

DIET-COST OPTIMIZATION STUDY

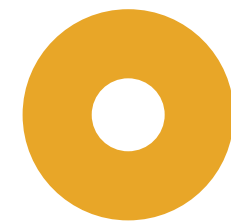


Eggs as a Cost-Effective, Nutrient-Dense Food

In cost-optimized diets across the lifespan, socioeconomic levels, and race/ethnicity

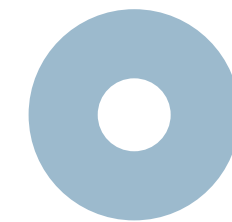
An analysis of the National Health and Nutrition Examination Survey (NHANES) 2011–2018 dietary intake using Purchase to Plate National Average Prices (PP-NAP)

Cost is a barrier to a nutritious diet



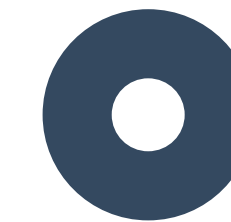
Economic pressure shapes choices

When households face cost constraints, food choices tend to shift toward energy-dense, nutrient-poor options.



A cost limit can lower quality

Modeling work has repeatedly shown that imposing a cost limit alone can reduce the nutrient density of a diet.



The open question

Which affordable foods get selected when a diet is optimized for cost while adequacy is still required?

Find the **least-cost** combinations of foods that meet shortfall-nutrient recommendations at **2000 kcal** — then measure the role of **eggs**.

30,678

participants analyzed

8

NHANES survey years (2011–2018)

3

lenses: age · race/ethnicity · income

Two national data sources

DIETARY INTAKE

NHANES • What We Eat in America

First 24-hour dietary recall, 2011–2018 cycles, ages 2+. Analyzed in SAS 9.4 with appropriate adjustments for nationally representative estimates.

FOOD COST

Purchase to Plate National Average Prices

PP-NAP links USDA nutrition databases to retail grocery scanner data to estimate a national average price for foods reported in NHANES; developed to support the Thrifty Food Plan.

11 shortfall nutrients had to be met

Optimized diets were required to reach age-specific cutoffs — the largest RDA or AI within each age group — for these under-consumed nutrients:

● Calcium

● Choline

● Dietary fiber

● Iron

● Magnesium

● Potassium

● Protein

● Vitamin A

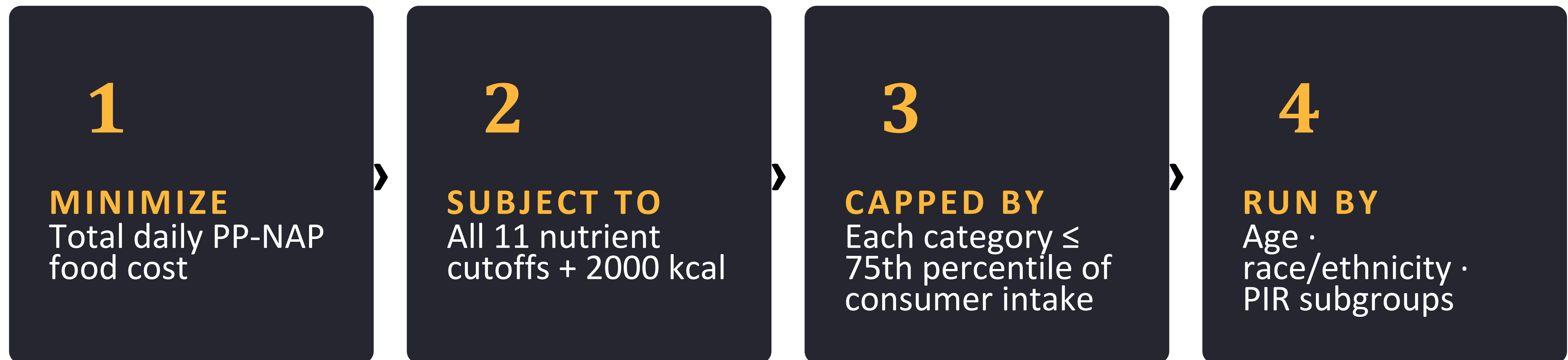
● Vitamin c

● Vitamin D

● Vitamin E

2000 kcal Energy Cap

How the diets were built



Excluded from all diets: alcoholic beverages · water · baby foods & formulas · “other” · nutritional drinks · nutrition bars

PIR = poverty income ratio



THE KEY RESULTS



EGG
NUTRITION
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Eggs entered every optimized diet.

