



**EVALUACIÓN DE DISEÑO, PROCESO E IMPACTO DEL PROGRAMA DE APOYO ALIMENTARIO
(PAL) EN EL RIESGO DE SOBREPESO Y OBESIDAD EN MENORES DE 5 AÑOS DE LOS HOGARES
BENEFICIARIOS**

Tesis para optar al título de Doctora en Ciencias en Nutrición Poblacional

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1. RESUMEN

La mala nutrición, por déficit o por exceso, afecta negativamente la salud, el desarrollo y el bienestar de los niños. Actualmente México enfrenta una doble carga de la enfermedad por la coexistencia de la desnutrición y sobrepeso o la obesidad. Como respuesta principalmente al problema de mala nutrición por déficit el país cuenta con programas y políticas de desarrollo social, con un componente nutricional. El objetivo de dichos programas es mejorar el estado nutricional y de salud de la población, especialmente en condición de pobreza. El programa de apoyo alimentario (PAL), es uno de éstos y está dirigido a poblaciones con escasos ingresos, particularmente quienes por residir en localidades sin servicios de salud y educación no son candidatos a recibir beneficios de otros programas. Esta propuesta evaluó el impacto del PAL en el riesgo de sobrepeso y obesidad en menores de 5 años de edad beneficiarios del programa. Se evaluó si este impacto fue diferente para dos modalidades de beneficios, en dinero o en despensas y combinaciones de estas dos modalidades con una estrategia educativa y si ese impacto estuvo mediado por la dieta. También se analizaron los resultados del análisis de mediación por dieta y un aspecto de la implementación del programa a través del número de beneficios recibidos por la población objetivo. Encontramos que el PAL no ocasiona incremento de peso de los niños beneficiarios. Más aún, el programa tuvo un efecto preventivo en el grupo de despensa acompañada del componente educativo. Los niños de ese grupo presentaron menor Índice de Masa Corporal para la Edad (IMC/E) que los del grupo control y ese efecto puede estar explicado por un mayor consumo de frutas y verduras y un menor consumo de dulces en los niños de ese grupo. El menor IMC/E en los niños del grupo de canasta con educación no resultó perjudicial para los niños.

Los resultados de esta investigación contribuyen al conocimiento sobre los posibles efectos del programa en el riesgo de obesidad de los niños beneficiarios. Estos resultados también sirven de referencia para el diseño, implementación y evaluación de programas de alimentación y nutrición similares en México y en otros países que enfrentan la doble carga de la mala nutrición por deficiencias y por excesos.

Palabras clave: Evaluación de programas, nutrición, sobrepeso, obesidad en preescolares.

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2. INTRODUCCIÓN

Diversos gobiernos y organizaciones internacionales han desarrollado estrategias para mejorar la salud y el bienestar de las poblaciones como un objetivo prioritario de sus políticas sociales. Para el logro de este objetivo se invierten grandes cantidades de dinero y recursos en la implementación de programas. Bajo el contexto de recursos limitados y grandes necesidades por resolver, resulta importante conocer si dichos programas tienen el impacto esperado para el cual fueron diseñados y si estos programas generan algún tipo de efecto no deseable en las poblaciones beneficiarias.

Este documento presenta los resultados del trabajo de investigación "Evaluación de diseño, proceso e impacto del Programa de Apoyo Alimentario (PAL) en el riesgo de sobrepeso y obesidad en menores de cinco años de los hogares beneficiarios" para obtener el título de Doctora en Ciencias en Nutrición Poblacional del Instituto Nacional de Salud Pública de México, INSP.

Este trabajo de investigación consistió en un análisis secundario de datos obtenidos de la evaluación de impacto del Programa de Apoyo Alimentario (PAL), en México. Éste es un programa de reducción de la pobreza que inició en 2003. Sus beneficios consistían en la distribución de una despensa de alimentos o su equivalente en efectivo. Su población objetivo eran las familias en condición de pobreza que no eran elegibles por el Programa de Desarrollo Humano Oportunidades por estar en localidades sin acceso a escuelas y centros de salud. Según sus reglas de operación, el objetivo del PAL es mejorar las condiciones de alimentación y nutrición de los hogares en condición de pobreza, ubicados en localidades marginadas rurales, que no estuvieran siendo atendidas por otros programas del Gobierno Federal (Secretaría de Desarrollo Social, 2004).

La evaluación inicial del impacto del PAL fue realizado por el INSP a través de un ensayo experimental aleatorizado, por conglomerados. El objetivo fue evaluar el impacto del programa en el crecimiento lineal de los niños y el estado de nutrición de las familias beneficiarias.

El presente estudio consistió en la evaluación del impacto del PAL en el riesgo de sobrepeso y obesidad en menores de 5 años beneficiarios, mediante un análisis secundario de datos de la evaluación original. La evaluación de impacto sobre el peso no saludable en niños no fue uno de los objetivos de la evaluación anterior que da origen a esta propuesta (González de Cossío T, 2008). La presente disertación analizó la pertinencia del programa con base en el análisis de mediación por dieta y un aspecto de la implementación del programa a través del número de beneficios recibidos (en dinero o en especie).

También se evaluó el papel de la dieta como potencial mediador del efecto del PAL en el riesgo de sobrepeso y obesidad de los menores de 5 años. De igual manera, se evaluó si el efecto del programa en el desenlace de interés se modifica según el sobrepeso de la madre (Gewa CA, 2009; Flores M, et al., 2005), nivel de pobreza basal de los hogares (Pinot de Moira A, 2010), origen étnico de los hogares

(Caballero B, 2003; Olaiz G, 2006), baja talla en el basal de los menores de 5 años (Hoffman DJ, 2000) y subgrupos de edad de los niños (Bonvecchio A, 2009).

El contenido de este documento presenta los antecedentes, los objetivos del trabajo de grado, un artículo de revisión de literatura científica y dos artículos científicos analíticos elaborados como producto de la tesis y al final del documento se presentan las reflexiones finales y conclusiones generales del trabajo de investigación realizado.

3. ANTECEDENTES

Esta sección presenta como antecedentes una breve descripción del PAL, el programa evaluado. Cabe mencionar que esta sección describe las dos intervenciones del programa en general (transferencias en especie o en dinero). Las modalidades de combinación de intervenciones establecidas para la evaluación de impacto que da origen a este estudio, al igual que la aleatorización de intervenciones en las comunidades son descritas más adelante en los artículos analíticos 1 y 2.

Descripción del Programa de Apoyo Alimentario, PAL

Descripción General

El Programa de Apoyo Alimentario, PAL, surgió en el año 2003 dirigido a mejorar las condiciones de alimentación y nutrición de los hogares en situación de pobreza, en localidades marginadas rurales que no estuvieran siendo atendidas por otros programas alimentarios del gobierno federal. Los criterios para seleccionar la población beneficiaria fueron establecidos por la Secretaría de Desarrollo Social (SEDESOL) (González de Cossío T, 2008).

Focalización. Para hacer parte de la población elegible para el PAL, se requería pertenecer a comunidades con 2,500 o menos habitantes, de alta y muy alta marginación¹, de acuerdo con criterios del Consejo Nacional de Población, CONAPO (se podrían atender hogares de familias pobres que resultaran elegibles en localidades rurales de marginación media en los casos que así lo determinara SEDESOL), y que no recibieran apoyos de otros programas alimentarios del Gobierno Federal.

Cobertura. Al inicio de su implementación el programa atendía más de 253 mil hogares en 5,700 localidades.

Intervenciones ofrecidas por el PAL. El PAL otorgaba en 2003 una transferencia mensual a los hogares elegibles que aceptaban participar, consistente en un paquete alimentario con un valor de 150 pesos Mexicanos. Las corresponsabilidades de la población beneficiaria eran: organizar comités del programa que funcionaran como contraloría social y asistir a pláticas mensuales sobre

¹ El índice de marginación es una medida resumen que permite diferenciar entidades federativas y municipios según el impacto global de las carencias que padece la población como resultado de la falta de acceso a la educación, la residencia en viviendas inadecuadas, la percepción de ingresos monetarios insuficientes y las relacionadas con la residencia en localidades pequeñas. El índice de marginación considera 4 dimensiones estructurales de la marginación, identifica 9 formas de exclusión y mide su intensidad espacial como porcentaje de población que no participa del disfrute de bienes y servicios esenciales para el desarrollo de sus capacidades básicas.

alimentación, nutrición y salud. Los productos del paquete alimentario (Ver Anexo 1) debían cumplir con la Norma Oficial Mexicana (NOM-169-SSA1-1998) (Secretaría de Salud de México, 1998) para la asistencia social alimentaria a grupos de riesgo. La despensa debía proporcionar 20% de las necesidades nutricionales de los beneficiarios. En los casos en los que las despensas no podían llegar a los hogares, por motivos de dificultades en la logística, se proporcionaba un costo monetario equivalente al del paquete alimentario distribuido (150 pesos/mes) (Secretaría de Desarrollo Social, 2004; González de Cossío, 2008).

Componente Educativo.

Como parte de las corresponsabilidades, los beneficiarios del programa debían asistir a una serie de pláticas educativas. Las comunidades elegidas para recibir el PAL debían organizarse y elegir democráticamente un comité de beneficiarios que sería el encargado de asumir las responsabilidades relacionadas con el manejo y operación del programa, así como la implementación de los contenidos educativos.

Una persona avalada y reconocida por la comunidad presidió cada comité con el fin de dar seguimiento a las principales funciones del comité de beneficiarios. Esas funciones incluían la realización de las sesiones educativas, la supervisión, evaluación y seguimiento de los aspectos operativos del programa (*Rodríguez-Herrero H, 2005*).

Los contenidos educativos fueron transmitidos usando un método en cascada en el cual cada educador debía enseñar periódicamente a un grupo de personas en cada región. Luego, esas personas (facilitadores) eran las responsables de replicar las sesiones educativas en sus localidades. Usualmente, el facilitador en las comunidades debía ser el presidente del comité de beneficiarios, quienes debían contar con la confianza y respeto por parte de la comunidad de beneficiarios y haber completado al menos el nivel de educación básica.

Los contenidos de las sesiones educativas estaban relacionados con salud y nutrición. Dentro de los temas de educación nutricional abordados estaban: grupos de alimentos, alimentación saludable durante el embarazo, lactancia materna, adecuados hábitos alimentarios de los niños, sobrepeso, actividad física y conservación de alimentos (*Diconsa, 2003*).

4. OBJETIVOS

4.1 Objetivo General

Evaluar el impacto del PAL en el riesgo de sobrepeso y obesidad de los menores de 5 años.

4.2 Objetivos Específicos

1. Evaluar el efecto del PAL en el riesgo de sobrepeso y obesidad en menores de 5 años, según subgrupos de comparación: estado nutricional de la madre, nivel socio económico basal de los hogares, origen étnico de los hogares, estado nutricional antropométrico basal de los menores de 5 años, y edad de los niños.
2. Evaluar el papel de la dieta como potencial mediadora del efecto del PAL en el Índice de Masa Corporal para la Edad (IMC/E) de los menores de 5 años.
3. Analizar la pertinencia del PAL según los resultados de la mediación de la dieta en el efecto del PAL en el IMC/E de los niños.
4. Evaluar la frecuencia de la entrega del programa (número de beneficios recibidos, en dinero o en despensas).

5. ARTÍCULO DE ENSAYO.

Título del artículo:

Español: Riesgo de sobrepeso en niños preescolares beneficiarios de programas de ayuda alimentaria

Portugués: Risco de sobrepeso em crianças pré-escolares beneficiários de programas de ajuda alimentaria

Inglés: Risk of overweight in preschool beneficiaries of food aid programs

Título resumido:

Español: Sobrepeso Infantil y programas alimentarios

Portugués: Excesso de peso na infância e programas de alimentação

Inglés: Childhood overweight and food programs

Descriptores: Evaluación de programas, nutrición, sobrepeso, obesidad en preescolares

RESUMEN

Varios países en transición nutricional enfrentan una doble carga de la enfermedad por la coexistencia de desnutrición, sobrepeso y obesidad. Como respuesta a este problema algunos países han implementado programas de desarrollo social, con componentes nutricionales. El objetivo de dichos programas es mejorar el estado nutricional de la población, especialmente en condición de pobreza. Algunos de estos programas tienen como estrategias de intervención las transferencias en especie (despensas) o dinero en efectivo. Pocos estudios han evaluado el potencial efecto de esos programas en el riesgo de sobrepeso en los niños beneficiarios. Esta revisión crítica de la literatura contribuye al conocimiento sobre el posible efecto de los programas alimentarios en el riesgo de sobrepeso de los niños beneficiarios. Esta revisión también puede servir de referencia para el diseño, implementación y evaluación de programas de alimentación y nutrición en países de ingresos bajos y medios que enfrentan la doble carga de la mala nutrición.

Descriptores: Evaluación de programas, nutrición, sobrepeso, obesidad en preescolares.

RESUMO

Vários países em transição nutricional enfrentam um duplo fardo de doenças pela coexistência de desnutrição, sobrepeso e obesidade. Em resposta a este problema, alguns países têm implementado programas de desenvolvimento social com componentes nutricionais. O objetivo desses programas é o de melhorar o estado nutricional da população, especialmente em condições de pobreza. Alguns destes programas têm estratégias de intervenção como transferências em espécie (tais como cestas de alimentos) ou transferências de dinheiro.

Poucos estudos avaliaram o potencial impacto desses programas sobre o risco de excesso de peso em crianças beneficiários.

Esta revisão crítica contribui para o conhecimento sobre o possível efeito de programas de alimentação no risco de crianças com excesso de peso beneficiários. Esta avaliação também pode servir como uma referência para a concepção, implementação e avaliação de programas de alimentação e nutrição em países de baixa e média renda enfrentando desnutrição.

Descritores: Avaliação de Programas, nutrição, excesso de peso, a obesidade em crianças pré-escolares.

ABSTRACT

Several countries in nutritional transition face a double burden of disease by the coexistence of undernutrition, overweight and obesity. In response to this problem, some countries have implemented social development programs with nutritional components. The purpose of these programs is to improve the nutritional status of the population in poverty conditions. Some of these programs have intervention strategies as in-kind transfers (such as food baskets) or cash transfers.

Few studies have evaluated the potential impact of these programs on the risk of overweight in beneficiary children.

This critical review contributes to knowledge about the possible effect of food programs in the risk of overweight children beneficiaries. This review may also serve as a reference for the design, implementation and evaluation of food and nutrition programs in countries of low and middle income facing malnutrition.

Descriptors: Program Evaluation, nutrition, overweight, obesity in preschool children.

INTRODUCCIÓN

Diversos gobiernos y organizaciones internacionales han desarrollado estrategias para mejorar la salud y el bienestar de las poblaciones como un objetivo prioritario de sus políticas sociales. Para el logro de este objetivo se invierten grandes cantidades de dinero y recursos en la implementación de programas. Bajo el contexto de recursos limitados y grandes necesidades por resolver, resulta importante conocer si dichos programas tienen el impacto que se espera para el cual fueron diseñados y si éstos generan algún tipo de efecto no deseable en las poblaciones beneficiarias.

Este artículo presenta evidencia que se enfoca en el potencial efecto que pueden tener los programas de ayuda alimentaria en el exceso de peso en niños beneficiarios.

La evidencia disponible puede contribuir a la toma de decisiones en política pública sobre diseño, implementación y evaluación de programas de nutrición en contextos similares.

