

# Hearth and Home in Medieval Iceland

## Understanding Chronic Respiratory Infection, Environment and the Vulnerable Child

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**ABSTRACT:** The study of otitis media in palaeopathology holds tremendous implications for transforming our understanding of the impact of partial or total hearing loss in past populations. The lived experience is scaffolded in the human and environmental entanglements which acknowledge the dwellings, landscapes, and the embodiment of biological, social, and cultural experiences. Analysis of the prevalence of otitis media and sinusitis at four medieval Icelandic sites: Hofstaðir, Keldudalur, Skeljastaðir, and Skriðuklaustur revealed that a number of adults and children alike were affected by chronic respiratory infection, and specifically featuring endemic tuberculosis in this population, and consequently a number of individuals also likely suffered from pathological hearing loss. Finally, the methods allow new inferences in understanding the extent of hearing loss as a hidden disability in the past.

**RÉSUMÉ:** L'étude des otites en paléopathologie a des implications considérables pour transformer notre compréhension de l'impact de la perte auditive partielle ou totale chez les populations du passé. L'expérience vécue paraît dans les interactions entre l'homme et l'environnement qui tiennent compte des habitations, des paysages et de l'incarnation des expériences biologiques, sociales et culturelles. L'analyse de la prévalence des otites et de la sinusite sur quatre sites médiévaux islandais – Hofstaðir, Keldudalur, Skeljastaðir et Skriðuklaustur – a révélé qu'un certain nombre d'adultes et d'enfants étaient touchés par des infections respiratoires chroniques, notamment la tuberculose endémique dans cette population, et que par conséquent, un certain nombre d'individus souffraient probablement également d'une perte auditive pathologique. Enfin, ces méthodes permettent de nouvelles déductions pour comprendre l'ampleur de la perte auditive en tant que handicap caché dans le passé.

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he study of disability in Iceland has recently ventured into accessing experiences of disability in the past in interdisciplinary perspective and produced compelling contributions. Archaeological evidence contributes to these endeavours by offering broad contextual clues as well as toolkits for extrapolating details about both individual and community-level experiences of disability in the past. For example, considering factors such as building materials and design, space and settlements, we can learn more about the risks to human health posed by dwellings (Roberts 2012). Drawing on concerted enquiries regarding the potential place of archaeology within disability studies and how care might have been evidenced in the past, palaeopathology has offered new insights into these questions for disability in an Icelandic context (cf. Tilley; Southwell-Wright). Using understanding gleaned from archaeological contexts of social conditions, dwellings, and the indoor and outdoor environments to build a context for the data acquired, this study in particular will unpack population-level data about possible cases of hearing loss in medieval Icelandic communities.<sup>1</sup>

In bioarchaeology, individuals are regarded as keepers of biological and social data, accessible primarily through the skeleton, enabling us to explore community dynamics, health, and vulnerabilities using identified patterns (Hodson; Tilley; Perry and Gowland). The human remains found in archaeological excavations in Iceland have indeed kept such data, giving researchers invaluable insights into household and community dynamics, and the impact of diet and environment on health throughout the life course (Zoëga and Murphy; Walser III et al.; Sayle et al.). In particular, the data in this study present an opportunity to advance child-conscious perspectives in our lens on the past, to interpolate elements of household and family dynamics. In this vein, this work is grounded in the anthropological framework of situated biologies, which is essential to exploring the dynamic interactions of the human body with its socio-cultural and ecological context. This framework can bring nuance to the perspectives—that is, as perspectives and not necessarily statements of fact—enshrined in inherited historical accounts (Niewöhner; Southwell-Wright).

Studying hearing loss as both an individual and broader societal experience can allow for comparison of health within and between populations and may also offer insights into speech and language acquisition in the past in this context. This study aims to describe the potential for hearing loss using skeletal remains from four medieval Icelandic assemblages: Hofstaðir, Keldudalur, Skeljastaðir, and Skriðuklaustur (as reported in Collins 2019). In these assemblages, the prevalence of pathological hearing loss appears to be contingent with evidence for chronic respiratory infection, especially endemic tuberculosis (TB). This study also explores the experiences of children in the

past, and especially how children in an assemblage may not only represent evidence for continuous transmission of TB but might also be used to form criteria to determine TB endemicity, or hyperendemicity in past populations. The results of this study uniquely allow us to shape a narrative about hearing loss at a populational level, using the skeletal remains as a primary biological resource situated in interacting and overlapping contexts.

The study of disability in palaeopathology has been characterized largely by identifying visible markers of trauma, joint disease or obvious deformity, especially changes which have resulted in reduced mobility and likely pain during an individual's lifetime; effectively, the focus has been on hyper visible manifestations of disease and difference, and deviance from burial norms, with extrapolations made largely from case studies (Stodder and Byrnes). Palaeopathology and bioarchaeology are grappling with precisely how to frame disability but perhaps it suffices to draw on this partial definition: disability comprises biological, psychological, and social elements, and is produced through interaction between physical and/or cognitive impairment and the cultural and physical environment (Tilley; Stodder and Byrnes). Our ongoing experiences with pandemic and endemic diseases have, to some degree, forced society to examine the overlapping and convergent nature of experiences of chronic illness and disability, including exploring the care-related implications for the larger community (Dimka, van Doren, and Battles; Tilley; Bohling, Croucher, and Buckberry; Stodder and Byrnes). The work presented here draws on current research paradigms in archaeology and palaeopathology, shaped by the lens of situated biologies. This study is a product also of the study of disability in the past, the bioarchaeology of care and the archaeology of childhood, all of which share overlapping methods and aims to access the tangibilities of life in the past. Additionally, this work ventures into territory once thought unattainable: to depict the prevalence of a form of sensory impairment in an archaeological population. In utilizing these frameworks, these ventures must thereby acknowledge that disability cannot be directly observed based on skeletal evidence for impairment (Kristjánsdóttir and Walser) but rather can be approached by suggesting reasonable inferences based on identified overlapping and contingent contexts. Evidence from palaeopathology can better inform the narratives we shape about many aspects of life in the past and help us to understand the lived experiences of the people in those communities we aim to depict in archaeological research.

