly derives from the iconic *sopa de quinua*, which is typically

consumed a couple of times a month, yet this soup normally contains little quinoa, being mostly composed of potatoes, pork bones, etc. [9]) Compared to other cereals such as rice, wheat, or barley, quinoa contains a higher protein content, fluctuating between 13%-20%, as well as a complete set of essential amino acids, including phenylalanine, histidine, and lysine [6-9,11,12]. Its contribution in fats is also important not only for the energy value it provides, but also for the predominance of unsaturated fatty acids. While there is growing consensus that highly nutritious foods such as quinoa should be consumed in greater proportions, and ideally to supplant the consumption of staples of much lower nutritional value such as white rice [6-8,11,12], few studies have attempted to assess the potential impact of introducing (or in the Andean regional

context, of reintroducing) such healthier dietary behavior [7,8,13].

Previous research: In September of 2013, we conducted a survey of 240 adult residents living in 16 socio-economically diverse neighborhoods in the small-to-medium size city of Riobamba, the capital of Chimborazo Province [14]. As expected, nearly all respondents believed quinoa to be more nutritious than white rice. Perhaps somewhat more surprising, 67% said that they would prefer eating quinoa, at least twice a week, instead of white rice as the “second plate” (accompaniment) for lunch or dinner. This despite the fact only 31% of these urban dwellers reported knowing how to prepare quinoa as a “rice” dish (*arroz de quinoa*). Many respondents complained about a lack of information about how to prepare quinoa other than in soup,

and many also felt that it should be more widely promoted. Meanwhile some smaller-scale surveys, interviews and focus groups that we conducted around the same time in three outlying regions found that while such rural respondents were, as expected, somewhat more likely to know how to prepare other quinoa dishes such as *arroz de quinoa*, the overall consumption of the grain was similarly reported to be generally low, and appears to have been decreasing over time [14].

Methods: Given this situation, an intervention to promote greater and more normative consumption of quinoa was initiated in late November of 2015 among 54 families, comprising a convenience sample of 131 participating adults residing in a diverse spectrum of neighborhoods in the urban area of Riobamba, a fast-growing city of some

200,000 inhabitants in the Andean region of Ecuador (see basic demographic description of participants in Tables 1-3). Recruitment of subjects was carried out through asking public university students to invite their families to participate. The introduction of quinoa was accomplished through securing donations from two local NGOs (SumakLife and COPROBICH), in sufficient quantity for the participating families (including all family members, regardless of whether participating or not in the study evaluation) to consume *arroz de quinoa*, free of charge, three times a week over a four-month duration as the accompaniment, instead of white rice, for lunch or dinner. Student research assistants, recruited from the ESPOCH University's School of Nutrition, were responsible for carrying out the

distribution of the quinoa (typically on a monthly basis, and in a similar quantity as the typical consumption of rice) and for instructing the participating families on how to prepare *arroz de quinoa* (i.e., in the same simple manner as rice), and for applying the questionnaires, BMI (weight and height) measures, and other study instruments. These measures were conducted at four intervals: baseline (in late November-early December of 2015), half-way through the intervention (two months' post-baseline), at the termination of the intervention (April, 2016) and at about seven months' post-baseline (between late June and early July of 2016). Bioethical approval was obtained on October 21, 2015 from the Human Subjects Committee of the Universidad de Los Andes (UDLA) in Quito.

Table 1: Age of Participants at Baseline (n = 131)

Age	Percentage
18-27	40.9%
28-37	11.0%
38-47	12.6%
48-57	23.6%
58-67	7.9%
68-77	2.4%
78-87	1.6%

Table 2: Gender of Participants at Baseline (n = 131)

Gender	Percentage
Female	60.0%
Male	40.0%

Table 3: Reported Income of Participants at Baseline (n = 131)

Income	Percentage
< \$100 per month	6.7%
\$100-\$349 per month	21.0%
\$350-\$599 per month	19.3%
\$600-\$999 per month	16.8%
\$1000-\$2499 per month	5.9%
> \$2499 per month	1.7%

The principal objectives of the study were: 1) to assess whether a substantial degree of behavior change could be achieved in the regular weekly diet of the study population, 2) to monitor the implementation and progression of such

dietary changes, including possible impact on BMI, and to evaluate, using primarily qualitative methods, the viability, sustainability and long-term potential of maintaining such changes in dietary habits among these urban

dwellers. Our main hypotheses were a) that the study participants would agree to and enjoy consuming quinoa instead of white rice three times a week, and b) that if such a shift in dietary patterns could be achieved, this could result in a significant decline in BMI over the 4-month study duration.