Obesidad en niños en edad preescolar

La prevalencia de obesidad en menores de 5 años de edad está incrementando en todo el mundo. En muchos países de ingresos altos, la obesidad en menores de 5 años se ha duplicado en las dos últimas décadas.¹ Por otra parte, en países de ingresos medios y bajos la velocidad de incremento de este desenlace es cada vez mayor, especialmente en áreas urbanas.²⁻⁴ El aumento en áreas urbanas probablemente se debe a una menor oportunidad de realizar actividad física acompañada de mayor acceso a bebidas con aporte calórico y alimentos densamente energéticos.

En todo el mundo, la prevalencia de sobrepeso y obesidad en niños aumentó de 4.2% (IC 95%: 3.2%-5.2%) en 1990 a 6.7% (IC 95%: 5.6%, 7.7%) en 2010.⁵ En 2011 habían 43 millones de niños menores de 5 años con sobrepeso (Puntaje Z de Peso para la Talla >2.0) en todo el mundo y se estima que la tendencia al incremento continuará hasta alcanzar 64 millones de niños en 2025.² La mayoría de los niños con sobrepeso viven en países de ingresos bajos y medios, en contraste con la prevalencia de sobrepeso en menores de 5 años en países de ingresos altos de 15%.²

En el contexto de América Latina, en México la prevalencia de obesidad en niños menores de 5 años se ha incrementado de 7.8% en 1988 a 8.4% en 2006 y 9.8% en 2012.^{4,6} Estas prevalencias en niños preescolares Mexicanos son similares a las encontradas en otros países de ingresos medios de la región como Brasil (16.8% de sobrepeso y 10.8% de obesidad en niños de 2 a 6 años)⁷ y Chile (11% a 13.6% en niños de 2 años y 17% a 20%, en niños de 3 a 4 años),⁸ pero mayores a las de países como Perú (6.9% de sobrepeso y obesidad en menores de 5 años de edad)⁹ y Colombia (6.2% de sobrepeso y obesidad en menores de 5 años).¹⁰

El sobrepeso (SP) y la obesidad (OB), tanto en la niñez como en la edad adulta, incrementan el riesgo de enfermedades crónicas. Entre estas enfermedades se encuentran el cáncer, enfermedad cardiovascular, diabetes mellitus tipo 2, hipertensión arterial, dislipidemias e intolerancia a la glucosa y arterioesclerosis.¹¹⁻¹³

La prevalencia de obesidad varía considerablemente dependiendo del nivel de ingresos de los países y del nivel socioeconómico de las poblaciones de estudio.¹⁴ Diversos estudios han encontrado asociación entre pobreza y obesidad.^{15,16} Esa relación puede estar mediada por factores relacionados con la pobreza como: el bajo acceso a dietas de alta calidad, baja disponibilidad de alimentos saludables, así como falta de espacios adecuados y seguros para realizar actividad física.¹⁵ En países de bajos ingresos, se ha encontrado una asociación positiva entre riqueza y obesidad, especialmente en mujeres adultas y niños.¹⁷ En contraste, en países de ingresos altos, se ha visto una asociación negativa en la cual hay mayor riesgo de obesidad en los grupos con menor nivel socio económico (NSE).¹⁸ La tendencia de esta asociación aún no es muy clara en países con ingresos medios.

Evaluación de programas

Ciertos países de ingresos bajos y medios han implementado políticas y programas para atender a la población en condición de pobreza. Algunos de estos programas incluyen intervenciones con el fin de mejorar el estado nutricional en esas poblaciones.¹⁹ Sin embargo, aún no se conocen claramente los efectos de estos programas en el aumento de peso no saludable de la población preescolar beneficiaria.

Los programas para el combate a la mala nutrición deben basarse en evidencia de intervenciones eficaces y efectivas. Para saber si se solucionan los problemas de mala nutrición de la población,²⁰ es igualmente importante evaluar el efecto de los programas sociales con componentes nutricionales, tanto en la reducción de la desnutrición como en el posible incremento de peso no saludable en la población beneficiaria.

Efecto de programas con componentes nutricionales en el crecimiento de los niños beneficiarios

La evidencia generada a partir de las evaluaciones de impacto es de gran utilidad para la planeación de inversiones en nutrición, el mejoramiento de las políticas de salud y el mejoramiento del estado de salud y nutrición de la población.¹⁹

En América Latina se han evaluado diversos programas que han demostrado su efectividad en mejorar el crecimiento de los niños en hogares en condiciones de pobreza.²¹⁻²⁶ Estos programas tienen componentes de transferencias monetarias, transferencias en especie (despensas, suplementos alimentarios, alimentos fortificados o micronutrientes) o ambas. Los mecanismos por los cuales estas intervenciones pueden tener efectos positivos en el estado nutricional de los niños han sido descritos usando la teoría de programas.²²

Los resultados del efecto de los programas de transferencias monetarias o en especie en América Latina, se han producido principalmente en menores de 2 años de edad, de comunidades rurales, pobres y con alta prevalencia de desnutrición antes de las intervenciones.²¹⁻²⁶ Los efectos positivos de estos programas se han producido principalmente en el aumento de la talla para la edad o en la disminución de la prevalencia de baja talla.

En México, el Programa *Oportunidades* (antes *Progresá*) tuvo un efecto positivo en el crecimiento lineal de los niños más pobres, de comunidades rurales y menores de 6 meses de edad en la línea basal (1.1 cm más los niños del grupo intervención vs los niños del grupo de la intervención cruzada).²¹ En Nicaragua, el programa *Red de Protección* también ha tenido efectos significativos en talla, en niños de 0 a 60 meses (5.5 puntos porcentuales menos en baja talla en los niños beneficiarios vs los niños control).²⁴ De igual manera en Colombia el programa *Familias en Acción*, tuvo un efecto positivo en niños de 0 a 24 meses (0.16 más en valores Z de T/E y 6.9 puntos porcentuales menos en baja talla).²³

La evidencia disponible acerca de los programas de transferencias monetarias condicionadas (PTMC) muestra que estos programas han logrado efectividad en incrementar el uso de servicios preventivos de salud.²⁷ Los PTMC también tienen efectos positivos en la antropometría de los niños y un pequeño impacto en el estado de micronutrientes.²² El impacto de los PTMC en el estado nutricional puede explicarse por la combinación de acciones dirigidas tanto a los determinantes subyacentes como a los inmediatos de la malnutrición infantil.²²

Asociación entre participación en programas con componentes nutricionales y sobrepeso de la población beneficiaria

Las prevalencias altas de sobrepeso y obesidad en niños de bajos ingresos, han llevado a cuestionar si la participación en programas con componentes nutricionales, dirigidos a población en condición de pobreza, contribuye a aumentar este problema de salud. Existe evidencia sobre estudios que han evaluado la asociación entre participación en programas de asistencia alimentaria y sobrepeso y obesidad en mujeres y niños en edad escolar beneficiarios.

En cuanto a niños en edad escolar, en Estados Unidos, se han evaluado datos de las tendencias del peso corporal de los niños que participan en el Food Stamp Program (FSP). Este es un programa de ayuda para personas con bajos ingresos y recursos para que puedan comprar los alimentos que necesitan. Se ha evaluado si existe una relación entre la participación en el FSP y el peso corporal a lo largo del tiempo. Este estudio encontró que la participación en FSP se asoció con un incremento del 9.1% en la probabilidad predicha de obesidad en mujeres de ingresos bajos.²⁸ Sin embargo, esta relación no se ha encontrado en los niños.

Otros autores en ese mismo país han evaluado si los programas alimentarios *The National School Lunch Program*, y *The School Breakfast Program* se asocian con sobrepeso en niños de diferentes grupos de ingresos socioeconómicos. Los datos hallados no mostraron asociación entre la participación en esos programas alimentarios y el sobrepeso en niños en condición de pobreza.²⁹

En el contexto Latinoamericano, hay evidencia de Chile, la cual muestra la posible asociación entre participación en programas de suplementación alimentaria y el aumento de la prevalencia de obesidad en niños.³⁰ En Chile han explorado los cambios en los índices antropométricos antes y después de recibir los beneficios de programas de alimentación. El *Programa Nacional de Alimentación Complementaria (PNAC)* está dirigido a niños menores de 6 años y mujeres embarazadas. El PNAC entrega alimentos suplementarios, promueve la lactancia materna y ofrece suplementos a las madres durante embarazo y lactancia. La evaluación del PNAC mostró que hubo una ganancia no significativa en la longitud de los niños, mientras, el peso para la edad, el peso para la talla, el sobrepeso y la obesidad incrementaron significativamente.³⁰

En México, también hay estudios para determinar la asociación entre la asistencia a programas y sobrepeso y obesidad en sus participantes.^{31,32} Se ha encontrado una asociación no deseable entre la participación en el programa *Oportunidades* y mayor prevalencia de sobrepeso en mujeres adultas. En hogares que recibieron mayor cantidad de transferencias acumuladas, se encontró una asociación positiva entre la participación en el programa y el IMC, mayor prevalencia de sobrepeso y de obesidad grado II.³³

Tradicionalmente, los programas de asistencia alimentaria han sido creados con el objetivo de solucionar problemas de deficiencias nutricionales, especialmente desnutrición.³⁴ La evidencia ha permitido observar que hay prevalencias altas de exceso de peso en niños participantes en algunos programas alimentarios. Sin embargo, la mayoría de estudios publicados no han encontrado una asociación significativa entre la participación en programas de asistencia alimentaria y el sobrepeso y la obesidad en los niños beneficiarios.³² Lo anterior resalta la necesidad de investigación adicional, especialmente dado que las relaciones pueden variar entre países debido a diferencias sociales, culturales y programáticas. Además, la mayor probabilidad de presentar sobrepeso puede deberse a una mayor disponibilidad de alimentos procesados y densamente energéticos a menor precio.

Posibles mecanismos de acción de los programas de transferencias sobre el riesgo de sobrepeso y obesidad en menores de 5 años

Los mecanismos que podrían explicar el efecto de la participación en programas nutricionales que incluyen transferencias, monetarias o en especie, en el riesgo de sobrepeso y obesidad pueden estar relacionados con la disponibilidad y acceso a alimentos con alto contenido de energía y con teorías de cambio económicas que sustentan lo que sucede en los hogares al recibir transferencias y por tanto

aumentar sus ingresos. Se ha demostrado que a mayor ingreso, mayor consumo de bienes, especialmente bienes normales.

Por otra parte la elasticidad ingreso hace referencia al aumento en el consumo de un bien que se produce por cada uno por ciento de aumento en el ingreso.

Por esto es importante estudiar cómo responden los hogares ante el aumento de sus ingresos.

La anterior conceptualización económica se relaciona con el efecto que puedan tener los programas de transferencias en el sobrepeso y la obesidad de los beneficiarios. Estos aspectos se relacionan porque a mayor elasticidad de bienes tales como ciertos alimentos, mayor consumo de éstos y por tanto, dependiendo del tipo de alimentos que sean más elásticos será mayor o menor el riesgo de presentar sobrepeso en los beneficiarios. Por ejemplo, si el grupo de frutas y verduras es elástico, a mayor ingreso las familias tendrán mayor consumo de este grupo de alimentos y podrían tener menor riesgo de sobrepeso. Por el contrario, si grupos de alimentos como los industrializados y densamente energéticos tienen alta elasticidad, éstos serían más consumidos a mayor ingreso de las familias y por ende podrían tener un mayor riesgo de presentar sobrepeso.

Programas con Transferencias Monetarias

A nivel del hogar, los programas que otorgan transferencias monetarias incrementan los ingresos disponibles en los hogares beneficiarios, aumentando así el poder de compra de alimentos. Adicionalmente, el precio de varios de los alimentos con mayor densidad energética y menor cantidad de nutrientes y de bebidas azucaradas es frecuentemente menor que el de alimentos saludables.³⁵ El aumento de ingresos en los hogares puede generar un incremento en la disponibilidad de alimentos no saludables, con altas cantidades de energía en el hogar. La disponibilidad de alimentos densamente energéticos y de bebidas azucaradas puede llevar a su consumo y posterior incremento del peso excesivo. En el caso de los programas que ofrecen transferencias de dinero, se supone que las familias darán un uso adecuado al dinero extra que reciben en términos de invertirlo en lo que más necesitan. Sin embargo, desde las políticas públicas, el supuesto de que las familias usan los recursos en lo que más necesitan, no siempre se cumple.

Programas con Transferencias en especie

Los programas con transferencias en especie, como despensas, incrementan la disponibilidad de alimentos en el hogar.³⁶ Desde el punto de vista económico, los programas sociales ofrecen alimentos como parte de sus intervenciones, porque pretenden respetar las preferencias alimentarias de sus beneficiarios y se asume que las familias que los reciben comprarán más alimentos según sus necesidades.³⁷ Sin embargo, no es claro el efecto de desplazamiento del ingreso, es decir, lo que sucede con el uso que le dan las familias al valor monetario disponible o ingreso disponible como consecuencia de la disponibilidad de alimentos como parte del programa. Ese valor monetario extra con el que cuentan podría destinarse al gasto en alimentos no saludables, con alto contenido energético. Esto es probable dado que son precisamente los alimentos densamente energéticos y bebidas azucaradas los que generalmente son más accesibles en términos de costo.^{38,39} No obstante, el consumo de ese tipo de alimentos no saludables depende de la elasticidad en el ingreso. Es decir, si

a mayor ingreso los hogares tienen un consumo mayor de bienes tales como alimentos no saludables o si a mayor ingreso los hogares consumen más bienes como alimentos saludables que antes no podían comprar. El consumo de bienes tales como los alimentos depende de las elasticidades de cada grupo de alimentos.

Por otra parte, la asociación entre pobreza y obesidad puede estar mediada por el bajo costo de alimentos densamente energéticos y las bebidas con azúcar añadida. Además, la palatabilidad de grupos de alimentos como las grasas y los azúcares puede incrementar el consumo de energía, lo cual afecta la calidad de la dieta y puede incrementar el riesgo de sobrepeso y obesidad.

La alta calidad de la dieta se ha visto asociada con mayor educación y mayores ingresos económicos.^{40,41} Algunos estudios han mostrado que la población en condición de pobreza gasta menos dinero en alimentos y tiene un consumo con mayor densidad energética y por tanto dietas de menor calidad.⁴² La ingesta de alimentos de las personas puede ser sensible al precio de los alimentos, de tal manera que cuando estos tienen bajo costo, las personas los podrían comprar con mayor frecuencia. Cuando los alimentos con alto contenido de calorías son más económicos que los alimentos con menor contenido calórico, más personas compran y consumen exceso de calorías.³⁵

Además del costo de los alimentos densamente energéticos y de su palatabilidad, existen otras posibles explicaciones para la elección de éstos que incluyen: inadecuado conocimiento de nutrición, excesiva vulnerabilidad al ambiente externo y alta disponibilidad de alimentos procesados, comidas rápidas y bebidas azucaradas.⁴³

Componente de Educación de los programas

Algunos programas alimentarios tienen intervenciones de transferencias en especie, transferencias de dinero en efectivo, o ambos y pueden o no estar acompañados por un componente educativo. Las sesiones educativas, en la mayoría de los programas, van dirigidas a informar y motivar a la población hacia la adopción y mantenimiento de estilos de vida saludables. Esos estilos de vida pueden incluir el consumo de alimentos saludables. El componente educativo en los programas alimentarios puede incrementar el consumo de alimentos sanos a través de la educación nutricional. Se ha visto que algunos programas alimentarios que tienen componentes de educación nutricional han mejorado comportamientos dietarios como por ejemplo el consumo de frutas y verduras en los grupos intervenidos comparados con el grupo control.⁴⁴ También se ha encontrado que programas que tienen componentes de educación nutricional en cuanto a adecuada alimentación complementaria para los niños han logrado incrementar el peso y la talla en niños de 6 a 24 meses de edad.⁴⁵ Sin embargo, no ha sido muy documentado cómo el componente educativo en programas que no fueron creados para combatir el sobrepeso pueda tener un efecto positivo en eventos saludables, como la disminución de la desnutrición y a la vez, pudiera evitar el exceso de peso no saludable en la población intervenida.