## **Whom the house holds**

Recent research has fostered closer examination of Icelandic households and intergenerational dynamics (Lewis-Simpson; McCooey; Zoëga) as well as

insights into disability in the Icelandic past (Sigurjónsdóttir and Rice). The Icelandic model of farmsteading and property ownership demarcated social status, with the property owner at the top of the hierarchy. All individuals belonged to a household and resided on a farmstead, and the household urged the participation of all capable in economic and social life (Bolender; McCooley; Zoëga and Murphy). These households, primarily based on farms, were integral social units with a stratified structure that signified land ownership, farmstead production, and social identity, demarcating property and status (Bolender). Despite these stratifications, all shared most and usually all of the living space available, making the experience and impact of the indoor environment a collective and general one.

Household was not necessarily synonymous with family or kinship but rather defined as a group of co-dependent people, some of whom may have been biologically related. Household and family are terms which may be overlapping but not synonymous. For this context, household is preferred. This may encompass multi-generational kinship and non-kinship households, and even some seasonally or otherwise temporally dependent members (Bolender; Zoëga; Crawford, Hadley, and Shepherd). Children within a household might include biological descendants of members of the household or may have joined the household under the fosterage or guardianship of others; the system of fosterage and guardianship was widely practiced, regulated by law and most possible eventualities and outcomes were considered in the law in case of changes in circumstance (Lewis-Simpson). Most of the body of literature concerning childhood in the past in Iceland delves into questions of chronological and social age using written sources, and perspectives from archaeology can augment current insights (Zoëga; Callow). Children may be portrayed as not entirely passive subjects, and while we encounter some ambiguities in the texts about how chronological or categorical ages correlate to social ages, there are some accepted general social boundaries (Callow; cf. Baxter).

The burial mounds of the pagan period often disproportionately represented (male) heads of households (Friðriksson and Vésteinsson). The latter communal churchyard burials which came to replace home fields, in contrast to the pre-Christian period, were generally inclusive of all household members and reflect these household demographics (Bolender; Zoëga). This shift towards household cemeteries subsequently paved the way for the adoption of communal burials in churchyards, reflecting the deep-rooted multi-generational kinship and non-kinship households (Zoëga). This departure from pre-Christian era practices, whereby household cemeteries incorporated individuals of all ages and genders, offers a more comprehensive representation of past society than pagan period burials, in a sense making them research-desirable as data that offer the most accessible total picture available to us.

The longhouse itself was built of commonly available building materials which were suitable for the cold and wet climate: turf walls and turf roof encasing a wooden frame (van Hoof and van Dijken; Zoëga, Sigurðardóttir, and Zoëga). The skills needed to construct and maintain these structures, from turf cutting to drying, storage, building, and repair, would have been fairly common knowledge, an essential seasonal chore for every household. By the eighteenth century and through to the twentieth, authorities expressed concern about improving the quality of life in the home and noted the health risks associated with turf structures, though these would have been naturally insulating and an essential building material in a landscape lacking replenishable timber (Zoëga, Sigurðardóttir, and Zoëga).

At the heart of the turf structure, the hearth figured large in the life of the household, providing a central source of light and warmth to the interior space as well as a cooking fire. However, an open fire comes with health risks which are compounded by prolonged exposure. It is known from modern contexts that the use of biomass fuels such as wood and peat produces particulates and volatile organic compounds (VOCs), which are associated with an increased risk of chronic obstructive pulmonary disease and markedly increased risks of lung cancer in women and acute respiratory infections in young children (Torres-Duque et al.; Aftab, Noor, and Aslam). Moreover, prolonged exposure to solid and biomass fuels increases the risk of pulmonary infections, especially TB, according to evidence amassed from various global locales (Fullerton, Bruce, and Gordon; Pokhrel et al.; Sahito et al.; Sumpter and Chandramohan; Haque et al.). These risks have also been measured in archaeological populations, especially in research which focused on lesions indicative of chronic sinusitis, again from varied global regions (Sundman and Kjellström; Boocock, Roberts, and Manchester; Merrett and Pfeiffer; Panhuysen, Coened, and Bruintjes; Roberts 2007; Lewis, Roberts, and Manchester; Davies-Barrett, Roberts, and Antoine).

Experimental archaeology measuring firewood consumption and exposure to particulate matter and VOCs in reconstructed longhouses and turfhouses of the early modern period found that participants were exposed to harmful levels of such substances, and it is highly likely that these health risks were also faced by people in the past (Beck et al.; Christensen and Ryhl-Svendensen; Trbojevic, Mooney, and Bell). Most such experiments were conducted in thatched-roof dwellings primarily using firewood, so results may not translate perfectly to turf structures. Since the turf in Icelandic houses was often used in the walls and roof, ventilation was likely poorer than in structures which used thatch; turf walls could be as much as 1.5 metres thick (Milek). Inhabitants would have lived with high pollution levels and low air exchange rates, which were recognized as a major health concern beginning at least in the early modern period (van Hoof and van Dijken; Zoëga, Sigurðardóttir, and Zoëga). Exposure

to particulate pollution and smoke would have held serious consequences for the health of the population, as households shared common living spaces in all seasons. Air-quality appraisal in some experimental structures has indicated that smoke tends to draft above wall height towards the roof, but particulate matter tends to remain closer to its point of origin (Beck et al.; Christensen and Ryhl-Svendson; Roberts and Cox). Christensen and Ryhl-Svendson note that measurements were taken at the standard height of 110 cm, approximating the breathing zone of a person seated, resting, or bent over while cooking—and more or less the height of a young child.

The association between TB prevalence and indoor air pollution has grown steadily from global data. Smoke exposure in the home from biomass fuels and spending prolonged periods of time in poorly ventilated structures are especially conducive to transmission of TB (Fullerton, Bruce, and Gordon; Pokhrel et al.; Sahito et al.; Sumpter and Chandramohan; Uys et al 2011). Globally, TB is also known to be more prevalent among males than females, yet women have been marked as experiencing particular risks when in constant proximity to biomass fuel use (Pokhrel et al.; Sharma, Kumar, and Singh; Horton et al.). The implications, therefore, of identifying TB in these past populations, interlinked with environmental and social conditions, are an increased likelihood for disease endemicity and many contingent health risks. The narrative in Iceland in particular has shifted to connote an experience of a chronic and debilitating infectious disease which likely persisted across centuries and throughout different regions of the country, until its near eradication with twentieth-century antibiotic treatment (Sigurðsson). The specific case descriptions of pathological lesions which have strong or definite associations with a TB diagnosis have indicated that TB was endemic in Iceland likely from the settlement period (Collins 2020).

