frequently overlap and the latter may be the larger barrier to accessing healthcare. Poverty itself leads to poor food availability which manifests as poor nutrition that ultimately produces poorer outcomes,[5] even when surgery is accessed. The finding that an overwhelming proportion of deaths occurred at home, when a much higher proportion of the population lives within the proximity of a well-resourced hospital, suggests that available services were not accessed because of other barriers. Even for public sector health facilities, out-of-pocket expenditures incurred remain high, discouraging citizens from accessing hospitals even when it is life-saving. Well-resourced facilities must also be free of charge at the point of care to fulfil any commitment of reaching the poorest. The recent National Sample Survey found that only 2% of rural respondents who were hospitalized for any indication could avail of even partial reimbursement from the much acclaimed public insurance scheme for the poor.[6]

A well-functioning surgical service within a reasonable geographical distance looks at the issue of access to healthcare through the lens of the three delays framework (deciding to seek care, reaching a medical facility, and receiving appropriate care), and attempts to intervene within the second and third delays.[7] With a meagre 1.1% of the gross domestic product allocated to health, it is unclear though how we could hope to eliminate even the physical infrastructure gaps. Even if hospitals are built, the key to quality services will remain well-trained, motivated human resources. The current group of trained surgeons zero in on the first-world modelled minimally invasive procedure to the exclusion of open procedures.

These procedures, which sell well in elite private hospitals, require high set-up costs and offer marginal benefits. We need a system of medical education and ethics planned for an equitable, inclusive and just healthcare system, one that preferentially accounts for the prolonged and shameful neglect of the rural poor. Well-resourced district hospitals should be the ideal breeding grounds for a fresh group of sympathetic doctors and other healthcare professionals.[8] These must include large numbers of superbly trained postgraduate doctors in family medicine and rural surgery. They need to have a wider spectrum of core competencies, transcend specialist-centric professional constructs, and should be well-equipped to provide quality care at the district setting.

In essence, developing a broad intervention, such as surgery, is daunting in under-resourced scenarios but also presents many opportunities. This complex service acts as an enabler for several other important healthcare services, indicating the availability of 'staff, space, stuff, and systems' in a responsive healthcare system, capable of meeting multiple health challenges.[9]

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Grip strength and mortality

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Zimbabwe; School of Public Health, University of the Western Cape, Cape Town, South Africa; Madras Diabetes Research Foundation, Chennai, India; State Key Laboratory of Cardiovascular Disease, Fuwai Hospital, National Center for Cardiovascular Diseases, Chinese Academy of Medical Sciences and Peking Union Medical College, Beijing, China.) Prognostic value of grip strength: Findings from the Prospective Urban Rural Epidemiology (PURE) study. *Lancet* 2015;**386:**266–73.

SUMMARY

This article from the PURE (Prospective Urban Rural Epidemiology) study looks at the prognostic significance and impact of hand grip strength, a marker of muscle strength, on total and cardiovascular mortality among its diverse cohorts worldwide. The study population consisted of households with at least one member aged 35–70 years, who intended to stay at the same address for the next 4 years. Ultimately 139 691 participants with known vital status during follow-up were included in the analysis. Besides a standardized questionnaire for demographic, nutritional and other medical and physical details, physical activity level was measured with International Physical Activity Questionnaire (IPAQ). Grip strength was measured by study personnel with a Jamar Dynamometer in a standardized protocol. While initially only the grip strength in the non-dominant hand was measured, the protocol was amended later to take three measurements from both arms of each participant and the highest value of each arm was used. Overall grip strength was simply a mean of maximum of these values from each arm.

The vital status was documented by an office visit or a telephonic call on an annual basis. Outcomes studied were time to all-cause mortality, cardiovascular mortality (death due to myocardial infarction [MI], stroke, heart failure, other cardiovascular death, or sudden unexpected death) and non-cardiovascular mortality. Non-fatal outcomes studied were MI, stroke, diabetes, pneumonia, hospital admission for pneumonia or chronic obstructive pulmonary disease (COPD), hospitalization for any respiratory disease, injury due to fall or fracture. Events were adjudicated locally with specific criteria and supporting documents, with adjudication by a central committee in a random sample. For unknown deaths, a verbal autopsy instrument was used.