Por esas razones, el componente educativo debe ser considerado en los análisis de evaluación de diseño y de impacto de programas de intervención nutricional.

COMENTARIOS

Dada la efectividad mostrada por algunas intervenciones en términos de reducción de la desnutrición, morbilidad y mortalidad, es necesario evaluar programas con componentes nutricionales para identificar si han tenido algún efecto no esperado. Resulta prioritario evaluar el efecto de estos programas en el sobrepeso y la obesidad, especialmente a edades tempranas y en población que vive en pobreza para contribuir a la solución de este problema.

Dadas las tendencias actuales de aumento de sobrepeso, se debería garantizar que los programas de asistencia alimentaria no contribuyan al desarrollo de sobrepeso y obesidad en la población beneficiaria. Los programas alimentarios de transferencias podrían contribuir al aumento del sobrepeso en su población beneficiaria a través de una mayor disponibilidad y acceso a alimentos con alto contenido de energía, ya sea por medio de la entrega de despensas o de dinero en efectivo. Sin embargo, el impacto de los programas en este desenlace ha sido poco estudiado y las evaluaciones que se han realizado han sido, en su mayoría, en población adulta o en edad escolar.^{28,31,32,46}

Las tendencias marcadas hacia el aumento del sobrepeso y la obesidad en preescolares confirman la necesidad de iniciar intervenciones efectivas a edades tempranas de la niñez. El objetivo principal de estas intervenciones debería ser revertir las tendencias que se han anticipado en el aumento de las prevalencias de sobrepeso y obesidad.⁵ Estudios recientes muestran que la tendencia hacia la obesidad en menores de 5 años inicia a edades tan tempranas como los 6 meses.^{47,48} Es por esto que la prevención de la obesidad en niños no debe dirigirse solo a la etapa escolar porque podría ser tardía.

Es importante conocer los factores que se relacionan con la obesidad en la población en edad preescolar pobre que recibe programas alimentarios de transferencias en especie o en dinero por parte del gobierno. Se requiere diseñar los programas con componentes nutricionales de tal manera que combatan la mala nutrición tanto por deficiencia como por exceso; esto resulta importante en poblaciones que enfrentan la doble carga. De igual manera es importante conocer si los programas de ayuda alimentaria además de disminuir la desnutrición también contribuyen, de manera inadvertida, al aumento del problema del sobrepeso en esos beneficiarios.

Resulta importante entender cómo la pobreza y la participación en programas, se relacionan con el sobrepeso y la obesidad en los niños beneficiarios y cuáles son los mecanismos que lo explican. Lo anterior implica una gran utilidad dado que se trata de población en edades tempranas en las cuales existe oportunidad de invertir en capital humano con altas posibilidades de beneficios a largo plazo y representa un área en la cual es necesario evaluar los efectos producidos por los programas, aislando los efectos de otros factores.

Por otra parte, ciertas limitaciones pueden afectar la interpretación de algunos estudios que han evaluado la relación entre participación en programas alimentarios y sobrepeso en su población beneficiaria. No todos los estudios de evaluación cuentan con un diseño experimental que permitan una estimación no sesgada del impacto. Algunos estudios han utilizado diseños de corte transversal que no permiten explorar la temporalidad en términos de la causalidad.²⁸⁻³² Tampoco han explorado la dieta como mediador potencial del efecto entre los programas y el desarrollo de exceso de peso en los beneficiarios. De igual manera, no han controlado por potenciales confusores como la actividad física, por auto selección de las personas dentro de los programas o por la relación dosis respuesta.

Aún existen vacíos en la literatura sobre el papel que ejerce la participación en programas de asistencia alimentaria y el riesgo de sobrepeso en preescolares de hogares de bajos ingresos. Se requiere más información sobre la relación entre las dinámicas que ocurren al interior de estos hogares en cuanto a distribución de los recursos cuando reciben dinero en efectivo, o en cuanto a la distribución intrafamiliar de alimentos. No existe información sobre la asociación entre sobrepeso y obesidad en niños en edad preescolar y la participación en programas de asistencia alimentaria. La evidencia que se genere a partir de estudios en este sentido permitirá implementar y desarrollar los programas de manera adecuada.

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6. ARTÍCULO ANALÍTICO 1.

Impact of a Mexican Food Aid Program on Body Mass Index in children under five years from beneficiary households: a cluster randomized trial

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Abstract

While food aid programs can benefit growth in the young, recent evidence suggests that they may also increase unhealthy weight gain in beneficiary adults. The question of whether this phenomenon occurs in children as well is the focus of this research.

Our primary purpose was to evaluate the impact of a Federal food aid program (PAL) on Body Mass Index for Age (BMI/Age) in beneficiary children under five years old and, secondarily, to examine whether this effect is heterogeneous across socioeconomic and nutritional variables.

We conducted a secondary analysis of a program evaluation that used a cluster randomized controlled effectiveness trial design. Data were analyzed from poor rural households and beneficiary children < 5 years of age. We analyzed a sample of 206 communities in southern Mexico that were randomly assigned to one of four groups: a monthly food basket with or without education, a cash transfer (\$14 USD/month) with education, or a control group.

PAL did not increase overweight or obesity and did not increase the BMI/Age of beneficiary children. To the contrary, BMI/Age z-scores in the food basket and education group, while within a healthy range, tended to be lower than the rest of groups. This association was found in low and medium socioeconomic status, indigenous households, children of mothers who completed primary education, children of mothers without overweight, those 0 to < 24 months, and children not stunted at baseline.

Our results indicate that PAL did not contribute to unhealthy weight gain in young children and the addition of education sessions for recipients of transfers may have contributed to healthier weights for beneficiary children.

Keywords: Impact evaluation, body mass index, childhood obesity, nutritional education

Introduction

Over the last two decades, some developing countries have implemented conditional in-kind or cash transfer programs targeted to poor populations to ameliorate the detrimental effects of poverty (Olinto P et al., 2003; Rivera JA, et al., 2004; Attanasio O et al., 2004; Maluccio JA, et al., 2004; Leroy JF, et al., 2008; Fernald LCH, et al., 2008). The main objective of these programs is to promote investment in long-term human capital through health, education, and nutrition interventions (Leroy JL, et al., 2009).

The design, implementation, strengthening and evaluation of large-scale programs are becoming a high priority for the public policy agendas of certain countries (Pelletier DL, et al., 2011). However, most evaluations of nutrition interventions to address undernutrition in low and middle income countries have been based on small-scale trials (Bhutta ZA, et al., 2008) and the unintended consequences of these are seldom evaluated. The present study addresses both of these gaps in the literature.

The Context

In Mexico, several large scale social programs to decrease poverty were implemented over the last 20 years (González de Cossío T, et al., 2008). Their explicit aim has been to break the intergenerational cycle of poverty. Some of these programs have included nutritional interventions to improve the nutritional status of the beneficiary population. Investing in nutrition over the long-term can improve education and employment opportunities as well as human capital (Levy S, et al., 2005; Morales-Ruán Ma del C, 2013).

The proportion of Mexican households that receive benefits from one or more programs is 40%, and higher in the southern region. The benefits include health and nutrition, education sessions and/or cash transfers. Two-thirds (68%) of Mexican households in rural areas receive benefits from some type of food assistance program (Gutiérrez JP et al., 2012).

Programs usually have been focused on combating nutritional deficiencies, and while undernutrition has decreased, there has also been a significant increase in overweight and obesity in children over recent years (Olaiz G, et al., 2006; Gutiérrez JP et al., 2012).

The rate of stunting in Mexican children younger than 5 years decreased from 22.8% in 1988 to 12.7% in 2006; and was 13.6% in 2012 (Olaiz G, et al., 2006; Gutiérrez JP et al., 2012). Nevertheless, in the same period, Mexico had a sustained increase in the prevalence of overweight and obesity in adults and children. The prevalence of overweight and obesity in children under 5 years increased from 7.8% in 1988 to 8.8% in 1999, and from 8.3% in 2006 to 9.7% in 2012 (Bonvecchio A, et al., 2009; Gutiérrez JP et al., 2012). In addition, the prevalence of overweight in preschool-age children in the southern Mexican states—the poorest in the country—was 15.9% in 2006, higher than the other regions ($p < 0.01$) (Bonvecchio A, et al., 2009).

Oportunidades is a human development program in Mexico designed to break the intergenerational transmission of poverty through several components, the most important of which are education, health, nutrition and cash transfers. Health and education benefits are transferred to beneficiaries through community schools and health centers (*Secretaría de Desarrollo Social, 2013*). However, there are thousands of communities in Mexico without schools or health centers to support the program. These are the poorest and most isolated communities in the country. For these communities, the Mexican Federal Government launched a program in 2003 called *Programa de Apoyo Alimentario* (Food Support Program; PAL, Spanish acronym) to address the nutritional needs of poor rural communities that could not benefit from the *Oportunidades* program (*Secretaría de Desarrollo Social, 2004*).

PAL was targeted to poor communities, providing in-kind (a food basket) or cash transfers to beneficiary households. The composition of the food basket followed the Mexican Official Norm for food aid programs (*Secretaría de Salud, NOM-169-SSA1-1998*), which states that food baskets should provide at least 20% of the recommended daily energy and protein requirements for an average-sized household. Thus, the food basket was designed to provide 450 calories (1883kJ)/d per adult equivalent. Benefits were received provided the recipient attended nutrition and health education sessions.

There is evidence to suggest that while addressing undernutrition problems, cash and in-kind transfer programs may contribute to overweight and obesity in adults (*Fernald LCH, et al., 2008; Fernald LCH, et al., 2008; Leroy JL, et al., 2013*). This potential adverse effect has not been studied in children.

For public policy purposes, it is relevant to assess the impact of programs aimed at alleviating poverty and improving the socioeconomic and nutritional status of the beneficiary population. This is pertinent because while programs have had a positive impact by decreasing stunting and anemia (*Rivera JA, et al., 2004*) and micronutrient deficiencies (*Leroy J, et al., 2010*), they may also contribute to increasing unhealthy weight gain in beneficiaries.

The main objective of this study is to evaluate the impact of PAL on the Body Mass Index (BMI) of beneficiary children under 5 years old. A secondary objective is to examine whether this effect is heterogeneous across socioeconomic and nutritional variables.

Materials and Methods

Design

This study is a secondary analysis of an impact evaluation program which was a cluster randomized controlled effectiveness trial.

Data used in the present study correspond to the information collected at baseline in 2003 and at follow-up in 2005.

Eligibility criteria

Communities were eligible to receive PAL if they had the following characteristics: rural (≤ 2500 inhabitants), high or medium marginalization index according to the National Population Council (a multidimensional assessment of poverty in a community which includes education, income, housing conditions and urbanization indicators) (CONAPO, 2001), communities without other federal food aid programs and preferably should have been registered and geo-referenced in the Territorial Integration catalog of the National Institute of Statistics, Geography and Informatics (*Secretaría de Desarrollo Social*, 2004).

PAL's impact was externally evaluated by a team from the Mexico National Institute of Public Health (Instituto Nacional de Salud Pública, INSP). The original impact evaluation question addressed the differential impact of cash or in-kind transfers on the poverty and nutritional status of beneficiary families. A further question related to whether or not conventional health and nutrition education sessions would modify the program effect.

Interventions/Study Groups

To evaluate these effects, a four-group design was implemented. The selected communities were randomly assigned to 1 of 4 study groups:

1. Control group (C): Potential target communities for PAL were in higher numbers than those that could be covered by the program during its initial implementation phase. Therefore, communities assigned to the control group were put on the waiting list for incorporation into the program at the end of the evaluation study.
 2. Food basket without education (FB): Food basket containing beans, rice, corn flour, powdered fortified milk (zinc, vitamin C, iron, folate), soup pasta, vegetable oil, cookies, powdered chocolate, cornstarch, ready-to-eat cereal, and one of these items: sardine/tuna, dry meat or lentils (*González de Cossío T, et al., 2006*). The food baskets were aimed at a poor average-sized family (4.4 family members).
 3. Food basket with education (FBE): Households assigned to this group received the food basket and an education component which consisted of educational sessions on health and nutrition. Nutritional education sessions were focused on food groups, they promoted a healthy diet during pregnancy, childhood and school ages, and they promoted breastfeeding and adequate complementary feeding. Sessions also included prevention of overweight, physical activity and recommendations about food preservation (*Diconsa, 2003*).
 4. Cash transfer with education (CTE): Beneficiary households in the cash transfer group received an amount equivalent to the value of the food basket provided by PAL (\$150 Mexican pesos per month, equivalent to \$14 USD/month) and the same education sessions as group 3.
- The contents and quantity of the FB were determined according to compliance with food-related norms (*Secretaría de Salud, NOM-169-SSA1-1998*), after which an equivalent price was established as the amount to be transferred.

On average, the households surveyed spent roughly 66% of their total expenses on food; with reductions in this percentage at follow-up with respect to the baseline for all study groups. (*González de Cossío T, et al., 2006*).

Treatment allocation was carried out by the Ministry of Social Development.

Co-responsibilities

As part of their participation in the program, the beneficiaries had to fulfill certain responsibilities. The target population had to build democratically elected beneficiary committees to assume responsibilities for managing and operating the program implementing the education contents and receiving, unloading and distributing the food or cash. A person endorsed and recognized by the community was to preside over each committee in order to provide follow-up on the primary functions of the committee. Those functions included holding education sessions on nutrition, overseeing, evaluating and providing follow-up on the operations and management of the program and obtaining the support needed to strengthen the organization (*Rodríguez-Herrero H, 2005*).

Delivery of PAL Benefits

The beneficiaries received the food baskets or their cash equivalent through the system of DICONSA stores and with the support of the beneficiaries committee (*Rodríguez-Herrero H, 2005*).

Education Sessions

The education contents were transmitted using a cascade method in which an educator would periodically teach a group of persons in each region who, in turn, would be responsible for replicating the education sessions in their localities (facilitators). Usually, the facilitator in the communities would be the president of the beneficiary committee, who needed to have the trust and respect of the community of beneficiaries and at least a basic degree of schooling (*Rodríguez-Herrero H, 2005*).

Although some communities in the Food Basket without education group voluntarily set up education sessions themselves (*González-Cossío T, 2006*), we analyzed FBE and FB separately (using intention to treat) to test whether these two interventions had different effects.

Sample Selection

Before the program started, a two-stage random sample was selected to collect the baseline data. During the first stage, a simple random sample of 208 communities was drawn from the pool of all eligible communities, from a subset of the poorest states in the country (Chiapas, Guerrero, Oaxaca, Quintana Roo, Tabasco and Veracruz). The subset of poor states as well as the random sampling was conducted by the program evaluation division of the Ministry of Social Development (independent of the INSP-evaluation team). The Ministry contracted INSP for the external evaluation of PAL.

The 208 communities were randomly assigned to one of the 4 study groups. Given the known age composition of the populations in the target communities, 33 households per community would achieve the sample size of families with and without children needed to evaluate the program's

impact. A systematic random sample of 33 households within each community was selected for baseline data collection. Two communities were lost to follow-up because they refused to participate and the final analytical sample included 206 communities and 5,823 households (*Gonzalez de Cossío T, et al., 2006*), roughly 40% of which had children < 5 years (Fig. 1).

