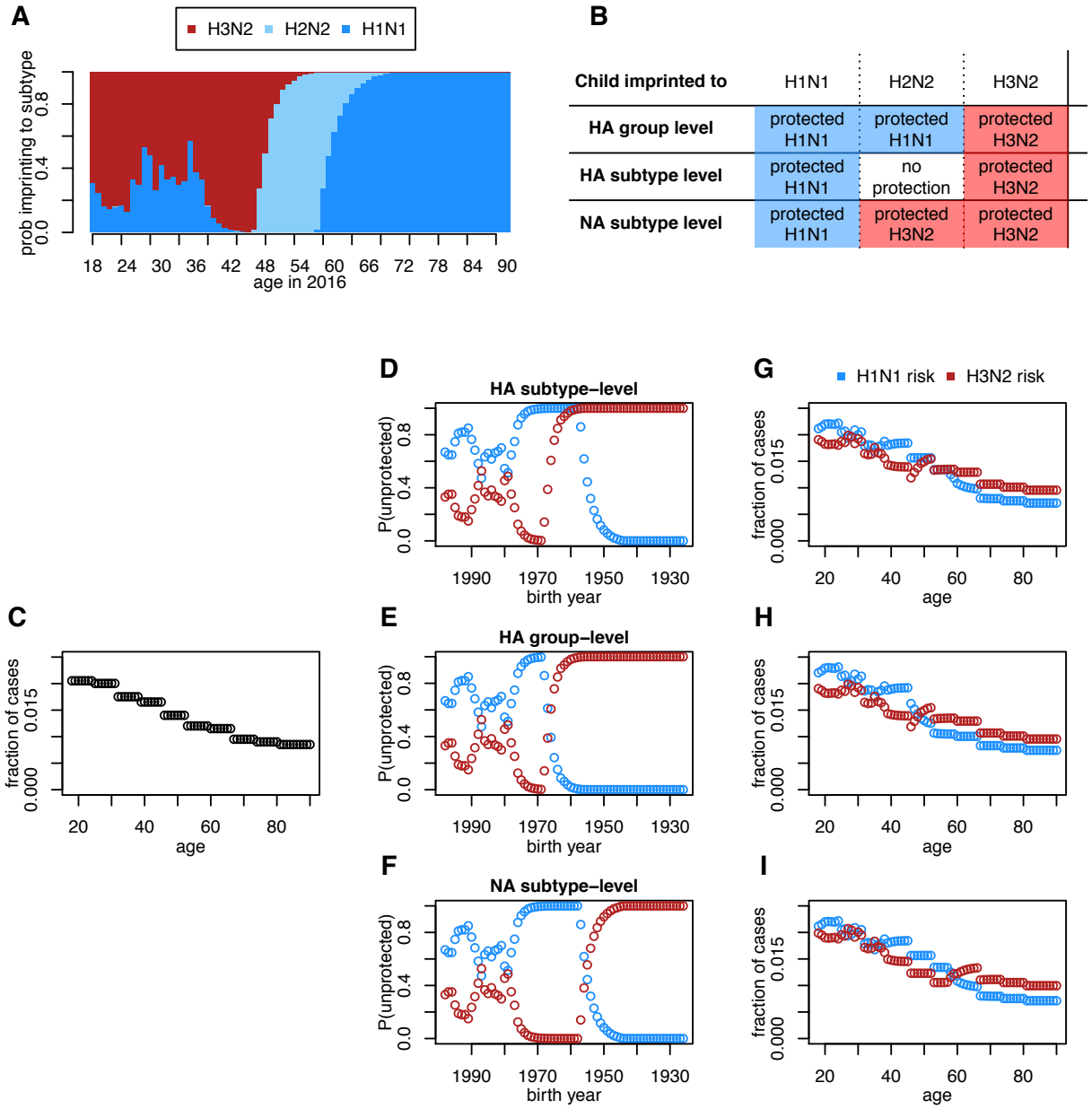
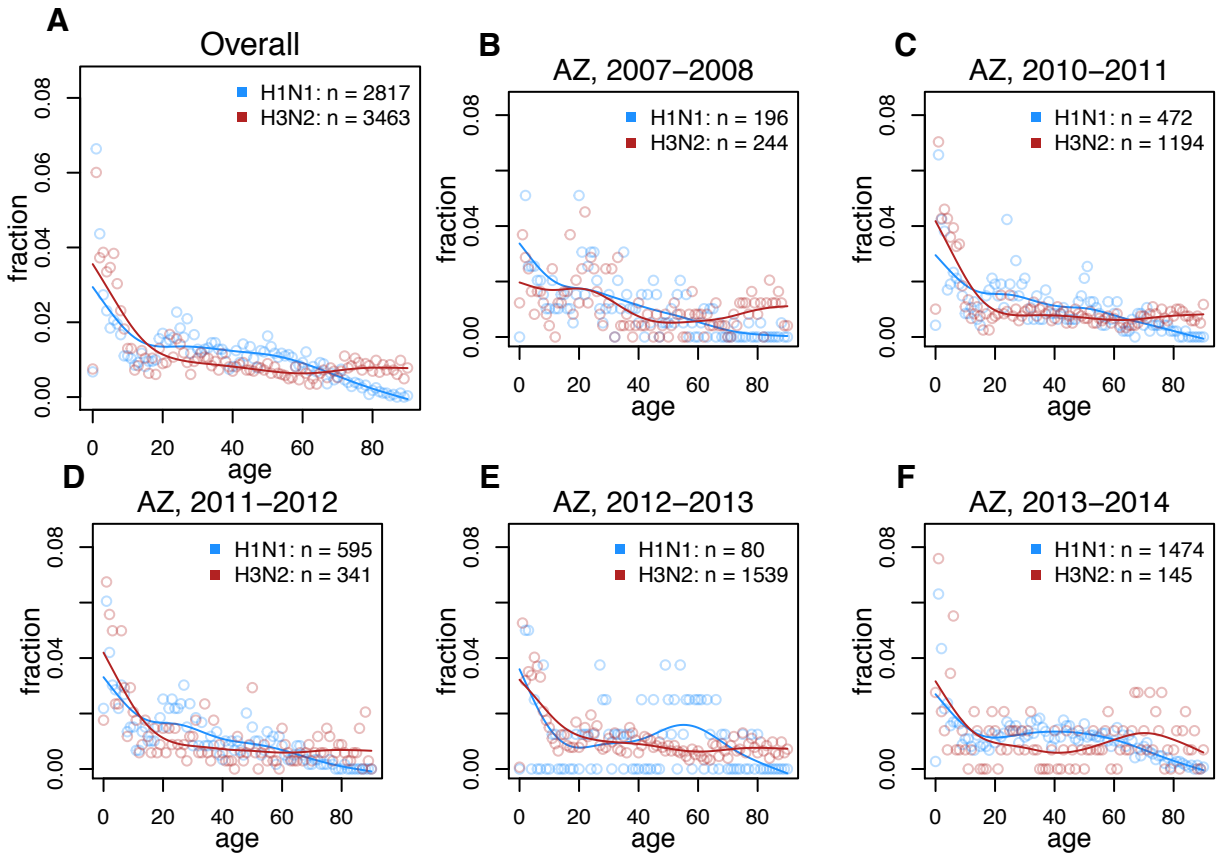
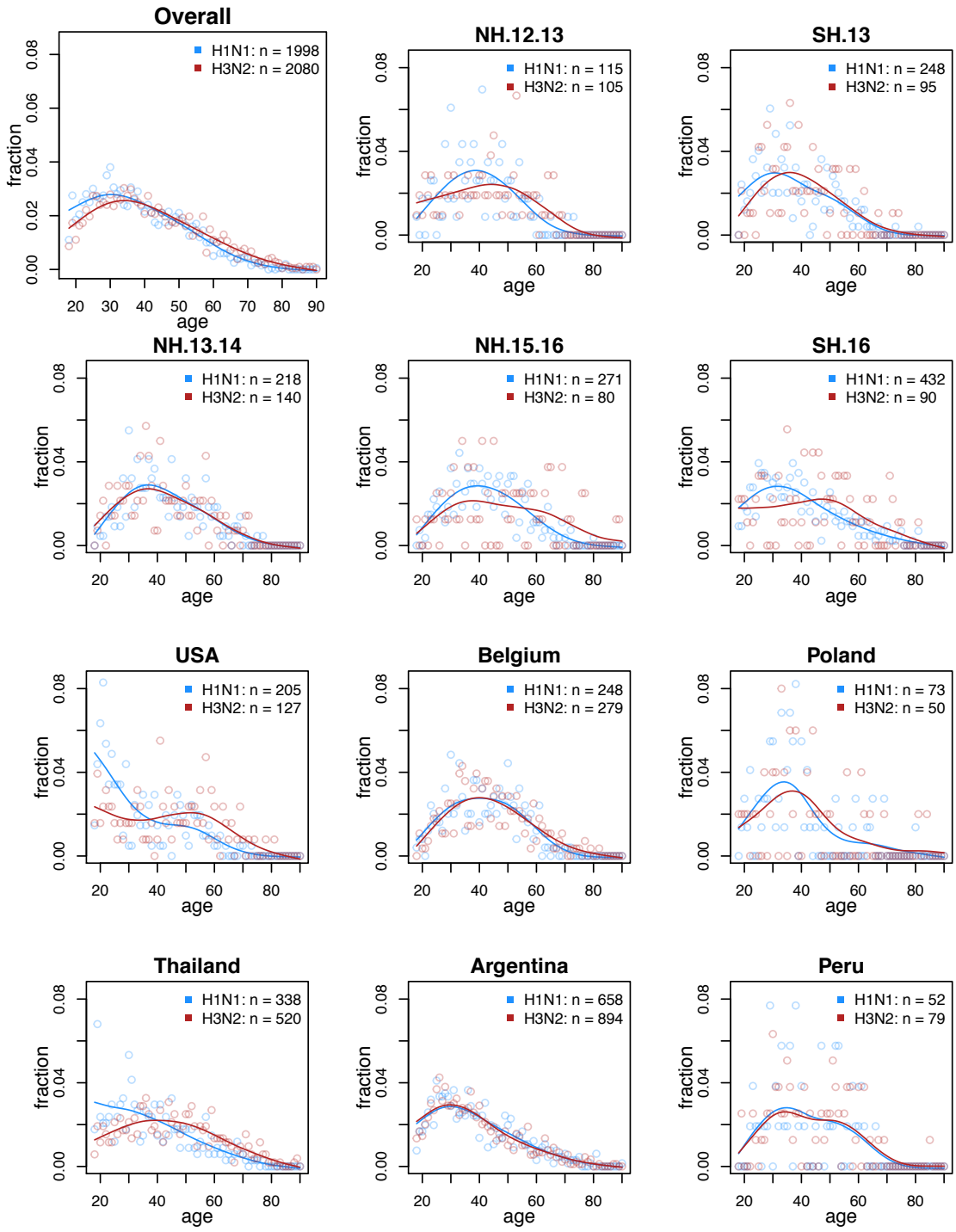


