Declines in Elevated Blood Lead Levels Among Children, 1997–2011

Byron S. Kennedy, MD, PhD, MPH, Andrew S. Doniger, MD, MPH, Susan Painting, BS, Lee Houston, BS, Michael Slaunwhite, BS, Frank Mirabella, BS, John Felsen, MPH, Paul Hunt, BS, Dawn Hyde, BS, Earl Stich, BS

Background: Ea l childhood lead e po e i a ocia ed i h n me o ad e e heal h effec . Elimina ing blood lead oi oning i a na ional heal h objec i e fo 2020.

Objective: To a e empo al end in childhood ele a ed blood lead le el (EBLL) a e .

Methods: Labo a o eillance da a e e collec ed f om 1997 o 2011 and anal ed in 2013 ing linea eg e ion o a e end in confi med EBLL a e among child en aged <6 ea in he U.S., Ne Yo k S a e ([NYS], e cl ding Ne Yo k Ci), and Mon oe Co n NY. Mon oe Co n a al o e amined a a ca e d of local blic heal h effo o ed ce childhood lead e po e . Blood lead c eening and home lead ha a d in ec ion da a e e collec ed f om 1990 o 2012 and anal ed in 2013.

Results: The e alence of EBLL≥10 μg/dL e 100 e ed child en dec ea ed f om 13.4 o 1.1 in Mon oe Co n , 6.3 o 1.0 in NYS, and 7.6 o 0.6 in he U.S. be een 1997 and 2011. The ab ol e ea l a e of decline in Mon oe Co n (lope=−0.0083, p<0.001) occ ed 2.4-fold fa e han ha in NYS (lope=−0.0034, p<0.001) and 1.8-fold fa e han ha in he U.S. (lope=−0.0046, p<0.001). The childhood blood lead e ing a e a con i en l highe in Mon oe Co n han in NYS and he U.S.; ho e e , e ing inc ea ed fo all h ee a ea (all lope >0, p<0.05), i h g ea e imp o emen ob e ed fo U.S. child en o e all (lope=0.0075, p<0.001).

Conclusions: In addi ion o na ional and a e ide olicie , local effo ma be imo an d i e of o la ion-ba ed decline in childhood EBLL a e .

(Am J P e Med 2014;46(3):259–264)

Background

Ea l childhood lead e po e ha long been ecogni ed a a i k fac o fo ad e e heal h effec , incl ding i e e ible ne obeha io al defici .[1–3] P blic heal h effo ha e he efo e foc ed on ed cing lead e po e a a e en ion a eg . Be een 1976 and 1991, blood lead le el declined b an iall among U.S. child en and ad l , a ib ed mainl o he emo al of lead f om ga oline and olde ed can .[4] S b e en l , o he o ce of lead e po e ha e ecei ed mo e a en ion, ch a lead-ba ed ain , d , and oil.[5] In 1992, fede al legi la ion (Ti le X, he Re iden ial Lead-Ba ed Pain Ha a d Red c ion Ac) a enac ed, hich emha i ed he e en ion and con ol of lead-ba ed ain ha a d in ho ing ni , e eciall fo child en <6 ea of age.[6]

Al ho gh a e age blood lead le el ha e declined among child en in he a , o oo ha he h e hold fo conce n ega ding blood lead le el , gi en ha no afe le el ha been demon a ed fo child en.[7] In 1991, he CDC lo e ed he ele a ed blood lead le el (EBLL) of conce n f om 25 o 10 μg/dL and ecommended ni e- al c eening.[8] Follo ing hi ecommenda ion, Ne Yo k S a e manda ed heal h ca e o ide o e fo m blood lead c eening in child en and e egnan omen in 1992. In 2012, he CDC ado ed an e en lo e efe ence EBLL fo child en, 5 μg/dL, ba ed on he 97.5 h e cen ile of he blood lead le el di ib ion among U.S. child en aged 1–5 ea .[9,10]

De i e he emo al of lead f om ain d ing he 1970 , lead-ba ed ain in ho ing ni ha emained a majo o ce of lead e po e, e eciall in man olde home . Hi o icall , Ne Yo k S a e ha had he highe

F om he Mon oe Co n De a men of P blic Heal h, Roche e , Ne Yo k

Add e co e ondence o: B on S. Kenned , MD, PhD, MPH, Mon oe Co n De a men of P blic Heal h, 111 We fall Rd, Room 950, Roche e. NY 14620. E-mail: bkenned @mon oeco n .go .