Study subjects included 2,627 children < 5 years of age at baseline from 206 beneficiary communities. This sample corresponds to children with complete data for body mass index at baseline and follow-up. A power analysis showed that the analytical sample was large enough (80.9%) to detect a difference of 0.2 SD in BMI/Age. The power calculation was based on a two-tailed test.

Variables

The study outcome was BMI/Age z-score in children < 5 years at baseline. We also analyzed this as a binary variable (presence of overweight and obesity in children under 5 years when BMI/Age > 2 SD and BMI/Age > 3 SD, respectively).

The main independent variable in this study was exposure to the program, expressed as pertaining to either: 1. Control group, 2. Food basket without education component, 3. Food basket with education component or 4. Cash transfer with education.

We developed a socioeconomic status index using factor analysis, and abstracted the first factor using the principal component abstraction method (*DiStefano C, et. Al., 2009*). The socioeconomic status of the households was obtained according to the characteristics for housing, possession of durable goods and services (floors, walls, ceilings, water, sanitary facilities and household appliances). The first component explained 61.7% of the total variation.

Data Collection

Mothers or caregivers reported all information regarding their children. Children were weighed and measured (length for those < 2 years and height for older children) at baseline. Fieldworkers who collected the anthropometric data were previously trained in interview techniques and standardized in anthropometric measures as described elsewhere (*Habicht JP. 1974*).

Statistical analyses

We compared baseline characteristics by study groups, including: sex, age, birth weight, breastfeeding, anthropometric nutritional status of children at baseline, maternal age, education, overweight, household socioeconomic status, ethnicity, food expenditure and total number of program benefits received (number of food baskets or cash transfers received).

A global significance test was used for each baseline characteristic (one-way ANOVA analyses for continuous variates and a chi-squared statistic for categorical variates).

We used an Analysis of Covariance (ANCOVA) model (*Jamieson J, 2004, Frison L, et al., 1992*) to estimate the effect of PAL on BMI/Age and on the prevalence of overweight and obesity in children. The estimator of the effect of ANCOVA is less variable than that for the differences-in-differences and

the comparison of means for the final stage. It was therefore decided to use the ANCOVA because of its greater statistical power (*Frison L, et al., 1992*).

All standard errors (S.E.) were adjusted for data dependencies at the community level using the Taylor series linearization (*Lohr SL, 2000*).

We contrasted each PAL group with the control group. Additionally, we performed pairwise comparisons to estimate differential effects of PAL between study groups with interventions.

The model was defined as follows:

$$ZBMI_{ki}^{follow-up} = \beta_0 + \beta_1 ZBMI_{ki}^{baseline} + u_{ki}$$

Where i is the subject index and k the community index.

To evaluate the heterogeneous effects of PAL, we estimated the effects of PAL on BMI/Age for each of the following categories: socioeconomic status, ethnicity, maternal education, overweight, child's age group, and whether or not there was stunting at baseline. These heterogeneous effects of the program were estimated separately for each of these characteristics. For each model, interaction terms of study groups with the corresponding covariate were specified.

The assumptions of the normality and linearity of the regression models were evaluated.

We conducted intent-to-treat analyses (*Gupta SK, 2011*). The interactions were considered statistically significant at $p < 0.10$ (*Hosmer DW, Lemeshow S. 2000*) and the main effects were considered significant when the estimators presented a $p < 0.05$.

The WHO macro program for Stata (*WHO Anthro, 2011*) was used to establish the nutritional status of children using WHO 2006 standards.

Statistical analyses were performed with Stata v.12 (*Stata Corp. 2011. Stata Statistical Software: Release 12. College Station, TX: Stata Corp LP*).

Data used in this paper were supplied by a previous study (*González-Cossío, T, et al. 2006*), which was approved by the Research Ethics Committee from the Mexico National Institute of Public Health (Instituto Nacional de Salud Pública, INSP).

Results

A total of 2,627 children with complete data were analyzed (Figure I). Baseline characteristics were compared between children included and excluded from the analysis; no differences were found. Results showed that missing values had a random distribution.

There was a baseline prevalence of 7.3% for overweight and 1.2% for obesity in children < 5 years. More than a quarter of the children (27.7%) belonged to indigenous households and more than half of the mothers had a primary education or less. There were no statistically significant differences between the comparison groups in any of the baseline characteristics (Table I).

To determine the effect of PAL on the outcome of interest, we made all possible comparisons between the study groups (every PAL intervention group versus control group and every PAL intervention group versus every other intervention group).

The prevalence of child overweight or obesity did not increase for any of the PAL groups, suggesting that PAL did not adversely affect the BMI/Age of beneficiary children.

We compared the number of benefits received (number of in-kind or cash transfers received) in each intervention group and analyzed this variable to identify whether or not there was heterogeneity in the number of benefits received according to study group. This provided an additional element to explain our findings. The mean benefits received by all beneficiaries was 13.14 ± 0.27 S.E. The mean benefits received was 13.28 ± 0.44 S.E. for the FB group and 13.84 ± 0.50 S.E. for the FBE group; the mean for the CTE group was 12.32 ± 0.43 S.E. Although there was a statistically significant difference for this variable between the CTE and FBE groups ($p=0.024$), we did not find a statistically significant association between the number of benefits received and any of the outcome variables (BMI/Age z-scores, overweight, and obesity). The distribution of this variable did not differ across variables used in the heterogeneity analysis.

With regard to the effect of PAL on the outcomes of interest, no statistically significant differences were found between each of the three intervention groups and the control group; this was also the case for BMI/Age, overweight and obesity in children (Table II and Table III).

When comparing the differential effects of PAL among intervention groups, we found that the mean BMI /Age z-scores at follow-up for the food basket with education group (FBE) was 0.12 ± 0.05 lower than that for the food basket without education group (FB) ($p = 0.035$), after adjusting for BMI/Age at baseline. There are indications that the mean BMI/Age z-scores at follow-up for the cash transfer group was higher than those for the food basket with education group ($p = 0.063$) (Table III). These differences were maintained after adjusting for stunting at baseline and stunting at follow-up (data not shown).

Most children with normal BMI/Age at baseline continued to be normal at follow-up (94.82%).

A substantial proportion (55.70%) of children who were overweight at baseline had a normal BMI/Age at follow-up. The percentage of children with normal weight for length/height at baseline who became overweight at follow-up was 3.62%, and the percentage with stunting at baseline who became overweight at follow-up was 3.45% (Fig. 2). In Figure 2 we may also observe that children with a higher BMI/Age at baseline did not gain excess weight at follow up, while several stunted children at baseline attained a normal weight at follow-up.

Heterogeneous Effects

The effect of PAL differed across relevant maternal and child characteristics.

When evaluating heterogeneous effects for each variable of interest with respect to the control group, we found that the children in the FBE group had lower BMI/Age z-scores than those in the control group among households with medium socioeconomic status ($p=0.084$), indigenous children ($p=0.068$), children whose mothers were not overweight ($p=0.011$) and children who did not present stunting at baseline ($p=0.050$) (Table IV).

In terms of the heterogeneous effects of PAL among intervention groups, the results show that children in the FBE group had lower BMI/Age z-scores than those in the FB group in the cases of lowest socioeconomic status ($p=0.025$), indigenous children ($p=0.068$), whose mothers had a primary education ($p=0.022$), mothers with overweight ($p=0.027$), children 0 to 24 months at baseline ($p=0.057$) and children not stunted at baseline ($p=0.030$) (Table IV).

Similarly, we found heterogeneous effects when comparing the FBE group and the CTE group. As with the FBE/FB contrast, children in the FBE group had lower BMI/Age z-scores than children in the CTE group in the case of children with the lowest socioeconomic status ($p=0.005$), indigenous children ($p=0.001$), children whose mothers did not have formal education ($p=0.100$), children 24 to 60 months at baseline ($p=0.086$) and children not stunted at baseline ($p=0.053$) (Table IV).

Discussion

The results of this study show that PAL does not contribute to unhealthy weight gain in beneficiary children. None of the study's three interventions had an effect on overweight in children. Additionally, the BMI/Age z-scores from baseline to follow-up for the food basket with education (FBE) group was lower than those for the control group and those that received cash transfers or food baskets without education.

We also documented some heterogeneous effects of the program in relation to some child, maternal and socioeconomic characteristics that have been shown previously to be associated with excessive weight gain in children (*Shrewsbury V, et al., 2008; Olaiz G, et al., 2006; Sassi F, 2001; Gewa CA, 2009; Hoffman DJ, 2000*).

In this study, BMI/Age z-scores for the FBE group remained lower than those for the control group and the rest of the intervention groups. This was the case for the FBE group as a whole and across all the socio demographic and anthropometric variables used to evaluate the heterogeneity of the impact of the program. There were statistically significant differences between BMI/Age z-scores for the FBE group as compared to the control group among children with a medium socioeconomic status, indigenous children, children of mothers who were not overweight and children who were not stunted at baseline. Our results further indicate that children in the FBE group did not increase their risk of overweight (as a dichotomous variable) as a result of PAL.

The evidence from this study is suggestive that education sessions contribute to maintaining a healthy weight for length/height in children of beneficiary households.

The mechanisms for this effect may involve a change in knowledge and attitudes among mothers and caregivers toward healthy eating behaviors (*Prochaska JO, et al., 1997; Spahn JM, et al., 2010*). It is not possible to examine this in more detail in the present study because we do not have information for this study population regarding changes in attitude and behavior toward food. The nutrition education sessions focused on promoting breastfeeding and complementary feeding and made recommendations for a healthy diet during pregnancy, childhood and school ages. In addition, these sessions focused on physical activity, children's growth and prevention of overweight (*Diconsa, 2003*).

Another factor that contributes to explaining our results is that a previous study about PAL showed evidence that children who received food baskets with education had a higher intake of bioavailable iron and zinc than those in the control and cash transfer groups (*González de Cossío T, et al., 2006*). The consumption of zinc has been related to an increase in the linear growth of children (*Bhutta ZA, et al., 2008*). The data from our study shows that children in the FBE group had lower BMI/Age z-scores than those in the control group and children in the FB group; this could be explained in part by a greater linear growth for children in the FBE group.

The results of this study are consistent with previous studies that show evidence of the effect of nutrition education on outcomes related to nutrition, such as: exclusive breastfeeding (*Bhutta ZA, et al., 2008; Thakur SK, 2012*), decrease in or prevention of overweight in children and adolescents (*In-lw S, et al., 2012; Silveira JA, et al., 2013*), decrease in the prevalence of stunted growth in childhood (*Penny ME, et al., 2005*) and increase in weight and height in children (*Santos I, et al., 2001; Imbad A, 2011*).

Strengths

The main strength of this study is the experimental design used to evaluate the impact of PAL. We carried out a randomized study (*Sørensen HT, et al., 2006*), which minimized the risk of selection bias (*Hernán MA, et al., 2004; Westreich D, 2012*). This enhances the internal validity of our results because randomization makes groups equivalent in terms of observed and unobserved characteristics (*Lachin JM, 1988*) and, therefore, the control group provides a valid estimate of the counterfactual. We did not find significant differences among the study groups for any characteristics of interest, which indicates that the randomization was effective. In addition, in sensitivity analysis, we estimated the effect of PAL on the outcomes of interest with the differences-in-differences method (*Bertrand M, 2004*) and we found the same results, though the statistical power was lower than with the ANCOVA method.

Furthermore, the possibility of selection bias (*Hausman JA, et al., 1979; Grasdahl A, 2001*) is minimal because when analyzing the general characteristics of children excluded from the analysis and comparing them with children included, we did not find statistically significant differences.

Finally, the results of this study have strong external validity because communities were randomly selected from a pool of eligible communities from southern and eastern regions of Mexico. Thus, our results can be generalized to population similar to the analyzed sample in terms of poverty and rurality.

Limitations

The results of the final follow-up report of the study communities indicated that approximately half of the beneficiaries in the food basket without education group did receive some type of education session on nutrition or health. These sessions were organized as an initiative of the facilitators of PAL at the local level (*González de Cossío T, 2006*). We have no data on the type, frequency, and quality of

the education sessions as implemented in the FBE or FB communities. As a consequence, we could not compare the differences between the content of education sessions in FBE and FB for the purpose of explaining the effect found on the FBE group. However, given that we used intention-to-treat analysis, the voluntary implementation of education in the FB communities would tend to minimize the difference between FB and FBE groups (rather than account for it).

Another limitation of this study was that we had a small sample size for the analysis of the heterogeneous effects of PAL. This factor can make it difficult to detect those effects, even when they exist, but this factor cannot explain the significant heterogeneous effects that were documented here.

Importance of study

This study is important because it is the only one to use a randomized experimental design to evaluate the impact of a large-scale Mexican food program on an adverse result, such as excessive weight gain, in beneficiary pre-school age children.

In Mexico, the highest increases in obesity among different age groups has been observed in the indigenous population, socioeconomic status quintiles 5 and/or 4 and in rural areas (*Secretaría de Salud de México, Seguro Popular. 2012*). Because the low-income population has shown the largest increases in obesity, it is important to evaluate the possible effect of social development programs—especially those with in-kind or cash transfers—on the increase in overweight in the population they serve. Our findings are useful to public policy because, while previous studies have found that PAL and other programs have increased overweight in beneficiary women (*Fernald LCH, et al., 2008; Leroy JL, et al., 2013*) we found that PAL does not increase the risk of overweight in beneficiary children. In addition, this study suggests that the nutrition education sessions provided by PAL may have positive effects in preventing excessive weight gain. This is an important finding for policy purposes because many countries will need to design and implement effective interventions to combat undernutrition without increasing overweight in the target population. Finally, this study suggests that the effects of food and cash transfers on BMI/Age, and the moderating effects of nutrition education, can vary across child, maternal and socioeconomic characteristics, such that programs may require a substantial amount of contextual tailoring in order to optimize nutritional outcomes.

Future research

Future research is necessary to evaluate the contents and quality of strategies such as the nutrition education interventions provided by PAL.

Additionally, food availability within rural and poor communities that receive cash transfers needs to be evaluated. This will be useful to obtain evidence about the food choices made by the beneficiaries of such interventions in their particular contexts. In this sense, we must assess whether interventions

like those included in PAL cause a change of behavior toward healthier food choices through the promotion of non-obesogenic behaviors, such as a better nutrition and increased physical activity. More in-depth investigations are also needed in terms of the process to implement programs, in order to better explain the results obtained from the evaluation of impact. Therefore, aspects need to be evaluated such as conditions related to the availability of programs, delivery and distribution to beneficiaries and the quality of the transferences.

It is also important to evaluate the fulfillment of the beneficiaries' co-responsibilities, the organization within the community and the cost to beneficiaries involved in accessing aid. These factors could affect the effectiveness of the programs (*Pelletier DL, et al., 2011*).

Conclusions

It is important to take into account that the PAL program was not designed to prevent or avoid overweight in children. Nevertheless, we found that PAL did not increase overweight in beneficiary children.

Furthermore, the program had an effect on the FBE group, as seen by the BMI/Age z-score in this group having decreased and it not having a harmful effect on beneficiary children.

Finally, our findings show heterogeneous effects of PAL, since BMI/Age z-scores for the FBE group were lower than those for the control group in the cases of medium socioeconomic status, indigenous children, children of women without overweight and children not stunted at baseline.

Recommendations

We recommend implementation and evaluation of programs that use strategies with proven evidence of effectiveness in reducing undernutrition while simultaneously not increasing overweight in beneficiary children.

It is necessary to design, implement and evaluate effective communication and education strategies to complement cash and in-kind transfer programs similar to PAL in order to increase healthy food choices and prevent adverse outcomes such as overweight.