Across every age group, every race/ethnicity, and every income level examined, eggs and omelets were selected when diets were minimized for cost — even though nothing required them to appear.



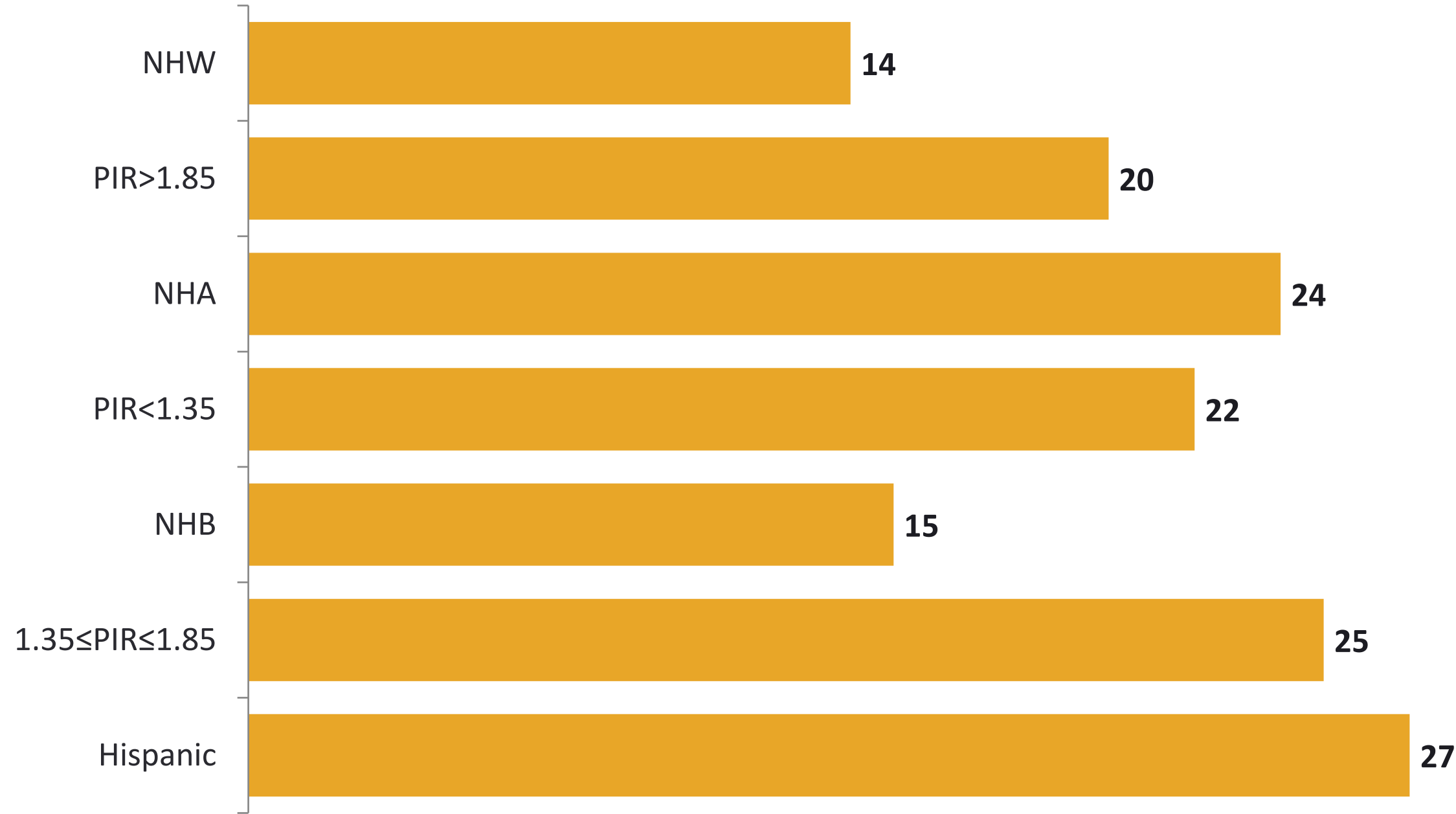
Optimization cut children’s (2-18 y) diet cost by 23%