The presence of respiratory infection is not only a measure of the burden of disease but also, in a sense, a proxy measure of household intimacy. The setting of the home, both the physical structure and the household and its members, are measures of familial and interpersonal intimacy, which, among other things, may drive endemic disease. Parents and caregivers determine how children spend a significant portion of their time, for example, engaging in tasks, and in proximity to whom (Baxter; Crawford, Hadley, and Shepherd). A child's risk of acquiring TB from a mother increased the risk of mortality eight-fold in high-burden endemic areas (Hamzaoui et al.). Hyperendemic refers to persistent, continuously high levels of disease, and the evidence from at least four medieval sites fits a number of criteria for identified hyperendemic TB (Collins 2019). Namely, cases are heavily clustered and individuals may be infectious simultaneously, and in all likelihood the medieval Icelandic cohorts regularly spent prolonged periods of time with a group in an enclosed space with inadequate ventilation (Uys et al. 2011; 2015; Hamzaoui et al.). Children

and adolescents usually acquire TB from infected adults, and those with latent TB are often the source of future epidemics, as they are reservoirs for future transmission with disease reactivation; this can even be many years after primary infection has occurred (Tsai et al.; Hamzaoui et al.). Without vaccination, 30–40% of infected infants are estimated to progress to intrathoracic TB, with 10–20% developing disseminated disease (Marais et al.; Perez-Velez, Roya-Pabon and Marais). Patients aged three to four years have the highest lymph node involvement, but the least number of lung tissue lesions compared with older children (Graham, Marais, and Amanullah; Delacourt). At five to ten years of age, the risk of active disease declines, but the risk of developing adult-type TB increases. With this age-related shift, a phenotypic shift also occurs, from a disease of primarily lymph node involvement and disseminated disease to cavitary lung-disease (adult-type), often coinciding with puberty (Graham, Marais, and Amanullah; Delacourt). Observation and differential diagnosis in skeletal remains must also consider these phenomena specific to young children (Lewis).

In modern studies, contact scores consider child-specific risk factors which include maternal TB status and sleep proximity, duration of exposure, exposure to multiple index cases, and index case infectivity (Mandalakas et al.). These factors demonstrably increased the odds of contracting TB in children aged three months to six years in a Cape Town study (Uys et al. 2011). Of course, the last component (index case infectivity) is unlikely to be ascertainable in an archaeological population, but all of the former components can be reasonably inferred from the archaeological context. Not only were children most likely to bear the brunt of the exposure to VOCs and particulate matter simply because of their proximity to the open hearth and environmental conditions, but they were also susceptible to contracting infectious respiratory disease because of unavoidable, prolonged contact with infected adults (inferred index cases).

## Hearing loss, a hidden disability

The study of disability in the Nordic past has relied heavily on textual witnesses (Crocker, Tirosh, and Jakobsson; Sigurjónsdóttir, Jakobsson, and Björnsdóttir; Lewis-Simpson). The rich corpus of saga literature and medieval miracle collections have little to say about hearing loss in particular (Smith; Samúelsson; Þorvaldsson; Michelson-Ambelang; Jónsson). Hearing loss is seldom mentioned in the sagas, and in only one of three instances could a possible pathological instance be read from the text (Michelson-Ambelang). Of the 104 healing miracles identified in the hagiographies of the saints Þorlákur, Jón, and Guðmundur *inn góði* [the Good], only two refer to deaf persons (Whaley). Some readings of later material have led scholars to believe that

hearing loss was not prevalent in pre-modern society. Alternatively, drawing on later eighteenth and nineteenth century sources, Smith has posited that marginalization of non-speaking individuals was a remnant of earlier social attitudes which may have denied them confirmation into the church, and hospital admission and care. In contrast, recent work has affirmed that close readings of the material available do indicate that deaf and non-speaking people maintained varying degrees of agency, not least through non-verbal communication and gestural systems practiced across multiple periods, as well as the use of wax tablets (Tirosch). However, not all could afford to invest in the technology or training needed to realize these forms of communication (Tirosch). To better elucidate the extent of hearing loss in the past and reduce bias in our narratives, other avenues are required, especially those which bring us nearer to assessing whole populations.

Hearing loss is sometimes recognized as a hidden or invisible disability (Mackenzie and Smith). Hearing impairment or loss can refer to any level of severity. However, deafness refers strictly to profound hearing loss. Otitis media, or middle ear infection, is responsible for 60% of hearing loss cases in children aged under 15 years, and chronic cases of otitis media are responsible for hearing loss in 31% of cases worldwide (World Health Organization). In children today almost 60% of hearing loss is due to preventable causes such as ear infections and birth complications (Bluestone and Klein). Most episodes of middle ear infection occur between the ages of 0–2 years, but otitis media with effusion (discharge) may peak between two and six years of age, and generally episodes of middle ear infection decrease by about age seven when the mastoid air cells are developed and help to pressurize the middle ear (Bluestone and Klein; Bluestone and Doyle; Cinamon). The complications of otitis media can include hearing loss, vestibular, balance and motor dysfunctions, perforation of the tympanic membrane, petrositis, labyrinthitis, facial paralysis, and otitis externa. Nearly all children who have discharge from the ears have some degree of hearing loss. Children face particular vulnerabilities with even short periods of hearing loss, in loss of consonant sounds for example, and detrimental effects on language acquisition (Bluestone and Klein). Consonant hearing loss and consonant confusion is, of course, also recognized among hearing-impaired adults (Phatak et al.). Hearing loss may be conductive, in which the sound conduction of the middle ear ossicles is in some way impaired. In sensori-neural hearing loss the labyrinth and nerves of the inner ear are involved; mixed hearing loss describes a combination of the above. Only conductive hearing loss can be identified with any certainty in skeletal remains.