In addition, so that programs similar to PAL achieve the effectiveness expected, assumptions need to be verified, such as the execution of programs taking into account the particular contexts that make their implementation possible (access to infrastructure, social and cultural conditions) and there being adequate mechanisms to operate the program.

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Declaration of conflict of interests

The authors declare that they have no conflict of interests.

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Tables and figures

Table I. Baseline characteristics of participants, by treatment group in the study of effectiveness of PAL in rural Mexico

Characteristics of Participants	All		Control Group		Food Basket without education		Food Basket with education		Cash transfer with education	
	n	Mean $\pm$ s.d or %	n	Mean $\pm$ s.d or %	n	Mean $\pm$ s.d or %	n	Mean $\pm$ s.d or %	n	Mean $\pm$ s.d or %
Children 0 to 5 years										
Age (months)	2627	30.7 $\pm$ 17.2	637	30.3 $\pm$ 17.2	675	31.0 $\pm$ 17.1	644	30.5 $\pm$ 17.1	671	31.1 $\pm$ 17.3
Sex (boys, %)	2627	52.2	637	52.9	675	53.7	644	52.9	671	49.3
Birth weight (kg)	1400	3.2 $\pm$ 0.5	344	3.1 $\pm$ 0.6	362	3.1 $\pm$ 0.5	335	3.2 $\pm$ 0.5	359	3.2 $\pm$ 0.5
Breastfeeding (Yes, %)	1851	23.4	460	22.6	475	24.0	445	21.7	471	25.2
BMI/Age (z-score)	2627	0.51 $\pm$ 1.04	637	0.48 $\pm$ 1.04	675	0.52 $\pm$ 1.09	644	0.47 $\pm$ 1.05	671	0.58 $\pm$ 0.99
Stunting (Yes, %) ¹	2622	27.6	637	28.5	674	29.5	642	23.6	669	28.5
Wasting (Yes, %) ²	2627	1.1	637	1.2	675	1.3	644	0.9	671	0.8
Overweight (Yes, %) ³	2627	7.3	637	6.9	675	8.5	644	6.5	671	7.4
Obesity (Yes, %) ⁴	2627	1.2	637	1.5	675	1.6	644	1.3	671	1.0
Mothers										
Age (years)	2530	27.7 $\pm$ 6.8	614	27.5 $\pm$ 6.8	660	27.8 $\pm$ 6.8	617	27.7 $\pm$ 6.8	639	27.7 $\pm$ 6.5
Education	2537		615		660		620		642	
Without formal education (%)		16.6		17.4		18.3		16.6		14.3
Primary (%)		57.2		54.9		53.6		61.9		58.7
Secondary (%)		20.0		21.3		21.6		15.3		21.6
High School (%)		4.5		4.3		4.6		5.6		3.5
Professional (%)		1.1		1.3		1.5		0.4		1.2
Overweight and obesity (Yes, %) ⁵	2288	51.9	555	49.9	587	54.0	560	51.7	586	51.8
Households										
Socioeconomic status (SD)	2603	0.0 $\pm$ 1.0	629	0.05 $\pm$ 1.00	670	-0.00 $\pm$ 1.01	640	-0.04 $\pm$ 0.97	664	-0.00 $\pm$ 1.00
Socioeconomic Status Levels										
Lowest Level (%)		33.3		32.4		33.5		33.9		33.4
Medium Level (%)		33.3		35.6		32.5		34.2		31.3
Highest Level (%)		33.3		31.9		33.8		31.8		35.2
Indigenous Ethnicity (Yes, %)	2627	27.5	637	30.4	675	33.7	644	18.0	671	27.8
Household food expenditures (MXP/week) ⁶	2592	211.2 (144.3,368.2)	624	236.0 (146.2,391.6)	669	178.4 (86.5,360.9)	642	233.4 (145.7,434.6)	657	198.9 (146.6,366.6)

1.Height for Age, z-score <-2.0 s.d ; 2.Weight for Height for Age, z-score <-2.0 s.d;

3. BMI/Age, Z-score>2.0 s.d; 4. BMI/Age, Z-score >3.0 s.d; 5. BMI $\geq$ 25 kg/m²;

6. Geometric means in Mexican pesos from February 2013 and interquartile intervals in parenthesis, adjusted by adult equivalents. *All estimates were adjusted for design.

Table II. Body Mass Index for Age, Overweight and Obesity: estimates by comparison group.

Variable	Control group (n=637)	Food basket without education (n=675)	Food basket with education (n=644)	Cash Transfer with education (n=671)
Body Mass Index-for-age (z-scores)				
Baseline, 2003-2004	0.48 (0.39,0.59)	0.52 (0.43,0.63)	0.47 (0.39,0.59)	0.58 (0.48,0.68)
Follow-up, 2005				
Post ¹	0.50 (0.38,0.62)	0.55 (0.44,0.65)	0.40 (0.30,0.51)	0.57 (0.48,0.65)
Change for simple differences ²	0.02 (-0.08,0.12)	0.02 (-0.07,0.12)	-0.08 (-0.15,-0.01)	-0.02 (-0.10,0.06)
Adjusted mean ³	0.52 (0.42,0.62)	0.54 ^a (0.47,0.62)	0.43 ^a (0.35,0.50)	0.53 (0.45,0.60)
Overweight (%)[‡]				
Baseline, 2003-2004	7.3 (4.9,9.4)	9.2 (6.4,12.1)	7.0 (4.9,9.1)	7.2 (5.3,9.0)
Follow-up, 2005				
Post ¹	6.9 (4.4,9.4)	7.0 (4.6,9.3)	6.8 (4.5,9.1)	8.2 (5.7,10.7)
Change for simple differences ²	0.0 (-2.6,2.6)	-1.6 (-4.8,1.5)	0.3 (-1.5,2.1)	0.7 (-1.4,2.9)
Adjusted mean ³	7.1 (4.7,9.6)	6.7 (4.4,9.0)	7.1 (5.0,9.1)	8.0 (5.9,10.1)
Obesity (%)[¥]				
Baseline, 2003-2004	1.23 (0.4,2.6)	1.56 (0.6,2.4)	1.38 (0.6,2.1)	1.08 (0.0,2.0)
Follow-up, 2005				
Post ¹	2.4 (0.9,3.8)	1.5 (0.4,2.5)	1.7 (0.6,2.8)	1.3 (0.4,2.3)
Change for simple differences ²	0.8 (-0.6,2.2)	-0.1 (-1.2,0.9)	0.3 (-1.0,1.6)	0.3 (-0.9,1.5)
Adjusted mean ³	2.4 (1.0,3.7)	1.4 (0.4,2.3)	1.8 (0.7, 2.9)	1.4 (0.5,2.3)

‡BMI/Age, z-score>2.0 s.d;

¥BMI/Age, Z-score >3.0 s.d

1. Mean (CI 95%) at follow-up

2. Mean (CI 95%) change from baseline BMI/Age to follow-up

3. Mean (CI 95%) at follow-up adjusted by baseline BMI/Age (ANCOVA MODEL)

a. Food Basket with Education different from Food Basket without Education, p=0.035

Figure 1. Trial Profile

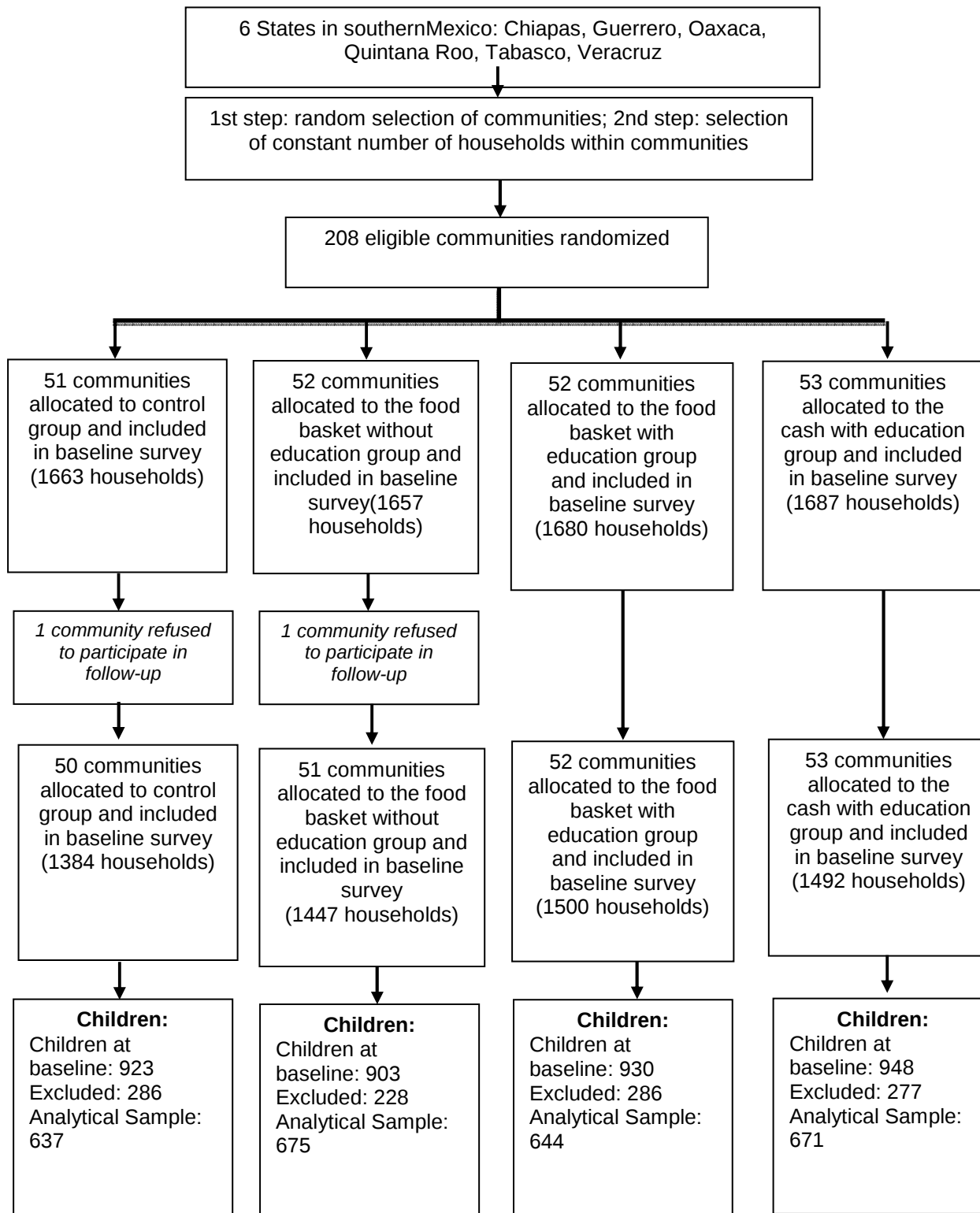
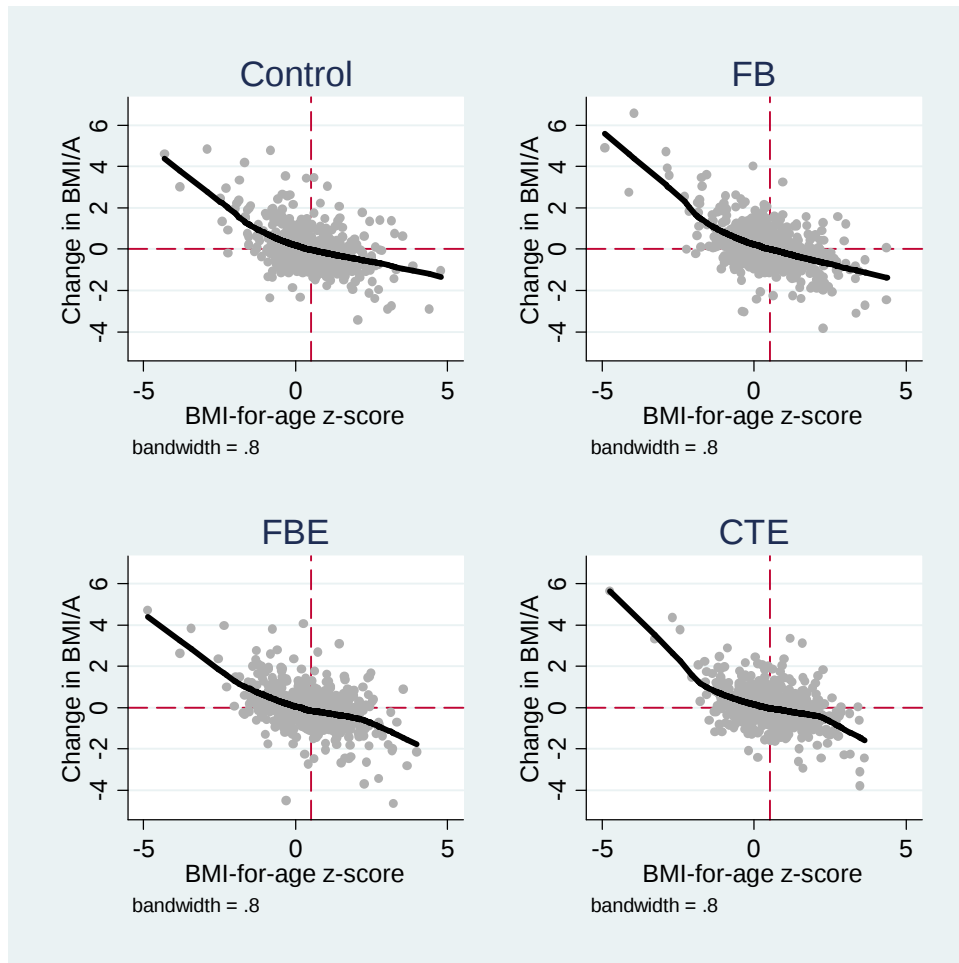


Figure 2. Change in BMI/Age from baseline to follow-up by comparison group



7. ARTÍCULO ANALÍTICO 2.

Effect of a Food Aid Program on Body Mass Index of Mexican Children, Mediated by Diet
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Running Title: Mediation of diet in the effect of PAL on BMI/Age

Key words: Body mass index, childhood obesity, diet, impact evaluation, nutrition.

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Abstract

Objective: To evaluate the role of the diet as a potential mediating variable in the effect of a Mexican Food Aid Program (Programa de Apoyo Alimentario, PAL) on Body Mass Index for Age (BMI/Age) of <5 y.

Design: Secondary analysis of a program impact evaluation using a cluster randomized control effectiveness trial design.

Setting: Poor and rural households in southern Mexico.

Subjects: We analyzed a sample of 2,100 beneficiary children < 5 y from 206 communities that were randomly assigned to receive monthly transfers of either a food basket, with (FBE) or without (FB) an education (E) component, or cash with E (~14 USD/month) vs. a control group. We used a path analysis model to analyze the effect of PAL on BMI/Age of beneficiary children and the role of diet in this effect.

Results: Children in the FBE group had lower BMI/Age z-scores than those in the control group ($p=0.027$). This effect was explained by a higher fruit and vegetables consumption and a lower sweets consumption by children belonging to the FBE group.

Conclusions: A food basket distributed together with nutrition education was associated with a reduction in BMI/Age. This result is likely due to nutrition education since the food basket did not include fruits and vegetables which were consumed in higher amounts by this group. Our findings indicate that the addition of nutrition education to food transfer programs can improve health weight gain among preschoolers by improving the quality of the diet.

Keywords: Body mass index, childhood obesity, diet, impact evaluation, nutrition.