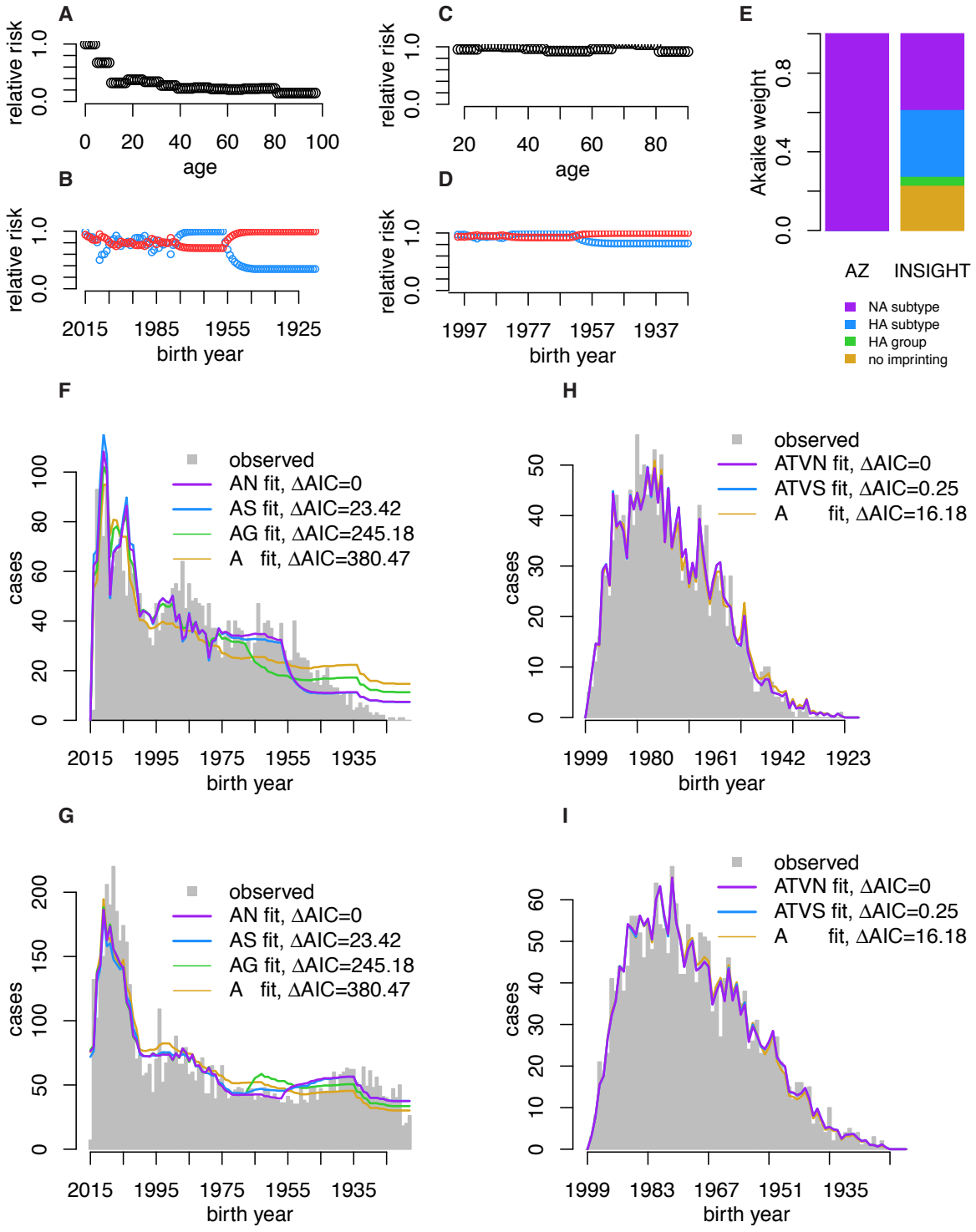
econstructed, birth
cases observed in
ted models. (**C**)
each tested model
eir childhood
ombination of age-
of H1N1 or H3N2



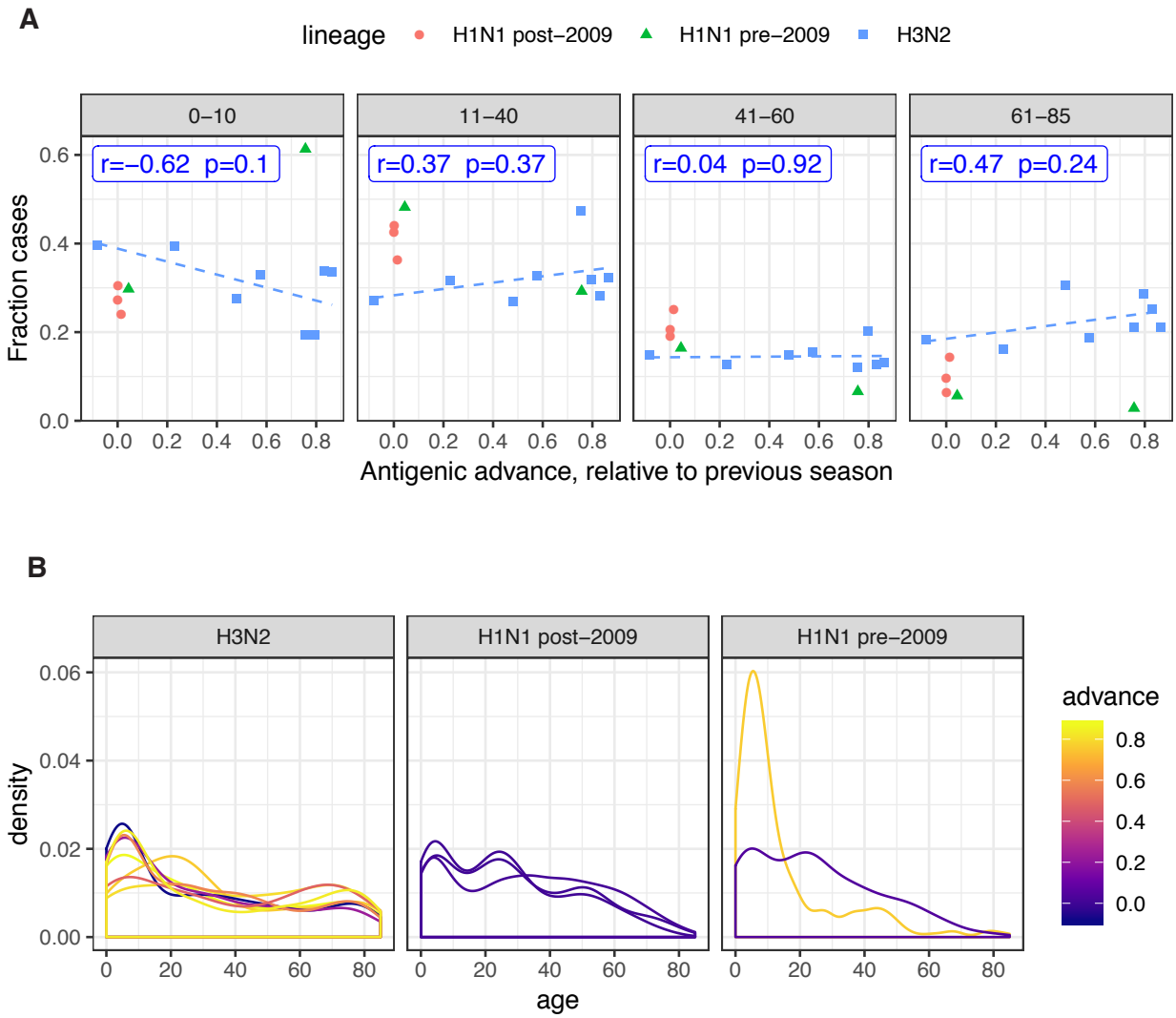
l H1N1 or H3N2 cases
listributions. **(A)** All
east 50 H1N1 and 50



nels follow the same
ıs. NH = Northern



n model AN, which
d the best fit to
ifferent forms of
m the AZDHS data,
rs were included: A =
g, G = HA group-



een annual antigenic
s. Each data point
ı subtype were
observed in each age
) in R. **(B)** Season-
ous season.