## Otitis media and TB in medieval Iceland

The study of otitis media in the skeletal assemblages from Hofstaðir, Keldudalur, Skeljastaðir, and Skriðuklaustur relied on general osteological and palaeopathological analysis coupled with the specific aims to investigate chronic upper respiratory tract infection (Collins 2019). In palaeopathology, interpretation and reporting of lesions of TB in skeletal assemblages has perhaps been somewhat dichotomized as either gastrointestinal or respiratory infection. However, the clinical evidence indicates that these systems are linked, and function or dysfunction in one system affects the function of neighbouring systems, as the mucosal barriers may be permeated in cases of inflammation, infection or even gastrointestinal reflux. Otitis media as a sequela of TB is known to occur without indications of pulmonary infection, although it remains notoriously difficult in clinical settings to identify TB as the culprit in cases of chronic otitis media (cf. Sens et al.). Generally tuberculous otitis has been discovered after patients have failed to respond to traditional treatments and often present false-negative cultures (Sebastian et al.). It should be noted that it is impossible to exclude other pathogens completely, but TB, according to abundant clinical evidence, is a most likely candidate for effecting such severe cases of otitis media, as seen in the ancient Icelandic population. For specialists working with human remains, it should become common practice to investigate the sinuses and ears, using a simple endoscope, to identify respiratory infection in the material under investigation and perhaps especially if there are suspected cases of TB. Uniquely, assessing lesions of the middle ear presents us with a key to real insights into the tangible experience of a hearing loss at population level (cf. Sigurjónsdóttir and Rice).

The results of the study, highlighting chronic infection of the middle ears, included a total of 303 individuals who had at least one temporal bone preserved from Hofstaðir, Keldudalur, Skeljastaðir, and Skriðuklaustur (Collins 2019). Of a total of 303, 210 were affected by chronic otitis media in either one or both ears (69%). Among all of the non-adult skeletal remains across all four sites, 62 of 108 (57%) had evidence of some form of chronic otitis media (Table 1), and among the adults, 145 of 196 individuals (74%) were affected (Table 2). Although there is no particular lesion which can be pathognomonic for TB in the ears, it is clear that among the individuals with diagnostic or a very likely diagnosis of TB, based on the post-cranial skeleton, there is a strong association, as 30 of the 38 identified individuals (79%) with definite or very likely TB diagnosis had otitis media.

Table 1. The crude prevalence of otitis media among non-adults at the four sites, including individuals aged 14–16.9 years, where (n) is the number affected of those with the bone preserved (temporal bone) (N).

Age (years)	Hofstaðir		Keldudalur		Skeljastaðir		Skriðuklaustur		Total	
	n	N	n	N	n	N	n	N	n	N
0-1.0	30	59	10	12			2	4	42	75
1-3.9	1	3	5	5			1	3	7	11
4-6.9						1	1	1	1	2
7-10.9	2	2	2	3				2	4	7
11-13.9	1	1			1	1	1	2	3	4
14-16.9	3	3		2			2	4	5	9
Male	1	1					1	1	2	2
Female	1	1						1	1	2
Unknown	1	1		2			1	2	2	5
<b>Total</b>	<b>37</b>	<b>68</b>	<b>17</b>	<b>22</b>	<b>1</b>	<b>2</b>	<b>7</b>	<b>16</b>	<b>62</b>	<b>108</b>

Table 2. Bilateral otitis media prevalence among adults, depicted by age and sex, where (n) is the number affected of those with a preserved temporal (N).

Age (years)	Hofstaðir		Keldudalur		Skeljastaðir		Skriðuklaustur		Total	
	n	N	n	N	n	N	n	N	n	N
17-25	6	6	1	3	4	4	12	18	23	31
Male	1	1		1	1	1	5	7	7	10
Female	5	5	1	2	3	3	7	10	16	20
Unknown								1	0	1
26-34	7	10			2	5	12	13	21	28
Male	2	4			2	4	6	6	10	14
Female	4	5				1	5	6	9	12
Unknown	1	1					1	1	2	2
35-44	20	26	6	7	8	10	9	11	43	54
Male	10	13	3	3	5	6	6	8	24	30
Female	10	13	3	4	3	3	3	3	19	23
Unknown						1				1
45+	21	26	7	9	20	27	10	18	58	80

<i>Male</i>	10	12	2	4	11	13	3	7	26	36
<i>Female</i>	11	14	5	5	9	14	6	10	31	43
<i>Unknown</i>							1	1	1	1
<i>Adult</i>	1	1	1	1			1	1		3
<i>Male</i>										
<i>Female</i>	1	1								
<i>Unknown</i>			1	1			1	1		
<b>Total</b>	<b>55</b>	<b>69</b>	<b>15</b>	<b>20</b>	<b>34</b>	<b>46</b>	<b>44</b>	<b>61</b>	<b>145</b>	<b>196</b>
<i>Male</i>	23	30	5	8	19	24	20	28	67	90
<i>Female</i>	31	38	9	11	12	21	21	29	73	99
<i>Unknown</i>	1	1	1	1		1	3	4	5	7

In this sample, 59 of 303 (19.5%) individuals were observed with the highest grades of change, including total destruction or obfuscation of the middle ear cavity. These are the individuals who are suspected to have suffered from profound conductive hearing loss, and some of these cases may have been mixed hearing loss because of the severity of disease and location of the lesions.

There were no significant differences detected between the rate of infection for skeletons sexed as male or female at any of the four sites. However, a caveat should be noted pertaining to the rates of ear infection among infants. The appearance of otitis media in infants, those aged under 12 months, is notable, because young infants are more susceptible to gastro-oesophageal reflux, which, in turn, predisposes them to an increased risk of sinusitis and otitis media. Reflux disrupts the protective system of mucociliary transport and other physical barriers between the digestive and respiratory systems (Openshaw; Tasker et al.; Phipps et al.). The immature barriers of an infant or young child would not have been very effective at protecting the sinuses and ears from regurgitated food, particles, pathogens, or other debris, and therefore, gastrointestinal reflux must be considered as a potential contributor to respiratory disease in the sample. However, it is unclear to what degree. This may offer an explanation for the presence of otitis media in this cohort, as it is not possible to identify or definitively account for this using the skeletal remains.

## Conclusions

The evidence from the human remains indicates that hearing loss in varying degrees was likely more prevalent in the past than previously known,

even considering very conservative interpretations of the results. These biological data dovetail with evidence from social contexts, e.g., that deaf and non-speaking people did indeed utilize means to articulate their needs and desires in interpersonal relationships (Tirosch), and environmental contexts, long recognized from archaeological data. This research further underlines the importance of not only including non-adult remains in future studies in order to depict the impact of disease on children in the past, but also taking care to understand particular disease aetiologies and how they may affect sensitive cohorts differently. The settings and surroundings of the indoor and outdoor environment, its social capacities and functions, and even the state of childhood itself all come to bear on the mechanisms for disease acquisition and the experience of disease.