Daily diet cost

~~\$6.19~~ →
\$4.78
–23% overall

11% of calories from eggs
at
13% of daily cost

Cost reduction ranged 14–27% across subgroups



Consistent across income and ethnicity

By race / ethnicity

- Current cost \$5.90 (NHB) to \$6.81 (NHA)
- Optimized costs 14–27% lower; smallest change NHW, largest Hispanic
- Eggs: 10–13% of calories at 9–16% of daily cost

By income (PIR)

- Current cost \$5.80 to \$6.50 across PIR levels
- Optimized costs 20–25% lower; largest change at $1.35 \leq \text{PIR} \leq 1.85$
- Eggs: 10–11% of calories at 11–15% of daily cost

Every optimized child diet also included: bananas · beans, peas & legumes · carrots · milk · flavored milk · oatmeal · ready-to-eat cereal

NHB = non-Hispanic Blacks; NHA = non-Hispanic Asians; NHW = non-Hispanic Whites

Optimization cut adults' (19+ y) diet cost by 33%

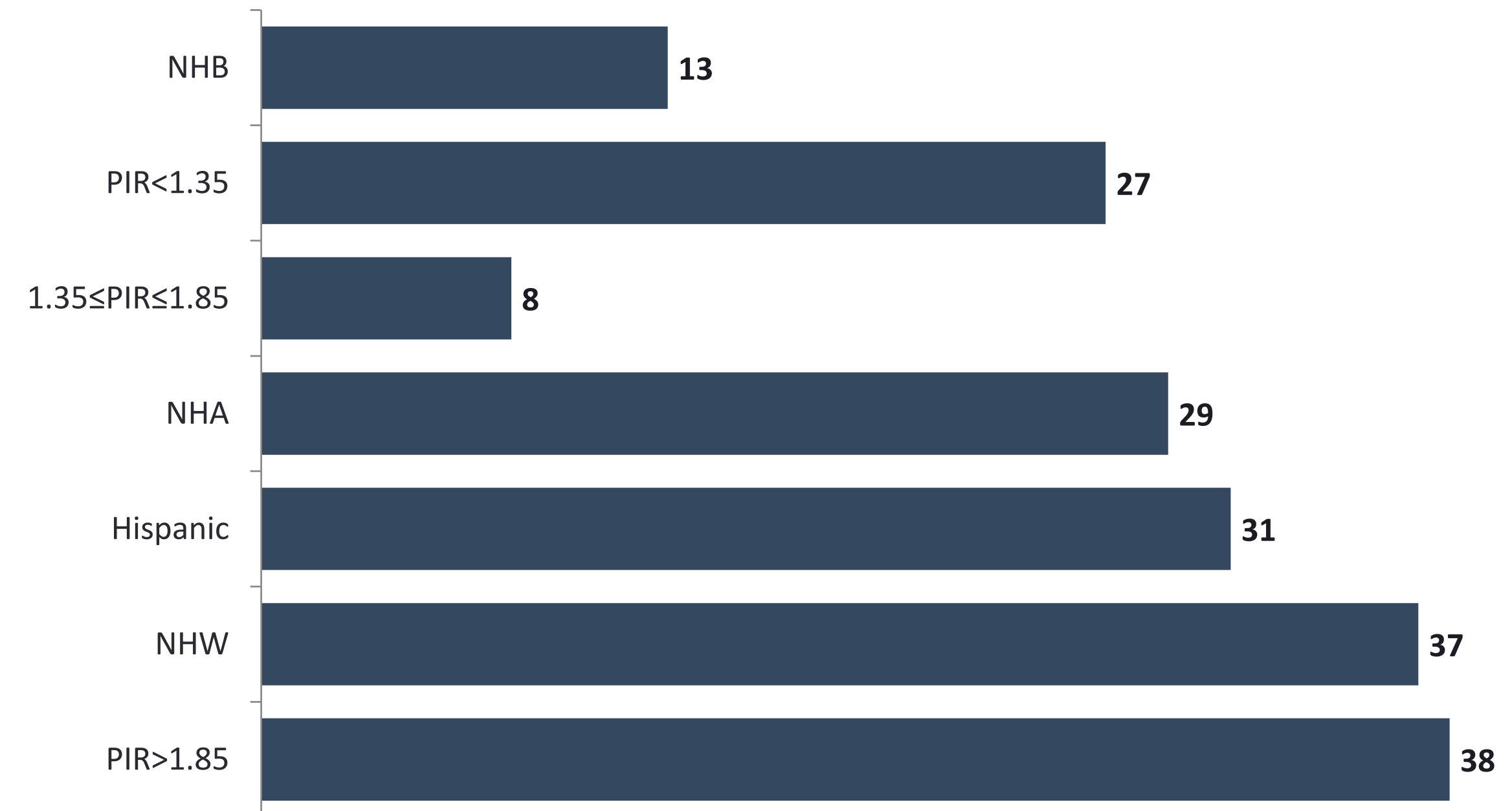
Daily diet cost

~~\$9.93~~ → \$6.65

–33% overall

8% of calories from eggs
at
8% of daily cost

Cost reduction ranged 8–38% across subgroups



Largest savings at higher income levels

By race / ethnicity

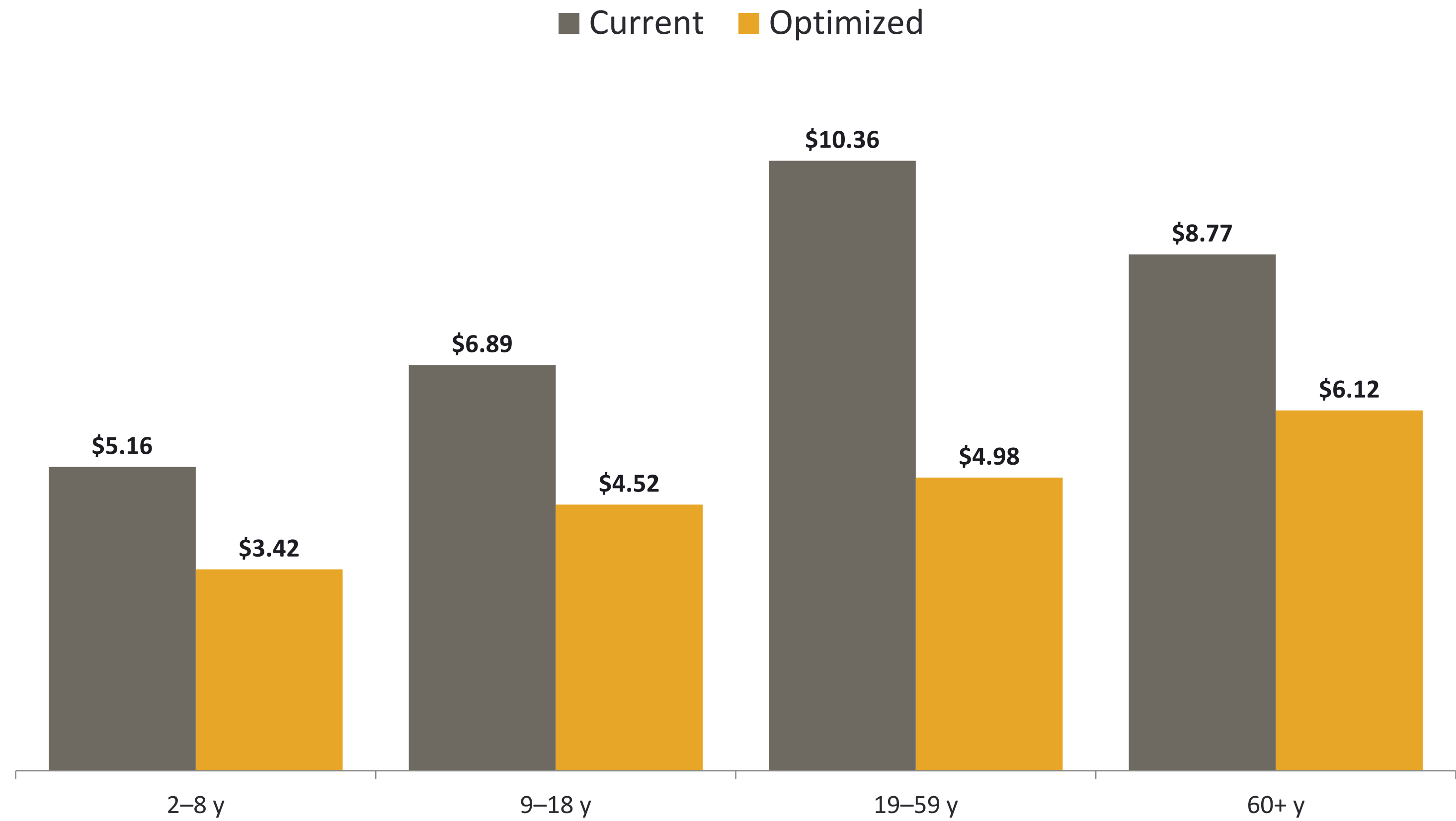
- Current cost \$8.61 (NHB) to \$10.41 (NHW)
- Optimized costs 13–37% lower; smallest change NHB, largest NHW
- Eggs: 6–9% of calories at 4–9% of daily cost