Introduction

Stunting has decreased in most regions of the world (*Black RE, 2013*) while overweight and obesity have been rapidly increasing in children worldwide (*De Onís, 2010*), and in Latin America (*Rivera JA, et al, 2013*) and often higher in rural than in urban settings (*Blankenau J, 2009*). This is a serious public health problem because weight at age 5 y is a predictor of future health of the individual (*Brophy S, 2009*), and related to chronic disease later in life (*FlegalKM, 2005*).

Obesity is influenced by environmental and dietary factors, one of which is the consumption of low-quality foods that are typically higher in calories (*Bleich SN, 2013*). Diets poor in micronutrients and dense in energy are common in poor populations and contribute to the burden of malnutrition.

Furthermore, diet is associated with accessibility to food, and having time to purchase and prepare it, as well as information and knowledge about what constitutes a proper diet (*Drewnowski, 2010*).

Mexico is undergoing a nutritional transition characterized by changes in eating patterns and physical activity that have led to increases in chronic diseases related to overweight and obesity. Excess weight has been associated with a high intake of calories and decreased micronutrients, fiber and physical activity (*Rivera, 2004*), and the prevalence of overweight and obesity in preschool children has recently increased, especially amongst the poor (*Rivera JA, 2013, Gutiérrez JP, 2012*).

While many interventions have been implemented in Mexico to decrease child under nutrition, especially among the poor, there has been concern over the past decade about whether poverty alleviation programs (cash or in-kind transfers) contribute to overweight and obesity in their beneficiary population (*Leroy JL, 2013, Morales-Ruán MC, 2013*).

Food aid programs in Mexico are intended to improve human capital through improvements in nutritional status (*CONEVAL, 2012*). So far, these success programs have focused on mitigating stunting and other nutritional deficiencies of vulnerable groups (*Barquera S, 2001, Rivera JA, 2004*), but increasing overweight and obesity rates have negatively affected the country. The potential negative effect of food aid programs on the weight of the target population is an increasing concern in the national nutrition public policy agenda.

The *Programa de Apoyo Alimentario* (Food Support Program; PAL, Spanish acronym) was implemented by the Mexican government to address the nutritional needs of poor rural communities that could not benefit from the *Oportunidades* program. This large Human Development Program transfers its benefits through schools and health centers; but thousands of Mexican communities lack these facilities. Thus, PAL was designed to be targeted to these isolated rural communities (*Secretaría de Desarrollo Social, 2004*). PAL offered a food basket to beneficiary households of target communities. Food baskets complied with the Mexican Official Norm for aid programs (*Secretaría de Salud, NOM-169-SSA1-1998*) which stipulated that food baskets should provide at least 20% of the recommended daily energy and protein requirements of an average-sized household. For those very isolated communities where food basket transportation was costly, a cash transfer was envisioned, offering an amount equivalent to the federal cost of the basket.

Previous analyses have shown that PAL had positive effects on the nutritional status of beneficiary children, such as increasing children's linear growth (*González de Cossío T, 2008*), and increasing the consumption of fruits and vegetables in households thus improving intake of fiber, iron, zinc and vitamins A and C, but also a significant increase in the household's energy consumption (*Leroy JL, 2010*). Moreover, our previous findings indicate that PAL did not contribute to unhealthy weight gain in young children and that the addition of educational sessions for recipients of transfers may have contributed to beneficiary children's healthier weights.

Therefore, the present study evaluates the role of the diet as a potential mediating variable in the effect of a Mexican Food Aid Program (Programa de Apoyo Alimentario, PAL) on Body Mass Index for Age (BMI/Age) of <5 y.

Methods

Design

This study is a secondary analysis of an impact evaluation program, which was based on a cluster, randomized control effectiveness trial. Data used in the current study correspond to the information collected at baseline in 2003 and at follow-up in 2005.

Eligibility Criteria

To be eligible to receive PAL, communities must have been rural (≤ 2500 inhabitants) have high or medium marginalization index according to the Mexican National Population Council (*CONAPO, 2001*), and be registered and geo-referenced in the territories catalog of the National Institute of Statistics, Geography and Informatics (*Secretaría de Desarrollo Social, 2004*). Communities receiving other federal food aid programs, such as Oportunidades or LICONSA were not eligible.

Interventions/Study Groups

To evaluate PAL's impact on nutritional status of beneficiary children and households, either its cash or basket mode, an impact evaluation trial was designed. The selected communities were randomly allocated to one of four study groups: control group (C), food basket without education (FB), food basket with education (FBE) or cash transfer with education (CTE). Treatment was randomly allocated by personnel of the Ministry of Social Development. Communities assigned to the control group were put on a waiting list for incorporation into the program immediately after program evaluation finished, in its scaling-up efforts.

The food basket: contains beans, rice, corn flour, powdered fortified milk (zinc, vitamin C, iron, folate), noodle soup, vegetable oil, cookies, powdered chocolate, corn starch, ready-to-eat cereal, and one of the following items: sardines/tuna, dry meat or lentils (*Leroy JL, 2010*). The food baskets were aimed at average-sized families of 4.4 members.

Cash Transfers: Beneficiary households in the cash transfer group received 150 Mexican pesos per month (equivalent to 14 USD).

Educational Sessions: The education component consisted of monthly educational sessions on health and nutrition as part of the co-responsibilities. The nutritional education sessions focused on promoting breastfeeding and complementary feeding, and recommendations for a healthy diet during pregnancy, childhood and school ages. In addition, these sessions incorporated lessons on physical activity, children's growth and the prevention of overweight (*Diconsa, 2003*). The educational contents were provided by facilitators. The cascade method was used, in which an educator periodically teaches people in each region and those people are then responsible for replicating the teachings in their communities. The facilitator in the community was usually the president of the PAL beneficiary committee, a position requiring at least a basic level of knowledge and schooling (*Rodríguez-Herrero H, 2005*).

Communities not assigned to receive nutrition and health sessions, organized themselves to receive them independently of the program (*González de Cossío T, 2006*). Thus, there were no true communities without the educational component, and the treatment distinction between FBE and FB is not clear. Nevertheless, impacts of the FBE and FB mode were analyzed separately (based on intention to treat).

Delivery of PAL Benefits: The equivalent of two months' worth of benefits, baskets or cash, were provided every other month to the beneficiaries through the DICONSA store system with the support of the beneficiaries committee (*Rodríguez-Herrero H, 2005*).

Sample Selection

A random sample of communities was selected to collect baseline data. This process was carried out in two stages. In the first stage, a simple random sample of 208 communities was drawn from the list of all eligible communities, from a subset of the poorest states in the country. These states were Chiapas, Guerrero, Oaxaca, Quintana Roo, Tabasco and Veracruz. The determination of the subset of poor states and the random sampling was conducted by the program evaluation division of the Ministry of Social Development (independent of the INSP-evaluation team). The Ministry contracted the INSP for the external evaluation of PAL.

The communities that were chosen were randomly assigned to 1 of the 4 study groups. Taking into account the known ages of the populations in the target communities, 33 households (with and without children) per community was determined to be an adequate sample size to evaluate the program's impact. Therefore, the collection of baseline data involved the selection of 33 households within each community based on a systematic random sample. Two communities were lost at follow-up because they refused to participate, thus, the final analytical sample included 206 communities and 5,823 households (*Gonzalez de Cossío T, 2006*), roughly 40% of which had children < 5 years of age (Fig. 1).

Study subjects included 2,100 children < 5 years of age at baseline from the 206 beneficiary communities. This sample included to children with complete data for body mass index and energy intake at baseline and follow-up.

Data Collection

Dietary information from children 6 to 59 months baseline was obtained using a 24-hour (24h) recall. The child's mother or caregiver gave the information. In 2005 another 24-hr recall was obtained again for the same children.

Fieldworkers were trained in interview techniques (24-hr recall method) and standardized in anthropometric measurements (*Habicht JP. 1974*).

Variables

Dependent Variables

The dependent variable in this study was BMI/Age z-score at follow-up in children (< 5 y at baseline). Dietary variables used were: a) fruit and vegetables consumption (expressed as quintiles of energy consumption from fruits and vegetables) and b) sweets consumption (expressed as quintiles of energy consumption from sweets).

Taking into account the Path Analysis model we applied, the diet variables were also considered as endogenous (or dependent) variables that act as mediators because they depend, in turn, on other variables such as each modality of PAL (FBE, FB, CTE) sex, ethnicity, SES and age (Figure 2).

Independent Variables

The main explanatory variable was exposure to the program according to group: 1. control, 2. food basket without education, 3. food basket with education or 4. Cash transfer with education.

The covariates sex, age, ethnicity (defined as indigenous or not indigenous), household socioeconomic status and BMI of mothers were also included. These covariables were included in the final model because they are related to the outcomes of interest and explain a significant part of the variability in the dependent variables; therefore, their inclusion makes the model more efficient.

Anthropometry: The WHO macro program Stata (*WHO Anthro, 2011*) was used to establish the nutritional status of children based on WHO 2006 standards.

Dietary variables: To analyze dietary variables twenty-three previously determined food groups were analyzed (*González de Cossío T, 2006*) and the frequency of consumption from each group was calculated. Fruits and vegetables (FV) and Sweets were shown to vary the most, and did not have the problem of a high density of zeros (22.9% reported not consuming FV and 18.9% reported not consuming sweets). Consumption was categorized according to quintiles in order to overcome the problem of a high frequency at the zero consumption level. Taking this problem into account was important because sufficient variation in the variables was needed in order to explain changes in the BMI/Age variable. The greater the variability in diet variables the more efficient the final models. In

addition, fruits and vegetables as well as sweets are variables that make it possible to generally characterize diet for an outcome such as BMI/Age.

Household socio economic status index: it was developed using factor analysis, and the first factor was abstracted with the principal component abstraction method (DiStefano C, et al., 2009), based on housing characteristics and possession of durable goods and services (floors, walls, ceilings, water, sanitary facilities and household appliances). The first component explained 61.7% of the total variation.

Values were missing for some of the covariates (0.8% for the social economic status index, 3.0% for mother's educational level and 12.0% for mother's BMI); these were imputed using the median at the cluster level.

Statistical Analysis

Baseline characteristics of the four groups were compared to test for differences in sex, age, birth weight, breastfeeding, anthropometric nutritional status of children at baseline, mother's age, education, overweight of mother, household socioeconomic status, ethnicity and dietary variables.

A global significance test was used for each baseline characteristic (one-way ANOVA analysis for continuous variates and chi-squared test for categorical variates).

Evaluation of the effect of PAL on BMI/Age, mediated by diet

Path analysis (Kline RB, 2011) was used to estimate the effect of PAL on child BMI/Age, and to test if this effect was mediated by diet. This approach can be used to test hypothesized causal relationships between sets of observed variables. The model was established based on the most current scientific literature (Figure 2) and specified double directionality (Paxton PM, 2011) between diet and BMI/Age. Path analysis was used to estimate, the total, the direct, and the indirect (i.e., mediated by diet) effects of each PAL group in predicting children BMI/Age z-score as follows:

Total effect= Direct effect + Indirect effect.

Direct effect: The direct effect of each PAL intervention group on BMI/Age represents that part of its total effect not mediated by diet (quintiles of consumption of fruits and vegetables and quintiles of consumption of sweets in our case) (Fig 2).

Indirect effect: represents the sequence of paths through one or more intermediate variables. The indirect effects of each PAL group on BMI/Age, via diet, were generated as the product of regression coefficients (the regression coefficient of BMI/Age z- score regressed on the diet variables multiplied by the coefficient of the diet variables regressed on the PAL groups) (Fig. 2). Due the non-recursive nature of our model these effects incorporate return effects. Return effects refers to the effect in the opposite direction of a determined path, that is, the double causality (or double directionality) between diet variables and BMI/Age.

All equations were estimated simultaneously. Each PAL group was contrasted with the control group. Intent-to-treat analysis was conducted (*Gupta SK, 2011*), and significance was set at 0.05 and results at the 0.1 were reported as indicative of associations.

All estimates were adjusted for the cluster sampling design.

Baseline comparisons and data imputation were performed with Stata v.12 (*Stata Corp. 2011. Stata Statistical Software: Release 12. College Station, TX: StataCorp LP*). Path analysis was conducted with Mplus 7.1 using weighted least-squares with mean and variance adjustment (WLSMV) method and theta parameterization taking into account data dependencies at the community level (*Muthén LK, 2012*).

The original study (*González-Cossío, T, et al. 2006*), was approved by the Research Ethics Committee of the Mexico National Institute of Public Health (Instituto Nacional de Salud Pública, INSP). Written informed consent was obtained from the mother or head of household in each household.

Results

A total of 2,100 children who had complete information about anthropometric nutritional status and diet were analyzed (Figure 1). A comparison of characteristics at baseline showed no significant differences between study groups for any of the characteristics analyzed (Table I).

A total of 52.0% of the children were male. Average maternal age was 27.5 ± 6.7 y. In terms of education, 14.4% of the mothers had no formal education, 58.1% had completed elementary school, 20.9% had completed junior high school, 4.9% high school and 1.2% college.

A total of 8.1% of the children studied were overweight and 1.4% obese (Table I). There were no statistically significant differences in the prevalence of overweight and obesity, or food consumption between study groups.

The most consumed foods were high fiber cereals, fruits and vegetables, fats and oils and sweets.

The main results from this study are presented in Table II. The most relevant findings are described below, by type of effect (direct, indirect and total).

Direct Effects

Results from path analysis are shown in Table II. We present the direct, indirect and total effects of PAL on outcomes (BMI/Age and diet), as well as the role of diet on BMI/Age.

Results show that the direct effect of energy consumption from fruits and vegetables and child BMI/Age was strongly negative, while that between consumption of sweets and BMI/Age strongly positive.

Estimation of the direct effect of PAL on BMI/Age show that children in the CTE group had a higher BMI/Age than those in the control group, without adding up mediation effects ($p=0.064$). No significant direct effects of PAL were found on BMI/Age for either the FB or the FBE group.

The direct effect of PAL on the consumption of energy from fruits and vegetables, show that children in groups receiving in-kind transfers (FB and FBE) had a higher probability of consuming high levels of fruits and vegetables than children in the control group ($p=0.082$ and $p=0.098$, respectively). No direct effects of PAL were found on the consumption of energy from fruits and vegetables for the CTE group, nor were any direct effects found on the consumption of energy from sweets.

Indirect Effects

Indirect effects were those reflecting the mediating role of diet on PAL's effect on the BMI/Age. Results show that the effect of PAL on the BMI/Age in the FBE group was mediated by diet ($p=0.027$); i.e., children in the FBE group had lower BMI/Age than those in the control group as a result of the effect of this intervention on diet. The results indicate that this mediation is primarily due to greater consumption of FV by children in the FBE group ($p=0.098$) as compared to the control group. There is also some evidence of a similar mediation of diet for the CTE group ($p=0.087$).

The effect of PAL on the BMI/Age of the FB group was not mediated by diet ($p=0.255$).

With respect to variables other than those considered by PAL, the results show that the age of the child, sex and the socio-economic level of the household were indirectly associated with the BMI/Age z-scores of the children and that this also mediated by diet. Specifically, while older children had a greater probability of a high consumption of FV ($p<0.001$), the probability of consuming more sweets did not significantly change; these dietary associations resulted in a lower BMI/Age. Males had a greater probability than females of a high consumption of sweets ($p=0.004$) while no significant differences were found between sexes for the consumption of FV. The dietary differences resulted in males having a higher BMI/Age than females ($p=0.015$). The indirect effect of socio-economic level (SEL) on BMI/Age indicated that as the SEL increased the probability of a high consumption of sweets also increased resulting in a higher BMI/Age ($p<0.001$).