The consequences of climate change will invoke fresh challenges for society in the near future, especially for its most vulnerable members, facing critical events such as migration and unrest (Crawford, Hadley, and Shepherd). Understanding respiratory infection in the past remains relevant in that latent TB and transmission mechanisms persist as a global health concern. The discourse in archaeology has focused on differences in rates of TB and disease transmission in dense vs. less densely populated areas, i.e., urban vs. rural settlements. While this is entirely valid, it may also be useful to pan our lens to understand the parameters of endemic and even hyperendemic settings and adopt this terminology. These terms offer the means to acknowledge appropriately the biological situatedness (as understood by Niewöhner and Lock) of individuals and communities and the acutely human experiences of life and health.

Generally, researchers should refrain from diagnosing profound deafness, particularly as it is impossible to ascertain this condition with absolute certainty. However, it is reasonable to hypothesize that severe conductive hearing loss was probable in certain circumstances, notably with evidence of disruption in the ossicular chain. Nonetheless, pinpointing sensorineural or mixed hearing loss presents an appreciable challenge. Here the evidence speaks to hearing loss (in varying degree) as a piece of the fabric of life in the past. Chronic respiratory infection and chronic conductive hearing loss (and perhaps also sensorineural hearing loss) seem to have been common enough according to the skeletal evidence that most Icelanders in the past must have come into regular contact with individuals who were experiencing hearing loss.

## NOTES

1. While some scholars prefer the term *impairment* as a more neutral descriptor, this paper often refers to medical literature, where the term *hearing loss* is generally used, in part because degrees of hearing loss can be

measured/quantified in living individuals through hearing threshold tests, for example.

## REFERENCES

- Aftab, Ammar, Amamah Noor, and Memuna Aslam. 2022. "Housing Quality and Its Impact on Acute Respiratory Infection (ARI) Symptoms among Children in Punjab, Pakistan." *PLOS Global Public Health* 2.9: e0000949. <https://doi.org/10.1371/journal.pgph.0000949>.
- Baxter, Jane Eva. 2022. *The Archaeology of Childhood*. 2nd ed. Rowman & Littlefield Publishers.
- Beck, Anna Severine, Lehne Mailund Christensen, Jannie Ebsen, Rune Brandt Larsen, Dyveke Larsen, Niels Algreen Møller, Tina Rasmussen, Lasse Sørensen, and Leonora Thofofte. 2007. "Reconstruction—and Then What? Climatic Experiments in Reconstructed Iron Age Houses in Winter." In *Iron Age Houses in Flames: Testing House Reconstructions at Lejre*. Edited by Marianne Rasmussen, 135–173. Vol. 3. Studies in Technology and Culture. Historical-Archaeological Experimental Centre.
- Bluestone, Charles D., and William J. Doyle. 1988. "Anatomy and Physiology of Eustachian Tube and Middle Ear Related to Otitis Media." *Journal of Allergy and Clinical Immunology* 81.5 (Part 2): 997–1003. [https://doi.org/10.1016/0091-6749\(88\)90168-6](https://doi.org/10.1016/0091-6749(88)90168-6).
- Bluestone, Charles D., and Jerome O. Klein. 2007. *Otitis Media in Infants and Children*. PMPH-USA.
- Bohling, Solange, Karina Croucher, and Jo Buckberry. 2022. "The Bioarchaeology of Disability: A Population-Scale Approach to Investigating Disability, Physical Impairment, and Care in Archaeological Communities." *International Journal of Paleopathology* 38 (September): 76–94. <https://doi.org/10.1016/j.ijpp.2022.05.006>.
- Bolender, Douglas. 2007. "House, Land, and Labor in a Frontier Landscape: The Norse Colonization of Iceland." In *The Durable House: Architecture, Ancestors, and Origins*. Edited by R.A. Beck, 400–21. Center for Archaeological Investigations Southern Illinois University.

- Boocock, P., Charlotte A. Roberts, and Keith Manchester. 1995. "Maxillary Sinusitis in Medieval Chichester, England." *American Journal of Physical Anthropology* 98.4: 483–95.
- Callow, Chris. 2006. "First Steps towards an Archaeology of Children in Iceland." *Archaeologia Islandica* 5: 55–74.
- Christensen, J. M., and M. Ryhl-Svendson. 2015. "Household Air Pollution from Wood Burning in Two Reconstructed Houses from the Danish Viking Age." *Indoor Air* 25.3: 329–40. <https://doi.org/10.1111/ina.12147>.
- Cinamon, Udi. 2009. "The Growth Rate and Size of the Mastoid Air Cell System and Mastoid Bone: A Review and Reference." *European Archives of Oto-Rhino-Laryngology* 266.6: 781–86. <https://doi.org/10.1007/s00405-009-0941-8>.
- Collins, Cecilia. 2019. "The Palaeopathology of Maxillary Sinusitis, Otitis Media and Mastoiditis in Medieval Iceland: Assessing the Prevalence and Aetiology of Chronic Upper Respiratory Disease and the Presence of Tuberculosis Using Microscopy, Endoscopy and CT." PhD diss., University of Reading. <https://doi.org/10.48683/1926.00084764>.
- . 2020. "Tuberculosis in Medieval Iceland: Evidence from Hofstaðir, Keldudalur and Skeljastaðir." *HOMO* (November): 299–316. <https://doi.org/10.1127/homo/2020/1098>.
- Crawford, Sally, Dawn M. Hadley, and Gillian Shepherd. 2018. "The Archaeology of Childhood: The Birth and Development of a Discipline." In *The Oxford Handbook of the Archaeology of Childhood*. Edited by Sally Crawford, Dawn M. Hadley, and Gillian Shepherd. Oxford University Press. <https://doi.org/10.1093/oxfordhb/9780199670697.013.1>.
- Crocker, Christopher, Yoav Tirosh, and Ármann Jakobsson. 2021. "Disability in Medieval Iceland: Some Methodological Concerns." In *Understanding Disability Throughout History*. Edited by Hanna Björg Sigurjónsdóttir and James Gordon Rice, 12–28. Routledge.
- Davies-Barrett, Anna, Charlotte Roberts, and Daniel Antoine. 2021. "Time to Be Nosy: Evaluating the Impact of Environmental and Sociocultural Changes on Maxillary Sinusitis in the Middle Nile Valley (Neolithic to