Results: Of the 131 individuals who initially agreed to participate and were interviewed at baseline, 130 were interviewed subsequently at the intervention half-way point (at two months' post-baseline). However, fewer subjects (98) were retained at the conclusion of the intervention, as well as at seven months' post-baseline (95). Loss to follow-up at termination was partly due to issues such as some study participants having moved to another address or region, but appeared was mainly related to the fact that after four

months the quinoa was no longer being provided free of cost, and hence there was less motivation for consenting to an interview. Between the baseline and four months later, there was essentially no change recorded in the mean BMI; the slight decline observed (from 25.7 to 25.5) was not statistically significant. However, at 2 months' and at 4 and 7 months' post-baseline, 52%, 40% and 47% of respondents, respectively, reported enjoying consumption of *arroz de quinoa* instead of white rice, either "very much" or "in general," and an additional 41% (in the first two interview rounds) and 36% (in the final round) reported liking it "more or less" (see results in Table 4). A somewhat lower proportion (39%, 36% and 39%, respectively, at 2, 4 and 7 months) reported that other family members enjoyed eating the quinoa (with 47%, 35% and 40% saying that the other

members liked it “more or less”). And 64%, 55% and 68% of respondents, respectively, reported either “definitely” or “very likely” wanting to continue eating *arroz de quinoa*. Furthermore, 59%, 66% and 65% reported enjoying

the flavor of this dish (which most respondents had not previously been acquainted with) at least “very much,” and 66%, 62% and 74% liked the “texture” at least very much.

Table 4: Main Study Results

	Interviewed at 2 Months (n = 130)					Interviewed at 4 Months (n = 98)					Interviewed at 7 Months (n = 95)				
	Not at all/ Definitely not	Not very much/ Very unlikely	More or less/ Maybe	In general/ Very likely	Very much/ Definitely	Not at all/ Definitely not	Not very much/ Very unlikely	More or less/ Maybe	In general/ Very likely	Very much/ Definitely	Not at all/ Definitely not	Not very much/ Very unlikely	More or less/ Maybe	In general/ Very likely	Very much/ Definitely
Enjoyment of Quinoa Prepared as “Rice”	0,0%	6,2%	40,8%	40,0%	12,3%	4,1%	15,3%	40,8%	23,5%	16,3%	4,2%	12,6%	35,0%	32,6%	14,7%
Family Members’ Enjoyment of Quinoa	2,3%	11,5%	46,9%	28,5%	10,0%	7,1%	22,4%	34,7%	24,5%	11,2%	3,2%	17,9%	40,0%	29,5%	9,5%
Wish to Continue Consuming Quinoa	4,6%	4,6%	26,9%	18,5%	45,4%	5,1%	7,1%	32,7%	17,3%	37,8%	3,3%	6,0%	23,2%	15,5%	52,1%
Family Members Wish to Continue	2,3%	5,4%	40,0%	11,5%	37,7%	9,2%	12,2%	28,6%	20,4%	27,6%	12,8%	16,0%	27,7%	12,8%	30,9%
Enjoy the Flavor	5,4%	6,2%	26,2%	27,7%	31,5%	7,1%	11,2%	13,3%	19,4%	46,9%	6,4%	6,4%	22,3%	18,1%	46,8%
Enjoy the Texture	2,3%	3,8%	24,6%	25,4%	40,8%	6,1%	12,2%	17,3%	13,3%	49,0%	2,1%	4,3%	19,1%	22,3%	52,1%

In qualitative interviews conducted concurrently with 37 of the study participants [15], a commonly expressed sentiment (mentioned somewhat more frequently at two

months’ post- baseline) was along the lines of: “In the beginning [of the study], we doubted whether we would like it [*arroz de quinoa*], because before that time we only knew how to eat

quinoa in soup. But now we are used to eating it several times a week, and it's something we would like to continue doing; it's a nice alternative to just eating rice all the time." A few respondents employed the interesting expression, "My body craves the quinoa now" (*El cuerpo la pide*). And several noted that "the quinoa doesn't [overly] fill me up, like rice does...." Meanwhile, some other participants made statements (especially at four months' post-baseline) such as, "At first we liked it, but now we are going back to eating rice; it's what we're used to eating our entire lives, it's our habit." And some intimated that, since they would now have to purchase the quinoa themselves, there might be less motivation to maintain the thrice-weekly consumption pattern of the study design. (The price of quinoa in

Ecuador currently is about double that of white rice.)

Discussion: The results from this pilot study were unable to demonstrate one of our initial hypotheses, since the change in BMI observed over the study duration was nil. (And in a sub-analysis that included only those participants who reported consuming quinoa rice at least twice a week during the previous month, there was also no significant impact observed for BMI.) In retrospect, it was probably overly-ambitious to assume that a relatively modest expected change in behavior – consumption of quinoa instead of white rice for three meals a week – would result in a significant impact on body weight (BMI) after only four months (in addition to the methodological limitation of the absence of a control group). Moreover, in the survey

questionnaire inquiring about the previous month's consumption, 88%, 64% and 51% of respondents reported, at 2,4 and 7 months respectively, that presumably a more reliable instrument of actual consumption patterns, only 33% and 9% reported having consumed quinoa in the most recent lunch (typically the main meal in Ecuador), at 2 and 7 months' post-baseline respectively (see Table 6). These data suggest there may have been some self-report bias (and/or recall bias) for the previous-month answers, hence the actual consumption of quinoa may have been considerably less than the hoped-for thrice weekly substitution for white rice, which may also help explain the

they had eaten quinoa at least 2-4 times a week during the previous month (see Table 5). However, in the 24-hour recall questionnaire, absence of an impact on BMI from this pilot study. (Another likely partial explanation for the rather steep fall-off in consumption of quinoa reported at the four-months' interview round is that, toward the end of the study, a number of families did not receive sufficient allotments of donated grain, due mainly to some logistical issues.) Moreover, the notion of simply replacing one food item with another should perhaps be reconsidered, within a broader context of diet and lifestyle improvement more holistically.