Total Effects

Total effects of PAL on BMI/Age were not found. Other findings show that, on average, children with higher BMI/Age were indigenous, males and those of the highest socio-economic levels. A one SD increase in socio-economic level was associated with an increase of 0.049 SD in BMI/Age ($p=0.008$). In addition, mean BMI/Age of indigenous children was 0.28 SD higher than that of non-indigenous children ($p=0.001$).

In terms of total effects of diet, indigenous children were found to be less likely to consume high levels of fruits and vegetables than non-indigenous children ($p=0.020$). Consumption of energy from sweets was associated with male sex, higher socio-economic status and being non-indigenous ($p=0.008$, $p<0.001$, $p<0.001$, respectively).

Discussion

In this study we explored whether a cash or an in-kind transfer -with or without an educational component- program to poor families, causes an unhealthy increase in child's weight. We also analyzed the potential mediating effect of diet in this causation chain of events. Our main findings

show that the program, in its in-kind plus education mode (FBE), did not increase child's BMI/Age, and this result is explained by the children increasing F&V consumption and decreasing consumption of sugar-rich foods in this PAL intervention group. The in-kind transfer without an organized educational component had no perceived effect on the studied outcomes.

Evidence exists that shows that total caloric intake frequently increased as a result of energy- dense and low-nutrient foods (Keast DR, 2013). The largest increases result from the consumption of foods such as sweetened soft drinks and fast foods, along with a decrease in the consumption of fruits and vegetables, particularly among low-income families (*Janssen I, 2005*).

Our results are consistent with other studies that have shown that children who consume more fruits and vegetables have less risk of overweight (*Lakkakula AP, 2008*), and with studies that have demonstrated that the consumption of sweetened drinks by children under 5 years is associated with a higher risk of overweight and obesity (*Lim S, 2009; James J, 2005*).

A previous analysis of PAL showed increased consumption of fruits and vegetables by beneficiary households that received in-kind transfers from PAL (*Leroy J, 2010*). Although the PAL program was not designed to increase the consumption of fruits and vegetables in particular, our evidence shows that consumption of that food group increased for the children in the FBE group. This may have occurred because PAL was a program specifically targeted to a very poor population and, therefore, our results can be explained by the assumption that families that received FBE made food substitutions. The PAL in-kind basket included 10 individual items, which were likely to have modified the types of food consumed by some households. When receiving foods provided by the program, through the food basket, families also purchased and consumed other healthy food groups, such as fruits and vegetables. This type of healthy eating habits along with a low consumption of sweets contributed to a lower BMI/Age in the children.

Our findings imply that in-kind transfers along with an educational component can differentially influence nutritional outcomes such as BMI/Age in those cases in which the transfers modify eating behavior in homes, such as increasing consumption of healthy foods such as fruits and vegetables and decreasing consumption of high-energy foods such as sweets.

Strengths

The main strength of this study is the experimental design used to evaluate the impact of PAL. We carried out a randomized study (*Sørensen HT, 2006*), which minimizes selection bias (*Hernán MA, 2004; Westreich D, 2012*) and increases the internal validity of our results since randomization makes groups equivalent in terms of observed and unobserved characteristics.

On the other hand, some cash transfer programs are coupled with in-kind nutritional supplements for young children (*Attanasio, 2004*). A strength of our study is that we could fully separate the effects of in-kind (food) versus cash transfers, unlike other impact evaluations such as mentioned previously. This was possible because of the evaluation design used.

Another strength of our study was the use of a path analysis, with which we could include all possible relations among variables and identify the most significant pathway to predict the outcome of interest (*Kline RB, 2011*). These relationships need to be examined in other populations in order to assess its generalizability and the factors that may produce different results.

Limitations

One limitation of this study was that the information about diet was exclusively based on a 24-hour recall (24-H recall). This weakens the correlation between baseline and follow-up data because of the lack of 24-H recall replicas. Repeated 24-h recalls are necessary to have a better estimation of usual intake, which depends of day-to-day variation in food intake (*Carriquiry AL, 2003*). This factor may have led to underestimates of the mediating role of diet, in the path between PAL and BMI/Age, but it would be expected to affect all four groups to the same extent and would not be expected to affect the differences in BMI/Age observed among the four study groups.

Another limitation of this study is the lack of information about physical activity among the children studied. Excessive energy intake with low energy expenditure are the two immediate causes of overweight (*Wyatt SB, 2006*) and, therefore, not having data for one of these two variables limits the ability to further explain our findings. In order for this factor to affect the overall finding in this study, the PAL did not contribute to unhealthy weight gains, it would be necessary to posit that PAL increased the energy intake among children (which is not shown in these data) and simultaneously increased the physical activity of these children to the same extent (through an unknown mechanism).

Importance of study

These results have important implications for public policy. Although evidence exists that indicate that interventions such as PAL can increase the weight of beneficiary women, our study provides solid evidence for policymakers. It indicates that in-kind transfers, accompanied by education, in very poor rural populations does not increase overweight in beneficiary children.

It was considerably important to have found that dietary mediation in the FBE group contributed to more consumption of fruits and vegetables and, thus, lower BMI/Age of the children in the population studied. This is significant since the consumption of healthy foods is lower in remote and poorer localities while the availability of processed, and energy-dense foods, refined carbohydrates and fats is more common and their prices are low (*Drewnowski, 2005*). Thus, our findings highlight the importance of an intervention such as FBE, which achieved the positive outcome of lower BMI/Age of children through the mediation of diet.

Conclusions

The addition of an education component to the transfer program seems to lead to more healthy gains in children due to a higher consumption of fruits and vegetables and a lower consumption of sweets.

Our results provide useful evidence in the area of child malnutrition prevention, because they indicate that food aid programs to poor families do not necessarily lead to unhealthy weight gain. This study provides the strongest evidence to-date regarding this important policy question.

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Declaration of conflict of interests

The authors report no conflicts of interest. The authors alone are responsible for the content and writing of the paper.

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Tables and figures

Table I. Baseline Characteristics of Participants, by Treatment Group

Characteristics of Participants	All		Control Group		Food Basket without education		Food Basket with education		Cash transfer with education	
	n	Mean $\pm$ s.d or %	n	Mean $\pm$ s.d or %	n	Mean $\pm$ s.d or %	n	Mean $\pm$ s.d or %	n	Mean $\pm$ s.d or %
Children										
Age (months)	2100	31.4 $\pm$ 16.7	500	31.0 $\pm$ 16.9	516	31.7 $\pm$ 16.5	524	31.2 $\pm$ 16.3	560	31.5 $\pm$ 17.3
Birth weight (kg)	1178	3.2 $\pm$ 0.6	283	3.1 $\pm$ 0.6	299	3.1 $\pm$ 0.6	286	3.2 $\pm$ 0.6	310	3.2 $\pm$ 0.5
Breastfeeding (Yes, %)	1644	23.6	410	23.3	430	25.1	407	21.2	423	24.5
BMI/Age (z-score)	2100	0.52 $\pm$ 1.05	500	0.50 $\pm$ 1.03	516	0.53 $\pm$ 1.08	524	0.46 $\pm$ 1.07	560	0.58 $\pm$ 1.01
Stunting (Yes, %) ¹	2096	25.5	500	25.8	516	25.3	522	22.6	558	28.3
Wasting (Yes, %) ²	2100	1.0	500	1.0	516	1.1	524	1.1	560	1.0
Overweight (Yes, %) ³	2100	8.1	500	8.0	516	9.3	524	7.2	560	8.0
Obesity (Yes, %) ⁴	2100	1.4	500	1.6	516	1.7	524	1.5	560	1.0
Energy (kcal)	2100	1628.35 $\pm$ 969.6	442	1663.8 $\pm$ 1001.4	470	1673.5 $\pm$ 979.6	461	1601.2 $\pm$ 909.7	507	1574.9 $\pm$ 987.7
Mothers	1845	53.3	434	50.0	456	54.3	466	55.1	489	53.7
Overweight and obesity (Yes, %) ⁵										
Households										
Socioeconomic status (SD)	2083	0.05 $\pm$ 0.99	494	0.07 $\pm$ 1.01	513	0.12 $\pm$ 1.00	522	-0.02 $\pm$ 0.94	554	0.02 $\pm$ 0.99
Ethnicity (Indigenous, %)	2100	24.4	500	29.6	516	28.2	524	15.0	560	25.1

1.Height for Age, z-score <-2.0 s.d ; 2.Weight for Height for Age, z-score <-2.0 s.d;
 3. BMI/Age, z-score>2.0 s.d; 4. BMI/Age, z-score >3.0 s.d; 5. BMI $\geq$ 25 kg/m²;
 All estimates were adjusted for the study design.

Table II. Direct, Indirect and Total Effects of PAL on BMI/Age in Mexican Children¹

	Direct Effects		Indirect Effects		Total Effects	
	Coef. $\pm$ SE	<i>p</i>	Coef. $\pm$ SE	<i>p</i>	Coef. $\pm$ SE	<i>p</i>
BMI/Age $\leftarrow$						
Energy from Fruits and Vegetables ²	-0.515 $\pm$ 0.118	<0.001	0.158 $\pm$ 0.047	0.001	-0.357 $\pm$ 0.079	<0.001
Energy from Sweets ³	0.647 $\pm$ 0.140	<0.001	-0.199 $\pm$ 0.065	0.002	0.448 $\pm$ 0.080	<0.001
FB	0.100 $\pm$ 0.112	0.371	-0.076 $\pm$ 0.066	0.255	0.024 $\pm$ 0.085	0.776
FBE	0.114 $\pm$ 0.095	0.230	-0.160 $\pm$ 0.073	0.027	-0.046 $\pm$ 0.079	0.559
CTE	0.189 $\pm$ 0.102	0.064	-0.122 $\pm$ 0.071	0.087	0.067 $\pm$ 0.074	0.367
Indigenous	0.418 $\pm$ 0.129	0.001	-0.131 $\pm$ 0.095	0.165	0.287 $\pm$ 0.089	0.001
Age of children	--	--	-0.002 $\pm$ 0.001	0.051	-0.002 $\pm$ 0.001	0.051
Male	--	--	0.065 $\pm$ 0.026	0.015	0.065 $\pm$ 0.026	0.015
Socioeconomic status	--	--	0.049 $\pm$ 0.019	0.008	0.049 $\pm$ 0.019	0.008
BMI of Mother	0.058 $\pm$ 0.007	<0.001	-0.018 $\pm$ 0.004	<0.001	0.040 $\pm$ 0.004	<0.001
Energy from Fruits and Vegetables $\leftarrow$						
BMI/Age	0.341 $\pm$ 0.080	<0.001	-0.105 $\pm$ 0.029	<0.001	0.236 $\pm$ 0.057	<0.001
Energy from Sweets	--	--	0.153 $\pm$ 0.022	<0.001	0.153 $\pm$ 0.022	<0.001
FB	0.178 $\pm$ 0.102	0.082	0.008 $\pm$ 0.029	0.778	0.186 $\pm$ 0.098	0.059
FBE	0.167 $\pm$ 0.101	0.098	-0.016 $\pm$ 0.027	0.561	0.151 $\pm$ 0.098	0.123
CTE	0.142 $\pm$ 0.106	0.180	0.023 $\pm$ 0.026	0.380	0.165 $\pm$ 0.104	0.113
Indigenous	-0.323 $\pm$ 0.104	0.002	0.098 $\pm$ 0.037	0.008	-0.225 $\pm$ 0.097	0.020
Age of children	0.005 $\pm$ 0.001	<0.001	-0.001 $\pm$ 0.000	0.114	0.004 $\pm$ 0.001	0.001
Male	-0.010 $\pm$ 0.048	0.826	0.022 $\pm$ 0.010	0.025	0.012 $\pm$ 0.043	0.787
Socioeconomic status	0.033 $\pm$ 0.037	0.373	0.017 $\pm$ 0.006	0.007	0.050 $\pm$ 0.033	0.139
BMI of Mother	--	--	0.014 $\pm$ 0.003	<0.001	0.014 $\pm$ 0.003	<0.001
Energy from Sweets $\leftarrow$						
BMI/Age	-0.414 $\pm$ 0.080	<0.001	0.127 $\pm$ 0.037	0.001	-0.287 $\pm$ 0.047	<0.001
Energy from Fruits and Vegetables	--	--	0.148 $\pm$ 0.021	<0.001	0.148 $\pm$ 0.021	<0.001
FB	0.041 $\pm$ 0.105	0.694	-0.010 $\pm$ 0.035	0.776	0.031 $\pm$ 0.099	0.753
FBE	-0.147 $\pm$ 0.114	0.197	0.019 $\pm$ 0.033	0.562	-0.128 $\pm$ 0.102	0.209
CTE	-0.030 $\pm$ 0.111	0.789	-0.028 $\pm$ 0.031	0.365	-0.057 $\pm$ 0.104	0.580
Indigenous	-0.263 $\pm$ 0.115	0.023	-0.119 $\pm$ 0.044	0.007	-0.382 $\pm$ 0.102	<0.001
Age of children	0.000 $\pm$ 0.001	0.841	0.001 $\pm$ 0.000	0.040	0.001 $\pm$ 0.001	0.382
Male	0.136 $\pm$ 0.047	0.004	-0.027 $\pm$ 0.013	0.035	0.109 $\pm$ 0.041	0.008
Socioeconomic status	0.135 $\pm$ 0.029	<0.001	-0.020 $\pm$ 0.010	0.042	0.115 $\pm$ 0.026	<0.001
BMI of Mother	--	--	-0.017 $\pm$ 0.004	<0.001	-0.017 $\pm$ 0.004	<0.001

1. Structural Equation Models (Path Analysis)

Coef.=Coefficient. SE: Standard Errors.

BMI/Age: Body Mass Index for Age at Follow-up.

FB: Food Basket without Education; FBE: Food Basket with Education; CTE: Cash Transfers with Education.