The Cox proportional hazards model was used to calculate hazard ratios and adjustment was done for the clustered nature of the sample. Impact of country income and race on grip strength was also studied. The effect estimates in relation to grip strength were presented per 5 kg reduction in grip strength. Several potential confounders were accounted for and five sensitivity analyses were done for differing baseline scenarios. Case-fatality rates were also estimated to calculate the effect of grip strength on incident disease, e.g. MI, stroke, etc.

The cohort was middle aged (median age 50, IQR 42–58 years) and 58% were women while one-fifth were of South Asian origin. The mean grip strength was 30.6 kg and was significantly higher for men. At baseline, grip strength tended to associate with several expected determinants such as young age, higher education, employment, higher physical activity, higher caloric and protein intake, and increasing height, weight and upper arm circumference. Age- and height-adjusted grip strength also increased with increasing income of the country but this was more pronounced for men. Of note, people with South Asian ethnicity had the lowest grip strength for men and one of the lowest for women. Low grip strength was also associated with presence of comorbid conditions at baseline such as hypertension, coronary artery disease (CAD), stroke, heart failure and COPD

During a median follow-up of 4 (2.9–5.1) years, 2.4% of the participants died. After adjustment, grip strength was inversely associated with all-cause mortality, cardiovascular mortality, non-cardiovascular mortality, MI, and stroke but not strongly with incident diabetes, hospital admission for pneumonia or COPD, injury from falls or fractures. The lack of association with falls or fractures was surprising. An association with cancer was seen only in high-income countries. The hazard ratios ranged from 1.16 (95% CI 1.13–1.20) for all-cause mortality to 1.07 (95% CI 1.02–1.11) for MI for each 5 kg reduction in grip strength. The results of the sensitivity analyses, for differing baseline scenarios, largely mirrored the original results. The inverse association of grip strength with mortality and cardiovascular mortality was consistent between the sexes and across age by tertile. Furthermore, high grip strength was also associated with lower case-fatality rates for incident MI, stroke, cancer, pneumonia, hospital admission for pneumonia or COPD, injury from a fall or fracture.

In view of the strong association of grip strength with mortality and incident cardiovascular disease, a post-hoc exploratory analysis compared prognostic importance of grip strength with systolic blood pressure (SBP) and physical activity levels. Hazard ratios (HR) were estimated per SD reduction of grip strength, per SD increase in SBP, and per SD reduction in log Met-min physical activity per week. Grip strength was the strongest predictor of death (HR 1.37 as compared to 1.15 for SBP and 1.09 for physical activity, p for all <0.0001) and predicted cardiovascular mortality equally well to SBP (HR 1.45 as compared to 1.43 for SBP and 1.12 for physical activity, p for grip strength and SBP <0.0001, p=0.01 for physical activity). For incident cardiovascular disease it was inferior to SBP (HR 1.21 for grip compared to 1.39 for SBP, p for both<0.0001 and 1.04 for physical activity, p=0.1) while physical activity levels were the worst predictors for all parameters.

COMMENT

PURE is one of the largest contemporary observational ongoing longitudinal studies worldwide. The aim of the PURE study is to examine the association between societal factors, risk factors and chronic non-communicable diseases across various sociocultural and economic environments. The demographic and mortality indicators of the PURE participants are only modestly different from national indicators.[1] Physical fitness is a known important predictor of morbidity and mortality and consists of cardio-respiratory capacity as well as muscle fitness. Grip strength is an important component of muscle fitness and has been shown to be linked with mortality as well as several cardiovascular outcomes, but this evidence has been predominantly restricted to white men in high-income countries.[2,3] PURE validates this association and extends its generalizability at a global level and within a variety of demographic and socioeconomic strata. Because of the heterogeneous populations it represents (17 nations and 8 ethnicities) and the large population number, the association of grip strength with health is proven unequivocal and universal.

Because of its extensive rather than intensive nature, PURE cannot provide reasons for the answers it provides. However, certain patterns do emerge in the data. Thus, while being associated with both, grip strength had a stronger inverse correlation with cardiovascular mortality than incident cardiovascular disease (CVD). One way that reduced grip strength could be related to mortality is the fact that people who have advanced disease are likely to be weak and also die prematurely due to disease. This 'reverse causation' bias was accounted for by the authors in a sensitivity analysis which excluded individuals dying within 6 months of enrolment, but produced the same result. Another sensitivity analysis excluding individuals with pre-existing CVD also mirrored the findings of the main study. Also higher grip strength was associated with lower case-fatality in incident CVD. Taken together, these observations imply that lower grip strength