waves of the 2009
northern hemisphere

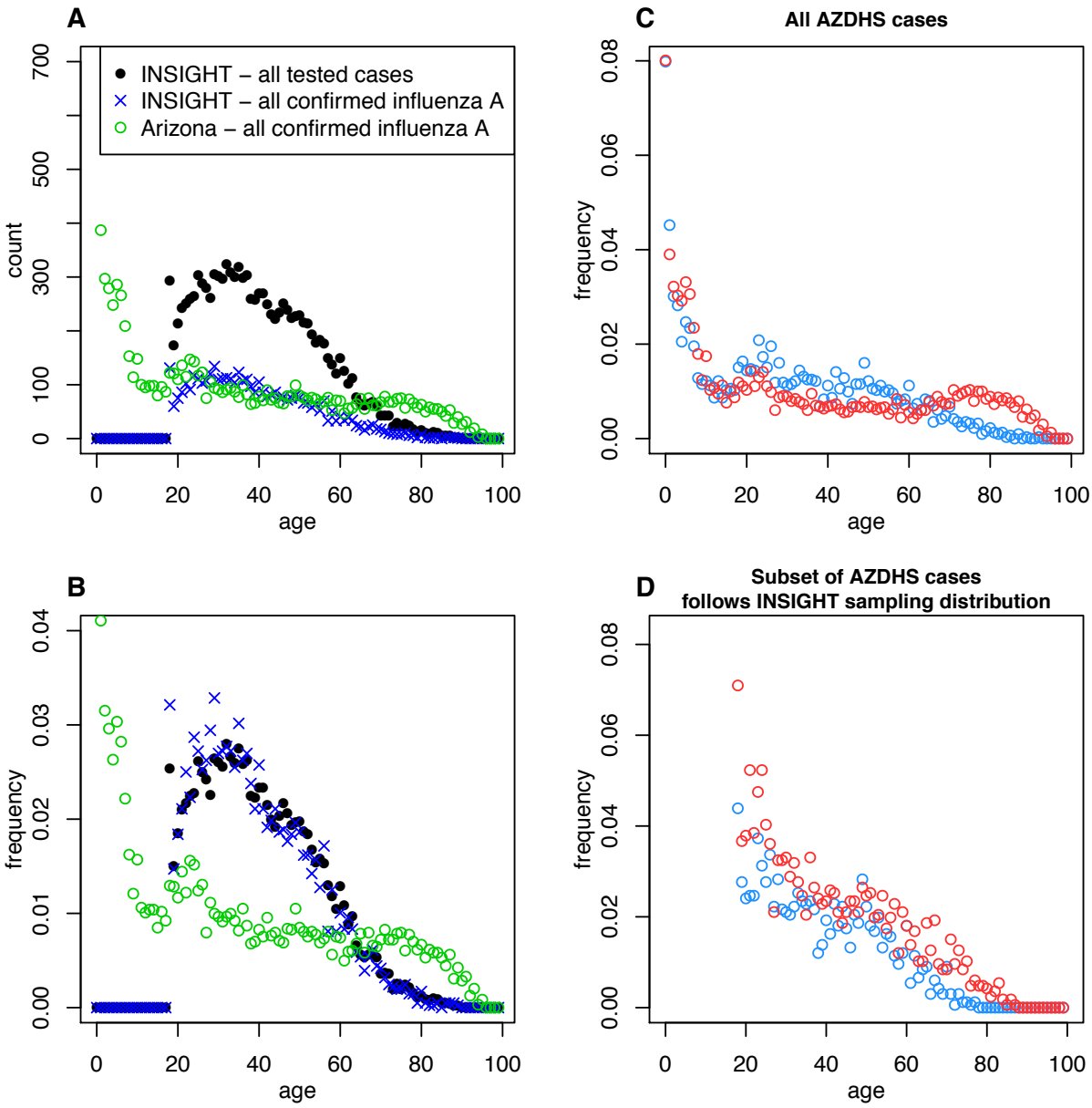
Season	Confirmed H1N1	Confirmed H3N2
1993-94	0	101
1994-95	12	38
2002-03	71	8
2003-04	0	71
2004-05	0	131
2005-06	1	321
2006-07	212	28
2007-08	196	244
2010-11	472	1204
2011-12	595	348
2012-13	80	1578
2013-14	1475	151
2014-15	5	2109
Total	**3119**	**6332**

May, and SH signifies
ic (*) were excluded

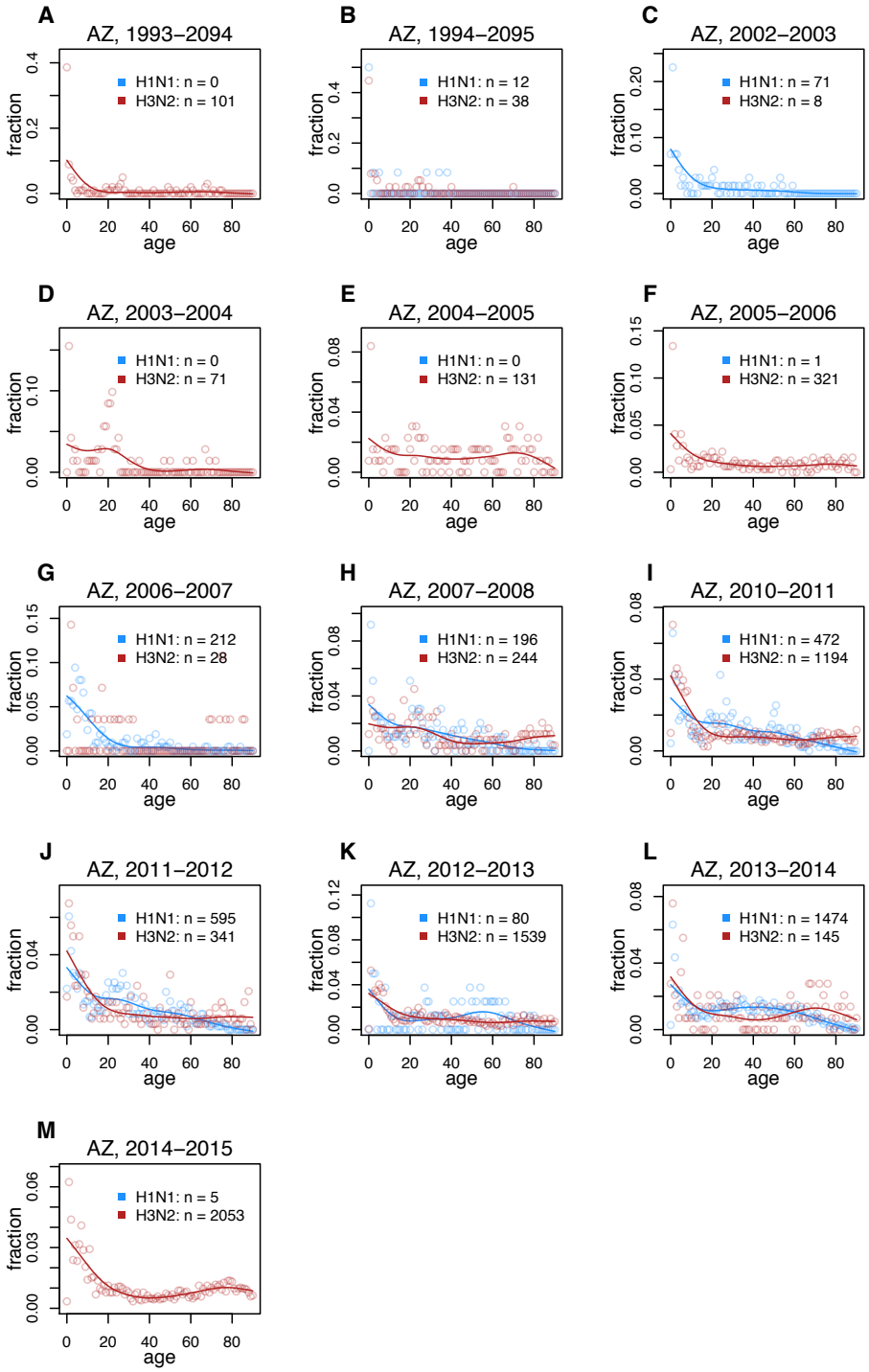
Season	Confirmed H1N1	Confirmed H3N2	Country	Total confirmed
NH 2010-11	93	13	Argentina	1552
SH 2011	25	243	Australia	21
NH 2011-12	1	123	Belgium	512
SH 2012	24	49	Chile	22
NH 2012-13	115	105	Denmark	50
SH 2013	248	95	Estonia	91
NH 2013-14	218	140	Germany	55
SH 2014	36	349	Greece	72
NH 2014-15	47	320	Japan	12
SH 2015	36	386	Peru	131
NH 2015-16	271	80	Poland	107
SH 2016	432	90	Spain	35
NH 2016-17	13	60	Thailand	727
Total	**1559**	**2053**	UK	14
			USA	211