0749-3797/$36.00

h :// .doi.o g/10.1016/j.ame e.2013.11.007

concen a ion of olde ho ing ock b il befo e 1950 and among he g ea e n mbe of lead-oi oned child en in he co n . .[11] Wi hin Ne Yo k S a e, Mon oe Co n (incl ding he Ci of Roche e) ha had ome of he highe a e of childhood lead oi oning, gge ing ha lead e o e ma a idel ac o la ge geog aphic a ea .[12,13] In 1992, Ne Yo k S a e manda ed blic heal h ac ion fo child en i h an EBLL≥20 µg/dL; hi h e hold a lo e ed o 15 µg/dL in 2009.[14]

The elimina ion of childhood lead oi oning i a na ional objec i e fo 2020.[15] A be e nde anding of ecen end in EBLL a e f om he na ional o local le el ma o ide in igh in o effec i e blic heal h a egie in eaching hi goal. Acco dingl , he o e of hi d a o e amine he empo al EBLL end fo Mon oe Co n , Ne Yo k S a e, and he U.S. f om 1997 o 2011. In addi ion, hi d o gh o de c ibe local blic heal h effo aimed a ed cing childhood lead e o e in he con e of limi ed e o ce and olic change o e ime, ing Mon oe Co n a a ca e d . Fo he la e d , da a f om 1990 o 2012 e e e amined.

Methods

Data Sources

In 1995, he CDC began collec ing childhood blood lead eil-lance da a f om a e and local heal h dep a men .[16] S eillance field fo hi na ional da aba e e e ac ed f om he a e child-ecific da aba e , hich a in da a collec ion me hod . The labo a o -ba ed da a incl ded e ed and confi med EBLL b ea and a e fo child en aged <72 mon h (i.e., 6 ea). A confi med EBLL a defined a a child i h one eno blood ecimen ≥10 µg/dL o an combina ion of o capilla and/o nkno n blood ecimen ≥10 µg/dL d a n i hin 12 ek of each o he .[17] Fo an gi en ea , a child a co n ed onl once. Fo a child i h a confi med EBLL, if he had ano he ele a ed e el in b e en ea , ega dle of he e e, hen ha al e o ld be con ide ed confi med. In he e en d , hi CDC eillance em a ed fo he U.S. and Ne Yo k S a e (e cl ding Ne Yo k Ci) da a, he ea Mon oe Co n da a e e ob ained di ec l f om he local heal h dep a men . Fo he comp a a i e anal i , he d e iod co e ed 1997–2011, he mo ecen ea fo hich da a e e a ailable.

Home lead in ec ion da a fo Mon oe Co n e e ed o e amine en i onmen al lead e o e. The ho ing ni of child en i h an EBLL e e in ec ed fo lead ha a d ing a i k a e men a oach. Lead ha a d incl ded ain ha a no in ac o a on a f ic ion-im ac face ch a e , indo , and doo in e-1978 ho ing along i h lead eading a o abo e he in e en ion le el anda d a he ime of in ec ion (e.g., c en l 0.5% lead b eigh o 1.0 mg/cm^2) ing a o able -a fl o e cence (XRF) anal e .[18] Fo hi anal i , da a f om 1990 o 2012 e e e amined. F he , empo al a e n of childhood EBLL≥5 µg/dL e e a e ed fo Mon oe Co n .

Data Analysis

The main o come fo he e en d a he ca e e alence a e of childhood lead oi oning, hich a defined a he n mbe of child en aged <6 ea (i.e., 72 mon h) i h a confi med EBLL≥10 µg/dL e 100 e ed child en <6 ea old. In addi ion, he c eening a e a defined a he n mbe of child en <6 ea old e ed fo blood lead e 100 child en <6 ea old. Fo bo h mea e , he empo al end e e a e ed ing linea eg e - ion and b comba ing he lo e fo he U.S., Ne Yo k S a e (e cl ding Ne Yo k Ci), and Mon oe Co n . S a i ical anal e e e e fo med ing he da a anal i mod le of Mic o of Office E cel 2010. Finall , end in Mon oe Co n home lead in ec ion cond c ed b he local heal h dep a men e e al o e amined ing linea eg e ion. All anal e e e cond c ed in 2013.

Results

S mma cha ac e i ic of he U.S., Ne Yo k S a e, and Mon oe Co n o la ion a e gi en in Table 1. De i e diffe ence in i e, he h ee geog aphic egion e e imila in he o o ion of child en aged <5 ea , gende di ib ion, e on e ho ehold, o la ion belo o e le el, and e ail ale e ca i a. Comp a ed o Mon oe Co n and he U.S., Ne Yo k S a e had highe e cen age of acial/e hnic and c l al di e i b lo e homeo ne hi a e . High chool g ad a ion a e and o la ion den i e e highe in Mon oe Co n han in Ne Yo k S a e and he U.S.

Be een 1997 and 2011, he e alence a e fo confi med EBLL≥10 µg/dL e 100 e ed child en dec ea ed f om 13.4 o 1.1 in Mon oe Co n , 6.3 o 1.0 in Ne Yo k S a e, and 7.6 o 0.6 in he U.S. (Fig e 1). The ab ol e ea l a e of decline in Mon oe Co n (lope=−0.0083, p<0.001) occ ed 2.4-fold fa e han ha in Ne Yo k S a e (lope=−0.0034, p<0.001) and 1.8-fold fa e han ha in he U.S. (lope=−0.0046, p<0.001) (Table 2). D ing he ame ime e iod, he blood lead e ing a e fo child en a con i en l highe in Mon oe Co n han in Ne Yo k S a e and he U.S. Ho e e , e ing a e inc ea ed fo all h ee a ea (all lope >0, p<0.05), i h g ea e im o emen ho ed b U.S. child en o e all (lope=0.0075, p<0.001) (Table 2).