- Medieval Periods).” *International Journal of Paleopathology* 34 (September): 182–96. <https://doi.org/10.1016/j.ijpp.2021.07.004>.
- Delacourt, Christophe. 2011. “Specific features of tuberculosis in childhood.” *Revue Des Maladies Respiratoires* 28.4: 529–41. <https://doi:10.1016/j.rmr.2010.10.038>.
- Dimka, Jessica, Taylor P. van Doren, and Heather T. Battles. 2022. “Pandemics, Past and Present: The Role of Biological Anthropology in Interdisciplinary Pandemic Studies.” *American Journal of Biological Anthropology* 178 (S74): 256–91. <https://doi.org/10.1002/ajpa.24517>.
- Friðriksson, Adolf, and Orri Vésteinsson. 2011. “Landscapes of Burial: Contrasting the Pagan and Christian Paradigms of Burial in Viking Age and Medieval Iceland.” *Archaeologica Islandica* 9: 50–64.
- Fullerton, Duncan G., Nigel Bruce, and Stephen B. Gordon. 2008. “Indoor Air Pollution from Biomass Fuel Smoke Is a Major Health Concern in the Developing World.” *Transactions of the Royal Society of Tropical Medicine and Hygiene* 102.9: 843–51. <https://doi.org/10.1016/j.trstmh.2008.05.028>.
- Graham, Stephen M., Ben J. Marais, and Farhana Amanullah. 2022. “Tuberculosis in Children and Adolescents: Progress and Perseverance.” *Pathogens* 11.4: 392 <https://doi:10.3390/pathogens11040392>.
- Hamzaoui, Agnes, Sadok Yaalaoui, Fatma Tritar Cherif, Leila Slim Saidi, and Anissa Berraies. 2014. “Childhood Tuberculosis: A Concern of the Modern World.” *European Respiratory Review* 23.133: 278–91. <https://doi.org/10.1183/09059180.00005314>.
- Haque, Md Atqul, N. Barman, M. T. Islam, M. Mannan, M. H. Khan, M. R. Karim, M. A. Rob, and M. A. Hossain. 2016. “Biomass Fuel Smoke and Tuberculosis: A Case-Control Study.” *Mymensingh Medical Journal: MMJ* 25.1: 31–38.
- Hodson, Claire M. 2021. “New Prospects for Investigating Early Life-Course Experiences and Health in Archaeological Fetal, Perinatal and Infant Individuals.” *Childhood in the Past* 14.1: 3–12. <https://doi.org/10.1080/17585716.2021.1905884>.
- van Hoof, Joost, and Froukje van Dijken. 2008. “The Historical Turf Farms of Iceland: Architecture, Building Technology and the Indoor

- Environment.” *Building and Environment* 43.6: 1023–30.  
<https://doi.org/10.1016/j.buildenv.2007.03.004>.
- Horton, Katherine C., Peter MacPherson, Rein M. G. J. Houben, Richard G. White, and Elizabeth L. Corbett. 2016. “Sex Differences in Tuberculosis Burden and Notifications in Low- and Middle-Income Countries: A Systematic Review and Meta-Analysis.” *PLOS Medicine* 13.9: e1002119.  
<https://doi.org/10.1371/journal.pmed.1002119>.
- Jónsson, Sigurjón. 1944. *Sóttarfar og sjúkdómar á Íslandi 1400–1800*. Hið íslenska bókmenntafélag.
- Kristjánsdóttir, Steinunn, and Joe W. Walsler. 2021. “Beneath the Surface: Disability in Archaeological and Osteobiographical Contexts.” In *Understanding Disability Throughout History*. Edited by Hanna Björg Sigurjónsdóttir and James Gordon Rice, 29–45. Routledge.
- Lewis, Mary. 2017. *Paleopathology of Children: Identification of Pathological Conditions in the Human Skeletal Remains of Non-Adults*. Elsevier Science.
- Lewis, Mary E., Charlotte A. Roberts, and Keith Manchester. 1995. “Comparative Study of the Prevalence of Maxillary Sinusitis in Later Medieval Urban and Rural Populations in Northern England.” *American Journal of Physical Anthropology* 98.4: 497–506.  
<https://doi.org/10.1002/ajpa.1330980409>.
- Lewis-Simpson, Shannon. 2008. *Youth and Age in the Medieval North*. Brill.
- Mackenzie, I., and A. Smith. 2009. “Deafness—the Neglected and Hidden Disability.” *Annals of Tropical Medicine & Parasitology* 103.7: 565–71.  
<https://doi.org/10.1179/000349809X12459740922372>.
- Mandalakas, A. M., H. L. Kirchner, C. Lombard, G. Walzl, H. M. S. Grewal, R. P. Gie, and A. C. Hesselning. 2012. “Well-Quantified Tuberculosis Exposure Is a Reliable Surrogate Measure of Tuberculosis Infection.” *The International Journal of Tuberculosis and Lung Disease* 16.8: 1033–39.  
<https://doi.org/10.5588/ijtld.12.0027>.
- Marais, B. J., A. C. Hesselning, R. P. Gie, H. S. Schaaf, D. A. Enarson, and N. Beyers. 2006. “The Bacteriologic Yield in Children with Intrathoracic Tuberculosis.” *Clinical Infectious Diseases* 42.8: e69–71.  
 doi:10.1086/502652.