included. A = age-
= HA group-level
ly INSIGHT data

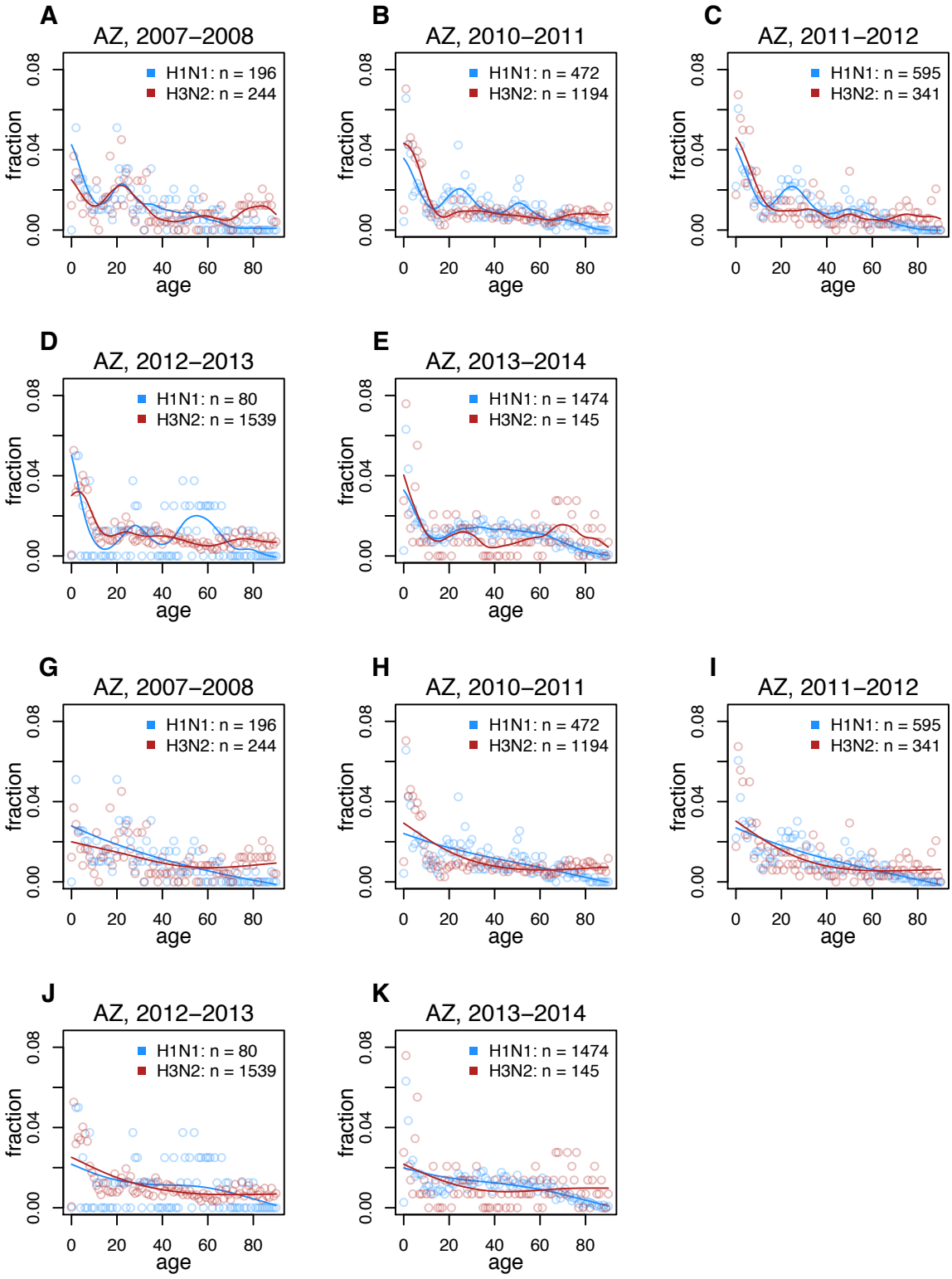
Model	ΔAIC
AZDHS models	
AN	0.00
AS	23.42
AG	245.18
A	380.47
INSIGHT models	
ATVN	0.00
ATVS	0.25
ATV	0.98
ATUVN	2.00
ATUVS	2.25
ATUV	2.96
ATVG	4.26
ATN	6.16
ATUVG	6.25
ATS	6.40
ATUN	8.10
ATUS	8.33
AT	8.67
AVN	8.79
AVS	8.95
AV	9.54
ATU	10.56
AUVN	10.79
AUVS	10.95
ATG	11.35
AUV	11.54
AVG	12.99
ATUG	13.23
AN	14.02
AS	14.18
AUVG	14.99
AUN	16.00
AUS	16.16
A	16.18
AU	18.14
AG	19.17
AUG	21.12



B), frequencies from
ases was not available
es at the extremes of
l to all tested cases.
HS cases, of the same
D illustrates that the
ype-specific