By income (PIR)

- Current cost \$8.58 to \$10.62 across PIR levels
- Optimized costs 8–38% lower; largest change at PIR>1.85
- Eggs: 7–9% of calories at 5–8% of daily cost

Every optimized adult diet also included: bananas · beans, peas & legumes · carrots · fish · margarine · milk · oatmeal · ready-to-eat cereal

Savings hold across the lifespan

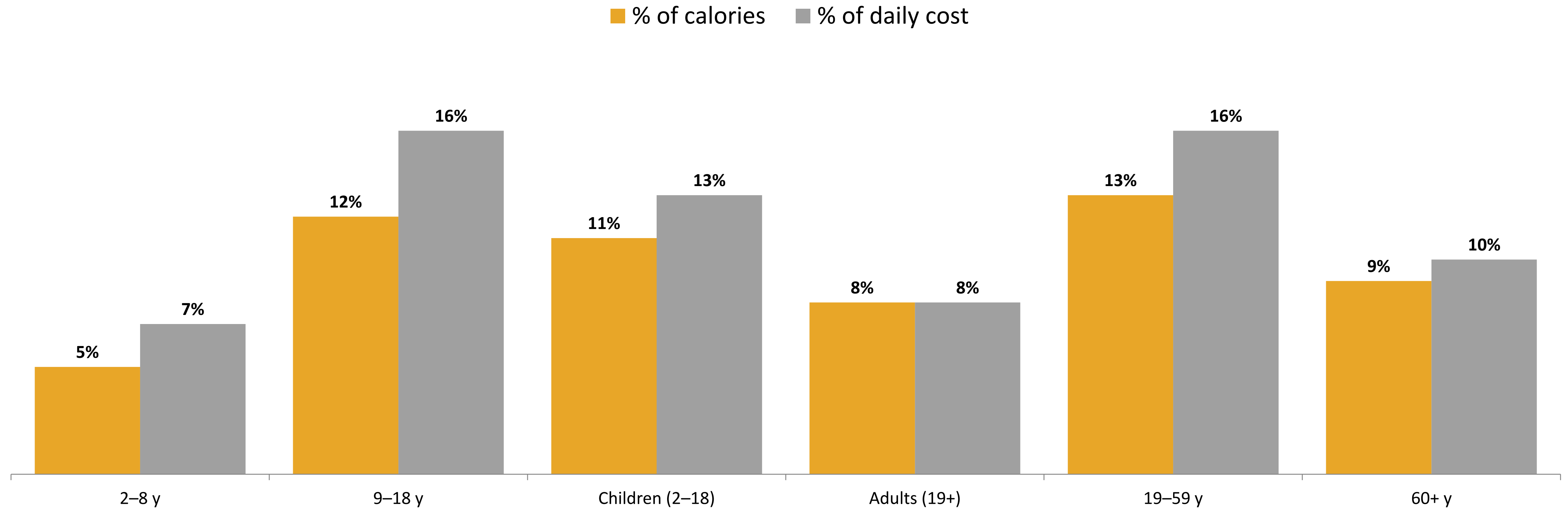


Cost Reduction

2–8 y	–34%
9–18 y	–34%
19–59 y	–52%
60+ y	–30%

Calories delivered $\approx$ cost incurred

Eggs supply a share of daily calories close to their share of daily cost, thus, demonstrating an efficient, nutrient-dense food.