Be een 1990 and 2012, he e alence a e of EBLL≥5 µg/dL fo child en in Mon oe Co n eaked in 1995 (40%) (Fig e 2), fo ea af e he CDC lo e ed he blood lead le el of conce n f om 25 o 10 µg/dL and ecommended ni e al c eening. On he o he hand, he o al n mbe of EBLL ca e eaked in 1994 (8106 child en), 2 ea af e Ne Yo k S a e manda ed blood lead c eening of m(g8m293.8(blobe)]TJ0-1.1878TD8(lead

enac men of manda ed ˎepo ing of all blood lead e ˎega dle of blood lead le el. Be een 2000 and 2003, he EBLL ˎa e declined ˎela i el li le, hich ma gge a dimini hed impac of he p e io in e en ion anda d e b Ne Yo k S a e (EBLL≥20 µg/dL) compa ed o he ˎic e anda d la e ado ed b Mon oe Co n in 2003 (EBLL≥15 µg/dL). Home lead in ec ion con- d c ed b he local heal h depa men al o eaked in 1994 (1050 ho ing ni), i h b e en decline h o gh 2012 (lope=−29.4, p<0.001). In an gi en ea, he o i i e ield of iden ified lead ha a d f om he e en i onmen al lead in ec ion anged f om 70% o 91% (Fig e 3).

Since he 1970 , he Mon oe Co n Depa - men of P blic Heal h (MCDPH) ha had a lead og am. In he ea l 1990 , he og am aff incl ded a o ima el en f ll- ime e i alen (FTE) o i ion incl ding ani a ian , n e , heal h ed ca o , and comm ni heal h o ke , hich inc ea ed o abo 20 in 1994, and hen back do n o en b 2005. The e - fo med home lead in ec- ion ; in c ed o e o ne and manage abo co -efficien in e im con ol mea e (e.g., ain face abili a ion a he han ain emo al); and ed ca ed familie abo in-home lead i k ed c ion and enco aged follo - blood lead e ing. Wi h e e nal g an ch a ho e f om he U.S. Depa men of Ho ing and U ban De elo men (HUD), he MCDPH o ided di ec o fo a ge ed lead ha a d emedia ion and in e im ho ing a i ance o empo a il eloca e familie d - ing hi oce . The MCDPH al o o ked i h a n mbe of akeholde , incl ding comm ni and academic h ician , ho ing and en i onmen al heal h e e , ed ca o , comm ni ad oca e and ci ic lead- e , a ell a mo e e iphe al echnical e e —o "bo nda ne o k"— ho nego ia e ela ion hi be een cience and oli ic and od ce and con m- e of info ma ion, o achie e ainable comm ni impac , hich ha ecei ed na ional ecogni ion.[19,20,21,22] A imeline of impo an e en ela ed o childhood lead ha a d con ol effo i mma i ed in Table 3.

Discussion

U ing labo a o -ba ed - eillance da a epo ed o a e and local heal h depa - men , he empo al end

ignifi

Thi d, childhood blood lead e ing a e e e bo i-mal f om he na ional o local le el ; con e en l , he e finding ma no be gene ali able o all child en.

In concl ion, ing ecen da a, hi d fo nd ha he a e of childhood lead oi oning, a defined, dec ea ed ignifican l na ion ide. The e decline e e g ea e fo Mon oe Co n , hich had highe ba eline a e of EBLL and an olde ho ing ock, han he U.S. o e all. The e e ience of Mon oe Co n demon a e he ole of local heal h de a - men ca aci and comm ni -ba ed effo in ed c- ing o ce of en i onmen al lead e o e fo child en be ond na ional and a e ide olicie .

Po Pi ie Coho S d : en i onmen al e po e o lead and child en' abili ie a he age of fo ea . N Engl J Med 1988;319(8):468–75.
2. Canfield RL, Hende on CR J., Co -Slech a DA, Co C, J ko TA, Lanphea BP. In ellec al impai men in child en i h blood lead concen- a ion belo 10 µg pe decili e. N Engl J Med 2003;348(16):1517–26.
3. Agenc fo To ic S b ance and Di ea e Regi . To icological pofile fo lead. A lan a GA: USDHHS, 2007.
4. Pi kle JL, B od DJ, G n e EW, e al. The decline in blood lead le el in he U.S.: he Na ional Heal h and N i ion E amina ion S e (NHANES). JAMA 1994;272(4):284–91.
5. Lanphea BP, Wei man M, Win e NL, e al. Lead-con amina ed ho e d and ban child en' blood le el . Am J P blic Heal h 1996;86(10):1416–21.