- McCooley, Bernadette. 2021. "Aspects of Farm Labour in Medieval Iceland: Gender and Childhood c. 1100–1400." In *The Routledge Handbook of Medieval Rural Life*. Edited by Miriam Müller, 242–63. Routledge.
- Merrett, Deborah C., and Susan Pfeiffer. 2000. "Maxillary Sinusitis as an Indicator of Respiratory Health in Past Populations." *American Journal of Physical Anthropology* 111: 301–18.
- Michelson-Ambelang, Todd. 2015. "Outsiders on the Inside: Conception of Disability in Medieval Western Scandinavia." PhD diss. University of Wisconsin-Madison.
- Milek, Karen. 2012. "The Roles of Pit Houses and Gendered Spaces on Viking-Age Farmsteads in Iceland." *Medieval Archaeology* 56.1: 85–130. <https://doi.org/10.1179/0076609712Z.0000000004>.
- Niewöhner, Jörg. 2020. "Situating Biologies: Studying Human Differentiation as Material-Semiotic Practice." In *Biosocial Worlds*. Edited by Jens Seeberg, Andreas Roepstorff, and Lotte Meinert, 44–68. Anthropology of Health Environments beyond Determinism. UCL Press. <https://www.jstor.org/stable/j.ctv13xpsqt.7>.
- Niewöhner, Jörg, and Margaret Lock. 2018. "Situating Local Biologies: Anthropological Perspectives on Environment/Human Entanglements." *BioSocieties* 13.4: 681–97. <https://doi.org/10.1057/s41292-017-0089-5>.
- Openshaw, Peter J. 2009. "Crossing Barriers: Infections of the Lung and the Gut." *Mucosal Immunology* 2.2: 100–02. <https://doi.org/10.1038/mi.2008.79>.
- Panhuysen, Raphaël G. A. M., Vincent Coened and Tjasse D. Brintjes. 1997. "Chronic Maxillary Sinusitis in Medieval Maastricht, The Netherlands." *International Journal of Osteoarchaeology* 7.6: 610–14. [https://doi.org/10.1002/\(SICI\)1099-1212\(199711/12\)7:6<610::AID-OA366>3.0.CO;2-Q](https://doi.org/10.1002/(SICI)1099-1212(199711/12)7:6<610::AID-OA366>3.0.CO;2-Q).
- Perez-Velez, Carlos M., Claudia L. Royo-Pabon, and Ben J. Marais. 2017. "A Systematic Approach to Diagnosing Intra-Thoracic Tuberculosis in Children." *Journal of Infection, Hot Topics in Infection and Immunity in Children* 74: S74–83. [https://doi.org/10.1016/S0163-4453\(17\)30195-0](https://doi.org/10.1016/S0163-4453(17)30195-0).

- Perry, Megan A., and Rebecca L. Gowland. 2022. "Compounding Vulnerabilities: Syndemics and the Social Determinants of Disease in the Past." *International Journal of Paleopathology* 39 (December): 35–49. <https://doi.org/10.1016/j.ijpp.2022.09.002>.
- Phatak, Sandeep A., Yang-soo Yoon, David M. Gooler, and Jont B. Allen. 2009. "Consonant Recognition Loss in Hearing Impaired Listeners." *The Journal of the Acoustical Society of America* 126.5: 2683–94. <https://doi.org/10.1121/1.3238257>.
- Phipps, C. David, W. Edward Wood, William S. Gibson, and William J. Cochran. 2000. "Gastroesophageal Reflux Contributing to Chronic Sinus Disease in Children: A Prospective Analysis." *Archives of Otolaryngology-Head & Neck Surgery* 126.7: 831–36. <https://doi.org/10.1001/archotol.126.7.831>.
- Pokhrel, Amod K., Michael N. Bates, Sharat C. Verma, Hari S. Joshi, Chandrashekhar T. Sreeramareddy, and Kirk R. Smith. 2010. "Tuberculosis and Indoor Biomass and Kerosene Use in Nepal: A Case-Control Study." *Environmental Health Perspectives* 118.4: 558–64. <https://doi.org/10.1289/ehp.0901032>.
- Roberts, Charlotte A. 2007. "A Bioarcheological Study of Maxillary Sinusitis." *American Journal of Physical Anthropology* 133.2: 792–807.
- . 2012. "Re-Emerging Infections: Developments in Bioarchaeological Contributions to Understanding Tuberculosis Today." In *A Companion to Paleopathology*. Edited by Anne L. Grauer, 434–57. Wiley-Blackwell.
- Roberts, Charlotte A., and Cox, Margaret. 2003. *Health & Disease in Britain: From Prehistory to the Present Day*. Sutton.
- Sahito, Ambreen, Asaad Ahmed Nafees, Unaib Rabbani, Ambreen Kazi, and Zafar Fatmi. 2015. "Biomass Fuel Use Is a Risk for Pulmonary Tuberculosis: Case Control Study." *European Respiratory Journal* 46 (suppl 59). <https://doi.org/10.1183/13993003.congress-2015.PA3413>.
- Samúelsson, Sigurður. 1998. *Sjúkdómar og dánarmein íslenskra fornanna: Sjúkdómsgreiningar byggðar á frásögnum fornritanna*. Háskólaútgáfan.
- Sayle, Kerry L., W. Derek Hamilton, Gordon T. Cook, Philippa L. Ascough, Hildur Gestsdóttir, and Thomas H. McGovern. 2016. "Deciphering Diet and Monitoring Movement: Multiple Stable Isotope Analysis of the

- Viking Age Settlement at Hofstaðir, Lake Mývatn, Iceland.” *American Journal of Physical Anthropology* 160.1: 126–36.  
<https://doi.org/10.1002/ajpa.22939>.
- Sebastian, Susan K., Vikas Vijayan, Vibhor B. Kumar, and Payal Garg. 2020. “Tuberculous Otitis Media in Children: Series of 4 Cases.” *International Journal of Pediatric Otorhinolaryngology* 135 (August): 110118.  
<https://doi.org/10.1016/j.ijporl.2020.110118>.
- Sens, Patrícia Maria, Clemente I. R. Almeida, Lupércio O do Valle, Luís H. C. Costa, and Miguel L. S. Angeli. 2008. “Tuberculosis of the Ear, a Professional Disease?” *Brazilian Journal of Otorhinolaryngology* 74.4: 621–27. [https://doi.org/10.1016/S1808-8694\(15\)30614-5](https://doi.org/10.1016/S1808-8694(15)30614-5).
- Sharma, P. P., Ashok Kumar, and Padam Singh. 2010. “A Study of Gender Differentials in the Prevalence of Tuberculosis Based on NFHS-2 and NFHS-3 Data.” *Indian Journal of Community Medicine: Official Publication of Indian Association of Preventive & Social Medicine* 35.2: 230–37.  
<https://doi.org/10.4103/0970-0218.66869>.
- Sigurðsson, Sigurður. 1976. “Um berklaveiki á Íslandi.” *Læknablaðið* 62: 3–50.
- Sigurjónsdóttir, Hanna Björg, Ármann Jakobsson, and Kristín Björnsdóttir, eds. 2013. *Fötlun og menning: Íslandssagan í öðru ljósi*. Félagsvísindastofnun Háskóla Íslands/ Rannsóknarsetur í fötlunarfræðum.
- Sigurjónsdóttir, Hanna Björg, and James G. Rice, eds. 2022. *Understanding Disability Throughout History: Interdisciplinary Perspectives in Iceland from Settlement to 1936*. Interdisciplinary Disability Studies. Routledge.
- Smith, Eiríkur. 2013. “Í skuld við fjölskyldu og Guð: Staða fatlaðs fólks fyrir upphaf læknisfræðilegs skilnings á Íslandi.” In *Fötlun og menning: Íslandssagan í öðru ljósi*. Edited by Hanna Björg Sigurjónsdóttir, Ármann Jakobsson, and Kristín Björnsdóttir, 93–126. Félagsvísindastofnun Háskóla Íslands.
- Southwell-Wright, William. 2013. “Past Perspectives: What Can Archaeology Offer Disability Studies?” In *Emerging Perspectives on Disability Studies*. Edited by Matthew Wappett and Katrina Arndt, 67–95. Palgrave Macmillan US. [https://doi.org/10.1057/9781137371973\\_4](https://doi.org/10.1057/9781137371973_4).