observed age
plotted if 10 or more
Smoothing splines
wer data points would



71
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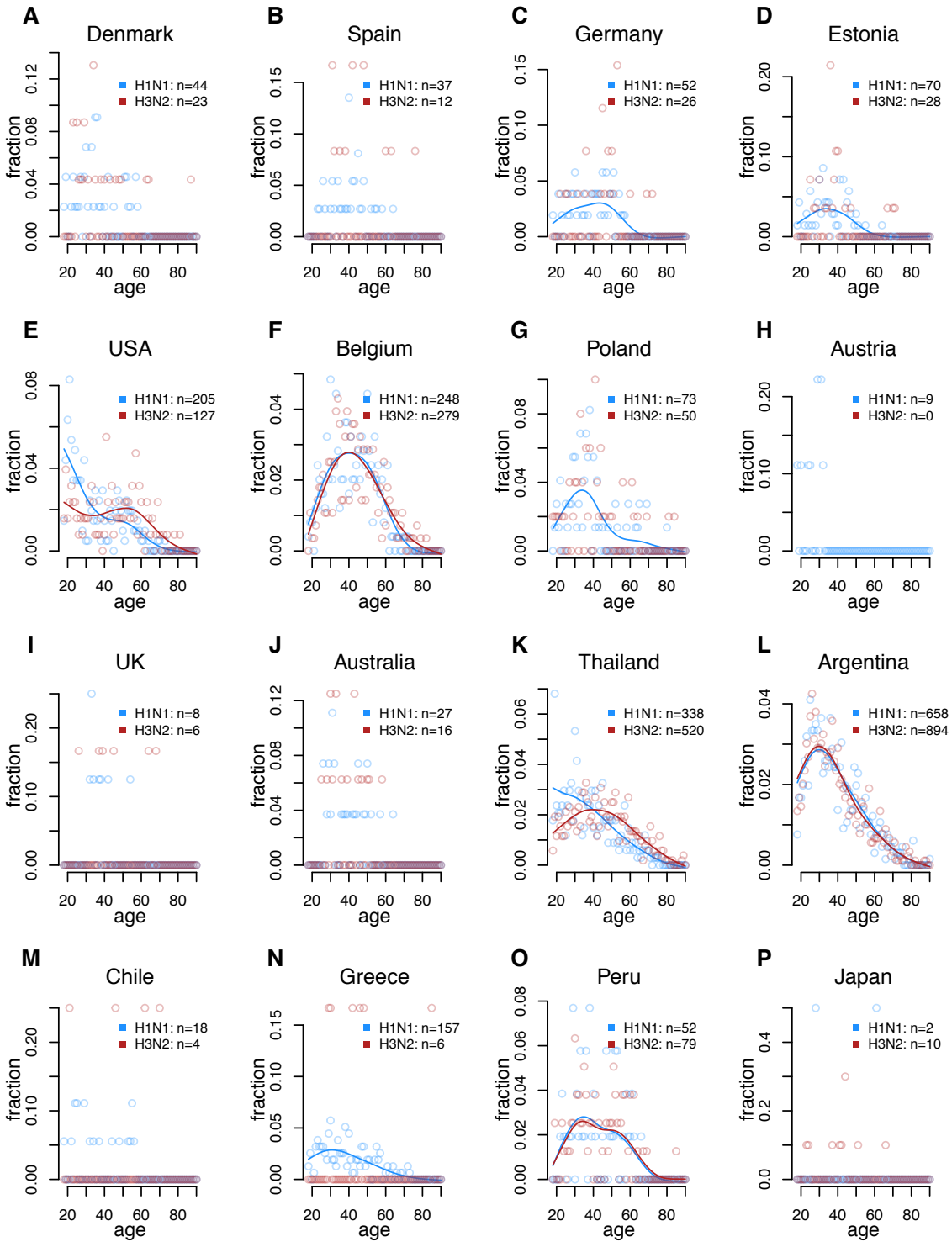
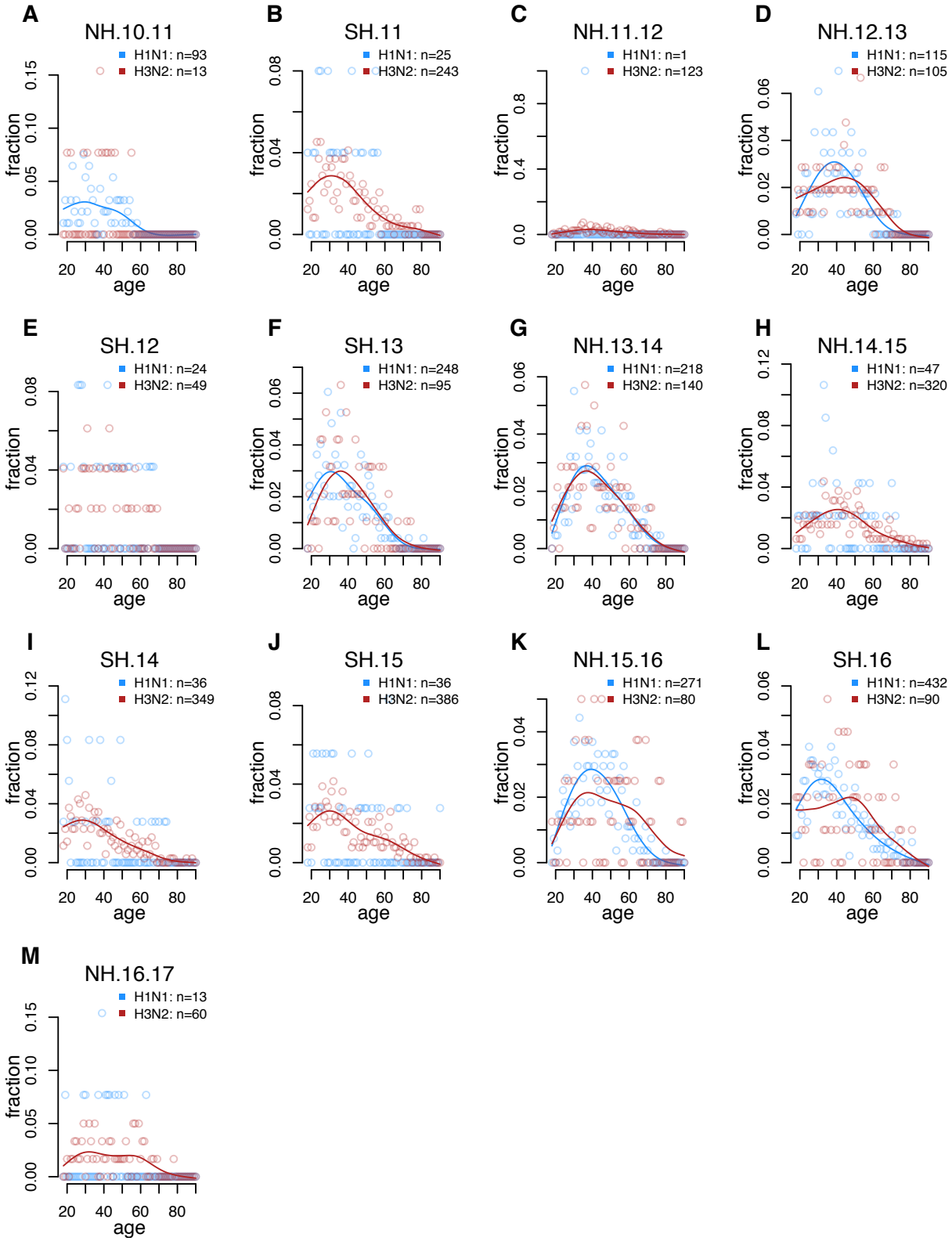
', with smoothing
splines shown in the

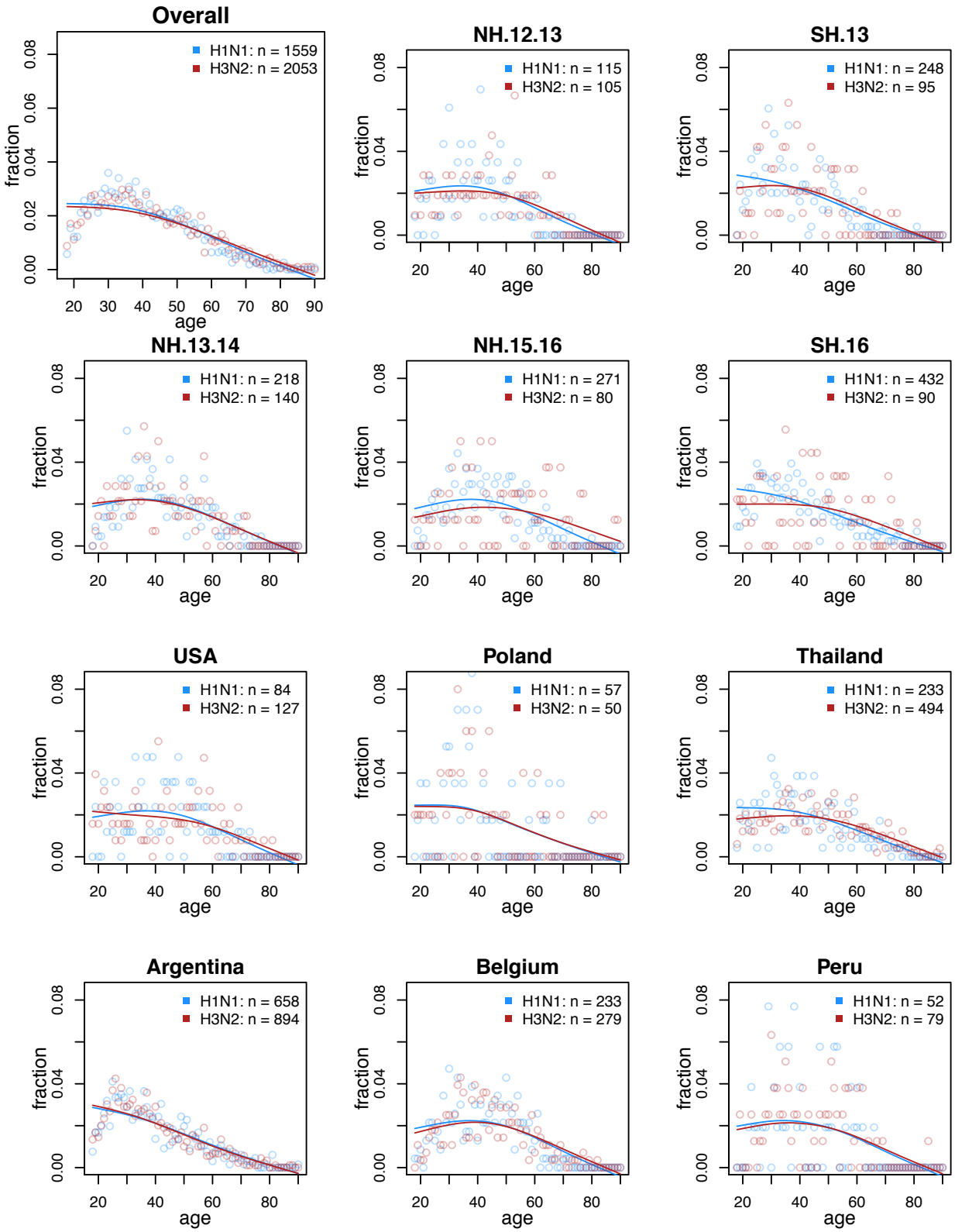


rved age distributions
rved, (as opposed to
Smoothing splines
er data points would



