

A prediction model for childhood obesity in New Zealand

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Introduction

- There are 8 prediction models for obesity in childhood
- Most developed from homogeneous populations
- Few are validated or statistically evaluated or tested
- Can a NZ-specific model facilitate a targeted intervention to give all children a chance to achieve a healthy weight in childhood?

Obesity prediction model

Primary outcome:

Obesity at 4 to 5 years of age

Obesity definition:

BMI $\geq 95^{\text{th}}$ percentile or BMI ≥ 1.65 SDS

(WHO standards)

Model developed using GUiNZ data



Growing Up in NZ (GUiNZ):

Includes 6,853 children (1,600 Māori, 1,400 Pacific, and 1,100 Asian)

Children born in 2009-10 followed longitudinally.

Data collected:

From before birth

Includes health, demographic, growth, behavioural, and cognitive data

Ethnicity and the model

Ethnicity	GUiNZ model derivation pop (mothers)	GUiNZ model validation pop (mothers)	GUiNZ overall cohort (at four years)	B4 School Check 2015-16
NZ European	64.7%	65.2%	68.0%	69.1%
Māori	11.1%	10.5%	25.0%	25.8%
Pacific	8.2%	8.9%	21.0%	14.1%
Asian	14.1%	13.0%	18.0%	15.9%
New Zealander	-	-	16.0%	-
Other	1.9%	2.5%	3.0%	n/a

Initial list of variables (N=59)

CATEGORICAL		
Alcohol_1st_trim_n_bin	Labour_induction	Other_drugs
Alcohol_2nd3rd_trim_n_bin	Living_with_biol_father	Other_drugs_9mo_birth_bin
Alcohol_b4pregn	Marijuana	Parity
Alcohol_b4pregn_n_bin	Marijuana_9mo_birth_bin	Partner_CVD
Alcohol_pregn	Mother_CVD_bin	Partner_diabetes
Baby_feeding_6wk_bin	Mother_educ	Partner_educ_bin
Child_ethnic_4	Mother_educ_bin	Partner_employm_bin
Child_ethnic_5	Mother_employm_bin	Partner_ethnic
Delivery	Mother_ethnic	Partner_smoke_pregn
Diabetes	Mother_smoke_b4pregn	Paternity
Diabetes_any	Mother_smoke_pregn	Preeclamp
Diabetes_3rd_trim	Mother_Uni_educ	Preeclamp_hosp
Gest_age_group	Nausea_1st_trim_bin	Pregnancy_type
Household_tenure	Nausea_2nd3rd_trim_bin	Rurality_bin
Hyperemesis	NCIU_special_care	Sex
Hypertension_3rd_trim	NZ_Dep	
CONTINUOUS		
Birth_wt	Mother_ht	Father_BMI
Mother_age	Mother_wt	Father_bwt
Mother_BMI	N_persons_house	Father_ht
Mother_bwt	Father_age	Father_wt

Derivation & Validation

Split validation (random) using GUiNZ

70% for model derivation (n=2,205)

30% for model validation (n=928)

Multiple models

run on derivation cohort and tested on validation cohort

any model with:

* AUROC >0.60

* Hosmer & Lemeshow test $p > 0.05$ (calibration)

Derivation & Validation

Many tests using interactive & complex Excel spreadsheets

Multiple iterations to identify most parsimonious model

Parameters assessed:

- ***Sensitivity = $n \text{ true positives} / (n \text{ true positives} + n \text{ false negatives})$***
- *Specificity = $n \text{ true negatives} / (n \text{ true negatives} + n \text{ false positives})$*
- ***PPV = $n \text{ true positives} / (n \text{ true positives} + n \text{ false positives})$***
- *NPV = $n \text{ true negatives} / (n \text{ true negatives} + n \text{ false negatives})$*

Probability of obesity – variable thresholds

Final model

Categorical variables:

- Maternal smoking in pregnancy (smoker vs non-smoker)
- Sex (males vs females)

Continuous variables:

- Maternal BMI
- Partner's BMI
- Number of persons in the household
- Birth weight