2. Quintile levels of Energy from Fruits and Vegetables; 3. Quintile levels of Energy from Sweets.

N=2100

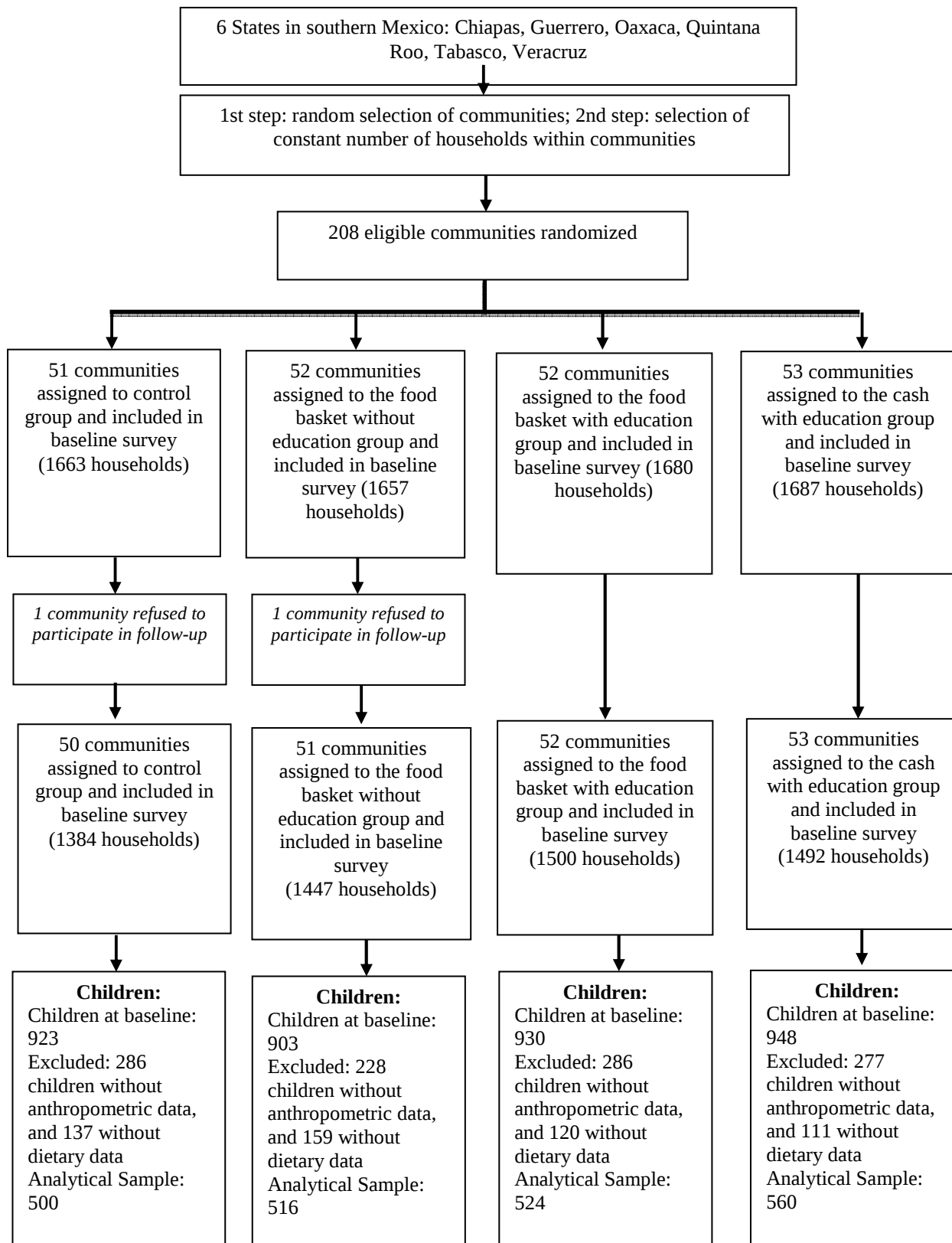
Figure 1. Trial Profile

Figure 2. Path Analysis Model

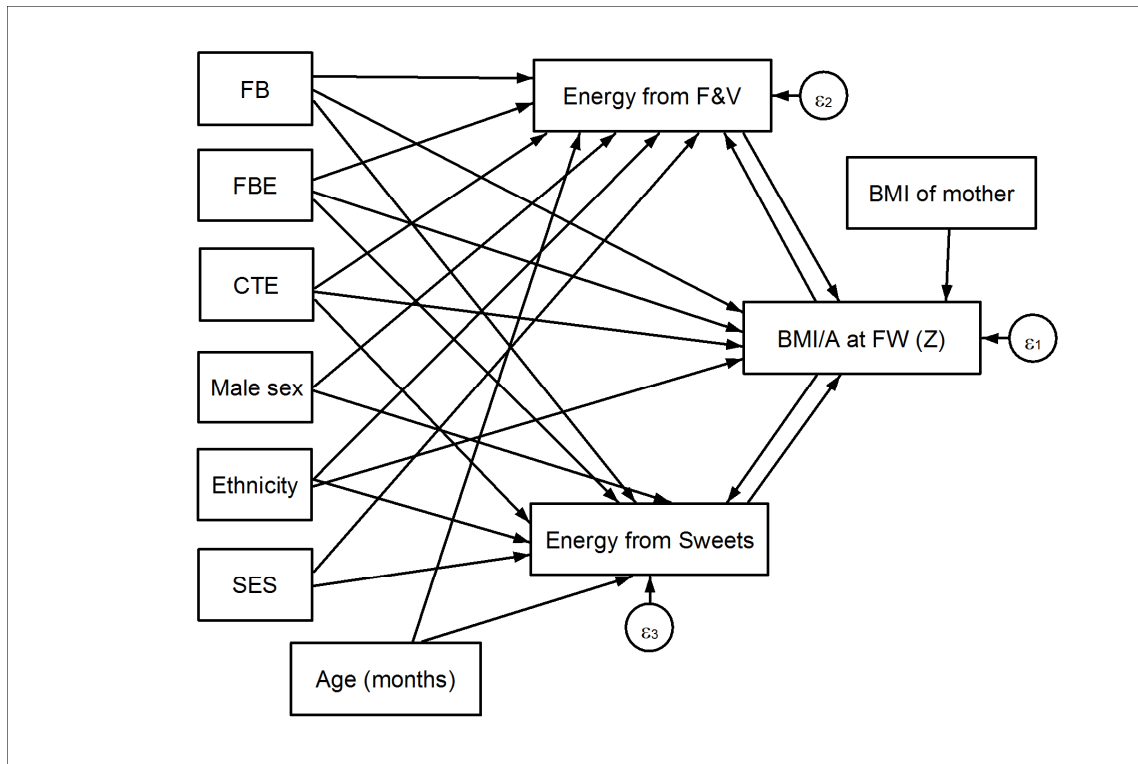


Figure 2. General mediation model used to estimate effects, Path Analysis.

Squares represent variables. Mediating variables are energy from fruits and vegetables and from sweets, and BMI/Age is the final outcome.

FB: Food Basket without Education Group; FBE: Food Basket with Education Group;

CTE: Cash Transfer with Education Group.

SES: Socio Economic Status; F &V: Fruits and Vegetables; BMI: Body Mass Index;

BMI/Age at FW: Body Mass Index at Follow Up

Arrows represent regression slope parameters from independent variables to outcomes.

For each PAL group the model can be decomposed in two paths: 1) BMI/Age regressed on PAL groups, and 2) a causal mediation chain of BMI/Age regressed on mediators (diet) which in turn are regressed on PAL groups.

8. CONCLUSIONES

- Nuestros resultados indican que ninguna de las modalidades de intervención del PAL contribuyó al aumento del sobrepeso y la obesidad en los niños beneficiarios del programa.
- Aunque el programa contemplaba que la entrega de beneficios se realizaría de manera mensual, la distribución fue bimensual y en cada entrega los grupos de despensa recibieron en promedio 2 paquetes, y en efectivo 1.2 transferencias.
- El promedio de beneficios recibidos fue 12.5 y no 18 como idealmente podrían haber sido en el transcurso de los años entre encuestas.
- No hubo diferencias entre el número de beneficios recibidos según el grupo de estudio.
- Bajo mejores condiciones de implementación y operación del programa, podrían ser mayores los impactos benéficos del programa.
- Aunque este programa no fue evaluado para evitar el riesgo de sobrepeso y la obesidad en niños beneficiarios, este estudio encontró que el PAL no ocasiona incremento del exceso de peso de los niños beneficiarios.
- El programa tuvo un efecto en el grupo de despensas de alimentos acompañada del componente educativo. En ese grupo de intervención los niños tuvieron menor IMC/E, sin que esta reducción tuviera efectos nocivos para los niños beneficiarios.
- También se encontraron efectos heterogéneos del PAL en el IMC/E de los niños. El IMC/E fue menor en los niños del grupo de despensas que en los niños del grupo control en los niños del nivel socio económico más bajo, niños indígenas, hijos de madres sin sobrepeso y niños sin talla baja en la línea de base.
- Se encontró mediación por dieta en el efecto del PAL en el IMC/E en el grupo que recibió despensa y educación. Los niños de este grupo presentaron menos IMC/E y ese efecto es explicado por un mayor consumo de frutas y verduras y un menor consumo de dulces en los niños de ese grupo comparados con los niños del grupo control.

9. RECOMENDACIONES

- Para la política pública es importante diseñar programas que si bien combatan desenlaces adversos como el hambre, la inseguridad alimentaria, la desnutrición y la deficiencia de micronutrientes, también puedan evitar el exceso de peso en sus beneficiarios.
- Es necesario continuar con los esfuerzos actuales para la prevención de la obesidad, especialmente desde etapas infantiles. Esto ayudará a contar con evidencia que indique cuáles son las estrategias de promoción de la salud con mejor relación costo - efectividad para lograr el objetivo de un peso saludable para todos los niños.
- La recomendación para el diseño de programas que tengan por objetivo evitar o disminuir la obesidad en niños, es que las intervenciones vayan acompañadas de un diseño de evaluación riguroso. La metodología sólida de un diseño de evaluación permitirá un análisis con suficiente poder estadístico para determinar lo que funciona, o no, bajo qué contextos y en quiénes.
- Dados los aumentos generalizados en el sobrepeso y obesidad en la población mexicana, incluyendo los menores de 5 años y en los diferentes grupos sociales, es necesario aprovechar los programas de nutrición dirigidos a la población vulnerable para incluir componentes de prevención de obesidad.
- Teniendo en cuenta que México tiene programas de desarrollo social y de salud que incluyen componentes nutricionales que han mostrado efectividad en desenlaces de salud, es recomendable fortalecer programas como el PAL, asegurando la adecuada cobertura y focalización, la entrega de servicios de calidad y el trabajo intersectorial.
- Es necesario fortalecer las capacidades de implementación de programas como el PAL ya que esto contribuirá al logro de los resultados esperados.
- Las evaluaciones cuantitativas de programas similares deben estar acompañadas de evaluaciones de proceso y de investigaciones cualitativas que evalúen el proceso de implementación del programa para corregir dificultades sociales, económicas y culturales que puedan afectar el impacto esperado de los mismos.
- Se recomienda el monitoreo de la población beneficiaria con el objetivo de prevenir desenlaces adversos como la ganancia de peso no saludable.
- Es necesario realizar otras investigaciones que evalúen aspectos como la calidad y oportunidad de la entrega de beneficios/servicios y de demanda y utilización por parte de los beneficiarios. Esa evidencia servirá para identificar puntos críticos y mejorar procesos que faciliten obtener los efectos deseados en las poblaciones que se benefician de programas con componentes nutricionales.

- Una recomendación para programas que incorporen componentes educativos es que las intervenciones sean rigurosamente diseñadas en cuanto a: 1. Su contenido (mensajes claros y sencillos), 2. El personal idóneo y capacitado que lo debe aplicar y 3. La modalidad de las capacitaciones que serán realizadas por el personal.
- La educación nutricional no debe limitarse a la sola transmisión de información, dado que requiere que los conocimientos se traduzcan en cambios efectivos hacia estilos de vida saludables.
- Los componentes claves a reforzar a través del componente educativo de programas similares al PAL son: distribución intrafamiliar de alimentos, consumo de micronutrientes, consumo excesivo de energía, compra preferencial de alimentos saludables, estilos de vida saludables, alimentación adecuada de los niños beneficiarios, actividad física, y prevención y control del sobrepeso.
- Se recomienda considerar el contexto cultural de la población en la planeación de intervenciones educativas de control y prevención del sobrepeso y la obesidad.

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11. ANEXOS

Anexo 1. Contenido de la despensa de alimentos entregada por el PAL

Alimentos	Cantidad
Leche Fortificada (Zinc, Vitamina C, Folato, Hierro), (kg)	1.920
Frijoles, (kg)	2.000
Arroz, (kg)	2.000
Harina de Maíz (kg)	3.000
Pasta para Sopa (kg)	1.200
Aceite vegetal (L)	1.000
Galletas (kg)	1.000
Chocolate enriquecido (kg)	0.400
Almidón de Maíz (kg)	0.100
Cereal, listo para comer (kg)	0.200
Uno de los siguientes ítems:	
Sardinas/atún (kg)	0.240
Carne seca (kg)	0.100
Lentejas (kg)	0.500

Anexo 2. Criterios de estimación de poder del estudio

Variable dependiente utilizada: Cambios en valores de Z de Índice de Masa Corporal para la Edad (IMC/E) en menores de 5 años.

Comando utilizado en stata:

```
sampsi 0 0.2, sd(`sd') n(657) r01(.4) pre(1) post(1)
```

Este es el poder estimado con la variable de respuesta continua, para dos muestras con mediciones repetidas.

Supuestos:

Significancia = 0.0500 (2-colas)

Media 1 = 0

Media 2 = 0.2

DS 1 = 1.4

DS 2 = 1.4

Efecto del diseño=2.0

Coeficiente de Correlación Intraconglomerado (ICC)=0.08

Número de conglomerados=13 (2627 niños/206 comunidades)

Tamaño de muestra n1 = 657 (2627 niños/4 grupos)

n2=657

n2/n1= 1.00

Número de mediciones en el seguimiento = 1

Número de mediciones basales = 1

Correlación entre mediciones basales y seguimiento = 0.4

Método: ANCOVA

Eficiencia relativa = 1.190

DS ajustada = 0.917

DS1 ajustada = 1.283

Poder estimado = 0.807

Este poder permite detectar una diferencia en el efecto de 0.2 D.E en el IMC/E

Appendix 3. Food Groups Consumed by Children at Follow-Up

Food Group	n	Frequency of Intake %	Grams		Energy (kcal)	
			Mean	Median [p25,p75]	Mean	Median [p25,p75]
Low-fiber cereal (<1.86 g) and low in fat(<6 g)	1129	37.4	34.0	0.0 [0,33.3]	55.8	0.0 [0,64.5]
High fiber cereals (≥1.86 g)	2677	88.8	103.9	79.3 [31.2,147]	251.2	188.7 [76.2,356.4]
Ready-to-eat industrialized cereals low in fiber (≤ 2.9 g)	32	1.1	0.3	0.0 [0,0]	1.1	0.0 [0,0]
Grains high in fiber(≥2.9 g)	10	0.3	0.1	0.0 [0,0]	0.3	0.0 [0,0]
Legumes	1966	65.2	66.7	35.7 [0,100]	33.6	16.8 [0,45]
Oilseeds	61	2.0	0.4	0.0 [0,0]	1.9	0.0 [0,0]
Fruits and Vegetables	2325	77.1	91.0	38.3 [1.9,113.5]	40.7	11.4 [0.7,45]
Poultry and Insects	572	19.0	15.3	0.0 [0,0]	32.0	0.0 [0,0]
Red Meat	341	11.3	7.3	0.0 [0,0]	15.8	0.0 [0,0]
Processed meat	107	3.5	1.3	0.0 [0,0]	3.8	0.0 [0,0]
Fish and Seafood	255	8.5	5.3	0.0 [0,0]	7.1	0.0 [0,0]
Low-fat Dairy (<4.96 g)	1301	43.2	75.2	0.0 [0,56]	122.4	0.0 [160.1]
High-fat Dairy (≥4.96 g)	1506	50.0	31.6	0.0 [0,54.9]	51.0	0.0 [0,85.1]
Fats and Oils	1958	64.9	5.4	1.7 [0,6]	47.8	14.5 [0,52.6]
Saturated Fat	253	8.4	0.8	0.0 [0,0]	6.4	0.0 [0,0]

Sweets	2444	81.1	22.1	13.8 [3.6,29.2]	82.2	52.5 [13.5,110.7]
Sweetened Beverages	285	9.5	20.8	0.0 [0,0]	8.9	0.0 [0,0]
Industrialized fast Foods	385	12.8	5.2	0.0 [0,0]	24.3	0.0 [0,0]
Industrialized Foods	1559	51.7	2.4	0.2 [0,1.4]	3.6	0.3 [0,2.4]
Low or No Energy	22	0.7	0.8	0.0 [0,0]	0.1	0.0 [0,0]
Industrialized Fruits and Vegetables	25	0.8	0.2	0.0 [0,0]	0.1	0.0 [0,0]
Low Fiber Cereal (<1.86 g) and High Fat (≥6 g)	603	20.0	14.2	0.0 [0,0]	33.7	0.0 [0,0]