g observed age

Smoothing splines



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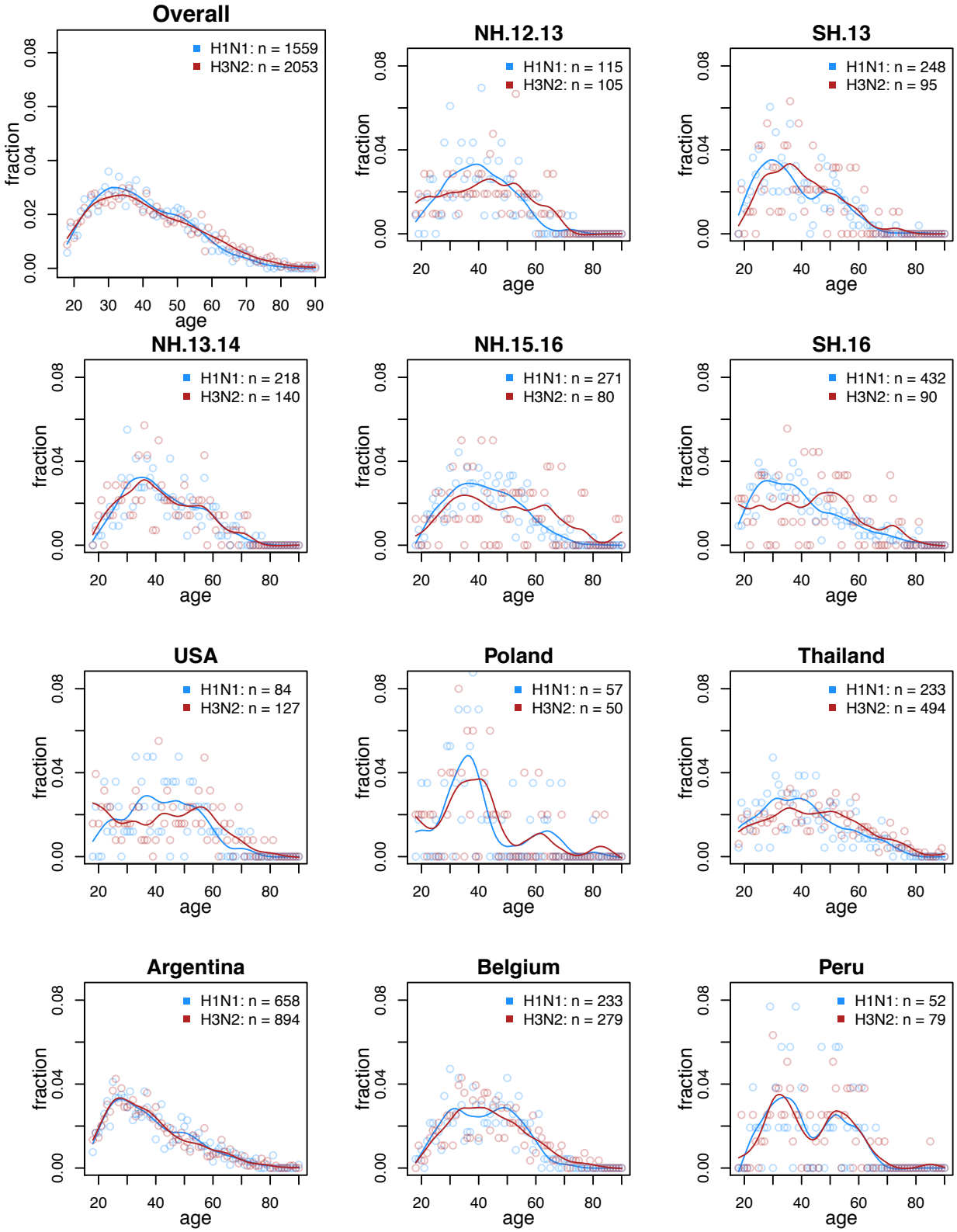
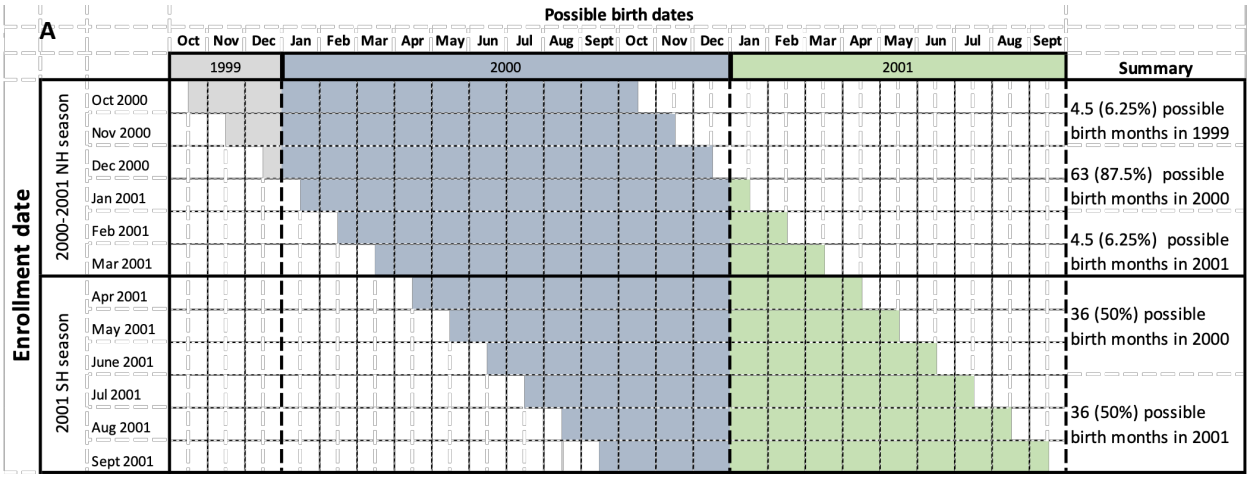
86 *g. 3*, except with a
87 :s.



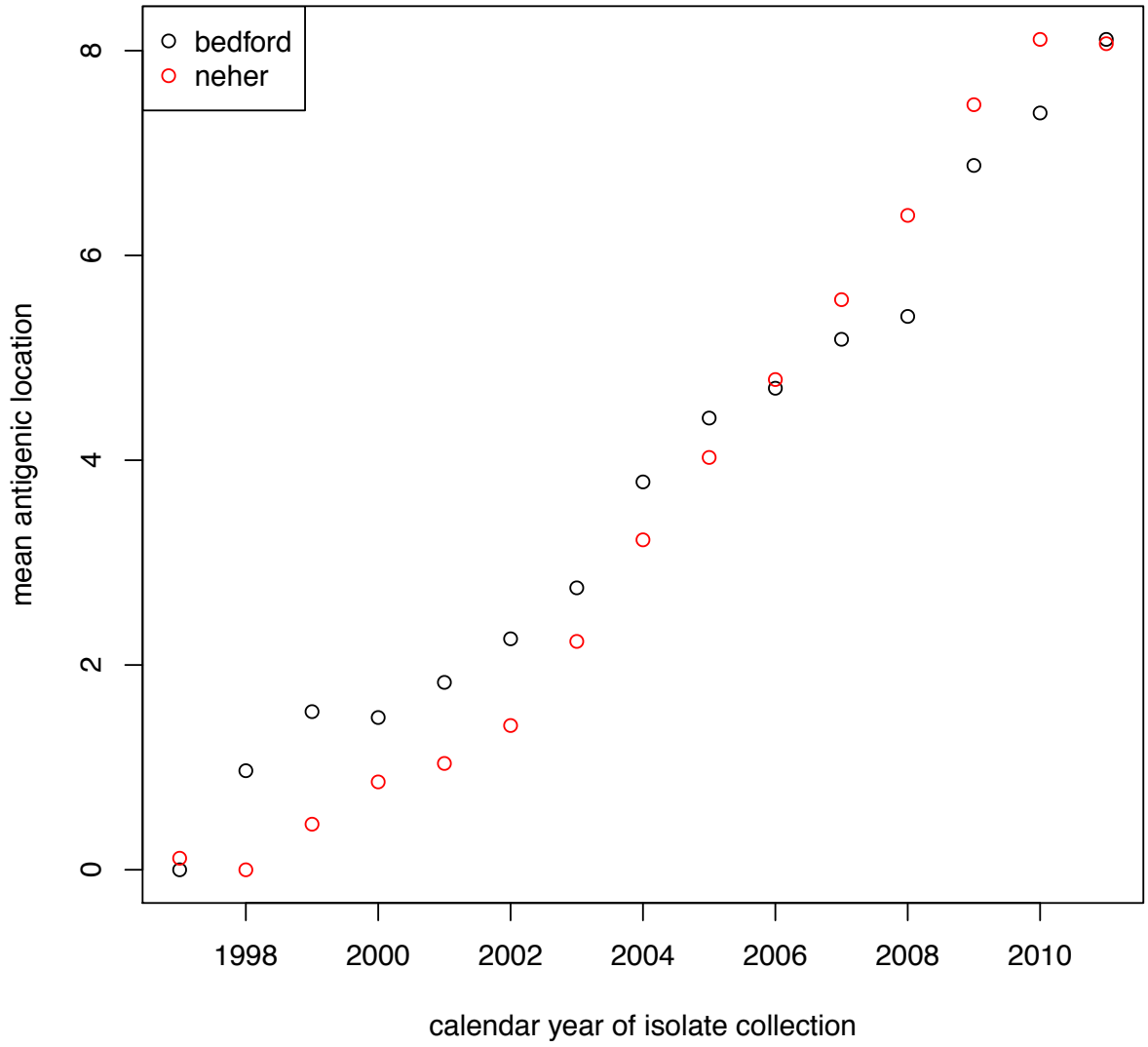
ig. 3, except with a



B

	Probability	Birth year formula
y0-y1 NH season	.0625	b = y1-age-1
	.875	b = y1-age
	.0625	b = y1 – age +1
y1 SH season	0.5	b = y1 – age -1
	0.5	b = y1 - age

h months (shaded) of
s the start of the NH
ı (top half of figure),
1999 (gray) or in 2001
of figure), have an
month of case
shown in (**A**), were
ears for cases observed
of birth year-specific
SH seasons.



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ord et al., and
n a given calendar year.