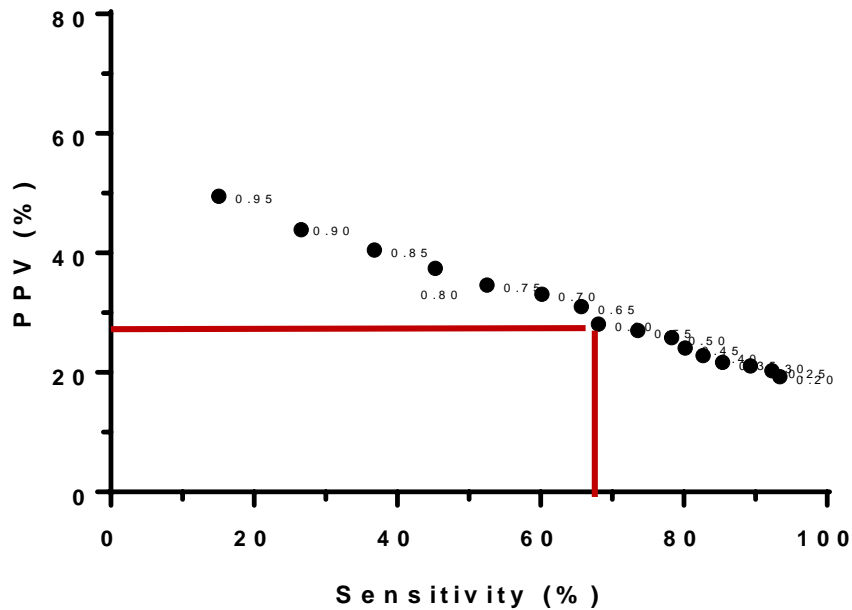
GUiNZ derivation cohort

n=2,205

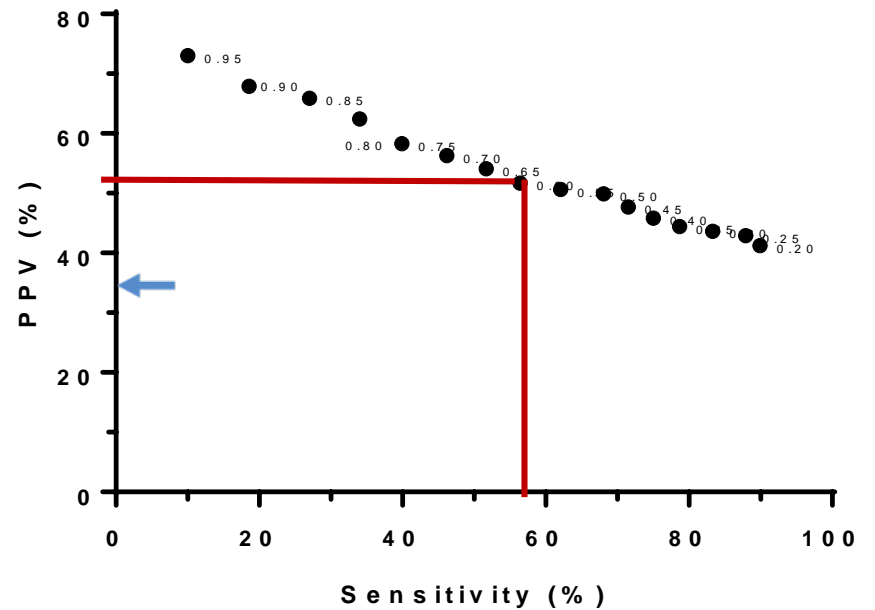
Obese 17%

Overweight/obese 37%

Obese



Overweight or obese



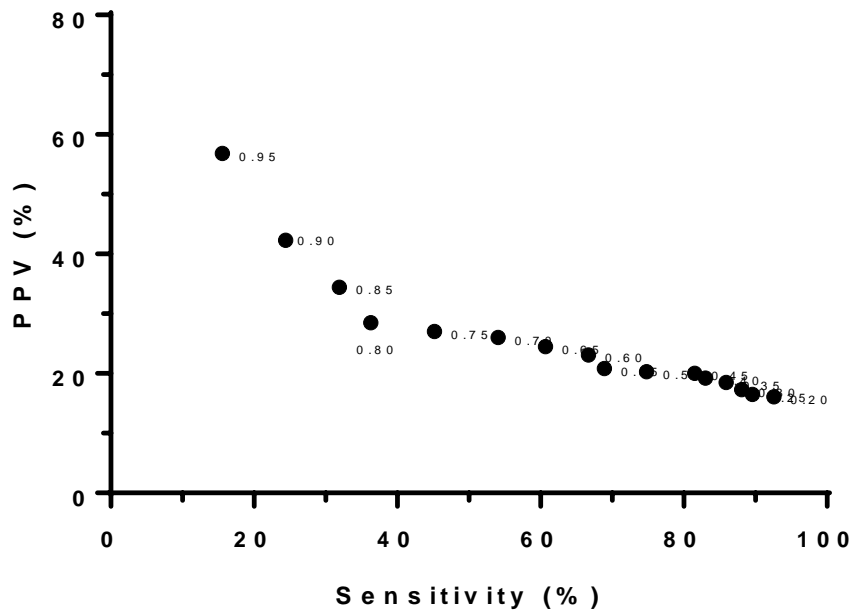
GUINZ validation cohort

n=928

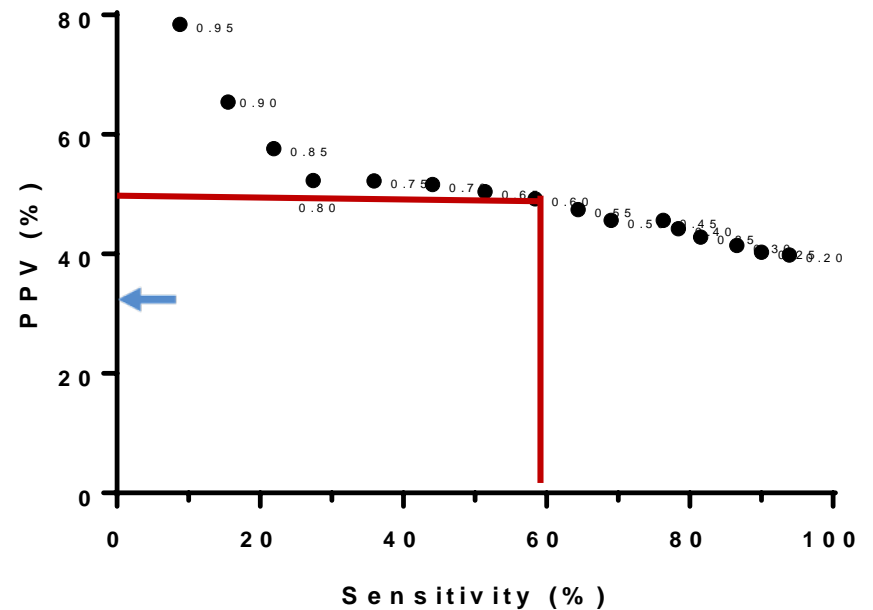
Obese 15%

Overweight/obese 36%

Obese



Overweight or obese