OPTIMIZED DIET · CHILDREN (2–18 Y)

What the least-cost 2000 kcal diet looks like for all children 2-18 y



EGG
NUTRITION
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Category	Grams	Price (\$)	kcal
Milk, lowfat	355.85	0.33	149.88
Milk, nonfat	282.75	0.27	96.06
Flavored milk, lowfat	77.70	0.13	48.36
Liver and organ meats	1.78	0.02	3.15
Fish	13.37	0.18	25.23
Eggs and omelets	121.71	0.61	218.21
Beans, peas, legumes	134.93	0.45	203.34
Bean, pea, legume dishes	262.18	0.83	402.61
Cheese sandwiches	11.23	0.07	37.52
Peanut butter and jelly sandwiches	1.04	0.00	3.74
RTEC, higher sugar (>21.2 g/100g)	40.83	0.28	156.49
RTEC, lower sugar (≤21.2 g/100g)	37.92	0.25	141.64
Oatmeal	174.48	0.26	157.22
Popcorn	10.81	0.09	57.34
Bananas	122.82	0.23	109.77
Carrots	61.92	0.19	26.03
Cabbage	49.84	0.16	16.03
Other starchy vegetables	84.62	0.36	94.09
Vegetable juice	12.14	0.02	2.63
Margarine	9.51	0.05	50.66
Total	1867.45	4.78	2000

\$4.78
per day · 2000 kcal

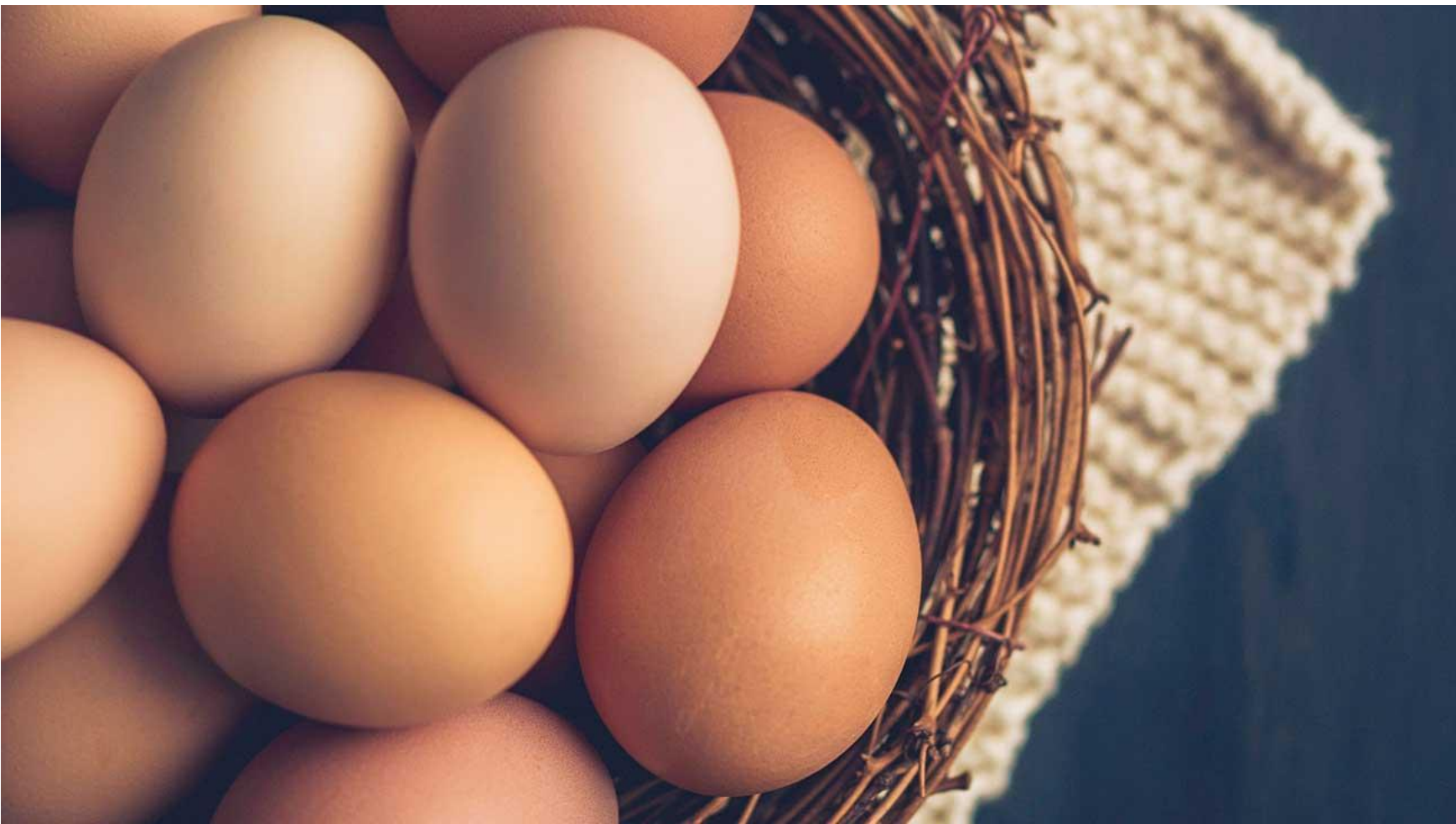


Full daily composition, all race/ethnicity and PIR levels · RTEC = ready-to-eat cereal · grams and price (\$) per category