definitely leads to increased risk of death among those with established CVD. In that context, the comment in an accompanying editorial by Sayer and Kirkwood is noteworthy;[4] one way that reduced skeletal muscle strength increases incident CVD and its fatality, may be through it being a biomarker of the ageing process across the life course. Put simply, reduced grip strength might be a marker (or does it participate in the process too?) for vascular ageing in those with lower chronological age. This fits in well with the exploratory analysis by the authors showing its superiority as a risk factor over blood pressure and physical activity for CVD. This has important implications for South Asians who tend to have lower grip strength. Only 10% women and 5% men of South Asian ethnicity were represented in the tertile group with highest grip strength.

While grip strength had a robust association with non-cardiovascular mortality, surprisingly it did not correlate strongly with incident non-CVD, even falls and fractures which might be expected to increase with lower muscle strength. This could be due to upper limb strength not being a surrogate for lower limb strength that is required to prevent falls and the contribution of other factors such as balance. Even simpler could be the explanation[4] that falls and injuries are not ascertained with same rigour in observational studies as the hard end-points such as mortality, MI and stroke. That it increased case-fatality rates for these conditions, once again directs us to the intriguing hypothesis that reduced muscle strength means, or causes (one does not know which at this point) an accelerated ageing process. Future work will undoubtedly put one of the spotlights on benchside for elucidating the pathways that connect grip strength with mortality and CVD. But it is the prospect of clinical trials investigating the impact of increasing grip strength on mortality and CVD, which is going to provide insightful times ahead for the clinician.

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Washing your hands of respiratory infections? Learn from the internet!

Little P, Stuart B, Hobbs FDR, Moore M, Barnett J, Popoola D, Middleton K, Kelly J, Mullee M, Raftery J, Yao G, Carman W, Fleming D, Stokes-Lampard H, Williamson I, Joseph J, Miller S, Yardley L. (Primary Care and Population Sciences Unit, University of Southampton, Southampton; National Institute of Health Research [NIHR] Research Design Service South Central and Centre for Applications of Health Psychology, University of Southampton, Southampton; Department of Primary Care Health Sciences, University of Oxford, Oxford; University of Birmingham, Birmingham; Research and Surveillance Centre RCGP, Birmingham; and West of Scotland Specialist Virology Centre, University of Glasgow, Glasgow, UK.) An internet-delivered handwashing intervention to modify influenza-like illness and respiratory infection transmission (PRIMIT): A primary care randomized trial. *Lancet* 2015;**386:**1631–9.

SUMMARY

This study was an open-label, randomized trial conducted in the UK. It assessed the effect of an internet-delivered intervention to modify handwashing techniques in reducing the incidence of respiratory tract infections (RTIs) among adults above 18 years of age.

Participants were enrolled using computerized lists of general practitioner practices in the UK by sending them invitations through emails. Patients with severe mental problems, those with terminal illness or those having a dermatological problem that would restrict their handwashing were excluded from the study. Participants were randomly assigned to either receive access to the internet-based intervention for handwashing along with a baseline questionnaire regarding the same or no access to the intervention or questionnaire. An additional cohort was also enrolled where participants were randomly assigned to an intervention group in which they received the internet-based intervention with no baseline questionnaire and a control group that received no intervention but a baseline questionnaire. This cohort was added later in the study because it was reported that administration of the baseline questionnaire might prompt changes in handwashing behaviour.

A total of 20 066 participants were enrolled from January 2011 to March 2013, spread over three winter seasons during the study period, which is the infective period for RTIs. Four internet-based sessions were provided once a week to study participants, which included information regarding influenza, role of handwashing in spread of disease and developing healthy practices.

Participants were supposed to provide details regarding several outcomes, which were measured by online login at 4, 8, 12 and 16 weeks of the initial login. The number of episodes of RTIs and their duration were documented by self-reporting because these measures could be remembered and recalled over a few weeks. The number of index individuals reporting at least one episode of RTI were also noted using structured questionnaires at the end of 16 weeks. Index persons were also supposed to report whether household members suffered from a similar illness during the week before the onset of symptoms in the index person, denoting transmission of infection from a co-inhabitant and also if any household member suffered from a similar illness following the index person, denoting spread from the index person to other household contacts. They were also asked to report episodes of loose stools or vomiting, which lasted for at least