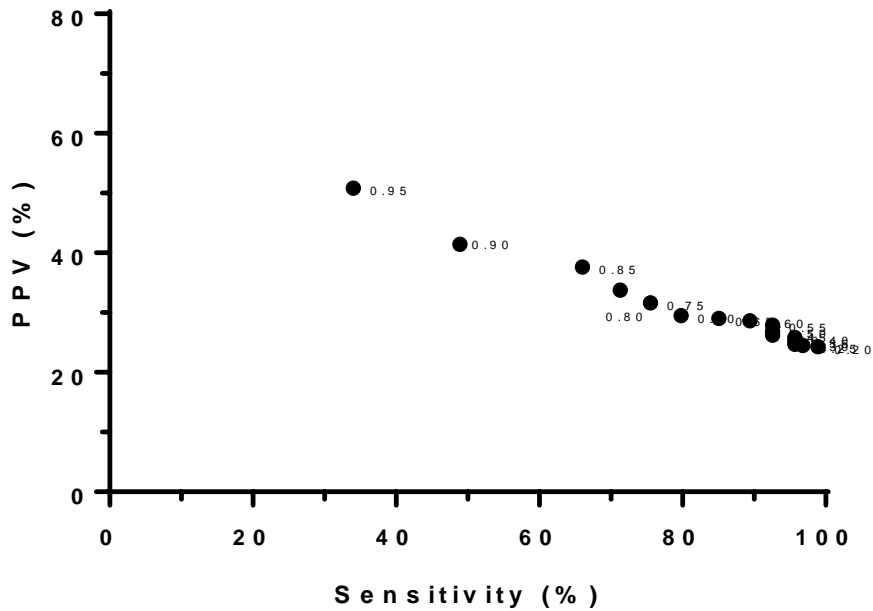
GUINZ Maori

n=403

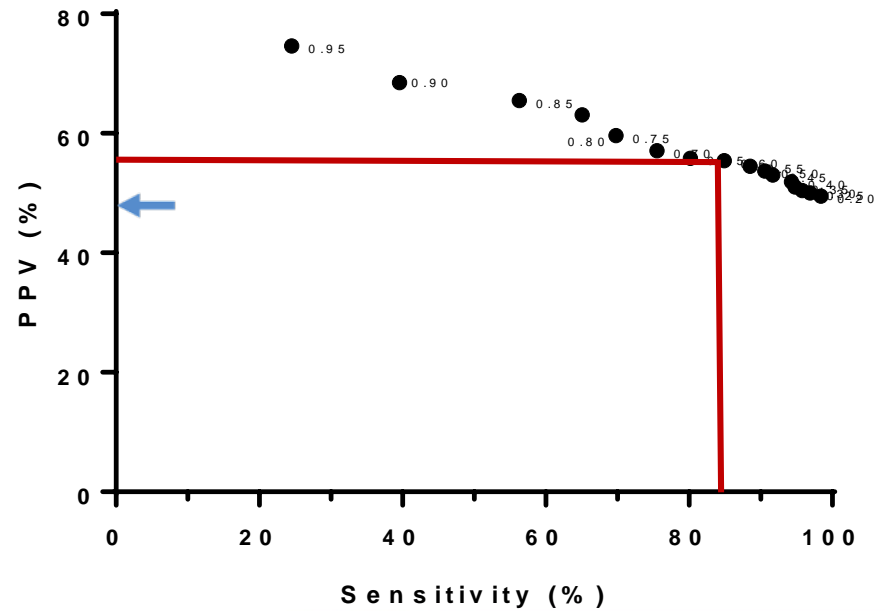
Obese 23.3%

Overweight/obese 47.6%

Obese



Overweight or obese



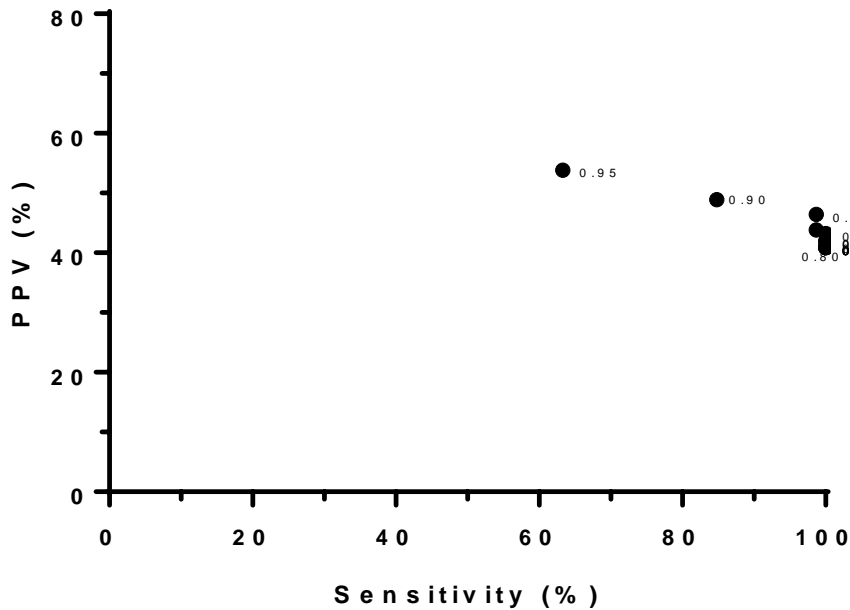
GUINZ Pasifika

n=195

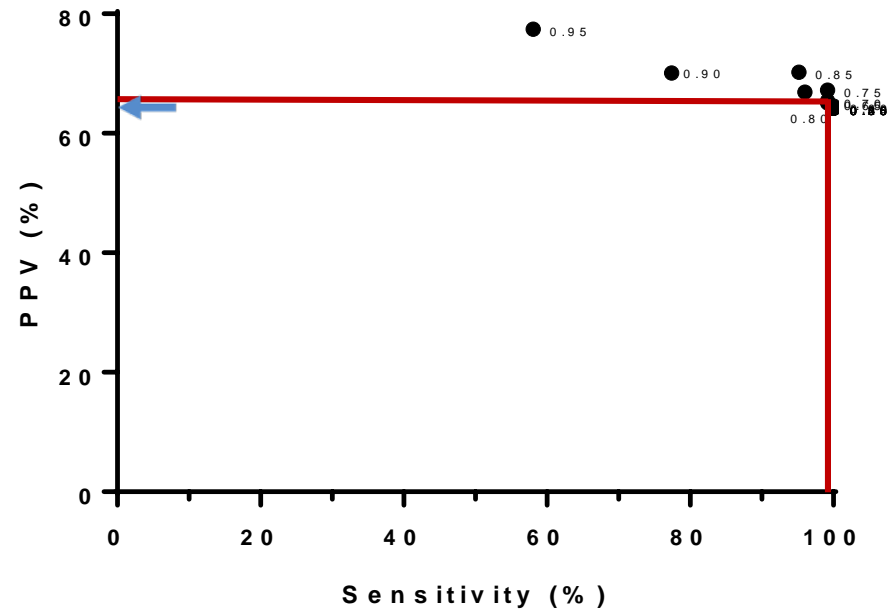
Obese 40.5%

Overweight/obese 63.6%

Obese



Overweight or obese



Conclusions

The current prediction model based upon birth data only has limited utility

The next model iteration planned will include:

Modelling of healthy weight

Infant auxology (accelerating weight gain)

Genomic and non-genomic SNPs (salivary samples) as well as epigenetic modification of these SNPs (newborn screening card samples)