What the least-cost 2000 kcal diet for adults looks like

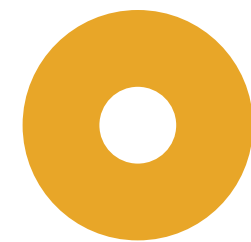
Category	Grams	Price (\$)	kcal
Milk, lowfat	121.66	0.12	51.32
Milk, nonfat	351.61	0.34	119.70
Milk substitutes	71.22	0.12	24.67
Fish	153.96	2.47	269.53
Eggs and omelets	90.44	0.50	160.75
Beans, peas, legumes	127.85	0.41	189.38
Bean, pea, legume dishes	213.37	0.76	324.99
RTEC, higher sugar (>21.2 g/100g)	42.98	0.30	159.78
RTEC, lower sugar (≤21.2 g/100g)	56.43	0.39	208.22
Oatmeal	215.51	0.30	181.25
Bananas	123.36	0.23	109.87
Carrots	66.91	0.21	29.21
Other starchy vegetables	53.95	0.21	68.09
Vegetable juice	105.18	0.24	24.97
Margarine	14.31	0.07	78.29
Total	1808.74	6.65	2000

\$6.65
per day · 2000 kcal



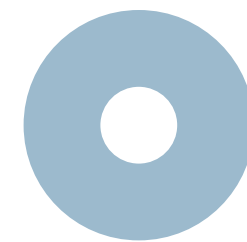
Full daily composition, all race/ethnicity and PIR levels · RTEC = ready-to-eat cereal · grams and price (\$) per category

Why the optimized diet keeps choosing eggs



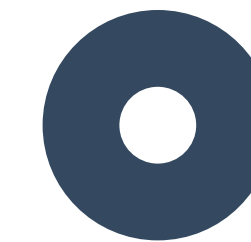
Complete protein

High-quality, highly bioavailable protein per dollar.



Choline-rich

Among the richest sources of choline — a nutrient >90% of Americans under-consume.



Affordable density

Low-cost relative to other animal-source proteins for the nutrients delivered.

Recurring supporting foods: milk · beans, peas & legumes · ready-to-eat cereals · oatmeal · bananas · carrots · margarine — foods that pair cost-efficiency with nutrient density.

Study strengths and limitations

Strengths

- Nationally representative NHANES intake data
- Established national price source (PP-NAP)
- Realistic 75th-percentile quantity caps prevent implausible amounts

Limitations

- Optimized for shortfall nutrients only — no caps on sodium, saturated fat, or added sugars
- Single 24-hour recall reflects population, not usual intake
- 2011–2018 national average prices may not match current or local costs



CONCLUSION



EGG
NUTRITION
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Eggs are a cost-effective, nutrient-dense food for low-cost, adequate diets for children and adults

When diets were minimized for cost while meeting shortfall-nutrient recommendations, eggs were selected in every optimized diet — across the lifespan, socioeconomic levels, and race/ethnicities. They can be readily incorporated into affordable, nutritionally adequate eating patterns.

Increased egg consumption within American children and adults may offer an economically and nutritionally viable strategy to benefit public health initiatives and help minimize shortfall nutrient gaps.

Questions?

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Analysis, interpretation, and slides completed by **Nutrition Impact, LLC**

Source:

Centers for Disease Control and Prevention, National Center for Health Statistics.
National Health and Nutrition Examination Survey (NHANES 2011-2018): What We Eat in
America. Hyattsville, MD: U.S. Department of Health and Human Services. Available at:
<https://www.cdc.gov/nchs/nhanes/>.

U.S. Department of Agriculture, Economic Research Service. Purchase to Plate —
Documentation: Purchase to Plate National Average Prices dataset for
WWEIA/NHANES. Available at: <https://www.ers.usda.gov/data-products/purchase-to-plate/documentation>.