Table 5: Reported Consumption of Rice and Quinoa during the Previous Month

Interviewed at Baseline (n = 131)								
	Never	1-3 Times Per Month	Once a Week	2-4 Times a Week	5-6 Times a Week	Once a Day	2-3 Times a Day	4-6 Times a Day
Rice	0%	0%	1.7%	13.4%	8.4%	36.1%	36.1%	3.4%
Quinoa	20.2%	50.4%	17.6%	11.8%	0%	0%	0%	0%
Interviewed at 2 Months (n = 130)								
	Never	1-3 Times Per Month	Once a Week	2-4 Times a Week	5-6 Times a Week	Once a Day	2-3 Times a Day	4-6 Times a Day
Rice	2.3%	13.1%	16.2%	39.2%	3.1%	16.9%	7.7%	0%
Quinoa	0.8%	2.3%	8.5%	74.6%	3.1%	6.9%	3.1%	0.8%
Interviewed at 4 Months (n = 98)								
	Never	1-3 Times Per Month	Once a Week	2-4 Times a Week	5-6 Times a Week	Once a Day	2-3 Times a Day	4-6 Times a Day
Rice	1.0%	8.2%	6.1%	27.6%	11.2%	31.6%	11.2%	2.0%
Quinoa	6.1%	10.2%	19.4%	59.2%	2.0%	2.0%	0%	1.0%
Interviewed at 7 Months (n = 95)								
	Never	1-3 Times Per Month	Once a Week	2-4 Times a Week	5-6 Times a Week	Once a Day	2-3 Times a Day	4-6 Times a Day
Rice	0%	1.1%	8.6%	54.9%	14.0%	14.0%	7.5%	0%
Quinoa	6.6%	19.8%	23.1%	49.5%	0%	1.1%	0%	0%

Table 6: Reported Consumption of White Rice and Quinoa during the Most Recent Lunchtime Meal

	Baseline	2 Months	4 Months	7 Months
Rice	70.0%	64.1%	80.0%	62.0%
Quinoa	0%	32.8%	9.0%	9.0%

Concerning our other main hypothesis - that participants would accept consumption of quinoa instead of white rice several times a week, over various months -- our findings suggest that it may be possible to introduce more nutritious foods in urban communities such as this one, with at least modestly successful outcomes. However, as noted there was somewhat of a decline in acceptability reported between the two-months' post-baseline and final measures (in addition to the drop-off in reported consumption observed at the conclusion of the study, as also previously noted). Furthermore, there was a relatively substantial discrepancy between the individual respondents' self-reported scores and those they attributed to other family members, suggesting there may have been some likability bias or hesitancy to acknowledge less-than-fully-positive

experiences with consuming the quinoa rice. (In controlling for gender, there was a somewhat significantly higher acceptance of quinoa reported among females, who generally were also more likely to prepare the dish, yet with no significant difference when controlling for age group.) In general, however, the overall findings do suggest that a modestly positive acceptance of such a (re)introduction of a traditional -- and until now largely abandoned -- dietary behavior may be achievable in such settings.

Although the generalizability of the results from this pilot observational study may be limited, a recent community intervention conducted in a different Andean region of Ecuador also reported fairly encouraging findings [13]. And in a field visit to Bolivia and Chile by the first author in April-May of

2016, various nutritional and public health similarities were observed between the three Andean countries, including the tendency to abandon more traditional, nutritious foods such as quinoa for more “modern” ones like white bread, pasta, white rice and other processed foods, along with the (likely-associated) growing epidemics of diabetes and other chronic diseases. In Bolivia, however, being the country with the world’s highest production as well as per-capita consumption of quinoa [6], the tradition of cultivating and consuming quinoa (in various forms, including *arroz de quínoa*) continues to be relatively vigorous, certainly in comparison with the present situation in Ecuador [9,10,16]. In Chile, in contrast, consumption of quinoa is largely very recent, though has been

growing steadily [17,18]. And although there has not been much cultivation in Chile, far greater numbers of hectares are being harvested in recent years, much of it of high quality grain [18].

Conclusion: Further and more extensive research, ideally including the use of controlled trials, more involved biometric indicators (such as for blood glucose), and a more comprehensive assessment of overall dietary behavior and other obesity-related factors, will be necessary to assess in greater detail and confidence the potential health impacts at the population level of the types of behavioral changes reported in this pilot intervention in an urban Andean region. (The authors declare that we have no conflict of interest regarding the publication of this paper.)

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