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111 **ıce intervals from**
112 sk of confirmed
113
114

Model	AN	AS	AG	A
ΔAIC	0.00	23.42	245.18	380.47
H1N1 impr. protection	0.34 (0.29-0.42)	0.29 (0.24-0.35)	0.67 (0.58-0.78)	
H3N2 impr. protection	0.71 (0.62-0.82)	0.9 (0.78- >1)	0.69 (0.6-0.8)	
Ages 5-10	0.68 (0.63-0.74)	0.66 (0.61-0.72)	0.66 (0.62-0.72)	0.62 (0.57-0.68)
Ages 11-17	0.33 (0.3-0.36)	0.31 (0.28-0.34)	0.33 (0.3-0.37)	0.3 (0.28-0.34)
Ages 18-24	0.38 (0.35-0.42)	0.36 (0.32-0.4)	0.39 (0.35-0.43)	0.35 (0.32-0.39)
Ages 25-31	0.34 (0.32-0.38)	0.33 (0.3-0.37)	0.34 (0.31-0.38)	0.31 (0.28-0.35)
Ages 32-38	0.28 (0.26-0.32)	0.26 (0.24-0.3)	0.28 (0.26-0.32)	0.26 (0.24-0.29)
Ages 39-45	0.23 (0.2-0.27)	0.21 (0.18-0.24)	0.24 (0.22-0.28)	0.21 (0.2-0.24)
Ages 46-52	0.24 (0.22-0.28)	0.21 (0.19-0.24)	0.24 (0.22-0.28)	0.23 (0.2-0.26)
Ages 53-59	0.22 (0.2-0.26)	0.2 (0.18-0.23)	0.2 (0.18-0.24)	0.2 (0.18-0.23)
Ages 60-66	0.21 (0.19-0.24)	0.22 (0.2-0.26)	0.19 (0.16-0.22)	0.18 (0.16-0.21)
Ages 67-73	0.22 (0.2-0.26)	0.25 (0.22-0.29)	0.2 (0.18-0.23)	0.19 (0.18-0.22)
Ages 74-80	0.23 (0.2-0.26)	0.25 (0.22-0.3)	0.2 (0.18-0.24)	0.2 (0.18-0.23)
Ages 81+	0.15 (0.14-0.18)	0.17 (0.15-0.2)	0.13 (0.12-0.16)	0.13 (0.12-0.15)

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116

Model	ATVN	ATVS	ATV	ATUVN	ATUVS	ATUV	ATVG	ATN
ΔAIC	0	0.25	0.98	2	2.25	2.96	4.26	6.16
Antivir. Trt.	1.41 (1.16-1.71)	1.41 (1.15-1.71)	1.40 (1.15-1.70)	1.41 (1.16-1.71)	1.41 (1.15-1.71)	1.40 (1.15-1.70)	1.41 (1.15-1.71)	1.39 (1.14-1.68)
Und. Cond.				1.00 (0.85-1.17)	1.00 (0.85-1.17)	0.99 (0.85-1.16)		
Vaccin., H1N1	0.65 (0.47-0.89)	0.65 (0.46-0.89)	0.62 (0.44-0.85)	0.65 (0.47-0.89)	0.65 (0.47-0.89)	0.62 (0.44-0.85)	0.63 (0.45-0.86)	
Vaccin., H3N2	0.84 (0.67-1.06)	0.84 (0.67-1.05)	0.86 (0.68-1.07)	0.84 (0.67-1.06)	0.84 (0.67-1.06)	0.86 (0.68-1.07)	0.84 (0.67-1.06)	
Impr., H1N1	0.82 (0.59-1.15)	0.77 (0.59-1.00)		0.82 (0.59-1.15)	0.77 (0.59-1.00)		0.98 (0.78-1.28)	0.79 (0.57-1.12)
Impr.„ H3N2	0.92 (0.70-1.26)	0.98 (0.82-1.19)		0.92 (0.70-1.26)	0.98 (0.82-1.19)		0.94 (0.79-1.21)	0.92 (0.69-1.25)
age 18-24	0.96 (0.84-1.09)	0.95 (0.84-1.08)	0.96 (0.85-1.09)	0.96 (0.84-1.09)	0.95 (0.83-1.09)	0.96 (0.84-1.09)	0.96 (0.85-1.10)	0.97 (0.86-1.11)
age 25-38	1.01 (0.91-1.14)	1.01 (0.91-1.14)	1.01 (0.91-1.14)	1.01 (0.91-1.14)	1.01 (0.91-1.14)	1.01 (0.91-1.14)	1.01 (0.91-1.14)	1.02 (0.92-1.15)
age 39-45	0.97 (0.85-1.12)	0.95 (0.84-1.08)	0.98 (0.88-1.10)	0.97 (0.85-1.12)	0.95 (0.84-1.08)	0.98 (0.88-1.10)	0.99 (0.87-1.12)	0.96 (0.84-1.11)
age 46-52	0.93 (0.81-1.08)	0.90 (0.80-1.03)	0.94 (0.83-1.06)	0.93 (0.81-1.08)	0.90 (0.80-1.03)	0.94 (0.83-1.06)	0.93 (0.82-1.07)	0.92 (0.80-1.07)
age 53-59	0.93 (0.81-1.07)	0.91 (0.79-1.05)	0.93 (0.82-1.07)	0.93 (0.81-1.07)	0.91 (0.79-1.05)	0.94 (0.82-1.07)	0.92 (0.79-1.10)	0.91 (0.80-1.05)
age 60-66	0.96 (0.78-1.18)	0.99 (0.82-1.18)	0.95 (0.81-1.12)	0.96 (0.78-1.18)	0.99 (0.82-1.19)	0.96 (0.81-1.13)	0.94 (0.78-1.15)	0.93 (0.76-1.14)
age 67-73	1.06 (0.81-1.36)	1.10 (0.88-1.38)	1.05 (0.85-1.28)	1.06 (0.81-1.38)	1.11 (0.88-1.39)	1.05 (0.85-1.29)	1.03 (0.82-1.30)	1.01 (0.78-1.31)
age 74-80	1.04 (0.72-1.46)	1.08 (0.78-1.47)	1.03 (0.76-1.38)	1.04 (0.72-1.47)	1.09 (0.78-1.48)	1.03 (0.76-1.39)	1.01 (0.72-1.39)	1.00 (0.69-1.41)
age 81-90	0.92 (0.55-1.47)	0.96 (0.58-1.49)	0.90 (0.56-1.38)	0.92 (0.55-1.48)	0.96 (0.58-1.50)	0.90 (0.56-1.39)	0.88 (0.54-1.40)	0.88 (0.53-1.41)

Model	ATUVG	ATS	ATUN	ATUS	AT	AVN	AVS	AV
ΔAIC	6.25	6.4	8.1	8.33	8.67	8.79	8.95	9.54
Antivir. Trt.	1.41 (1.16-1.71)	1.38 (1.14-1.68)	1.39 (1.14-1.68)	1.39 (1.14-1.68)	1.38 (1.13-1.67)			
Und. Cond.	0.99 (0.85-1.16)		0.98 (0.84-1.15)	0.98 (0.84-1.15)				
Vaccin., H1N1	0.63 (0.45-0.87)					0.66 (0.47-0.91)	0.66 (0.47-0.91)	0.63 (0.46-0.86)
Vaccin., H3N2	0.85 (0.67-1.06)					0.84 (0.67-1.06)	0.84 (0.67-1.06)	0.86 (0.68-1.08)
Impr., H1N1	0.98 (0.78-1.27)	0.74 (0.57-0.97)	0.79 (0.57-1.12)	0.75 (0.57-0.97)		0.81 (0.59-1.14)	0.77 (0.59-1.00)	
Impr.„ H3N2	0.94 (0.79-1.21)	0.97 (0.81-1.17)	0.92 (0.69-1.25)	0.97 (0.81-1.17)		0.94 (0.71-1.29)	0.99 (0.82-1.20)	
age 18-24	0.96 (0.84-1.10)	0.97 (0.85-1.10)	0.97 (0.85-1.11)	0.97 (0.85-1.10)	0.98 (0.86-1.12)	0.96 (0.84-1.10)	0.95 (0.84-1.09)	0.96 (0.85-1.10)
age 25-38	1.01 (0.91-1.14)	1.02 (0.92-1.15)	1.02 (0.92-1.15)	1.02 (0.92-1.15)	1.02 (0.92-1.15)	1.01 (0.91-1.14)	1.01 (0.91-1.14)	1.01 (0.91-1.14)
age 39-45	0.99 (0.87-1.12)	0.95 (0.84-1.07)	0.96 (0.84-1.11)	0.95 (0.84-1.07)	0.97 (0.87-1.10)	0.97 (0.86-1.13)	0.96 (0.85-1.09)	0.99 (0.89-1.11)
age 46-52	0.93 (0.82-1.07)	0.89 (0.79-1.01)	0.92 (0.80-1.07)	0.89 (0.79-1.02)	0.93 (0.82-1.05)	0.92 (0.81-1.08)	0.90 (0.80-1.03)	0.94 (0.83-1.06)
age 53-59	0.92 (0.79-1.10)	0.89 (0.77-1.03)	0.91 (0.80-1.06)	0.89 (0.77-1.03)	0.92 (0.81-1.05)	0.93 (0.81-1.07)	0.92 (0.80-1.06)	0.94 (0.83-1.08)
age 60-66	0.94 (0.78-1.16)	0.96 (0.80-1.15)	0.94 (0.76-1.15)	0.96 (0.80-1.16)	0.92 (0.79-1.08)	0.98 (0.80-1.19)	1.00 (0.83-1.19)	0.96 (0.82-1.13)
age 67-73	1.03 (0.82-1.31)	1.06 (0.84-1.32)	1.02 (0.78-1.32)	1.06 (0.84-1.33)	1.00 (0.81-1.22)	1.08 (0.82-1.38)	1.12 (0.89-1.39)	1.05 (0.86-1.29)
age 74-80	1.01 (0.72-1.41)	1.04 (0.75-1.42)	1.00 (0.69-1.42)	1.05 (0.75-1.43)	0.98 (0.72-1.31)	1.09 (0.76-1.52)	1.13 (0.81-1.52)	1.07 (0.79-1.43)
age 81-90	0.89 (0.54-1.41)	0.92 (0.56-1.43)	0.89 (0.53-1.43)	0.92 (0.56-1.45)	0.85 (0.53-1.31)	0.99 (0.59-1.57)	1.03 (0.62-1.58)	0.96 (0.59-1.47)