- Stodder, Ann L. W., and Jennifer F. Byrnes. 2019. "(Re)Discovering Paleopathology: Integrating Individuals and Populations in Bioarchaeology." In *Evaluating Evidence in Biological Anthropology: The Strange and the Familiar*. Edited by Cathy Willermet and Sang-Hee Lee, 103–25. Cambridge Studies in Biological and Evolutionary Anthropology. Cambridge University Press.  
<https://doi.org/10.1017/9781108569125.007>.
- Sumpter, Colin, and Daniel Chandramohan. 2013. "Systematic Review and Meta-Analysis of the Associations between Indoor Air Pollution and Tuberculosis." *Tropical Medicine & International Health* 18.1: 101–8.  
<https://doi.org/10.1111/tmi.12013>.
- Sundman, Elin Ahlin, and Anna Kjellström. 2011. "Chronic Maxillary Sinusitis in Medieval Sigtuna, Sweden: A Study of Sinus Health and Effects on Bone Preservation." *International Journal of Osteoarchaeology*, 23.4: 447–58.  
<https://doi.org/10.1002/oa.1268>.
- Tasker, Andrea, Peter W. Dettmar, Marguerite Panetti, James A. Koufman, John P. Birchall, and Jeffrey P. Pearson. 2002. "Is Gastric Reflux a Cause of Otitis Media with Effusion in Children?" *The Laryngoscope* 112.11: 1930–34. <https://doi.org/10.1097/00005537-200211000-00004>.
- Tilley, Lorna. 2015. *Theory and Practice in the Bioarchaeology of Care*. Springer International Publishing. <https://doi.org/10.1007/978-3-319-18860-7>.
- Tirosh, Yoav. 2020. "Deafness and Nonspeaking in Late Medieval Iceland (1200–1550)." *Viator* 51.1: 311–44.
- Torres-Duque, Carlos, Darío Maldonado, Rogelio Pérez-Padilla, Majid Ezzati, Giovanni Viegi, and Forum of International Respiratory Studies (FIRS) Task Force on Health Effects of Biomass Exposure. 2008. "Biomass Fuels and Respiratory Diseases: A Review of the Evidence." *Proceedings of the American Thoracic Society* 5.5: 577–90.  
<https://doi.org/10.1513/pats.200707-100RP>.
- Trbojevic, Nikola, Dawn Elise Mooney, and Aidan Bell. 2011. "A Firewood Experiment at Eiríksstaðir: A Step towards Quantifying the Use of Firewood for Daily Household Needs in Viking Age Iceland." *Archaeologia Islandica* 9 (January): 29–40.

- Tsai, Kuo-Sheng, Hsiao-Ling Chang, Shun-Tien Chien, Kwo-Liang Chen, Kou-Huang Chen, Ming-Hsin Mai, and Kow-Tong Chen. 2013. "Childhood Tuberculosis: Epidemiology, Diagnosis, Treatment, and Vaccination." *Pediatrics and Neonatology* 54.5: 295–302. <https://doi.org/10.1016/j.pedneo.2013.01.019>.
- Uys, Pieter, Hilmarie Brand, Robin Warren, Gian van der Spuy, Eileen G. Hoal, and Paul D. van Helden. 2015. "The Risk of Tuberculosis Reinfection Soon after Cure of a First Disease Episode Is Extremely High in a Hyperendemic Community." *PLOS ONE* 10.12: e0144487. <https://doi.org/10.1371/journal.pone.0144487>.
- Uys, Pieter, Ben J. Marais, Simon Johnstone-Robertson, John Hargrove, and Robin Wood. 2011. "Transmission Elasticity in Communities Hyperendemic for Tuberculosis." *Clinical Infectious Diseases* 52.12: 1399–1404. <https://doi.org/10.1093/cid/cir229>.
- Walser III, Joe W., Steinunn Kristjánsdóttir, Darren R. Gröcke, Rebecca L. Gowland, Tina Jakob, Geoff M. Nowell, Chris J. Ottley, and Janet Montgomery. 2020. "At the World's Edge: Reconstructing Diet and Geographic Origins in Medieval Iceland Using Isotope and Trace Element Analyses." *American Journal of Physical Anthropology* 171.1: 142–63. <https://doi.org/10.1002/ajpa.23973>.
- Whaley, Diana. 1993. "Nicknames and Narratives in the Sagas." *Arkiv för nordisk filologi* 108: 122–46.
- World Health Organization. 2020. "Deafness and Hearing Loss." <https://www.who.int/news-room/fact-sheets/detail/deafness-and-hearing-loss>.
- Zoëga, Guðný. 2018. "The Old and The Young in Early Medieval Iceland: The Evidence for Three-Generational Families in the Household Cemeteries of Skagafjörður, Northern Iceland." *AmS-Skrifter* 26: 105–18. <https://doi.org/10.31265/ams-skrifter.v0i26.213>.
- Zoëga, Guðný, and Kimmarie A. Murphy. 2020. "Resources, Stress, and Response in Late Viking Age Iceland." In *The Routledge Handbook of the Bioarchaeology of Climate and Environmental Change*. Edited by Gwen Robbins Schug, 103–21. Routledge.

Zoëga, Guðný, Sigríður Sigurðardóttir, and Bryndís Zoëga. 2023. "Turf Building in Iceland: Past, Present, and Future." *Open Archaeology* 9 (December). <https://doi.org/10.1515/opar-2022-0345>.

Þorvaldsson, Reynir Berg. 2010. *Saga heyrnarlausra á Íslandi*. Félag heyrnarlausra.