Table S2. Maximum likelihood parameter estimates and 95% profile confidence intervals from each model fit to INSIGHT data (1/2).

Model	ATU	AUVN	AUVS	ATG	AUV	AVG	ATUG	AN
ΔAIC	10.56	10.79	10.95	11.35	11.54	12.99	13.23	14.02
Antivir. Trt.	1.38 (1.13-1.68)			1.39 (1.14-1.68)			1.39 (1.14-1.69)	
Und. Cond.	0.98 (0.84-1.14)	1.00 (0.86-1.18)	1.00 (0.86-1.18)		1.00 (0.86-1.17)		0.97 (0.84-1.14)	
Vaccin., H1N1		0.66 (0.47-0.91)	0.66 (0.47-0.91)		0.63 (0.46-0.86)	0.64 (0.46-0.89)		
Vaccin., H3N2		0.84 (0.67-1.06)	0.84 (0.67-1.06)		0.86 (0.68-1.08)	0.85 (0.67-1.07)		
Impr., H1N1		0.81 (0.59-1.14)	0.77 (0.59-1.00)	0.96 (0.76-1.25)		1.00 (0.80-1.30)	0.95 (0.76-1.25)	0.78 (0.57-1.11)
Impr.,, H3N2		0.94 (0.71-1.29)	0.99 (0.82-1.20)	0.94 (0.77-1.20)		0.94 (0.79-1.20)	0.94 (0.77-1.21)	0.93 (0.70-1.28)
age 18-24	0.98 (0.86-1.11)	0.96 (0.84-1.10)	0.95 (0.84-1.09)	0.98 (0.86-1.12)	0.96 (0.85-1.10)	0.97 (0.85-1.10)	0.98 (0.86-1.12)	0.98 (0.86-1.11)
age 25-38	1.02 (0.92-1.15)	1.01 (0.91-1.14)	1.01 (0.91-1.14)	1.02 (0.92-1.15)	1.01 (0.91-1.14)	1.01 (0.91-1.13)	1.02 (0.92-1.15)	1.02 (0.92-1.15)
age 39-45	0.98 (0.88-1.10)	0.97 (0.85-1.13)	0.96 (0.85-1.09)	0.98 (0.86-1.11)	0.99 (0.89-1.11)	1.00 (0.89-1.13)	0.98 (0.86-1.11)	0.97 (0.85-1.12)
age 46-52	0.93 (0.83-1.06)	0.92 (0.81-1.08)	0.90 (0.80-1.03)	0.92 (0.81-1.06)	0.94 (0.83-1.06)	0.93 (0.82-1.07)	0.93 (0.81-1.07)	0.91 (0.80-1.07)
age 53-59	0.92 (0.81-1.06)	0.93 (0.81-1.08)	0.92 (0.80-1.06)	0.91 (0.77-1.09)	0.94 (0.82-1.08)	0.92 (0.80-1.10)	0.92 (0.78-1.10)	0.92 (0.80-1.06)
age 60-66	0.93 (0.79-1.09)	0.98 (0.79-1.19)	1.00 (0.83-1.20)	0.91 (0.75-1.11)	0.96 (0.82-1.14)	0.94 (0.79-1.15)	0.92 (0.76-1.12)	0.95 (0.78-1.16)
age 67-73	1.00 (0.81-1.24)	1.08 (0.81-1.39)	1.12 (0.88-1.39)	0.98 (0.78-1.25)	1.06 (0.85-1.30)	1.03 (0.83-1.30)	0.99 (0.78-1.26)	1.03 (0.79-1.32)
age 74-80	0.99 (0.72-1.32)	1.09 (0.76-1.52)	1.13 (0.81-1.53)	0.96 (0.69-1.33)	1.07 (0.78-1.44)	1.04 (0.76-1.44)	0.97 (0.69-1.35)	1.05 (0.73-1.46)
age 81-90	0.86 (0.53-1.32)	0.99 (0.59-1.57)	1.03 (0.62-1.59)	0.84 (0.51-1.33)	0.96 (0.59-1.48)	0.94 (0.57-1.48)	0.85 (0.52-1.35)	0.94 (0.56-1.50)
Model	AS	AUVG	AUN	AUS	A	AU	AG	AUG
ΔAIC	14.18	14.99	16	16.16	16.18	18.14	19.17	21.12
Antivir. Trt.								
Und. Cond.		1.00 (0.86-1.17)	0.99 (0.85-1.16)	0.99 (0.85-1.16)		0.98 (0.84-1.15)		0.98 (0.84-1.15)
Vaccin., H1N1		0.64 (0.46-0.89)						
Vaccin., H3N2		0.85 (0.67-1.07)						
Impr., H1N1	0.75 (0.57-0.97)	1.00 (0.80-1.30)	0.78 (0.57-1.11)	0.75 (0.57-0.97)			0.98 (0.78-1.27)	0.97 (0.78-1.27)
Impr.,, H3N2	0.98 (0.82-1.19)	0.94 (0.79-1.20)	0.93 (0.70-1.28)	0.98 (0.82-1.19)			0.93 (0.78-1.20)	0.93 (0.78-1.20)
age 18-24	0.97 (0.86-1.11)	0.97 (0.85-1.10)	0.98 (0.86-1.11)	0.97 (0.85-1.11)	0.98 (0.87-1.12)	0.98 (0.86-1.12)	0.99 (0.87-1.12)	0.98 (0.86-1.12)
age 25-38	1.02 (0.92-1.15)	1.01 (0.91-1.13)	1.02 (0.92-1.15)	1.02 (0.92-1.15)	1.02 (0.92-1.15)	1.02 (0.92-1.15)	1.02 (0.92-1.15)	1.02 (0.92-1.14)
age 39-45	0.95 (0.85-1.08)	1.00 (0.88-1.13)	0.97 (0.85-1.12)	0.95 (0.85-1.08)	0.98 (0.88-1.11)	0.98 (0.88-1.11)	0.99 (0.88-1.12)	0.99 (0.88-1.12)
age 46-52	0.89 (0.79-1.02)	0.93 (0.82-1.07)	0.91 (0.80-1.07)	0.89 (0.79-1.02)	0.93 (0.83-1.05)	0.93 (0.83-1.06)	0.92 (0.81-1.06)	0.92 (0.81-1.06)
age 53-59	0.90 (0.78-1.04)	0.92 (0.80-1.10)	0.92 (0.80-1.06)	0.90 (0.78-1.04)	0.93 (0.81-1.06)	0.93 (0.81-1.07)	0.91 (0.78-1.09)	0.91 (0.78-1.10)
age 60-66	0.97 (0.81-1.16)	0.94 (0.79-1.16)	0.95 (0.77-1.17)	0.98 (0.81-1.17)	0.93 (0.80-1.09)	0.93 (0.80-1.10)	0.91 (0.76-1.11)	0.92 (0.76-1.13)
age 67-73	1.07 (0.85-1.33)	1.03 (0.82-1.31)	1.04 (0.79-1.33)	1.07 (0.85-1.34)	1.00 (0.82-1.23)	1.01 (0.82-1.24)	0.98 (0.79-1.25)	0.99 (0.79-1.26)
age 74-80	1.08 (0.78-1.47)	1.04 (0.76-1.45)	1.05 (0.73-1.47)	1.09 (0.78-1.48)	1.02 (0.74-1.35)	1.02 (0.75-1.37)	0.99 (0.71-1.38)	1.00 (0.72-1.39)
age 81-90	0.98 (0.59-1.51)	0.94 (0.57-1.49)	0.95 (0.56-1.51)	0.98 (0.60-1.53)	0.91 (0.56-1.39)	0.91 (0.56-1.41)	0.89 (0.55-1.40)	0.90 (0.55-1.42)

Table S3. Maximum likelihood parameter estimates and 95% profile confidence intervals from each model fit to INSIGHT data (2/2).